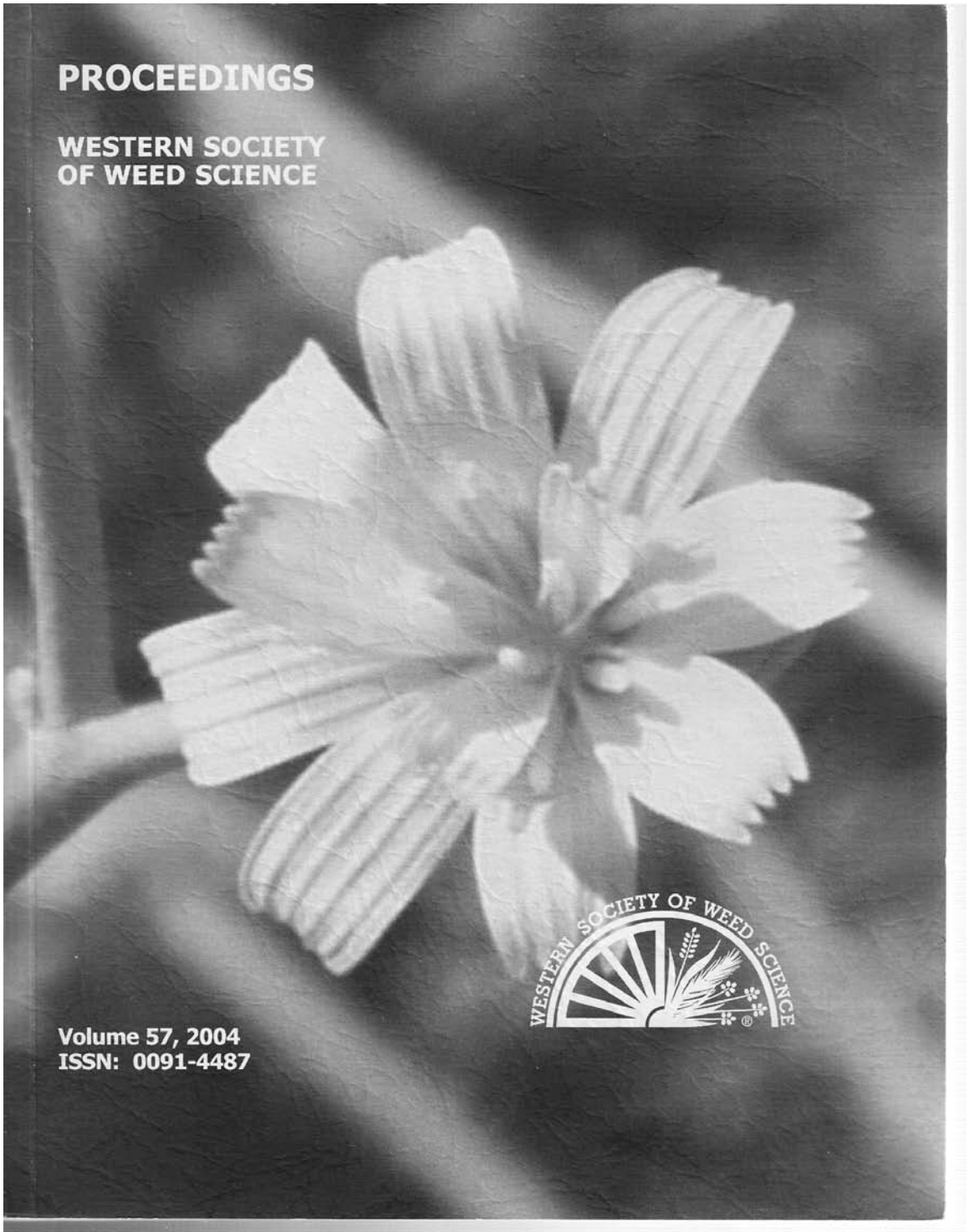
PROCEEDINGS

WESTERN SOCIETY OF WEED SCIENCE



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2004-2005

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2004

PROCEEDINGS

OF

THE WESTERN SOCIETY OF WEED SCIENCE

VOLUME 57

PAPERS PRESENTED AT THE ANNUAL MEETING

MARCH 9-11, 2004

DOUBLE TREE HOTEL
WORLD ARENA

COLORADO SPRINGS, COLORADO

PREFACE

The Proceedings contain the written summary of the papers presented at the 2004 Western Society of Weed Science Annual Meeting plus summaries of the research discussion groups and of the business transacted by the Executive Board.

The paper number located in brackets at the end of each abstract corresponds to the paper number in the WSWS Program.

Authors and keywords are indexed separately. Index entries are published as received from the authors.

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Cover photograph, rush skeletonweed (*Chondrilla juncea* L.), by Tim Prather. Other photography by Kai Umeda and Phil Banks.

Proceedings Co-Editors: Joan Campbell and Traci Rauch

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Section 1. Weeds of Range and Forest

A GIS METHODOLOGY FOR PREDICTING OCCURRENCES OF DALMATIAN TOADFLAX (LINARIA DALMATICA (L.) P. MILLER) IN LIVERMORE, CO. Dirk V Baker[†] Department of Bioagricultural Science and Pest Management, Colorado State University, Fort Collins, CO, USA, 80523

Abstract. Dalmatian toadflax (*Linaria dalmatica* (L.) P. Miller) is an invasive weed that can aggressively invade and dominate native communities. There has been little research performed to investigate this weed, particularly with the intent of discovering the requirements and limiting factors of the plant. The purpose of this project was to explore the use of Geographic Information Systems (GIS) methodology in this and other research requiring the measurement of geographical information. This work is preliminary to longer-term research that will attempt to ascertain the major predictors or factors associated with the establishment and especially the spread of invasive weeds. Initial results indicate that there is little, if any, real difference in slope, aspect, stream distance and road distance between location of the plant and randomly generated points. While this is not surprising, it is an important first step that provides for a refinement of the methodology and eliminates four broad variables as important for this plant in this area. GIS is a powerful set of tools for analyzing and measuring spatial data that could potentially provide for significant savings in time spent in the field by eliminating the need to conduct many field measurements. [Paper Number 1]

NITROGEN RESPONSE OF PICLORAM-RESISTANT YELLOW STARTHISTLE. Kevin S. Branum[†]; Amber D. Vallotton; Tracy M. Sterling[*] New Mexico State University, Las Cruces, NM, USA, 88001

Abstract. Yellow starthistle is spreading rapidly across the western United States, decreasing native plant and animal diversity, depleting soil moisture reserves and invading recreational areas. Resistance to picloram in yellow starthistle was first observed near Dayton, WA in 1988. Previous research found that picloram-resistant (R) and -susceptible (S) accessions have similar competitive ability and that a single recessive gene confers picloram resistance in yellow starthistle. Previous observations suggested that environment may have an effect on the level of resistance; however, the temperature under which yellow starthistle grew did not alter picloram response in the earlier work. Therefore, another experiment was designed to look at the effect of nitrogen on the picloram response in yellow starthistle. Seedlings of both accessions were grown in Metro Mix 360 in a greenhouse and were watered daily. At eight weeks of age, plants were treated with one of two nitrogen treatments (with nitrogen and without nitrogen) using Hoagland's solutions for four weeks prior to picloram application. Picloram was then applied with a CO2 sprayer at 0, 0.14, 0.28, and 0.56 kg ae/ha. Nitrogen treatments were continued for an additional 28 days. Photosynthesis and relative chlorophyll content at herbicide application were higher among plants with nitrogen regardless of accession. Susceptible plants were consistently more epinastic to increasing picloram through 28 DAT. Chlorosis increased in plants without nitrogen regardless of accession but nitrogen did not affect epinasty ratings. These results suggest that picloram resistance in yellow starthistle is unaffected by nitrogen level. [Paper Number 13]

PERFORMANCE OF POSTEMERGENCE HERBICIDES ON EIGHT NATIVE GRASS SPECIES GROWN FOR SEED IN CENTRAL OREGON. Marvin D Butler[†,*]; Claudia K Campbell Oregon State University, Central Oregon Agricultural Research Center, 850 NW Dogwood Lane, Madras, OR, USA, 97741

Abstract. Herbicide screenings were conducted over two seasons on eight native grass species: great basin wildrye, bluebunch wheatgrass, streambank wheatgrass, big bluegrass, Idaho fescue, Indian ricegrass, squirreltail and prairie junegrass. Fall applications were made October 18 2000 and October 14 2001.

These included 1x and 2x label rates of dicamba, dimethenamid, diuron, flufenacet+metribuzin, metribuzin, oryzalin, oxyfluorfen, primisulfuron, pronamide, sulfosulfuron, and terbacil. Treatments were applied to the same plots two years in a row to increase confidence related to crop safety. During 2002 treatments producing the most negative effect were 2x rates of terbacil at 1.2 lb ai/a and pronamide at 0.43 lb ai/a. Treatments with the least effect on both stand reduction and reduced heading across grass species were 1x rates of diuron at 1.4 lb ai/a, oxyfluorfen at 3.0 lb ai/a and metribuzin at 0.16 lb ai/a. Stand reduction across herbicide treatments was least for great basin wildrye, and was the greatest for prairie junegrass, squirreltail. The least herbicide impact on heading was observed with great basin wildrye and streambank wheatgrass, while it was most severe for squirreltail and prairie junegrass. [Paper Number 15]

BIG HORN RIVER RESTORATION PROJECT. Mr. Steve Christy[†] Bureau of Land Management, P.O. Box 119, Worland, WY, 82401

Abstract. Restoration of native plant communities on the Big Horn River in northern Wyoming is becoming increasing important due to the establishment of a variety of invasive and noxious weed species. A demonstration project for riparian restoration has been established on approximately 300 acres at the Goose Island site just south of Manderson, WY, along the Big Horn River. This study is aimed at protecting existing stands of cottonwood trees, and restoring the site to native woodlands. Treatments were designed to reduce the density of exotic plant species, primarily Russian olive and Tamarisk. Other invasive species on the site are Russian knapweed, perennial pepperweed, leafy spurge, Canada thistle and whitetop (hoary cress). Primary objectives of the treatments were to 1) protect existing stands of cottonwood from wildfire hazards by reducing fuel loads; 2) reduce the density and frequency of exotic weed invasions; 3) increase recruitment of native vegetation on the site; 4) provide a demonstration and interpretive site for future restoration projects. Combinations of mechanical and chemical treatments were initiated in the spring of 2000 to achieve these goals. Revegetation treatments include the planting of grasses to establish competition with the noxious weeds. The species planted include Bozoisky wildrye, Trailhead basin wildrye, Critana thickspike wheatgrass, Sodar streambank wheatgrass, Luna pubescent wheatgrass, Lodorm green needlegrass, Pryor slender wheatgrass, Rosana western wheatgrass, alkali sacaton, Jose tall wheatgrass, and Shoshone beardless wildrye. Several forbs were also in the mix. Results to date have document the difficulty in controlling Tamarisk and Russian olive infestations. Conventional techniques of reseeding and planting with rooted seedlings of desirable trees and shrubs have been unsuccessful because of extremely dry conditions. Establishment of cottonwoods by planting 2-m poles 1-m deep has been hampered by changing ground water levels, high soil salt concentrations and low precipitation. Imazapyr and triclopyr show some promise of being able to control if not eliminate saltcedar and Russian olive from the sites. While removal of some invasive non-native species has been successful at the Goose Island Restoration project, restoration of desirable species has not. It remains important to establish competitive grass communities to dissuade against future weed invasions. Vigorous plant competition is the best long-term strategy for noxious weed control in these riparian sites. [Paper Number 9]

THE STRESS RELATED VEGETATION INDEX APPLIED TO IDAHO'S CANYON GRASSLANDS. Lee Eubank[†]; Tim Prather[*]; Markus Tuller[*] Dept. of PSES, University of Idaho, Moscow, ID, 83844-2339

Abstract. Remotely sensed imagery offers a relatively inexpensive way to analyze environmental change across large tracts of land. In this study, Landsat TM was used to extract temporal and spatial moisture variation of the canyon grasslands in north central Idaho using the stress related vegetation index (SRVI). This index is an algebraic ratio of three TM bands (5 * 3)/ 4) that summarizes reflectance data. Because SRVI is little used, the objective of this study was to determine whether measurements based on SRVI could provide useful information for analysis of seasonal water-relationships across the rough topographic terrain of the canyon grasslands. An unsupervised classification of 1987 Landsat TM images was used to

run the SRVI model for range shrub and grass cover types. The SRVI images proved useful in showing typical within-season and across-season moisture variation. The SRVI was also able to depict topographical moisture variability showing an increase in moisture on flatter surfaces than steeper surfaces. [Paper Number 16]

EVALUATION OF IMAZAPIC FOR MEDUSAHEAD CONTROL ON RANGELAND SITES IN NORTHERN CALIFORNIA. Guy B Kyser[1,†,•]; Joseph M DiTomaso[1,•]; Morgan P Doran[2,•]; Steven B Orloff[3,•]; Robert G Wilson[4,•] [1]Department of Vegetable Crops and Weed Science, University of California, 1 Shields Ave., Davis, CA, USA, 95616; [2]Solano County Cooperative Extension Offices, 501 Texas St., Fairfield, CA, USA, 94533-4498; [3]Siskiyou County Cooperative Extension Offices, 1655 South Main St., Yreka, CA, USA, 96097; [4]Lassen County Cooperative Extension Offices, 707 Nevada St., Susanville, CA, USA, 96130

Abstract. In California's Mediterranean climate, noxious annual grasses germinate throughout fall and winter, interfering with revegetation of rangeland. Medusahead is especially problematic owing to its poor forage qualities and persistent thatch. No herbicides registered in California selectively control annual grasses without injuring perennial grass seedlings. Imazapic is a preemergence herbicide currently being tested in restoration projects in other parts of the United States. Because imazapic selectivity depends on a number of environmental and application factors, we established rate trials at five sites in or near northern California. We fall-applied imazapic at rates from 35 to 210 g ae/ha on undisturbed rangeland versus rangeland which had been cleared by tilling, mowing and raking, or burning. At some sites we reseeded with perennial grasses. In the following year we monitored treatment effects on all plant species using visual estimation of plant cover in quadrats. At all sites, increasing rates of imazapic correlated with increasing bare ground and decreasing plant cover. Disturbance treatments usually reduced medusahead cover even without imazapic. Disturbance also tended to result in decreased cover of other annual grasses but had zero to positive effects on forb cover. Rates of imazapic up to 70 g ae/ha produced acceptable injury in perennial grasses. Species richness and diversity tended to be slightly lower at high rates of imazapic but were not greatly impacted by disturbance. Interactions between imazapic rate and disturbance were complex and inconsistent from site to site. Overall, an application of 70 g ae/ha imazapic to cleared ground was the most effective treatment for balancing medusahead control with safety for desirable plants. [Paper Number 6]

DETECTING THE LOCATIONS OF WHITETOP WITH REMOTE SENSING IMAGERY. Lawrence W. Lass[1,†,•]; Timothy S. Prather[1,•]; Nancy Glenn[2]; Jacob Mundt[2]; Keith Weber[3]; Jeffery Pettingill[4]; Brian Wilbur[5,•] [1]University of Idaho, Dept. of Plant, Soil, and Ent. Sciences, Moscow, ID, USA, 83844-2339; [2]Idaho State University -Boise Center, Department of Geoscience, 12301W Explorer Dr. Suite 102, Boise, ID, USA, 83713; [3]Idaho State University, Department of Geoscience, Pocatello, ID, USA, 83209; [4]Bonneville County Weed Control, 605 N. Capital Avenue, Idaho Falls, ID, USA, 83402; [5]Ada County Weed Control, 517 N. Meridian Street, Meridian, ID, USA, 83642

Abstract. Knowing where to search for new invaders reduces survey time and increases productivity of ground-based crews. Whitetop (*Cardaria draba* (L) Desv.) is a deep-rooted perennial mustard that infests many irrigated pastures in the desert soils of the west. Plants are often distributed several kilometers from the source before they are recognized as a problem. Hyperspectral and multispectral images at 2 and 3 meters spatial resolution were used to identify locations of whitetop. Dense infestations having 80 to 100% cover and larger than 6 by 10 m were detectable with the tested sensors. Results showed if cover densities ranged from 20 to 40% imagery detected the site about 50% of the time. Images classified for whitetop tended to over commit in alfalfa fields contaminated with tumble mustard (40 to 60% cover). New high spatial and spectral resolution sensors offer the opportunity to detect smaller infestations. [Paper Number 10]

PREFERENCE AND PERFORMANCE OF A BIOLOGICAL CONTROL AGENT OF YELLOW AND DALMATIAN TOADFLAX. Daniel K MacKinnon[†]; Ruth A Hufbauer Colorado State University, Fort Collins, CO, USA, 80521

Abstract. Often, weed biological control is considered successful only with reductions in existing populations of weeds due to biological control agents (BCAs). The slowing or halting the spread of a weed, although not as dramatic or noticeable, is also successful control. Weeds tend to radiate and expand through numerous foci or patches, not as a single expanding front. These foci are of greater importance to the spread than the larger populations from which they originated (Moody and Mack, 1988). BCAs that significantly reduce the number of dispersing plant propagules (typically seeds) and are themselves vagile and have good host-finding abilities may be valuable in managing invasions because they can establish on undetected patches of weeds that escape other types of control and can reduce the ability of larger patches to establish further infestations. Two invasive weeds, *Linaria genistifolia* ssp. *Dalmatica* (Dalmatian toadflax) and *Linaria vulgaris* (yellow toadflax) disperse and establish through seed dispersal. *Brachypterolus pulicarius* (Coleoptera: Kateridae), inadvertently introduced from Europe is a BCA that can significantly reduce seed set in both toadflax species and disperse without assistance. However, *B. pulicarius* if often not found on Dalmatian toadflax stands but is almost always found on yellow toadflax. To understand the underlying factors behind this observation, we are conducting preference and performance studies as well as a genetic analysis of beetle populations in the Rocky Mountain Region. Our completed studies show that beetles collected from both toadflax species prefer yellow toadflax. Larval performance studies rearing larvae on both toadflax species to determine performance differences and molecular analysis to detect genetic structuring between beetle populations is currently being studied. The results will help us evaluate the current practice of collecting beetles and redistributing them onto uncolonized patches of Dalmatian toadflax. [Paper Number 11]

REVEGETATION WITH A VISION: CASE STUDIES FOR RESEARCH, MANAGEMENT, AND EDUCATION. Monica Pokorny[†,*] Center for Invasive Plant Management, Bozeman, MT, 59717-3120

Abstract. The Restoration Program at the Center for Invasive Plant Management was created to promote revegetation as a means to restore and maintain plant communities that function at a sustainable level, resist invasion, and meet land use objectives. Together with public and private land managers, we are establishing restoration case studies to restore invasive plant infested lands to desired plant communities, research restoration / revegetation techniques, and disseminate research findings. Our on-the-ground restoration research includes testing seeding methods, herbicide treatments, seed mixtures with varying diversities, and modifying processes that cause plant community dynamics. Educational components include field tours, educational signs, journal and newspaper articles. [Paper Number 14]

MANAGEMENT STRATEGIES FOR THE ESTABLISHMENT OF NATIVE GRASS IN DOWNY BROME INFESTED RANGELAND. Mr. James R. Sebastian[†]; Mr. George K. Beck Dr.[*]; Mr. Scott J. Nissen Dr.[*] Colorado State University, Bioag and Pest Mgt Department, Ft Collins, CO, USA, 80523; Colorado State University, Bioag and Pest Mgt Department, Ft Collins, CO, USA, 80523

Abstract. Abstract. Downy brome (Bromus tectorum; BROTE) is a winter annual grassy weed that occupies degraded rangeland, roadsides, and waste places. BROTE competes with desirable perennial grasses for winter and early spring moisture. Management strategies are needed to rapidly restore the productivity and biological diversity of degraded grasslands where BROTE has invaded. This experiment was designed to use imazapic or glyphosate herbicides to improve perennial grass establishment by controlling downy brome after seeding. A replicated field experiment evaluating time of seeding, time and rate of herbicide application, and the response of cool and warm season grasses was initiated in 2002. A strip, strip-plot design with four replications was used in this study. Each experimental unit consisted of four perennial grass treatments seeded in the fall or spring across herbicide treatments sprayed in spring

or fall. Warm or cool season grasses were seeded separately or as a mixture, while one strip was left unseeded as a control. Remnants of Luna pubescent wheatgrass (*Agropyron trichophorum*), western wheatgrass (*Agropyron smithii*), blue grama (*Bouteloua gracilis*), and sideoats grama (*Bouteloua curtipendula*) already existed at this site prior to drilling. Spring or fall-applied herbicides were sprayed perpendicular to seeded rows of grass on November 20, 2002 or April 4, 2003. Visual estimates of downy brome control and perennial grass injury were conducted in May, July, and September 2003. Fall applied imazapic (71 to 100% control) out performed all spring imazapic treatments (21 to 55% control) at the May and July evaluation dates. Glyphosate (both timings) controlled more than 95% of BROTE at these same evaluation dates. Fall applied imazapic displayed residual activity by controlling 82 to 96% of BROTE that germinated and emerged in September 2003 (approximately 9 months after fall treatments were applied in 2002 and after the originally sprayed BROTE had completed it's lifecycle). Spring imazapic treatments that were applied to tillered BROTE in April, 2003, failed to control BROTE effectively through the growing season; however, imazapic's residual soil activity provided 24 to 97% control of BROTE that emerged in September 2003, the fall following spring applications. Perennial grass species that were already present at this site (prior to seeding) were evaluated for stand reduction and height suppression. Fall treated imazapic applications caused 21 to 51% grass injury at the May evaluation, but injury dropped to 0 to 6% by the end of the growing season in September 2003. Spring applied imazapic caused 35 to 68% grass injury at the May evaluation and 20 to 31% injury in September. Due to extremely hot, dry conditions the seeded grass did not establish well the summer following drilling, therefore, drilled grass was not harvested in 2003. Remnant perennial grass and downy brome biomass were collected on September 23, 2003 from inside two randomly harvested 20 cm by 50 cm quadrats. Remnant perennial grass and downy brome biomass were separated and weights converted to pounds per acre (dry weight). Spring treatments showed 5 to 8-fold increases in grass production compared to the non-sprayed controls. These same treatments applied in fall had 15 to 21-fold increases in grass production compared to non-sprayed controls. The highest grass production in this study (861 lb/A) occurred with the fall treated plots sprayed with 6 fl oz/A of imazapic; although, this was not significantly higher than the other fall applied treatments. The highest grass production in the spring treated plots was 357 lb/A (8 fl oz/A imazapic). Downy brome dry weights were 500 and 529 lb/A in non-sprayed controls while fall applied herbicides reduced BROTE biomass to 0 to 20 lb/A. The lowest downy brome dry weights from spring treatments were approximately 14 lb/A in glyphosate treated plots and 94 lbs/A with the highest rate of spring applied imazapic (12 fl oz/A). BROTE was stunted and thinned from spring-applied imazapic treatments and provided BROTE dry weights approximately 1.6 to 5 times less than from non-sprayed control plots. [Paper Number 12]

GETTING MORE BANG FOR YOUR BUCK: MAXIMIZING ISSR POLYMORPHISMS IN YELLOW TOADFLAX (*LINARIA VULGARIS* MILL.). Jason R Sutton[†]; Sarah M Ward[*]; K George Beck[*] Colorado State University, Fort Collins, CO

Abstract. The ability to identify levels of genetic variation within a particular species is partially dependent on the effectiveness of a selected marker system. A marker system should be economical, labor efficient, and effective at producing a high degree of information about the species of interest. We evaluated the ability of two marker systems, inter-simple sequence repeat (ISSR) and inter-simple sequence repeat-restriction fragment length polymorphisms (ISSR-RFLP), to identify genetic variation in yellow toadflax (*Linaria vulgaris* Mill.) a perennial exotic forb found throughout the United States and Canada. Effectiveness of each marker system was determined by counting the total number of scorable bands produced by ISSR and ISSR-RFLP procedures. The ISSR marker system targets the tandem repeat regions found scattered throughout plant genomes. ISSR uses single primers that typically consist of a few di- or trinucleotide sequence repeats complementary to a microsatellite sequence plus one to three "anchoring" bases. The resulting amplification product is the intervening nucleotide sequence lying between two microsatellites complementary to the ISSR primer. ISSRs are considered more reproducible that random amplified polymorphic DNA (RAPD) markers, more economical than amplified fragment length polymorphism (AFLP) markers, and have been used to assay genetic variability among cultivated

plants as well as assess hybridization in natural populations of Penstemon. ISSR-RFLP markers are obtained by digesting individual ISSR primer products with a restriction enzyme. This allows the detection of additional amounts of variation within a particular ISSR primer amplification product. To further optimize the amount of information produced by each marker system, amplification products were separated on 2% agarose gels stained with ethidium bromide, and 5% polyacrylamide gels with silver staining to determine if the increased resolution of polyacrylamide gel electrophoresis (PAGE) equated to a greater number of scorable bands for each marker system. We found that ISSR-RFLPs visualized on agarose gels did result in different banding patterns than ISSR primers alone, indicating restriction enzyme digestion, but did not greatly increase the total number of scorable bands over ISSRs. Our results show ISSR-RFLPs visualized on PAGE gels resulted in the greatest total number of bands with greater than 50% more scorable bands than products of either marker system on visualized agarose gels, and more than a 50% increase of scorable bands than ISSR primers alone visualized on PAGE gels. We conclude that ISSR-RFLP markers visualized on PAGE gels are a efficient way to maximize the number of scorable bands identified for a particular ISSR primer in yellow toadflax. [Paper Number 5]

SUMMER DIETS OF SHEEP GRAZING WITHIN SPOTTED KNAPWEED INFESTATIONS. Brian D. Thrift†; Tracy K. Brewer; Brent L. Roeder; Jeffrey C. Mosley; Rodney W. Kott; Bret E. Olson Montana State University-Bozeman, Bozeman, MT, 59717-2900

Abstract. Spotted knapweed (*Centaurea maculosa*) is a perennial, invasive forb that presently infests millions of hectares of private and public rangelands in western North America. This noxious weed reduces wildlife and livestock forage, decreases biological diversity, and increases surface water runoff and soil erosion. Previous research has demonstrated that domestic sheep readily graze spotted knapweed, indicating that prescribed sheep grazing may be a cost-effective tool for suppressing this weed. In response, this study quantified the diets of a ewe-lamb band (n = 720 ewes, 1086 lambs) that was prescriptively grazed on foothill grassland in western Montana. Sheep grazed within heavy and moderate infestations of spotted knapweed until perennial grasses were reduced to a 5-8-cm residual stubble height. Sheep diets were measured in mid-June and mid-July. The amount of knapweed in sheep diets did not differ (P = 0.79) between June and July, averaging 40% of the diet. Sheep ate significantly more knapweed in the heavy infestation versus the moderate infestation (P = 0.09; 57% vs. 24% of their diet, respectively). Graminoids comprised 37% of sheep diets in June. In July, sheep ate fewer graminoids (P = 0.04) in the heavy infestation (28% of their diet), but within the moderate infestation where less spotted knapweed was available, grazing to the prescribed residual height forced the sheep to eat more graminoids (62% of their diet). Crude protein in sheep diets decreased ($P < 0.01$), while NDF and ADF increased (P = 0.04 and $P < 0.01$, respectively) between June and July. Results indicate that prescribed sheep grazing is a promising tool for suppressing spotted knapweed. [Paper Number 3]

UPTAKE AND TRANSLOCATION OF HERBICIDES IN AFRICAN RUE UNDER WATER STRESS. Amber D. Vallotton†; Larissa A. Gibbs; Laurie B. Abbott; Tracy M. Sterling* New Mexico State University, Las Cruces, NM, US, 88003-8003

Abstract. African rue is an exotic herbaceous perennial established in several western states and occurring mostly in disturbed sites. African rue tolerates harsh, water-stressed conditions, which may contribute to this species ability to expand into new areas. Previous work screened water-stressed African rue seedlings for their sensitivity to herbicides and found that although less active physiologically, the seedlings were more sensitive to herbicide application of hexazinone, imazapyr, and metsulfuron. To better understand how water stress alters African rue's sensitivity to these herbicides, hexazinone, imazapyr, and metsulfuron uptake and translocation were studied in two experiments using water-stressed, greenhouse-grown African rue seedlings. Water stress was induced by withholding water six days prior to herbicide treatment. Physiological and water status were measured using a LiCor LI-6400 photosynthetic system and pressure chamber, respectively. Herbicides were applied at recommended rates using a backpack sprayer. Immediately following herbicide application, water-stressed plants were watered at the

base of each plant. The upper leaves of each plant were then treated with appropriate radiolabeled herbicide solutions and maintained at room temperature until harvest 24, 48, and 96 hours after treatment. Along with visual ratings, uptake and translocation were determined by separating each plant into treated leaf, upper stem, lower stem, and roots, then air-dried and oxidized. Radiolabel content was determined using liquid scintillation spectrometry. Herbicide leaf uptake in stressed plants, across all herbicides and harvest times, ranged from 10 to 13% in experiment 1 and 11 to 19% in experiment 2, with no radiolabel found in roots or soil. Well-watered control plants had 8% more uptake in experiment 1 than in experiment 2. Water stress reduced mean leaf water potential from -1.4 to -3.0 and -1.1 to -7.2 MPa, and mean photosynthesis from 14 to 0.7 and 10 to 3 μmol CO_2 m^{-2} s^{-1} in experiments 1 and 2, respectively. Translocation was minimal with generally more radiolabel moving from treated leaves in stressed plants compared to well-watered plants. Based on different levels of water stress indicated by leaf water potentials for each experiment, the greater herbicide uptake in stressed plants in experiment 2 could be due to cuticular dessication resulting from excessive water stress. Current evaluations involving sequentially increasing water stress levels may better elucidate our understanding of herbicide uptake and translocation in African rue. [Paper Number 2]

THE IMPACT OF HERBICIDES AND HERBIVORY ON ROOT DEVELOPMENT OF SALTCEDAR. Eric M LaMalfa[1,†]; Ralph E Whitesides[2,*] [1]Undergraduate student, College of Natural Resources, Dep. of Forest, Range, and Wildlife Science, UMC 5230, Utah State Univ., Logan, Utah, USA, 84322-5230; [2]Professor, College of Agriculture, Department of Plants, Soils, and Biometeorology, UMC 4820, Utah State University, Logan, Utah, USA, 84322-4820

Abstract. Abstract. Since it's introduction, saltcedar (*Tamarix ramosissima*) has rapidly spread throughout lowlands and riparian areas in the western United States. Single treatment approaches to control have proven impractical because no method completely eliminates mature saltcedar and it's later progeny. This study evaluated saltcedar's response to various combinations of simulated herbivory (hand removal of 100% new growth) and herbicide treatments. Stem tissues was propagated in pots, and 16 treatments were initiated after 3 months of growth. Single treatment groups received one of three types of herbicide (triclopyr, imazapyr, or 50:50 imazapyr+glyphosate) or one of three frequencies of defoliation (continuous, 2 week, 4 week). Combination treatments received both defoliation events and herbicides in various temporal combinations. The mean root dry matter was used to quantify the plant's cumulative response, and above ground dry matter was used to determine the relative forage yield of grazed plants. All combination treatments showed a greater deleterious effect on forage yield than single treatment herbivory. All treatments evaluated reduced root biomass when compared to the untreated control. Combination treatments of grazing+triclopyr caused the largest reduction in root biomass. When grazing occurred on 4-week intervals, followed by herbicides, root biomass was reduced more than in other combinations. If herbicides were applied and grazing followed, root growth was reduced but not as much as when grazing preceded herbicide treatment. A 4-week grazing interval reduced root biomass more than any other single treatment. A single application of triclopyr or imazapyr significantly reduced root biomass, however, imazapyr+glyphosate was the least effective herbicide treatment. In this short-term study, simulated grazing prior to application of triclopyr was most effective in reducing root biomass of container-grown saltcedar plants. [Paper Number 7]

Section 2. Weeds of Horticultural Crops

WEED CONTROL USING THE ATARUS STINGER STEAMER IN PLASTIC CULTURE STRAWBERRIES. Thaddeus R Gourd[1,†,*]; Tim Ferrell[2] [1]Colorado State University Cooperative Extension for Adams County, 9755 Henderson Road, Brighton, CO, USA, 80601; [2]Berry Patch Farms, 13785 Potomac Street, Brighton, CO, USA, 80601

Abstract. Weeds are a chronic problem associated with organic strawberry production in Colorado. Plastic mulch helps reduce weeds within the bed of strawberries. The greatest weed threat comes from weeds

growing at the edge of the plastic bed. Soil typically holds the plastic mulch in place and is prone to weed infestations. Mechanical cultivation and hand weeding (hoeing) typically are used to control these weeds; however, there is a danger of damaging the plastic mulch, thus creating more areas for weeds to invade. The use of thermal (steam) weed control systems addresses this problem and is an alternative to mechanical cultivation and herbicides for controlling weeds. The weeds encountered in this study were kochia *Kochia scoparia*, redroot pigweed *Amaranthus retroflexus* dandelion *Taraxacum spp.*, field bindweed *Convolvulus arvensis*, annual rye *Lorlium multiforum*, Canada thistle *Cirsium arvense*, and downy brome *Bromus tectorum*. The purpose of this study was to examine whether steam treatments in the late spring could reduce the occurrence of weed populations spreading under the edge of plastic mulch of strawberry beds. Weeds were steamed using the trailer mounted Atarus Weed Blaster Steamer weed control device. The Atarus Stinger Steamer utilizes thermal quench technology, uses propane as a fuel source and uses 2 gallons of water per minute to produce 800 degree F saturated steam at 75 psi. This machine holds 211 gallons of water, which allows about an hour and a half of steaming operation. The tractor speed was 1.2 mph at the time of application. The first steam application was applied on May 29, 2003, when weeds were 1 to 6 inches tall. The second steam application was applied on June 6, 2003. Each plot consisted of two strawberry beds 300 feet long on six-foot centers. There were 4 replicates. Two steam applications were very effective on kochia and pigweed. Steam gave good control of annual rye, downy brome and field bindweed. Good activity was seen immediately after treatment of steam on Canada thistle and dandelion; however, rapid re-growth reduced control levels from fair to poor four days after the second steam application. Steam applications only damaged the plastic mulch when steam generators were positioned perpendicular to the strawberry bed. No damage to the plastic mulch was observed when generators were positioned parallel with the strawberry bed. [Paper Number 18]

WEED CONTROL IN ALMONDS WITH TRIFLOXYSULFURON SODIUM. Tom Lanini[1,†,•]; Tim Tripp[2,•] [1]University of California, Department of Vegetable Crops, 124 Robbins Hall, Davis, CA, USA, 95616; [2]Syngenta Crop Protection, Davis, CA, USA, 95616

Abstract. Weed control in almonds is often accomplished using a combination of chemical and nonchemical methods. The tree rows (berms) are typically treated with a preemergence herbicide during the fall or early winter, with rainfall used for incorporation. If weeds are present at the time of application, a postemergence herbicide is also added. Trifloxysulfuron sodium is currently being developed by Syngenta. The objectives of this experiment were to assess weed control and almond tolerance with trifloxysulfuron sodium. Two studies were initiated on January 17, 2003 in a 3 yr. old almond orchard located near Winters, CA. Treatments included trifloxysulfuron sodium at 21 g ae/ha with or without glyphosate at 1680 or 840 g ae/ha, glyphosate alone at 1680 or 840 g ae/ha and an untreated. The predominant weeds present included cheeseweed (*Malva parviflora*), smooth brome (*Bromus mollis*), foxtail barley (*Hordeum jubatum*), field bindweed (*Convolvulus arvensis*), redstem filaree (*Erodium cicutarium*), yellow starthistle (*Centaurea solstitialis*), prickly lettuce (*Lactuca, serriola*), and Italian ryegrass (*Lolium multiflorum*). Visual evaluations of control of each species were made on February 5, February 26, March 28, April 30, and June 23, 2003. Cheeseweed control in the almond orchard was fair to poor with all treatments. By 40 DAT, cheeseweed control had declined on almost all plots, with the exceptions of the the glyphosate plus trifloxysulfuron sodium plot where control improved slightly. Cheeseweed control continued to decline through the 103 DAT evaluation. Grass control at 19 DAT was best with glyphosate treatment. Trifloxysulfuron sodium by itself did not appear to affect the grasses at 19 DAT. By 40 DAT, grass control improved on almost all plots. By March 28th, grass control was generally excellent on all plots with the exception of foxtail barley on the trifloxysulfuron sodium plots. Redstem filaree control at 19 DAT was generally good to excellent if glyphosate was used. Trifloxysulfuron sodium alone was not effective in controlling filaree. At the later evaluations, glyphosate applied at 1680 g/ha continued to provide excellent control, while filaree control in the lower rate (840 g/ha) treatments began to decline. The low rate of glyphosate plus either trifloxysulfuron sodium was also effective in controlling filaree at the 70 day evaluation. Yellow starthistle control at 70 DAT was excellent with all treatments. By 103 DAT, glyphosate treatments were all starting to allow some yellow

starthistle to escape. Treatments that included trifloxysulfuron sodium all provided 100% control of yellow starthistle, regardless of whether glyphosate was added or not. Glyphosate was effective (78% or greater) in controlling prickly lettuce at 70 DAT, whereas trifloxysulfuron sodium treatments were not effective (55% or less). By 103 DAT, the low rate of glyphosate was no longer providing effective prickly lettuce control, whereas the treatments which included trifloxysulfuron sodium were still providing excellent control (90 % or greater). Overall, it appears that trifloxysulfuron sodium is weak on grasses, cheeseweed, and field bindweed, although adding glyphosate improved the performance. Trifloxysulfuron sodium plus glyphosate was an excellent combination in controlling redstem filaree, yellow starthistle, and prickly lettuce. Since yellow starthistle is such a large problem in the Western US, trifloxysulfuron sodium should be considered for use in non-cropland in addition to potential orchard applications. [Paper Number 19]

ROTATIONAL CROP RESPONSE TO SOIL RESIDUES OF HALOSULFURON. Carl R Libbey[†]; Timothy W Miller[*] Washington State University, 16650 SR 536, Mount Vernon, WA, USA, 98273

Abstract. Field studies were carried out to evaluate the effect of residual halosulfuron on rotation crops commonly grown in northwestern Washington. Two iterations were implemented at WSU-Mount Vernon from 2001 through 2003. Halosulfuron was applied at each of four rates (0.027, 0.053, 0.080, and 0.105 kg ha^{-1}) to bare soil and roto-tilled to a depth of approximately 10 cm in the same direction as herbicide application. Non-treated controls were included. Red beet, spinach, cauliflower, potato, and green pea rotational crops were then seeded within 7 days at 90 degree angles to the direction of herbicide application [0 months after treatment (MAT)]. Pickling cucumber, the crop in northwestern Washington in which halosulfuron is commonly used, was also seeded. Red beet, spinach, and cauliflower were seeded again at approximately 2, 12, and 13 months after treatment, and green pea and potato at approximately 2 and 12 MAT. After six weeks, plants were cut at the soil line, dried, and weighed. Cucumber biomass was relatively unaffected by the rate of halosulfuron applied, even when seeded into soil residuals of 2x the use rate (0.105 kg ha^{-1}). Red beet biomass was significantly reduced by halosulfuron residual in soil until 13 MAT. Spinach and cauliflower biomass were significantly reduced until 4.5 MAT, although a nonsignificant treatment effect was still apparent at 12 MAT. Similarly, pea and potato biomass were significantly reduced until approximately 1.5 MAT, and a nonsignificant treatment effect was still apparent in potato until 12 MAT. Results were consistent for both iterations of the trial, and indicate that current rotational crop restrictions for halosulfuron could be reduced to approximately 15 months for red beet, spinach, and cauliflower (from the current 24, 24, and 18 months for these crops, respectively) when grown in the mild maritime climate of northwestern Washington. Similarly, the current 9 month restriction for seeding green pea or cucumber may be overly stringent in this climate. [Paper Number 17]

DEGRADATION OF FLUROXYPYR AND DICAMBA DURING COMPOSTING OF TREATED TURFGRASS. Randy L. Smith[1,†]; Craig Blewett[1]; Jamie M. Breuninger[1]; Dan L. Loughner[1]; Mike Tolley[1]; Jack Handly[2]; Will F. Brinton[3] [1]Dow AgroSciences LLC, Indianapolis, IN; [2]Weed Man, Auburn, CA; [3]Woods End Research Laboratory, Inc., Mt. Vernon, ME

Abstract. Degradation of fluroxypyr, [(4-amino-3,5-dichloro-6-fluoro-2-pyridinyl)oxy]acetic acid and dicamba, 3,6-dichloro-2-methoxybenzoic acid was assessed in a model leaf-yard waste compost. The compost study was performed in a replicated laboratory bench-scale system. Fluroxypyr and dicamba herbicides had been previously applied to grass under controlled, turf plot conditions. Fluroxypyr and dicamba were applied at 0.28 kg ae/ha and 0.19 kg ae/ha labeled rates, respectively. At seven days after application treated and untreated grass clippings were harvested and sent for use in this study. Experimental compost was prepared from these grass clippings by blending according to a prior formula using leaf debris to achieve a typical yard-waste compost. Bench-scale composting was conducted for 39 days in 4.5-liter Dewar flasks, which allowed the compost to naturally self-heat to temperatures similar to those achieved in full-scale composting. Compost sample analysis indicated that in bench-top composting

of the treated grass clippings, both fluroxypyr and dicamba degraded rapidly from initial levels of approximately 100 ppb. No detectable residues of either compound were found after 24 days of thermophilic composting. Degradation profiles for both compounds fit first order decay models with half-lives of approximately 5 days indicating that under good composting conditions residues of either chemical would not be expected to exist after composting. [Paper Number 20]

BROADLEAF WEED CONTROL IN TURF WITH FLUROXYPYR BASED HERBICIDE FORMULATIONS. Dan L. Loughner; Darin W. Lickfeldt; Randy L. Smith[†]; Jamie M. Breuninger Dow AgroSciences LLC, Indianapolis, IN

Abstract. Fluroxpyr, [(4-amino-3,5-dichloro-6-fluoro-2-pyridinyl)oxy]acetic acid was evaluated in combination with triclopyr, mecoprop-P, 2,4-D and dicamba for broadleaf weed control in turf. Numerous field trials were conducted across the country in 2002-2003 utilizing common protocols. Treatment combinations were applied as both a liquid spray and on a fertilizer granule carrier. Fluroxypyr was applied at 0.28 kg ae/ha in each combination while mecoprop-P (MCPP), 2,4-D and dicamba were included at 1.67, 1.11 and 0.14 kg ae/ha, respectively. Triclopyr was applied at either 0.42 or 0.83 kg ae/ha depending on which combination it was included. Performance comparisons were made with both liquid and fertilizer granule combinations of triclopyr/clopyralid and mecoprop-P/2,4-D/dicamba. Broadleaf weed control evaluations were made approximately 2, 4 and 8 weeks after treatment. Results demonstrated those liquid spray combinations of fluroxypyr with triclopyr at 0.83 kg ae/ha or MCPP resulted in greater than 90% control of *Plantago lanceolata*, *Trifolium repens*, *Glechoma hederacea* and *Medicago lupulina*. The same combinations provided approximately 80% control of *Taraxacum officinale*. Granule fertilizer combination of fluroxypyr and triclopyr at 0.83 kg ae/ha resulted in approximately 80% control of *Trifolium repens*. These results are similar to those expressed by the comparison standards. [Paper Number 21]

Section 3. Weeds of Agronomic Crops

ITALIAN RYEGRASS CONTROL WITH MESOSULFURON (AE F130060) IN WESTERN OREGON. Richard Affeldt[†,*]; Carol Mallory-Smith[*]; Chuck Cole[*]; Jed Colquhoun Oregon State University, Corvallis, OR

Abstract. From 2000 to 2003, 27 trials were conducted to evaluate Italian ryegrass control in winter wheat with mesosulfuron-methyl in several formulations. Italian ryegrass density is high in western Oregon because it is grown as a seed crop in rotation with winter wheat. Italian ryegrass resistance to ACCase inhibitors is widespread and resistance to some ALS inhibitors (chlorsulfuron and metsulfuron) has been confirmed. Field trials were conducted at Hyslop Research Farm with susceptible Italian ryegrass and in grower's fields with herbicide-resistant Italian ryegrass. Italian ryegrass control with mesosulfuron was variable. In a trial in 2001 with mesosulfuron / iodosulfuron (0.0134 lb ai/A) applied on five dates across two planting dates, Italian ryegrass control was greater than 90% in all treatments where it had all emerged at the time of application. In 2002, Italian ryegrass control was poor to fair and variable across growth stages when mesosulfuron was applied alone (0.011 lb ai/A) at three Italian ryegrass growth stages. In a trial in 2002, Italian ryegrass control and winter wheat yield were greater with mesosulfuron / iodosulfuron at 0.011 lb ai/A than with mesosulfuron alone at three rates. In 2003, Italian ryegrass control was similar to results in 2002 where mesosulfuron was applied with and without iodosulfuron. However, in general, Italian ryegrass control in 2003 with mesosulfuron alone was better than in 2002. Iodosulfuron is a broadleaf herbicide, but these results suggest that there was a synergistic effect on Italian ryegrass control with the mesosulfuron / iodosulfuron combination. [Paper Number 53]

PEPPERMINT TOLERANCE AND WEED CONTROL WITH FLUMIOXAZIN. Richard Affeldt[†,•]; Carol Mallory-Smith[•]; Chuck Cole[•]; Jed Colquhoun[•] Oregon State University, Corvallis, OR

Abstract. Flumioxazin is a soon-to-be-registered broadleaf herbicide for use in dormant peppermint. Three field trials were replicated in western, central, and eastern Oregon. One experiment in each region addressed one of the following issues: 1) crop tolerance to flumioxazin tank-mixed with paraquat, 2) crop tolerance to split-applications of flumioxazin and oxyfluorfen, and 3) herbicide combinations for season-long weed control. The combination of flumioxazin and paraquat did not increase crop injury compared to paraquat alone. The addition of flumioxazin improved common groundsel control in one trial and provided good prostrate knotweed control in another trial. Split-applications of 0.125 lb ai/A of flumioxazin were evaluated in an attempt to reduce crop injury that was observed from the 0.25 lb ai/A rate in previous research. However, injury was severe and fresh weight was reduced from split-applications where the mint was. Flumioxazin at 0.125 lb ai/A per season, alone or with paraquat, was as safe as oxyfluorfen with paraquat at either timing in all three trials. Three trials compared flumioxazin or oxyfluorfen tank-mixed with paraquat for winter burn-down, followed by sulfentrazone, pendimethalin, clomazone, and/or norflurazon for season-long weed control. In all three trials crop injury was minimal and common groundsel control was good. Mint fresh weight and oil yield were comparable to the untreated check for all herbicide treatments. [Paper Number 48]

CORRELATION OF SITE-SPECIFIC SOIL PROPERTIES AND GROWTH PATTERNS OF WINTER ANNUAL/BIENNIAL WEED POPULATIONS. Jon-Joseph Q. Armstrong[†]; J. Anita Dille[•]; Christopher L. Schuster[•] Kansas State University, Throckmorton Plant Science Center, Manhattan, Kansas, 66506

Abstract. The establishment of winter annual/biennial weeds in no-tillage cropping systems often occurs as aggregated or patchy spots. Aggregated weed populations are often related to available plant nutrients and site properties within the surrounding microenvironment. Previous research has examined the association between site-specific characteristics and frequency of weed species; however, additional research is needed to determine site properties that influence winter weed growth and development. Field studies were conducted near Manhattan, KS in the fall and winter of 2003-2004 to determine correlations among growth patterns of winter annual/biennial weeds and their site-specific properties. Three 18-acre fields were mapped with GPS equipment and then divided into 1600-m^2 grids. Intersecting grid lines constituted sampling areas, with 156 total sampling areas within the three fields. Sampling areas were determined to have a high weed density (>35 plants/m^2), medium weed density (10-35 plants/m^2), low weed density (1-10 plants/m^2), or no weeds present in mid-October. Soil samples were taken from 16-selected sampling areas within each field and analyzed for pH, N-P-K and organic matter content, and cation exchange capacity. Bi-monthly weed emergence in selected 1-m^2 sampling areas was recorded for each winter weed species present beginning November 1st. The primary winter weeds within the three fields were henbit, horseweed, downy brome, and prickly lettuce. Soil pH within the fields varied from 5.3 to 7.3, organic matter varied from 1.3 to 3.6%, and cation exchange capacity ranged from 15 to 28%, with no significant correlation to winter weed establishment or development. However, positive correlations existed between nitrogen, phosphorous, and potassium levels within the soil and the presence of winter weeds. A correlation between percentage of crop residue and winter weed establishment was visually noted in late November. Results indicate that the establishment and dispersion of winter annuals/biennials was related to microenvironmental effects; specifically, available plant nutrients and crop residue. [Paper Number 39]

PREPLANT APPLIED GRAMINICIDE EFFECTS ON WHEAT AND BARLEY. Joan M Campbell[1,†]; Donn C Thill[1,*]; Robert Stougaard[2]; Dan Ball[3]; Joe Yenish[4] [1]University of Idaho, Moscow, ID, USA, 83844-2339; [2]Montana State University, Kalispel, MT; [3]Oregon State University, Pendleton, OR; [4]Washington State University, Pullman, WA

Abstract. Glyphosate is the major herbicide used to control volunteer wheat before planting a spring crop. An alternate herbicide would be required if a glyphosate-resistant crop was planted in a previous season or if a glyphosate-resistant weed population were present in the field. The use of an alternate herbicide to glyphosate may also help prevent a glyphosate-resistant weed population from developing. Quizalofop at 0.34, 0.048, and 0.096 lb ai/a, fluazifop at 0.375 lb ai/a, sethoxydim at 0.75 lb ai/a, and clethodim at 0.25 lb ai/a were applied 2, 1, and 0 weeks before planting 'Zak' spring wheat and 'Baronnesse' barley. Crop injury and grain yield from treated plots were compared to an untreated control. The experiment was repeated at Kalispell, MT; Moscow, ID; Pendleton, OR; Moro, OR; and wheat only was planted at Pullman, WA. The experimental design was a randomized complete block with four replications in experiments in ID and WA and three replications in experiments in OR and MT. Spring wheat grain yield was reduced only at MT with sethoxydim and clethodim applied the day of planting (30 and 29.8 bu/a, respectively) compared to the untreated control (42.9 bu/a). Barley grain yield was reduced at ID with clethodim applied 2 and 0 weeks before planting (4704 and 5148 lb/a, respectively) compared to the untreated control (6423 lb/a). Barley grain yield at MT was reduced with fluazifop, sethoxydim, and clethodim applied 1 week before planting (32.7, 26.1, an 29.8 bu/a, respectively) compared to the untreated control (47.8 bu/a). Barley grain yield was reduced greatly compared to all other treatments with fluazifop, sethoxydim, and clethodim applied the day of planting (19.1, 7.6, and 6.1 bu/a, respectively). Quizalofop did not injure wheat or barley at any rate at any location. [Paper Number 37]

REDUCED OAT (*AVENA SATIVA*) CONTROL IN WINTER WHEAT WITH MESOSULFURON-METHYL AND BROADLEAF HERBICIDES. Chuck Cole[†]; Carol A Mallory-Smith[*]; Richard P Affeldt[*]; Jed B Colquhoun[*] Department of Crop and Soil Science, 107 Crop Science Building, Corvallis, OR, USA, 97331-3002

Abstract. Field trials were conducted at the Hyslop Research Laboratory near Corvallis, Oregon in 2001 and 2002 to evaluate whether certain broadleaf herbicides affect oat control with mesosulfuron. 'Madsen' and 'Foote' winter wheat were seeded in October 2001 and 2002, respectively. 'Cayuse' oat was seeded over the trial area after drilling the winter wheat. Two formulations of mesosulfuron-methyl were included in the trials: a 75% DF formulation that contained only mesosulfuron-methyl and a 60.8% DF formulation that also contained iodosulfuron. All mesosulfuron-methyl treatments were applied at 0.0134 lb ai A^{-1} with UAN at 0.5 gal A^{-1}, NIS at 0.25% v/v, and a crop safener, mefenpyr-diethyl at 0.0268 lb ai A^{-1}. Oat control developed slowly following early December applications in 2001, with control ratings for both mesosulfuron-methyl formulations applied alone increasing through May, 2002. Oat control was comparable with the two formulations of mesosulfuron-methyl in 2001. Mesosulfuron-methyl in combinations with bromoxynil plus MCPA at 0.75 lb ai A^{-1}, 2,4-D amine at 0.375 lb ae A^{-1}, or dicamba at 0.125 lb ae A^{-1} antagonized oat control in both years and reduced grain yield compared to each mesosulfuron-methyl formulation applied alone in 2001. The treatment of mesosulfuron-methyl, dicamba, and 2,4-D amine was the most antagonistic. In 2002, the 60.8% DF formulation of mesosulfuron-methyl with iodosulfuron provided greater oat control than the 75% DF formulation of mesosulfuron-methyl alone, and grain yield was reduced when dicamba was used in combination with mesosulfuron-methyl. [Paper Number 26]

VEGETATIVE BUFFER STRIPS FOR WEED SUPPRESSION NEAR SALMON HABITAT. Jed B Colquhoun[†,•]; Ryan D Lins[•]; Charles M Cole[•] Oregon State University, Corvallis, OR, 97331

Abstract. This research balances the concerns of growers in protecting the economic sustainability of certified grass seed production through practical and long-term weed management strategies in non-cropland ditches and waterways surrounding agricultural fields, and concerns of the public and government in restoring water quality for human health and salmon habitat in agricultural areas. Birdsfoot trefoil, medium red clover, white clover, alfalfa, and creeping red fescue were evaluated as potential vegetative waterways species that would suppress weeds, such as wild carrot, while minimizing soil erosion and herbicide runoff. Vegetative waterway strips measured 30 meters in length by the width of the ditch, with three replications of each treatment. Weed and cover crop biomass and ground cover were quantified on a monthly basis. By June of the establishment year, ground cover was over 65% where birdsfoot trefoil, medium red clover, or creeping red fescue were planted. Creeping red fescue provided greater weed suppression in the establishment year than the conventional herbicide treatment (diuron and glyphosate). Creeping red fescue was also planted in a replicated large-scale vegetative waterway trial. In the establishment year, creeping red fescue ground cover was over 90% and suppressed weed growth better than the conventional herbicide treatment. [Paper Number 36]

WHEAT STRAW MANAGMENT AND ITS EFFECTS ON WEED POPULATIONS, STAND ESTABLISHMENT AND YIELD IN DIRECT-SEED CHICKPEA. Mary K Corp[1,†,•]; Daniel A Ball[1,•]; Mark C Siemens[2] [1]Oregon State University, Pendleton, OR; [2]USDA Agricultural Research Service, Pendleton, OR

Abstract. No-till and other reduced tillage farming systems can be environmentally more sustainable than conventional tillage based systems, yet controlling weeds without tillage in no-till production of chickpeas is difficult. Crop residue on the soil surface intercepts herbicides during spraying which inhibits their efficacy. Another problem is that most herbicides currently registered for use in chickpeas require soil incorporation to be effective. The objective of this research was to identify a method of managing wheat residue prior to no-till seeding of chickpea that would provide effective weed control using herbicides. The study was conducted on a commercial dryland field near Adams, Oregon in 2003 on Athena silt loam soil. Plots (30 ft X 100 ft) were established following conventional wheat harvest with a rotary combine in the fall of 2003. A split-block design was used with 4 replications. Residue management treatments included heavy tine harrowing, stubble flailing, removing stubble by baling, rotary harrowing, using a mulch treader, and an undisturbed check were preformed in the fall. Imazethapyr at 0.047 lb ai/A (52.7 g/ha) was applied preplant on 27, February, 2003 over all main treatments. Preplant herbicide application was followed by four spring-preformed residue treatment sub-blocks made across the fall main treatments on 4, April, 2003. Spring sub-plot treatments included heavy tine harrowing, rotary harrowing, mulch treader, and an untreated check. 'Dwelley' chickpeas were seeded using a 10 ft wide, 10 in. row spacing, John Deere 1560 plot drill at 175 lb on 13, April, 2003. Metribuzin + glyphosate was applied at a rate of 0.25 + 0.375 lb ai/A to all plots on 15, April, 2003. Seedling stand counts, weed counts, and yield data were collected. Results of the study showed the five fall residue management methods gave significantly better Russian thistle control than leaving the residue undisturbed. Spring residue treatment had no effect on weed control. In residue management treatments where the entire residue was left on the soil surface, improvements in weed control were thought to be due to earlier germination of weeds caused by soil disturbance in the fall. In the baled treatments, superior stand establishment was thought to be responsible for out competing weeds. Although Russian thistle control was statistically equivalent in all five residue management methods, significantly higher yields (P=0.10) were obtained in the baled method. Skew tread management technique resulted in significantly lower yield (P=0.10) than the other methods including the undisturbed check. These results were thought to be due to excessive "hair-pinning" during seeding in the heavy mats of residue left in the field by the skew tread treatment. In this study, post harvest mechanical manipulation of wheat straw during the fall was found to improve Russian thistle control in chickpeas. Spring residue treatments were found to have

no effect on weed control. Baling residue resulted in the best stand establishment, effective weed control and best crop yield. [Paper Number 43]

WEED MANAGEMENT AND THERMAL DEPENDENCE OF RESISTANCE IN GLUFOSINATE TOLERANT COTTON. Peter A. Dotray[1,3,†]; K. Marty McCormick[1]; Todd A. Baughman[2]; J. Wayne Keeling[3]; James R. Mahan[4] [1]Texas Tech University, Lubbock; [2]Texas Cooperative Extension, Vernon; [3]Texas Agricultural Experiment Station, Lubbock; [4]USDA-ARS, Lubbock

Abstract. The use of glufosinate ammonium (Ignite) in LibertyLink cotton will be an option for growers in 2004. Glufosinate has broad spectrum postemergence activity on numerous annual and perennial broadleaf and grassy weeds. It is a fast-acting herbicide, but movement in plants is limited. Coker 312, stripper-type, and FiberMax cotton lines have been studied and all have excellent tolerance to glufosinate. Research comparing weed management and economic returns in LibertyLink, Roundup Ready, and non-transgenic cotton varieties is underway on the Texas High Plains. In the first year of a three year study, weed management and economic returns were greatest in the glyphosate tolerant cotton system. Additional research examining weed management in glufosinate tolerant cotton indicates that residual herbicides, such as a dinitroaniline herbicide preplant incorporated, prometryn preemergence (PRE), or pyrithiobac PRE or postemergence improved ivyleaf morningglory, Palmer amaranth, common cocklebur, lanceleaf sage, and devil's-claw control over glufosinate-only systems. Other studies in the High and Rolling Plains examined glufosinate efficacy at different rates (0.42 and 0.52 lb ai/A) applied to weeds at 2-, 4-, 6-, 8-, 10-, and 12-inches in size. Palmer amaranth and devil's-claw was controlled at least 90% 1-week after treatment (WAT) when glufosinate was applied to 2- and 4-inch weeds, respectively. Less effective control was observed following glufosinate applications to larger plants. Increasing the rate of glufosinate did not increase activity. By 2 WAT, glufosinate at either rate applied to 2-inch weeds and at 0.52 lb ai/A applied to 4-inch weeds controlled devil=s-claw at least 90%. Ivyleaf morningglory and common cocklebur was controlled at least 90% when glufosinate was applied to weeds up to 6-inches in size. These weeds were controlled at least 80% 2 WAT regardless or rate or weed size. Glufosinate activity using adjuvants (non-ionic surfactant, crop oil concentrate, methylated seed oil, organosilicone surfactant, ammonium sulfate, water conditioning agent, drift control agent) rarely improved control when compared to glufosinate used alone. In the laboratory, phosphinothricin acetyl transferase (PAT) and glutamine synthetase (GS) were isolated from glufosinate tolerant cotton. Kinetics of both PAT (the detoxifying enzyme) and GS (the target site enzyme) were thermally dependent from 15 to 45 C. [Paper Number 45]

INFLUENCE OF TRIBENURON, THIFENSULFURON AND METSULFURON ON GRASS CONTROL IN CEREALS. Michael T Edwards[†,*]; Gilbert E Cook[*]; C. William Kral[*]; James D Harbour[*] DuPont Crop Protection, 390 Union Blvd, Suite 500, Lakewood, CO, USA, 80228

Abstract. Current labels for clodinafop (Discover®) and fenoxyprop (Puma®) allow tank mixing metsulfuron-methyl (Ally®), thifensulfuron-methyl (Harmony® GT) and tribenuron-methyl (Express®) with certain restrictions on rates, other broadleaf products and grass species controlled. The current labels for tralkoxydim (Achieve®) only allow tank mixing thifensulfuron-methyl (Harmony® GT) at the higher use rate and only for wild oat control. In this presentation we will provide data on wild oat (AVEFA – Avena fatua L.) control when these grass control products are tank mixed with various mixtures the sulfonylurea (SU) broadleaf herbicide products. MATERIAL and METHODS DuPont internal and University/Contractor trials have been conducted in the western United States over the past 15 years in multiple locations to wheat and barley. Tests were generally replicated 3 to 4 times in a randomized complete block design. Standard post-emergence application methods using CO2 backpack sprayers, flat fan nozzles, applied in a water carrier at 20-30 PSI and 10-20 GPA were used in the majority of the trials. Fifty-five tests with tralkoxydim (Achieve®) have been conducted on wild oat since 1988. One hundred and twenty-five tests with fenoxyprop (Puma®) have been conducted on wild oat and foxtails since 1988. Eighty-eight tests with clodinafop (Discover®) have been conducted on wild oat and foxtails since 1998.

CONCLUSIONS The clodinafop (Discover®) label for wild oat control can be modified to allow tank mixing with metsulfuron-methyl (Ally®), thifensulfuron-methyl (Harmony® GT) and tribenuron-methyl (Express®) containing products when used with an MCP product and/or a fluroxypyr (Starane™) product. The fenoxyprop (Puma®) label for wild oat control can be modified to allow tank mixing with thifensulfuron-methyl (Harmony® GT) and tribenuron-methyl (Express®) containing products when used with an MCP product and/or a fluroxypyr (Starane™) product. The tralkoxydim (Achieve®) label for wild oat control can be modified to allow tank mixing with thifensulfuron-methyl (Harmony® GT) when used with an MCP product or a fluroxypyr (Starane™) product. [Paper Number 44]

TRIBENURON-TOLERANT SUNFLOWER: HERBICIDE APPLICATION TIMING AND HERBICIDE PROGRAMS. James D. Harbour[1,†,•]; Michael T. Edwards[1,•]; Christopher M. Mayo[1,•]; Robert N. Rupp[1,•]; Eric P. Castner[1]; Larry H. Hageman[2,•]; Bruce H. Stanley[3] [1]DuPont Ag & Nutrition, 390 Union Blvd, Suite 500, Lakewood, CO, USA, 80228; [2]DuPont Ag & Nutrition, P.O. Box 604, Rochelle, IL, USA, 61068; [3]DuPont Ag & Nutrition, P.O. Box 30, Elkton Rd., Newark, DE, USA, 19714

Abstract. Field research was conducted in KS, TX, SD, ND, NE, CO, and IL in 2002 and 2003 to determine the efficacy and crop response when tribenuron was applied to 2-leaf (V2), 8-leaf (V8), and post-bud (R1) tribenuron-tolerant sunflower. Standard small-plot research techniques were used at all the research locations. Tribenuron was applied at 0.125, 0.1875, 0.25, and 0.5 oz ai/a to V2, V8, R1; and, each herbicide rate was applied sequentially to V2 followed by (fb) V8 growth-stage sunflower. Phytotoxicity tended to be greater when tribenuron was applied to V2 or V2 fb V8 growth-stage sunflower than V8 or R1 sunflower. Tribenuron controlled common lambsquarters regardless of herbicide rate or application timing, but common purslane was not controlled by tribenuron. Kochia, palmer amaranth, redroot pigweed, Russian thistle, and puncturevine were controlled to the greatest level when tribenuron was applied sequentially to V2 fb V8 growth-stage sunflower. Field research was also conducted in KS, ND, and WY in 2002 and 2003 to determine efficacy and tribenuron-tolerant sunflower response in various weed control programs currently used in the US. Ethafluralin was applied pre-plant incorporated and pendimethalin, sonalan, and sulfentrazone were applied pre-emergence to tribenuron-tolerant sunflower. At approximately V8 growth-stage sunflower, tribenuron (0.125 oz ai/a) was applied post-emergence. Further, tribenuron was applied without a soil-applied herbicide for a POST-only herbicide treatment program. Phytotoxicity was less than 4% (14 DAA) regardless of herbicide treatment program. These weed control programs provided good-to-excellent control of kochia, Russian thistle, and puncturevine. [Paper Number 4]

GLYPHOSATE BRAND EVALUATION IN WINTER WHEAT STUBBLE FIELDS. Robert K Higgins[1,†]; Brady F Kappler[2]; Robert N Klein[3,•]; Drew J Lyon[1,•]; Gail A Wicks[3,•] [1]University of Nebraska Panhandle Research & Extension Center, Scottsbluff, NE; [2]University of Nebraska Department of Agronomy & Horticulture, Lincoln, NE; [3]University of Nebraska West Central Research & Extension Center, North Platte, NE

Abstract. The proliferation of glyphosate products has had a profound effect on the generic herbicide market. No matter how many herbicides are introduced, the question always comes back to: Will glyphosate product A perform as well as glyphosate product B? Field studies were conducted for three years at two locations in western Nebraska to evaluate different brands of glyphosate herbicides. The studies were conducted in wheat stubble near Grant and Sidney, Nebraska. In 2001 and 2002, glyphosate application rates were 0.42 and 0.84 kg ae/ha. In 2003, glyphosate application rates were reduced to 0.31 and 0.62 kg/ha. Herbicides investigated over the three years included Roundup UltraMax, Roundup Ultra, Roundup WeatherMAX, Roundup UltraDry, Touchdown, Clearout 41 Plus, Glyfos Xtra, Cornerstone, Glyphomax, Glyphomax Plus, and Engame. Most of the products represent the isopropylamine (IPA) salt of glyphosate; however, Touchdown is formulated as the diammonium salt of glyphosate, Roundup UltraDry is formulated as the mono-ammonium salt of glyphosate, and Roundup WeatherMAX is formulated as a potassium (K) salt of glyphosate. In addition, a product known as Engame was included

in the study. Engame is a pure acid formulation of glyphosate. All sites were evaluated for percent weed control 2 and 4 weeks after treatment. Over the 3 years, differences were small and varied slightly across the different trade names. Engame provided significantly better weed control (kochia, Russian thistle, and sandbur) at all rates than any of the K or IPA salt formulations of glyphosate. When it comes to selecting a glyphosate product, rate, environmental factors, and cost will most likely play a larger role in the decision process than brand name. [Paper Number 49]

SUMMARY OF GLYPHOSATE-RESISTANT WHEAT RESEARCH IN NORTH DAKOTA. Kirk A. Howatt[1,†,*]; Greg J. Endres[2,*]; John R. Lukach[3]; Briam M. Jenks[4,*]; Steve A. Valenti[5,*]; Craig M. Rystedt[5] [1]North Dakota State University, Fargo, ND, 58105; [2]NDSU-Carrington Research Extension Center, Carrington, ND, 58421; [3]NDSU-Langdon Research Extension Center, Langdon, ND, 58249; [4]NDSU-North Central Research Extension Center, Minot, ND, 58701; [5]Monsanto Company, St. Louis, MO, 63167

Abstract. Studies were conducted with similar treatment lists at multiple locations from 1999 through 2003 to evaluate crop response and weed control in glyphosate-resistant wheat with glyphosate and conventional herbicide treatments. Weed species present in a study differed with location and year. Weeds reported were present in three to ten experiments. Thirteen experiments contributed yield data. Weed control tended to be better when glyphosate at 420 to 840 g ae/ha was applied to 4-leaf wheat compared with 2-leaf wheat because of late emerging weed cohorts. Glyphosate at 630 g/ha applied to 4-leaf wheat gave greater control of wild oat, foxtail species, redroot pigweed, and common lambsquarters than the highest-yielding conventional herbicide treatment; 10, 9, 19, and 6 percentage points difference respectively. Glyphosate at 630 g/ha applied to 4-leaf wheat provided similar control of wild buckwheat with the conventional herbicide treatment, 80%. Two applications of glyphosate at 420 g/ha improved control of wild buckwheat to 88% but did not improve control of wild oat, foxtail species, redroot pigweed, or common lambsquarters compared with one application of glyphosate at 630 g/ha to 4-leaf wheat. Two applications of glyphosate tended to increase control of Canada thistle compared with one application of glyphosate, and one application of glyphosate tended to provide better Canada thistle control than the conventional herbicide. In studies with Canada thistle, wheat treated with two applications of glyphosate produced 17% more grain than the best conventional treatment. Across all studies, wheat treated with two applications of glyphosate produced 5% more grain than one application of glyphosate at 630 g/ha or the highest-yielding conventional treatment. [Paper Number 42]

POTENTIAL OF ACETIC ACID, PELARGONIC ACID AND PINE EXTRACT AS "ORGANIC HERBICIDES". Renae A. Barbour[1]; Dr. Thomas M. Wolf[1]; Mr. Brian C. Caldwell[1]; Eric N. Johnson[2,†] [1]Agriculture and Agri-Food Canada, Saskatoon Research Center, 107 Science Place, Saskatoon, SK, Canada, S7N 0X2; [2]Agriculture and Agri-Food Canada, Scott Research Farm, Box 10, Scott, SK., Canada, S0K 4A0

Abstract. The use of foliar sprays may help conserve soil and water in organic agriculture. Experiments were conducted to investigate the potential of acetic acid (vinegar), pine extract (Interceptor™) and pelargonic acid (Scythe®) as foliar weed control agents on broadleaf and grassy weeds. Products were mixed with water at concentrations ranging from 3 to 20%, and applied with flat fan sprays at 50 to 2000 L/ha. Effects on oriental mustard (*Brassica juncea* L.) and tame oat (*Avena sativa* L.) were evaluated using dose response modelling. At high doses, vinegar controlled mustard but not oats, suggesting an opportunity for in-crop selectivity. Pine extract showed less selectivity than vinegar. Pelargonic acid worked faster and gave more complete control than pine extract or vinegar on mustard and oats, and was non-selective on tested plants. Relative potency was similar or varied slightly with plant growth stage for all products. Overall use rates at which control was obtained were high, and further research is required to determine the economic feasibility of these products. [Paper Number 32]

VINEGAR FOR PRE-SEED AND POST-EMERGENCE CONTROL OF BROADLEAF WEEDS IN SPRING WHEAT. Eric N. Johnson[1,†]; Dr. Thomas M. Wolf[2]; Mr. Brian C. Caldwell[2] [1]Agriculture and Agri-Food Canada, Scott Research Farm, Box 10, Scott, SK, Canada, S0K 4A0; [2]Agriculture and Agri-Food Canada, Saskatoon Research Center, 107 Science Place, Saskatoon, SK, Canada, S7N 0X2

Abstract. Research conducted by the USDA indicated that control of some annual and perennial weed species was attained by the application of vinegar with a 10 to 20% acetic acid concentration. It was hypothesized that vinegar may be a potential non-selective pre-seed or pre-emergence herbicide option in organic crops. Initial greenhouse studies indicated that grass weeds were more tolerant to vinegar than broadleaf weeds. Thus, a field study was conducted at the Scott Research Farm in 2003 to investigate the efficacy of a pre-seed application of vinegar and the potential for selective broadleaf weed control in spring wheat. Vinegar (10% acetic acid concentration) was applied 3 days prior to seeding spring wheat (*Triticum aestivum* L.) using concentrations of 0, 200, 400, 800, 1600 and 2400 L ha-1 with a commercial standard (glyphosate @ 450 g ai ha-1) treatment included. The same vinegar treatments were applied post-emergence to spring wheat in the 1-2 leaf stage (commercial standard of bromoxynil-MCPA @ 560 g ai ha-1). Vinegar applied in pre-seed application volumes of 1600 L ha-1 or higher resulted in over 80% control of shepherd's-purse (*Capsella bursa-pastoris* (L.) Medik.). Wheat exhibited significant initial injury symptoms to vinegar at post-emergence rates greater than 400 L ha-1 but was able to recover from all application rates with very little visible injury evident 28 DAT. In-crop application volumes of greater than 800 L ha-1 resulted in greater than 80% control of wild mustard (*Sinapis arvensis* L.) and cow cockle (*Viccaria hispanica* (Mill.) Rauschert). Application volumes of ≥ 1600 L ha-1 were required to provide weed control comparable to the commercial standards; however wheat yields were maximized and similar to the commercial standards at application volumes of 400-800 L ha-1. Further evaluation of vinegar as a pre- and post-emergence herbicide is required to determine its cost-effectiveness in organic systems. [Paper Number 33]

COMMON LAMBSQUARTERS DENSITY AND SEED BANK CONTRIBUTION UNDER CONVENTIONAL OR GLYPHOSATE-RESISTANT CROPPING SYSTEMS. Andrew R Kniss[1,†,•]; Robert G Wilson[2,•]; Sandra M Frost[1]; Lisa L Boggs[1]; Stephen D Miller[1,•] [1]University of Wyoming, Laramie, WY, 82071; [2]University of Nebraska, Panhandle Research and Extension Center, Scottsbluff, NE, 69361

Abstract. Agricultural management practices such as tillage, crop rotation, and herbicide use typically favor one or more weed specie over others within the community. Common lambsquarters (*Chenopodium album*) has been noted recently as a species with the ability to increase under continuous glyphosate-resistant crop use. The purpose of this analysis was to investigate common lambsquarters density and seed bank contribution under glyphosate-resistant and conventional cropping systems. Long-term field studies were initiated at Torrington, WY and Scottsbluff, NE in 1998 as part of a four-state effort to examine potential weed shifts brought on by glyphosate-resistant cropping systems. A split-plot randomized complete block design was employed with two crop rotations as whole-plot factors, and four herbicide treatments as split-plot factors at each location. At Scottsbluff, common lambsquarters density was influenced by herbicide treatment and crop rotation over time. Continuous use of glyphosate at the recommended rate of 0.84 kg ae/ha was as efficacious at controlling common lambsquarters as conventional or rotational herbicide treatments. Herbicide treatment also influenced the amount of lambsquarters seed in the seed bank, with continuous glyphosate use at recommended rates reducing the amount of seed compared to conventional herbicide treatments. At Torrington, herbicide treatment by crop rotation interaction was present with respect to weed density, as the herbicide treatments tended to give more variable weed control in the corn-sugarbeet-wheat rotation. Continuous corn resulted in less lambsquarters seed in the seed bank when compared to the rotational cropping sequence. [Paper Number 23]

PREPLANT AND POSTEMERGENCE HERBICIDES FOR WEED CONTROL IN DRY BEANS. Abdel O Mesbah[1,†,*]; Stephen D Miller[2,*] [1]University of Wyoming, Powell, WY, 82435; [2]University of Wyoming, Laramie, WY, 82071

Abstract: Field experiments were conducted in 2001, 2002, and 2003 at the Powell Research and Extension Center to evaluate weed control and dry bean response to preplant incorporated, postemergence, or preplant incorporated followed by postemergence herbicides. Preplant incorporated treatments consisted of pendimethalin, dimethenamid, flumioxazin, and ethafluralin applied alone or in combination. Postemergence treatments consisted of imazamox alone or in combination with bentazon and sethoxydim were applied at two trifoliate bean stage. Nitrogen plus crop oil concentrate or nonionic surfactant were added to the poste emergence treatments. Depending on the weed species, control was good to excellent with all the preplant treatments. Similar finding were achieved with postemegence treatments except for barnyard grass. Excellent weed control was achieved by preplant followed by postemergence treatments. The addition of sethoxydim increased wild oat control by 5 to 10%. Bean injury with flumioxasin increased with increasing rates and was greater in combination treatments than when applied alone. Dry bean yields were higher in herbicide treated compared to the weedy check. [Paper Number 22]

NATURAL TOLERANCE OF *CUSCUTA SPP.* TO HERBICIDES INHIBITING AMINO ACID BIOSYNTHESIS. Talia Nadler-Hassar[1]; Dale Shaner[2]; Baruch Rubin[3]; Scott Nissen[1]; Phill Westra[1] [1]BSPM dept. Colorado State University, Fort Collins, CO; [2]USDA/ARS Water management Research, Fort Collins, CO; [3]R.H smith Institute of Plant Sciences and Genetics, the Hebrew University of Jerusalem., Rehovot, Israel

Abstract. Cuscuta campestris is a non-specific above-ground holoparasite which is totally dependant on a host for assimilate, nutrient and water supply. It is considered among the most damaging parasites due to its wide distribution and large host range. Many groups of herbicides are incompatible in the control of *Cuscuta* since their target sites do not exist or are not essential for its development. Another concern is the close connection between the parasite and the host. The development of herbicide resistant crops could be a potential solution for *Cuscuta* control. It has been proposed that the herbicide applied to the host would rapidly accumulate in the parasite due to its non-selective strong sink ability and lead to its death. Our research will attempt to evaluate the potential of herbicide resistance crops in *Cuscuta* control. In vitro assay conducted on isolated *C. campestris* segments indicate that the parasite has active acetolactate synthase (ALS) and 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS). ALS and EPSPS are key enzymes the biosynthesis pathways of branched chain and aromatic amino acids (respectively). Dose response assays were conducted by growing *Cuscuta* spp seedlings on germination paper in the presence of glyphosate, imazamox and glufosinate. The ED_{50} generated from these assays indicate that seedlings of *C. campestris*, *C. gronovii* and *C. subenclusa* were much more tolerant to glyphosate then the seedlings of the herbicide susceptible and tolerant controls used (Sorghum and RR canola). Interestingly the dose response assays show that *C. campestris* seedlings have a higher tolerance for imazamox but are significantly more sensitive then the herbicide susceptible and tolerant controls to glufosinate. When grown on herbicide resistant canola hosts the parasite responded unexpectedly. *C. campestris* growing on a glufosinate resistant host were unaffected by the herbicide where as glyphosate and imazamox inhibited the growth of the parasite growing on glyphosate and imidazolinone resistant canola. The greenhouse assays conducted with herbicide resistant canola and sugar beet indicate that although the development of parasite may initially be inhibited by glyphosate and imazamox it my recover and cause damage to the host. [Paper Number 52]

EVALUATION OF THE SPATIAL DYNAMICS OF WEEDS IN IRRIGATED CORN. Scott O'Meara[†]; Raj Khosla; Phil Westra[*] Colorado State University, Fort Collins, CO

Abstract. Weeds are generally spatially aggregated into clusters when sufficient populations are present. Site-specific herbicide application to weed patches could provide large economic and ecological benefits. However, the high costs of assessing weed spatial distributions often counteract the financial advantages of site-specific herbicide application. Therefore, a study was conducted to develop methods towards cost effective mapping of spatially dynamic weed populations. Weed species were counted within a 0.27 m^2 quadrat for 7 site-years in Eastern Colorado. All sites were in irrigated continuous corn. Two stratified-random sampling strategies were used, point samples (using a 0.33 acre or 900 m^2 grid), and cluster sampling (2.5 acre grid with 3 to 9 points per cluster). Soil samples were also taken at cluster sample sites and analyzed for texture and nutrients. Bare-soil color-infrared photographs from an aerial platform were used to delineate fields into high, medium, and low productivity zones. Weeds in all sites were spatially aggregated, and large areas were weed-free. Weed distributions could thus be represented by a negative binomial distribution. Non-parametric analyses of correlations between weed density/occurrence and management zones did not show repeatable patterns between sites or years. Soil properties showed little correlation with weed densities, although several variables demonstrated a threshold over which significantly less weed free quadrats were found. Predicting the spatial distribution of weeds without intensive sampling is challenging. Variables that had low to moderate correlations with weed dynamics were inconsistent across sites, indicating that mapping strategies need to be site dependent. Additional studies in remote sensing and real-time sensor-sprayer technologies will be integral in future implementation of weed mapping and precision herbicide application. [Paper Number 51]

DISTRIBUTION OF RESISTANCE TO IMAZAMOX AND TRIBENURON IN NATIVE SUNFLOWER. Brian L. S. Olson[1,†]; Rob M Aiken[1]; Kassim Al-Khatib[2,*] [1]Kansas State University - NW, Colby, KS; [2]Kansas State Univeristy, Manhattan, KS

Abstract. Genetic diversity is abundant in native sunflower species. However, with the introduction of imazamox (Clearfield) tolerant sunflowers and the future introduction of tribenuron-methyl (Express) tolerant sunflowers, an evaluation of the native sunflower tolerance to these herbicides needed to be gauged in order to evaluate future possible genetic outcrossing of the imazamox tolerant and tribenuron-methyl tolerant gene from domesticated sunflowers to native sunflowers. Thanks to the National Sunflower Association 2002 weed survey, native sunflower samples were collected from various areas in North and South Dakota, Nebraska, Kansas, and Colorado. This collection allowed for the testing of sunflower from a wide geoagraphical area to be evaluated for resistance to either imazamox or tribenuron-methyl. Most of the collected sunflower consisted of common sunflower (Helianthus annuus) with a few sites having prairie sunflower (Helianthus petiolaris). The collected seeds were cleaned, surface sterilized, scarified, gibberellic acid vacuum infiltrated, germinated, planted in pots, and placed in a greenhouse. Sunflower seedlings at 7.5 to 10 cm were treated with either imazamox at 43.8 g ai/ha (Beyond at 5 oz/A) with a nonionic surfactant at 0.25% v/v and 28%N at 2.5% v/v or tribenuron-methyl at 17.3 g ai/ha (Express at 0.33 oz/A) with a nonionic surfactant at 0.25% v/v. Treatments had six to 10 replications and the study was repeated twice. Sunflower survival to either imazamox or tribenuron-methyl was classified as resistant while plant death was classified as susceptible. Resistance to imazamox and tribenuron-methyl was determined in 46 populations of common sunflower and three populations of prairie sunflower. In all fields sampled, at least 8% and 57% of the fields exhibited resistance to imazamox or tribenuron-methyl. More resistance to these herbicides occurred in Colorado, Kansas, and Nebraska than North and South Dakota. This may be due to more prevalent use of sulfonylurea and imidazolinone herbicides over a longer period of time in the southern sampling area than in the north. In addition, this survey clearly indicates that imazamox and tribenuron-methyl resistance occurred in fields before the release of Clearfield or Express tolerant sunflower. [Paper Number 25]

DEVIL'S CLAW CONTROL IN IMAZAMOX TOLERANT (CLEARFIELD) SUNFLOWER. Brian L. S. Olson[1,†]; Dallas Peterson[2,*] [1]Kansas State University - NW, Colby, KS; [2]Kansas State Univeristy, Manhattan, KS

Abstract. Devil's claw has been a difficult weed to control in sunflowers due to the limited herbicides labeled for the crop. In 2002, the National Sunflower Association field survey identified devil's claw as a troublesome weed in High Plains sunflower production. With the advent of imazamox tolerant (Clearfield) sunflowers, imazamox, sold as Beyond, could be applied to sunflowers and potentially control devil's claw. Research was initiated to evaluate devil's claw control with imazamox, and a comparison of adjuvants to be used with imazamox, a nonionic surfactant or crop oil concentrate, was incorporated into the study. Two sites located near Oberlin, KS, Site 1 and Site 2, that had naturally occurring infestations of devil's claw had a preemergence application of pendimethalin at 1,387 g ai/ha applied to suppress grasses and some broadleaves. At planting, an experimental Clearfield NuSun sunflower hybrid (EXPCL 346CL) was seeded at 43,250 plts/ha, and a burndown application of glyphosate 1,121 g ai/ha was applied. Application treatments consisted of imazamox at 35 g ai/ha and UAN at 1% v/v with either a non-ionic surfactant at 0.25% v/v or crop oil concentrate at 1% v/v added. Treatments were applied using a 6-tip CO2 backpack sprayer when the devil's claw was at the 2, 8, and 14 true leaf stage. Weeds rated were devil's claw with the addition of tumble pigweed at Site 1 and puncturevine at site 2. Weed control ratings were consistent with application timing having the greatest affect on sunflower yield and weed control rating regardless of the weed. Early treatments provided 90%+ control for devil's claw and tumble pigweed and 83% control for puncturevine. A 40% reduction in control was typically observed with later treatment applications. Residual weed control from the early application treatments was not an issue due to the lack of rainfall which inhibited later weed emergence. No difference between NIS or COC was observed when ratings were taken on devil's claw, puncturevine, tumble pigweed, or on sunflower yield. No injury was observed on the sunflowers from the various imazamox applications. However, ratings were taken every two weeks and any visual symptoms would have likely disappeared by that time. No affect on oil content was observed between the control or various treatment applications. In conclusion, the Clearfield sunflower system appears to have potential for controlling many troublesome weeds like devil's claw that occur in High Plains sunflower production. [Paper Number 24]

GLYPHOSATE-RESISTANT *LOLIUM MULTIFLORUM* IN OREGON. ALEJANDRO PEREZ-JONES[†]; KEE-WOONG PARK; JED COLQHHOUN[*]; CAROL MALLORY-SMITH[*] 107 CROP SCIENCE BUILDING, OREGON STATE UNIVERSITY, CORVALLIS, OR, USA, 97331

Abstract. A suspected glyphosate-resistant *Lolium multiflorum* population was collected from a filbert orchard near Portland, OR. Glyphosate was applied multiple times per year for about 15 years in the orchard. Greenhouse studies were conducted to determine if this population was glyphosate-resistant. The plants were sprayed with glyphosate (13 to 3370 g ae/ha) 14 days after planting using an overhead compressed air sprayer calibrated to deliver 187 L/ha. Aboveground biomass was harvested 3 weeks after herbicide treatment, dried at 70 C for 48 h and weighed. Biomass data are reported as percent of untreated control. The study was conducted twice. At 421 g ae/ha, biomass of the susceptible biotype was reduced by 95%, while that from the resistant biotypes was only reduced by 25%. This level of resistance is similar to that reported from a glyphosate-resistant population from Chile. The mechanism of resistance is still unknown. However, no amino acid change was found after the EPSPS gene was amplified and sequenced. [Paper Number 92]

LONGSPINE SANDBUR ECOLOGY IN CULTIVATED SUNFLOWER. Leandro D. Perugini[1,†]; Phillip W. Stahlman[2,*]; J. Anita Dille[1,*] [1]Kansas State University, Department of Agronomy, Manhattan, KS, USA, 66506; [2]Kansas State University, Agricultural Research Center, 1232 240th Ave., Hays, KS, USA, 67601

Abstract. Longspine sandbur [*Cenchrus longispinus* (Hack.) Fern.] is a troublesome annual grass weed infesting cultivated sunflower fields in the central Great Plains of the United States. Field research was conducted at Hays, KS in 2003, to determine the critical period of absence for longspine sandbur in cultivated sunflower and the effects of delayed weed emergence relative to sunflower plants on longspine sandbur growth and bur production. Treatments were five weed free periods (0, 2, 3, 4, and 5 weeks) after sunflower emergence and a season-long weed free control. Treatments were replicated five times. At appropriate intervals, plots were overseeded with longspine sandbur seeds and incorporated 1 to 2 cm, then all plots were irrigated each time with 15±3 mm of water to stimulate germination. After establishment, sandbur seedlings were thinned to 22 plants/m² and later emerging weeds, including sandbur, were removed by hand. Growth and development of longspine sandbur was monitored by counting tillers, measuring tiller length and plant height weekly throughout the growing season. Bur number was determined after longspine sandbur plants were hand harvested on September 22. Longspine sandbur plants emerging simultaneously with sunflower averaged 11 tillers/plant and 328 burs/plant. In comparison, tiller number and bur production of sandbur plants emerging 2 weeks later than sunflower were about 50% less than when emerging at the same time as sunflower. Sandbur plants emerging 3 weeks later than sunflower produced less than 2 tillers/plant and 43 burs/plant. Growth of sandbur plants emerging 4 or 5 weeks later than sunflower was reduced substantially by moisture stress and low light intensity below the sunflower canopy; few plants produced more than 1 or 21 burs. In this experiment, 22 longspine sandbur plants/m² did not reduce sunflower yield at any weed free period. [Paper Number 41]

WEED MANAGEMENT SYSTEMS IN CHICKPEAS. Ryan Rapp[†]; Stephen D. Miller[*]; David W. Wilson[*] Department of Plant Science, 1000 East University Ave, Laramie, Wyoming, 82071

Abstract. Farmers in the Central High Plains are interested in decreasing fallow and developing a more intensive dryland cropping system. Many are interested in a legume because of the potential benefits they afford such as reduced fertilizer requirements, improved soil quality and improved pest management. Chickpeas (*Cicer arietinum*) is a grain legume which has caught their attention. Field studies were conducted in southeast Wyoming at the Archer and Torrington Research and Extension Centers in 2003 to evaluate weed control and chickpea response with herbicides or grazing sheep. Herbicide plots were 3 by 9m while grazed plots were 37 by 39m. Weed and crop response ratings were made two weeks after grazing or herbicide application.

Chickpea tolerance varied widely depending on herbicide treatment and sheep stocking rate and utilization percentage. In general, chickpea exhibited good tolerance to the low stocking rate with 25% utilization or herbicide treatments containing trifluralin, ethafluralin, pendimethalin, dimethenamid and sulfentrazone. Together broad spectrum weed control ranged from poor to good (0 to 100% control of individual weed species) and was generally better with herbicide compared to sheep grazing techniques. Treatments containing trifluralin, ethafluralin and sulfentrazone provided the highest level of weed control while post treatments containing imazethapyr, imazamox, pyridate or bentazon provided the lowest level of control. Sheep grazing provided intermediate levels of control. This research will again be conducted at two sites in 2004 with modifications in herbicide and sheep grazing treatments.
[Paper Number 47]

HERBICIDE SUPPRESSION OF KENTUCKY BLUEGRASS STANDS IN AN ALTERNATE YEAR SEED PRODUCTION SYSTEM. Janice Reed[†]; Dr Donn Thill[•] University of Idaho, Moscow, ID

Abstract. Sustained bluegrass seed production historically has relied on open-field burning of post-harvest residue. Burning maintains stand longevity by reducing thatch accumulation. However, burning has been associated with significant air quality issues and public health impacts. Mechanical removal of post-harvest residue usually results in greatly reduced Kentucky bluegrass stand life. Bluegrass stand suppression using herbicides in an alternate-year seed production system may sustain productivity and allow in-situ residue decomposition. Experiments were established to determine the optimum time of glyphosate application for stand suppression and sustained seed yield of three Kentucky bluegrass cultivars (Nublue, Newport, and Palouse). Plots were 10 by 30 ft arranged in a randomized complete block design with four replications. Glyphosate was applied to all cultivars at five spring timings in 2001, and the seed yield measured in 2002. Nublue seed yield was highest at the second glyphosate application, while all other timings were equal to or greater than the untreated control. Palouse seed yield was highest at the first application time compared to the two later timings and the untreated control. Newport seed yield was not differ amongst treatments. The experiment was repeated in 2002 and glyphosate injured all three bluegrass cultivars at all application times. Recovery from glyphosate suppression was greatest in Nublue and 2003 seed yield did not differ amongst application timings or the untreated control. Kentucky bluegrass seed yield was lowest for the latest timing in Newport and the second timing in Palouse; yield at all other timings did not differ from the untreated control. The effect of six herbicides on stand suppression and rejuvination of two Kentucky bluegrass cultivars (Newport and Quantum Leap) was initiated in 2002. Plots were 8 by 30 feet, arranged in a split block design with four replications. The main plot was herbicide and the sub-plot was herbicide timing. Herbicides were applied in 2002 to both cultivars at three spring timings. Bluegrass suppression and regrowth were visually estimated and seed yield was determined in 2003. Sulfosulfuron did not suppress the stand or affect the yield of either cultivar compared to the untreated control. All plots treated with glyphosate were severely injured and did not produce seed. Newport seed yield from plots treated with quizalofop, paraquat, and glufosinate, at all timings were equal to or greater than the untreated control. Imazapic applied at the two earlier timings reduced yield, but yield at the later timing did not differ from the untreated control. Quantum Leap yield did not differ among herbicides or application timings. The experiment was repeated in 2003 on cultivars Rambo and Cenex 22. The experimental design was the same as the 2002 experiment, but the sulfosulfuron treatment was dropped. All plots treated with glyphosate were severely injured and had no regrowth in 2003. Rambo regrowth in June 2003 did not differ between application timings for paraquat, imazapic, and glufosinate. Plots treated with quizalofop at the earlier timing had more regrowth than the later application timing. Cenex 22 regrowth was greatest at the early timing of paraquat, and the late timing of imazapic and quizalofop. Cenex 22 plots treated with glufosinate at the second timing had the greatest regrowth compared to the early and late timings. Rambo and Cenex 22 seed yield will be determined in 2004. [Paper Number 34]

ADDITIVE EFFECTS OF GROUP 2 HERBICIDES ON CROP TOLERANCE AND RE-CROPPING RESTRICTIONS. Ken L. Sapsford[1,†,•]; Mr. Eric N. Johnson PAg.[2,•]; Mr. Frederick A. Holm PAg.[1,•]; Linda Hall[3]; Dr. Jim Moyer[5]; Leighton Blasko[4] [1]University of Saskatchewan, Saskatoon, SK; [2]Agriculture and Agri-Food Canada, Scott, SK; [3]University of Alberta, Edmonton, AB; [4]BASF, Calgary, AB; [5]Agriculture and Agri-Food Canada, Lethbridge, AB

Abstract. Recent severe droughts on the Canadian Prairies have raised concerns over herbicide residue carryover, particularly with residual Group 2 herbicides. Field observations have led to speculation that the repeated use of different residual Group 2 herbicides may result in additive or synergistic injury to sensitive rotational crops. A 3-year study was initiated in 2002 at 8 locations in Saskatchewan and Alberta, Canada to investigate the effect of repetitive application of different residual Group 2 herbicides in successive years. The two objectives of the study are: 1) to determine if a crop is predisposed to Group

2 injury if a residual Group 2 herbicide was applied the previous year and; 2) to determine if the repeated application of different residual Group 2 herbicides in two successive years results in increased plant-back sensitivity to successive rotational crops. The study consists of a field pea-spring wheat-canola crop sequence. The field pea phase received either a non-residual herbicide (bentazon) or an application of imazamox: imazethapyr (1:1) at 30 g ai ha-1 in 2002. In 2003, the wheat phase received a post-emergence application of a non-Group 2 check (clodinafop-propargyl), imazamethabenz, flucarbazone, sulfosulfuron, or florasulam/MCPA at registered field application rates. In 2003, the application of residual Group 2 herbicide predisposed the spring wheat crop to injury from the post-emergence Group 2 applicationat only one of eight locations. The sequence of imazamox:imazethapyr in 2002 followed by flucarbazone, sulfosulfuron, and florasulam/MCPA in 2003 resulted in higher levels of wheat injury and lower wheat yields than the imazamox:imazethapyr / non-Group 2 sequence or the non-Group 2/ Group 2 sequence at a site with low soil organic matter and low soil pH. In 2004, the effect of successive residual Group 2 herbicide application on canola will be assessed (objective # 2). The results suggest that under some conditions, an application of a Group 2 herbicide in spring wheat should be avoided if a residual Group 2 herbicide was applied the previous year. [Paper Number 38]

INTERACTIVE EFFECTS OF SPRAY QUALITY, AIR INDUCTION, AND HERBICIDE MODE OF ACTION ON WEED CONTROL. Dr. Tom Wolf[1]; Mr. Ken L Sapsford PAg.[2,†,•]; Mr. Fredrick A Holm PAg.[2,•]; Linda Hall[3]; Dr. Rene Van Acker[4] [1]Agriculture and Agri-Food Canada, Saskatoon, Sk, Canada; [2]University of Saskatchewan, Saskatoon, Sk, Canada; [3]Alberta Agriculture, Food and Rural Development, Edmonton, Ab, Canada; [4]University of Manitoba, Winnipeg, Man, Canada

Abstract. Experiments were conducted to evaluate the relative importance of herbicide rate (full label rate and either 0.75 or 0.5 x), spray quality (medium, coarse, and very coarse), and air-induction (with or without) on post-emergent weed control using 8 different modes of action (Groups 1, 2, 4, 6, 8, 9, 10, and 22) on broadleaf and grassy weeds. A total of 90 experiments were conducted over three years in Manitoba, Saskatchewan, and Alberta. Analyses of variance were conducted on weed control, and the frequency of significant effects was tabulated for each variable. Herbicide rate was the most important determinant of weed control, having significant effects in 49% of cases (63% for grasses, 44% for broadleaves). Spray Quality had a significant effect on weed control 21% of the time (34% and 17% for grasses and broadleaf weeds, respectively). Air induction had relatively minor effects, being significant in only 15% of cases for both grasses and broadleaves. On grasses, Group 2 products were less sensitive to herbicide rate, spray quality, and air-induction than Group 1 products. On broadleaves, Group 2 and 4 products were among the least sensitive to spray quality. Group 9 was sensitive to herbicide rate and spray quality, although overall control rarely dropped below 80%. In contrast, Group 10 was less sensitive to these variables but overall levels of control were below those of Group 9. [Paper Number 40]

INTERACTION OF MESOTRIONE WITH ALS-INHIBITING HERBICIDES ON GREEN FOXTAIL, LARGE CRABGRASS, SHATTERCANE, AND VELVETLEAF. Christopher L. Schuster[†]; Kassim Al-Khatib[•]; J. Anita Dille[•] Kansas State University, Throckmorton Plant Science Center, Manhattan, Kansas, United States, 66506

Abstract. Mesotrione is an effective broadleaf herbicide, but may not control a broad spectrum of grass weeds. As a result, atrazine and/or acetolactate synthase (ALS) inhibiting herbicides are often mixed with mesotrione for additional grass control. However, recent complaints contend that green foxtail, large crabgrass and shattercane control is reduced when mesotrione is applied in combination with ALS-inhibiting herbicides, especially when the mesotrione rate is reduced. Greenhouse experiments were conducted to evaluate interactions between mesotrione or mesotrione + atrazine and ALS-inhibiting corn herbicides when applied on green foxtail, large crabgrass, shattercane and velvetleaf. Plants were grown in 7-cm containers then treated with 0.25, 0.5, 0.75 or 1 times the use rates of mesotrione (105 g ai/ha), mesotrione + atrazine (105 + 280 g/ha), nicosulfuron (35 g/ha), foramsulfuron (37 g/ha), rimsulfuron (18 g/ha), or a combination of mesotrione or mesotrione + atrazine with any one of the three ALS-inhibiting

herbicides. Visual ratings of plant injury were determined 7 and 21 days after treatment (DAT) based on a scale of 0 to 100%. Mesotrione provided greater than 90% control of large crabgrass and velvetleaf, while the addition of atrazine resulted in greater than 98% control of the two species. The addition of an ALS-inhibiting herbicide to mesotrione or mesotrione + atrazine had no adverse effects on the control of large crabgrass or velvetleaf. However, tank mixing mesotrione with nicosulfuron, foramsulfuron, or rimsulfuron resulted in slower green foxtail and shattercane response to the herbicide. Antagonistic interactions were observed 21 DAT on green foxtail and shattercane, when mesotrione was combined with nicosulfuron or foramsulfuron. Similar antagonistic interactions were present when any one of the three ALS-inhibiting herbicides was mixed with mesotrione + atrazine. Results indicate that the addition of an ALS-inhibiting herbicide to a mesotrione application will result in decreased efficacy of ALS-inhibiting herbicides on green foxtail and shattercane. [Paper Number 35]

MAPPING HERBICIDE BINDING USING BULK SOIL ELECTRICAL CONDUCTIVITY. Dale L Shaner[†]; Hamid Farahani; Gerald Buchleiter USDA ARA, 2150 Centre Ave, Building D, Suite 320, Fort Collins, CO, USA, 80526

Abstract. One of the promises of precision agriculture is reducing the environmental impact of herbicides by altering the rate of application based on the heterogeneity of soil properties within a field. However, there are few cost effective methods for determining the variation in soil properties that affect herbicide behavior. One method to determine soil heterogeneity is to measure the bulk soil electrical conductivity (EC). Under non-saline conditions, EC is strongly dependent on soil organic matter (OM) and clay content, which are also major determinants of herbicide binding. It has been proposed that EC can be used to predict the fraction of organic carbon in the soil (foc), which, in turn, can be used to predict herbicide binding. Field scale EC maps were made of three irrigated sandy fields in eastern Colorado and soil samples were taken from three different EC zones within each field. The foc and soil-herbicide partition coefficients (Kd) for three herbicides (EPTC, metribuzin and metolachlor) were determined in the laboratory. The correlations between EC and foc (R2=0.56) and between foc and Kd (R2=0.48, 0.40, and 0.51, for EPTC, metribuzin and metolachlor, respectively) were good. Regression tree analysis was done to divide the fields into different Kd zones based on EC. Additional soil samples taken from these EC zones but located in previously unsampled areas of the three fields showed that one could predict Kd values based on the EC zone. This approach could prove to be a cost effective way to map fields for herbicide binding and help to make better decisions regarding variable rate application. [Paper Number 27]

METABOLISM OF ACIFLUORFEN AND LACTOFEN IN COMMON WATERHEMP. Douglas E Shoup[†]; Dr. Kassim Al-Khatib[*] Kansas State University, Manhattan, KS, US, 66506

Abstract. Protoporphyrinogen oxidase (protox) inhibiting herbicide-resistant common waterhemp was first reported in 2001 in Kansas. The resistant biotype had a high level of resistance to acifluorfen, lactofen, fomesafen, and sulfentrazone applied as a postemergence treatment. The objective of this study was to determine the metabolism of acifluorfen and lactofen in protox-resistant and -susceptible common waterhemp. Protox-resistant common waterhemp were grown in a greenhouse and treated with acifluorfen or lactofen with and without tridiphan to inhibit glutathione S-transferase enzymes. Plants were treated at 10 to 15 cm in height and rated for visual injury at 2 weeks after treatment (WAT). In a separate study, protox-resistant and susceptible common waterhemp were treated with ^{14}C-lactofen at the 15-leaf growth stage. Leaves were harvested 24 hr after treatment (HAT), rinsed with deionized water, immediately frozen in liquid nitrogen, and ground into a fine powder. Water and methanol were used to extract lactofen and its metabolites. Supernatant was then evaporated to 0.5 mL using a centrivap at 35 C. Extracts were injected into a Beckman high-performance liquid chromatograph (HPLC) using a Zorbax ODS endcapped Sb-C18 column (4.6 x 250 mm) operated at 25 C with a mobile phase of water and acetonitrile at pH 3 with a flow rate of 2 mL m^{-1}. Radioactivity was measured with an EG&G Berthold scintillation spectroscope. Resistant common waterhemp responded equally to acifluorfen, lactofen,

acifluorfen + tridiphan, and lactofen + tridiphan. Injury ranged between 50 and 61% by 2 WAT. Lactofen was metabolized into two metabolites after 24 hr in both protox-resistant and -susceptible common waterhemp. Less than half of the parent lactofen molecule was metabolized. Metabolites eluted from the column at approximately 11 and 25 min and the parent lactofen molecule eluted at approximately 50 min. There was no difference in lactofen metabolism between resistant and susceptible common waterhemp, indicating that metabolism is not the basis for resistance. [Paper Number 30]

PROTOPORPHYRINOGEN OXIDASE (PROTOX)-RESISTANT COMMON WATERHEMP RESPONSE TO HERBICIDES AT DIFFERENT GROWTH STAGES. Douglas E Shoup[†]; Jeanne S Falk; Dr. Kassim Al-Khatib[*]; Dallas E Peterson[*] Kansas State University, Manhattan, KS, US, 66506

Abstract. A biotype of common waterhemp in Kansas with resistance to protox-inhibiting herbicides has a high level of resistance to acifluorfen, lactofen, fomesafen, and sulfentrazone when applied as a postemergence treatment. However, field experiments with preemergence treatments of sulfentrazone or flumioxazin resulted in greater than 85% control of the resistant common waterhemp biotype. Two experiments were conducted at the site where the resistant biotype was confirmed to determine common waterhemp response to herbicides at different stages of growth. The first experiment was conducted in 2002 and 2003. Protox-inhibiting herbicides acifluorfen, lactofen, fomesafen, sulfentrazone, flumioxazin, oxyfluorfen, and azafenidin were applied as preemergence and postemergence treatments. A second experiment was conducted in 2003 to evaluate common waterhemp response to herbicides applied at three different growth stages: two leaf, four to six leaf, and eight to ten leaf. Herbicide treatments were acifluorfen, fomesafen, bentazon, acifluorfen + bentazon, and fomesafen + bentazon. In 2002, all protox-inhibiting herbicides applied preemergence gave greater than 80% common waterhemp control, whereas postemergence herbicide control was less than 55% for all herbicides except flumioxazin, where control was 78%. In 2003, only preemergence treatments of lactofen, fomesafen, and oxyfluorfen gave greater than 80% common waterhemp control, whereas oxyfluorfen was the only postemergence herbicide that gave less than 55% control. For the second experiment, common waterhemp control at the two-leaf growth stage was greater than 80% for all herbicides except bentazon. At the four- to six-leaf growth stage, control was greater than 80% for all herbicide treatments except acifluorfen at the low rate and bentazon where control was 74 and 77%, respectively. At the eight- to ten-leaf growth stage, only acifluorfen + bentazon and fomesafen + bentazon gave greater than 80% common waterhemp control. Control with all other herbicide at the eight- to ten-leaf growth stage was between 50 and 68%. [Paper Number 31]

YELLOW AND PURPLE NUTSEDGE CONTROL IN THE CALIFORNIA PRODUCTION SYSTEM. Ron N Vargas[1,†]; Steve Wright[2,†,*]; Tome Martin Duvall[1]; Lalo Banuelos[2] [1] University of California Cooperative Extension, 328 Madera Ave., Madera, CA, 93637; [2]University of California Cooperative Extension, Tulare, CA, 93274

Abstract. Introduction Both yellow (*Cyperus esculantus* L.) and purple (*C. rotundus* L.) nutsedge are widespread, persistent and hard to control perennial weed problems in cotton grown in the San Joaquin Valley of California. Cotton grown in rotation with garlic and carrots can exasperate the problem. Nutsedge emerges prior to and with cotton, vigorously competing for soil moisture. If not controlled, yellow nutsedge has been shown to reduce cotton yield by 12, 20 and 34 percent when allowed to compete for 6, 12 and 25 weeks. Current control options only provide suppression and partial control. To give cotton a head start, sweeps or other shallow cultivating tools can be used to dislodge emerging nutsedge before planting. Preplant soil fumigation with metham-sodium may provide some control. After cotton emergence, the use of precision equipment to cultivate as closely as possible and hand weeding can aid in reducing competition from nutsedge. MSMA can be applied as a broadcast or directed spray, but control is often erratic and injury does occur to cotton. Glyphosate applied over the top of Roundup Ready cotton provides the best control, but normally requires two applications and control or suppression can be erratic. Procedures: Several studies were conducted between 2000 and 2003 to evaluate different

control strategies for nutsedge. Glyphosate was evaluated in combination with ammonium sulfate, MSMA and in sequential applications applied at various rates and timings to Roundup Ready cotton. An experimental compound, Envoke (trifloxysulfuron sodium) was evaluated by itself, and in sequential applications with glyphosate at various rates and timings. Uniform fields of Acala Upland cotton, infested with either yellow or purple nutsedge, were divided into plots and replicated four times in a randomized complete block design. Herbicides were applied with CO2 backpack sprayers using 8002 flat fan nozzles delivering a volume of 20 gallons of spray solution per treated acre at 30 to 40 PSI. Evaluations of nutsedge control and cotton phytotoxicity were made at various intervals up to 45 days after treatment. Results Control of yellow and purple nutsedge has been erratic with glyphosate (Roundup or Touchdown IQ) applied to 3 to 6 inch tall Roundup Ready cotton. One application of glyphosate at either 1 or 2 lbs. ai rate has provided 48 to 100 percent control. Sequential applications provide better control than one single application. When glyphosate was applied in combination with 10 or 15 pounds of ammonium sulfate control was increased. Sulfosate (Touchdown5) provided similar results in control, but caused considerable injury to cotton which resulted in yield reductions. In most studies, applications of glyphosate in combination with cultivation provided acceptable control. Evaluations of Envoke have indicated that the low rates needed to prevent cotton injury provide unacceptable control. Envoke applied alone, at all rates tested, in combinations with Staple or Touchdown, and in sequential applications with itself provided unacceptable control. When glyphosate was followed by an application of Envoke control was acceptable. Research reported at the 2002 Beltwide Cotton Production Conference indicated Envoke applied over the top of cotton to nutsedge in the 3 to 4-leaf stage provided extremely effective control. Our studies over the past four years have shown Envoke to be ineffective in controlling either yellow or purple nutsedge in the arid climate of the San Joaquin Valley of California. [Paper Number 50]

THE BIOLOGY AND WATER USE OF KEY SUMMER ANNUAL WEEDS IN COLORADO CROPS. Alan Helm[1,†]; Dr. Philip Westra[2,*]; Dr. Brien Henry[3,*] [1]Colorado State University Cooperative Extension, Holyoke, CO; [2]Department of Bioagricultural Science and Pest Management, Colorado State University, Fort Collins, CO, 80523; [3]Central Plains Resource Management Research Unit, USDA Agricultural Research Service, Akron, CO, 80720

Abstract. On May 21, 2003, eight common weed species were planted in pots at the integrated vegetation management greenhouse at Colorado State University. The 8 species were *Amaranthus retroflexus, Chenopodium album., Kochia scoparia, Salsola iberica, Panicum miliaceum , Echinochloa crus-galli, Setaria virdis, and Chenchrus longispinus*. These species were planted in 3 different sized pots (10454cm3, 1303cm3, and 207cm3) with 4 replications. These pots were maintained at field capacity to determine total weed biomass production in a given soil volume over a determined growth period. All plants were harvested on August 22, 2003. Measurements taken were biomass, leaf area index (LAI), height to node ratio for broad leaf plants, tillers per centimeter for grasses and percent moisture. LAI was measured using a LiCor leaf area measuring instrument. Among the broadleaf weeds *Amaranthus retroflexus* showed the highest LAI and height to node ratio in the large pots with an average of 2277 cm2 LAI and 3.73 cm per node. Within the grass weeds, *Panicum miliaceum* provided the greatest LAI with 2361 cm2. *Echinochloa crus-galli* produced the highest number of tillers per plant. Salsola iberica produced the greatest biomass among all weed species. Percent moisture at harvest for all weed species averaged between 75 and 85 percent. These preliminary data indicate what biomass and leaf area these weeds are capable of producing under optimum conditions. Future research will be conducted to determine biomass production during development at different growth stages (establishment, inflorescence, and seed production). This information will be used to educate farmers about the importance of timely weed control, particularly in light of on-going drought and water management issues in the Central Great Plains. [Paper Number 46]

INFLUENCES OF TILLAGE IN CROP SYSTEMS ON GRASS WEED SEED VIABILITY. Dr. David W Wilson[†,•]; Dr. Stephen D Miller[•] University of Wyoming, Laramie, WY, U.S., 82071

Abstract. A reliable and accurate means of studying the effects of tillage on weed seed viability was begun in September of 2001. The study used microchip tracking methods with a string grid system to relocate each of 160 tagged mesh packets of 100 weed seeds. This method allows packets to move freely in the field, simulating seed movement in soil during tillage. The viability of wild oats and feral rye in a wheat/sunflower/millet crop rotation under five types of reduced tillage were compared to laboratory stored controls. The five tillage treatments included a no-till field and the use of an Australian prickle chain, a rod weeder, a field cultivator and a disk harrow in four other fields. Packets were placed one meter apart perpendicular to the direction of tillage and 10 meters apart in the direction of tillage. All fields were tilled from south to north after weed packet implantation and prior to winter wheat seeding. No additional tillage has occurred on the fields since the initial application other than soil movement due to planting operations. The movement of recovered packets was recorded at time of recovery (September 2002 and 2003) followed by tetrazolium chloride viability testing of the samples. Results from the second year of a four year study showed significant differences between the tillage treatments and the stored control, but no significant differences between the types of tillage treatment used for either weed species. The viability of feral rye ranged between 0 to 2 percent across tillage treatments, with a laboratory stored control viability of 47 percent. The viability of wild oat ranged between 3 to 8 percent across tillage treatments, with a laboratory stored control viability of 43 percent. No-till treatments had viabilities of 1 percent for feral rye and 8 percent for wild oats in the second year. The movement of packets varied from 0 to 68 cm horizontally and 0 to 15 centimeters vertically in the soil profile. [Paper Number 29]

WISDEM: A MODEL FOR PREDICTING WEED SHIFTS OVER TIME. John R. Withrow Jr.[1,†]; Dr. Philip Chapman[2]; Dr. Philip Westra[1,•] [1]Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO, 80523; [2]Department of Statistics, Colorado State University, Fort Collins, CO, 80523

Abstract. The next generation version of a decision-aid model developed by Wiles, Dunan, and Canner is presented as an ecologically-based approach to weed management and potential weed shifts in Roundup Ready crops. The model, known as WISDEM, allows for the concurrent presence of multiple weed species, diverse crop rotations, multiple herbicide applications and tillage practices, and complex seasonal weed emergence patterns. It is, thus, introduced as an effective weed management decision-making tool specifically for selecting optimal weed management products and optimal application timings. In this forum the above model is described in theoretical detail along with comparisons of model results with recent weed population data in Roundup Ready crops. [Paper Number 28]

SIX YEARS OF WEED SHIFT DATA IN ROUNDUP READY CROPS. Dr. Philip Westra[1,†,•]; Jason Miller[2,•]; John R. Withrow Jr.[1]; [1]Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO, 805; [2]Department of Agronomy, Kansas State University, Manhattan, KS;

Abstract. A long-term weed shift study utilizing Roundup Ready crops was initiated in 1998. The study design was a split-split plot design arranged as a randomized complete block study with 4 replications. The major split compares a continuous corn rotation with a corn-sugarbeet-corn-sugarbeet-spring wheat-corn rotation. Fixed in space in each rotation in each block were four herbicide treatment regimes consisting of 1. 1 pint of glyphosate, 2. 1 quart of glyphosate, 3. 1 quart of glyphosate every other year (rotating mode of action), and 4. strictly conventional chemistry. Glyphosate treatments were applied in the crop 2 times during the growing season. The smallest experimental plot area in the study was 9.3 m wide by 33 m long. Soil cores were taken at 15 georeferenced locations in each plot in the spring of each year. Following elutriation, seeds were identified and counted by species. At each of the 15 locations, a .25 m^2 quadrat was used to count emerged weeds prior to post-emerge herbicide application, 2 weeks

following the last herbicide application, and prior to crop harvest. Crops were harvested to determine yields. Because the study included repeated measures within years and across years at the same georeferenced points, data analysis has required special techniques to assess main effects and trend analyses over time. Weeds encountered included barnyard grass, green foxtail, wild proso millet, redroot pigweed, kochia, jimson weed, hairy nightshade, velvetleaf, wild buckwheat, common lambsquarter, and toothed spurge. Weed population changes due to crop rotation have been minimal although generally better weed control occurred in the continuous corn. This may be partly due to the fact that sugarbeets are not highly competitive with weeds when they occur in the rotation. Grass control in the glyphosate treatments has been very good. By year six, both common lambsquarter and wild buckwheat levels are significantly higher in the 1 pint glyphosate treatment versus the 1 quart glyphosate treatment. To date, no glyphosate resistant weeds have been identified in this study, and rotating herbicide mode of action did not provide better weed control than the 1 quart of glyphosate applied by itself. Some pre-harvest weed escapes may be the result of germination that occurs after the final herbicide treatment. [Paper number 105]

Section 4. Teaching and Technology Transfer

THE UNDERGRADUATE LEARNING FARM - HANDS-ON EXPERIENCES. J. Anita Dille[†]; Christopher L. Schuster Kansas State University, Manhattan

Abstract. Undergraduate education in Agronomy must provide students with specific skills for successful employment. Students need to be technically competent, but must also develop skills in problem-solving, critical thinking, and team work abilities. Agronomy students would greatly benefit from more hands-on experiential learning activities developed to test technical and diagnostic skills. A new facility being made available to undergraduate students at KSU is the Learning Farm, where students can develop these skills through hands-on field site experiences and investigations. The Learning Farm encompasses 80 acres and is located within the Agronomy North Farm, which is three miles northwest of the Agronomy department building. The Learning Farm is divided into a long-range plan of crop and tillage rotations, with a website acting as a resource for all field information (http://www.oznet.ksu.edu/agronomy/academics/undergrad/LearningFarm/welcome.asp). Undergraduate students gain knowledge of the Learning Farm through class field trips, in-class research exercises, and undergraduate research assistantships. One example of a current undergraduate research project at the Learning Farm is understanding site-specific correlations among winter annuals/biennials and soil properties. Initial results indicate a correlation among winter annual emergence and the type of crop residue present during the early fall months. The Learning Farm will provide a venue for integrating skill development throughout the four-year Agronomy curriculum and provide a resource for extension education and developmental training in the future. Continued evaluation of learning and skill development will occur to maximize creativity, innovation, improvement, and coordination involving the Undergraduate Learning Farm. [Paper Number 54]

A PILOT PROJECT TO DETERMINE THE FEASIBILITY OF MANAGING DALMATIAN TOADFLAX ON AN OPERATIONAL SCALE THROUGH BIOLOGICAL CONTROL. Sharlene Sing[1,†]; Diane Johnson[2]; Jay Winfield[3]; Ron Gibson[4]; Vic Roberts[5]; Hank McNeel[6]; Bob Peterson[7]; George Markin[1,*] [1]USFS - RMRS Forestry Sciences Laboratory, 1648 South 7th Avenue, Bozeman, MT, USA, 59717; [2]USFS - Helena National Forest - Townsend Ranger District, 415 South Front Street, Townsend, MT, USA, 59644; [3]USFS - Helena National Forest - Helena Ranger District, 2001 Poplar Street, Helena, MT, USA, 59601; [4]USFS - Beaverhead-Deerlodge National Forest - Boulder Work Center, 14 Depot Road, Boulder, MT, USA, 59632; [5]USDI - Bureau of Land Management - Lewistown Field Office, P.O. Box 1160, Lewistown, MT, USA, 59457; [6]USDI - Bureau of Land Management - Montana State Office, 5001 Southgate Drive, Billings, MT, USA, 59107; [7]Montana State University - Department of Entomology, 333 Leon Johnson Hall, Bozeman, MT, USA, 59717

Abstract not submitted [Paper Number 56]

IMPACTS OF THE NATIONAL JOINTED GOATGRASS RESEARCH PROGRAM. Tony White[†,*] Kansas State University, 1232 240th Ave., Hays, KS, USA, 67601

Abstract. Jointed goatgrass (*Aegilops cylindrica* Host) is a troublesome weed that currently infests over 5 million acres of winter wheat in the Western United States and costs producers over $145 million dollars in reduced yields, grain dockage, and reduced land values. Jointed goatgrass is difficult to control in conventional wheat because of their life cycle similarities, genetic compatibility, and similar seed size. These similarities make seed cleaning and selective herbicide development difficult. In 1994, the National Jointed Goatgrass Research Program was established through a special grant from the Cooperative State Research, Education, and Extension Service (CSREES) through the United States Department of Agriculture. This program is guiding wheat producers how to identify jointed goatgrass, how to prevent its spread, and how to manage it in a winter wheat cropping system. The program continues to develop new management strategies and implement them through a commitment to technology transfer. Methods developed to control jointed goatgrass will also help control other costly weeds in winter wheat, such as downy brome, feral rye, and other winter annual grasses. Best management practices, developed through the National Jointed Goatgrass Research Program, have reduced the economic impact of jointed goatgrass. As a result, United States wheat production will remain profitable and competitive in the world market. [Paper Number 55]

Section 5. Wildlands and Wetlands

CAN SOIL CHARACTERISTICS BE USED TO PREDICT WEED SPECIES ALONG THE IRRIGATION CANALS IN SOUTHERN NEW MEXICO?. C. Fiore[†,*]; J. Schroeder[*]; R. Sanderson; A. Ulery; L. Murray; L. DeMouche; S. Schuster New Mexico State University, Las Cruces, NM, 88003

Abstract. Elephant Butte Irrigation District (EBID) services approximately 30,000 hectares of water-righted land in southern New Mexico's Mesilla Valley. A network of open canals, laterals and drains supply water for agronomic and horticultural crops in both rural and urban landscapes. These canals are classified as either intermittent or continuous flow conveyances, creating different environments that are home to a variety of plant species. Weeds that grow along the network of canals reduce the amount of available water for irrigation, obstruct the flow of water, and produce seeds that are deposited, and germinate in irrigated crops and in urban landscapes. The objective of this paper is to describe a portion of the survey being conducted to map the predominant vegetation and soil characteristics on the Leasburg and Mesilla canals, and the associated laterals and sub-laterals of these canals that are maintained by EBID. Over one hundred kilometers of these canals have been sampled at randomly selected sites over the past two irrigation seasons. A square meter was sampled at each site. GPS point, percent total plant cover, and the five dominant plant species (identification and percent of total cover) were recorded. Three soil samples were taken at each site, composited and analyzed for

texture, organic matter, pH, electrical conductivity (EC), and sodium adsorption ratio (SAR). Maps were generated to illustrate distribution of plants and soil properties along the canals. The amount of vegetation cover varied, but only nine percent of the area sampled had less than 25% ground cover. Grasses covered 46% of the total area sampled with *Cynodon dactylon* being the dominant species. Broadleaves covered 22% of the area sampled with *Plantago lanceolata* the most commonly identified. *Equisetum hyemale* comprised about 12% of the vegetation cover. Dead or mowed areas were found on about 6% of the sample sites and were categorized as unidentifiable. Soil characteristics were quite variable with the exception of texture where 47% of the sites were classified as loamy sand or sandy loam soils. Soil EC ranged from 0.82 to 49.7 dS/m; NO3 -N 1:5 (soil:water) extract ranged from 1.2 to 1035.2 ppm; and SAR ranged from 0.74 to 190.18. [Paper Number 60]

ARE WEED SPECIES ASSOCIATED WITH CRAYFISH HABITAT ALONG THE IRRIGATION CANALS?. Sara A Schuster[†]; David Cowley; Cheryl Fiore[*]; Leigh Murray; Jill Schroeder[*] New Mexico State University, Las Cruces, NM, 88003

Abstract. The irrigation canals in southern New Mexico are ecosystems within themselves. Vegetation along the canals was sampled and mapped in 2002. Initial observations indicated that in areas of heavy bermudagrass, canal banks were eroded. Crayfish are one of the organisms found in these canals, and their presence may contribute to erosion. They dig burrows into the sides of the canals in search of water when the irrigation season ends. These burrows may cause the sides of the bank to erode, causing slower water flow and less water available for irrigation. If we know the favored habitat of crayfish and the conditions they avoid, we can control their population size, possibly by managing the vegetation more effectively. We sampled 51 randomly chosen sites on three canals to compare the dominant vegetation, soil texture, the presence or absence of erosion and the number of crayfish burrows. We concluded that crayfish prefer to burrow where grasses are growing, particularly *Cynodon dactylon*, as 33% of the burrows were found at sites dominated by *C. dactylon*. Other plant species related to extensive burrowing activity were *Sorghum halepense* and *Plantago lanceolata*, while *Equisetum hyemale* was not related to crayfish burrowing. Our findings do not support the hypothesis that burrows are associated with the erosion of the canal banks, since 70% of the total amount of burrows were found in sites that had little to no erosion. This shows situation to be more complex; there are more factors relating to eroding canal banks than a burrowing crayfish. [Paper Number 58]

EFFECTS OF GRAZING, BURNING, AND HERBICIDES FOR WEED CONTROL AND PERENNIAL GRASS GROWTH STIMULATION. Ms. Kelly T. Uhing[†] Adams County Weed Department, 9755 Henderson Road, Brighton, CO, United States, 80601

Abstract. Established perennial grasses require stimulation in order to recycle nutrients, increase light intensity to plants, and improve plant water supply. Perennial grasses that do not receive proper stimulation can result in poor growth and sometimes death. As a result, these areas become susceptible to noxious weed invasion. The purpose of this study is to determine which method best stimulates perennial grasses in order to make them more competitive against noxious weeds. In addition, areas were monitored to determine which treatment had optimum effect on existing noxious weeds.
Research plots were established on March 31, 2003 in Adams County, Colorado. In those plots, the majority of the existing grasses were blue grama, western wheatgrass, crested wheatgrass, and sand dropseed with significant leaf litter covering a majority of the plots. Broadleaf weeds included perennial pepperweed, kochia, curly dock, and field bindweed. Treatment methods inlcuded grazing, burning, herbicide applications, and an untreated check. Each treatment was replicated four times in 20 foot by 40 foot plots. Animals used for grazing were sheep and a guard llama. For the controlled burns, the Atarus Ranger propane flamer was used. The herbicides used were 2,4-D at 1.5 pints/acre or 591.4 millileters/liter water and Escort at 1. ounce/acre or 0.75 grams/liter water. Grazing occured from April 8 - 12, 2003, burning followed on April 15, 2003, and herbicides were applied on May 12, 2003. Follow-up vegetation surveys were conducted in June and July 2003. It was observed that burning had the best effect

on grass stimulation and significantly reduced the amount of leaf litter. The numbers for blue grama and western wheatgrass had significantly increased as compared to the pre-burn vegetative survey. Grazing had a similar effect on the grasses but increased kochia populations had occured. Herbicides provided excellent weed control, but grass populations observed in those plots before or after the treatments were lower. In general, burning and grazing have proven to be effective methods at stimulating grass growth in order to provide necessary competition against noxious weeds. [Paper Number 59]

Section 6. Basic Science

GUIDES TO HELP PRODUCERS MANAGE WEED RESISTANCE. Randy Anderson[1,†]; Donn Thill[2,*]; Traci Rauch[2,*]; Brad Hanson[2,*]; Dan Ball[3,*]; Mike Ensminger[4,*]; Kirk Howatt[5,*], Steven Seefeldt[6] Mary Corp[3], Jim Harbour[7]; [1]USDA-ARS, Brookings, SD, 57006; [2]University of Ihado, Moscow, ID, 83844; [3]Oregon State University, Pendleton, OR, 97801; [4]Syngenta, Richmond, CA, 94804; [5]North Dakota State University, Fargo, ND, 58105; [6]USDA-ARS, Dubois, ID, 83423, [7]DuPont, Moorhead, MN

Abstract. The number of weeds resistant to herbicides continues to increase, leading to higher input costs with crop production. A goal of the WSWS Herbicide Resistant Plants Committee is to help producers understand factors influencing weed resistance and plan management strategies that minimize selection pressure. To achieve this goal, we first developed two fact sheets that explains management concepts based on population ecology. One fact sheet summarized the impact of herbicide use frequency on rate of resistance development, whereas a second fact sheet described impact of crop rotations on population dynamics of a resistant species. The fact sheets explain principles that will be useful in planning management strategies, and are designed to help scientists with technology transfer to producers. Scientists and producers can access the fact sheets on the WSWS Web page (www.wsweedscience.org). A research team at the University of Idaho also developed an extension bulletin that summarizes soil persistence of herbicides used in winter wheat in the Pacific Northwest. The bulletin describes factors affecting herbicide persistence, then lists herbicides by mode of action and plantback restrictions. The bulletin's purpose is to help producers plan weed management across several years rather than only within a single cropping season. [Paper Number 57]

COMPARISON OF EFFICACY, ABSORPTION, AND TRANSLOCATION OF AN ISOPROPYL AMINE SALT AND ACID FORMULATION OF GLYPHOSATE IN VELVETLEAF. David Belles[1,†,*]; Dale Shaner[2]; Phil Westra[1,*]; Galen Brunk[1] [1]Bioagricultural Science and Pest Management Dept. Colorado State University, Fort Collins, CO; [2]USDA/ARS Water Management Research Center, Fort Collins, CO

Abstract. Growth analysis, absorption and translocation studies were conducted to compare an acid formulation of glyphosate with an isopropyl amine formulation. Four to six leaf velvetleaf were treated with 0, 210, 280, 420, 560 and 840 g ae ha-1 of the acid and isopropyl amine formulations. The acid formulation at each application rate reduced velvetleaf biomass more than the isopropyl amine formulation. The GR_{50} value for the acid formulation was 4 times lower than the GR50 for the isopropyl amine formulation based on a log-logistic regression analysis of velvetleaf dry weight. Absorption of 14C glyphosate into leaves of 4 to 6 leaf velvetleaf was 3.6 times greater (19 vs. 5% of applied) after 6 h when applied as the acid formulation compared to isopropyl amine formulation. Translocation out of the treated leaf of the acid formulation was also greater. After 72 h, 1.6 times more 14C glyphosate applied in the acid formulation had translocated out of the treated leaf compared to the isopropyl amine formulation (22 vs. 14% of applied). The greater efficacy of the glyphosate acid formulation over the isopropyl amine formulation on velvetleaf is probably due to the greater rate of absorption of the herbicide and increased translocation. [Paper Number 66]

GREENHOUSE GERMINATION AND EMERGENCE OF JOINTED GOATGRASS *(AEGILOPS CYLINDRICA)* AND WHEAT *(TRITICUM AESTIVUM)* AFFECTED BY PLANTING DEPTH. Joshua B. Cannon[†,•]; Lynn Fandrich[•]; Jesse Rue; Carol Mallory-Smith[•] Oregon State University, Corvallis, Or, USA, 97331

Abstract. Burial depth has been shown to affect germination and emergence of several weed species, including jointed goatgrass. Information about germination and emergence responses to planting depth for multiple jointed goatgrass populations is lacking. Jointed goatgrass spikelets from three Pacific Northwest populations, as well as winter 'Madsen' and spring 'Penewawa' wheat seeds were planted in pots at depths of 0.0, 0.64, 2.54, 5.08, 7.62, and 10.16 cm. Pots were placed in a greenhouse set to 18/16 C day/night temperatures with 12 h photoperiod, and watered when the soil surface appeared dry. Two weeks after planting, germinated seeds and emerged seedlings were counted. Germination was not affected by burial depth for any of the seed types. Spring wheat germinated less than all other seed types at each burial depth. Emergence did not change for any seed type between 0.0 and 2.54 cm depths and decreased 10% between 2.54 and 5.08 cm for all seed types. At 7.62 cm, emergence was less than 30% for any jointed goatgrass population. Wheat emergence also decreased between 5.08 and 7.62 cm, but emergence was over 40% for both varieties. Emergence decreased for all seed types to 7% at the 10.16 cm depth. Since emergence at different burial depths did not vary among any of the seed types, there is no depth at which wheat would emerge more successfully than jointed goatgrass. [Paper Number 64]

USING SADIE (SPATIAL ANALYSIS BY DISTANCE INDICES) TO EVALUATE THE SPATIAL INTERACTION OF *MECINUS JANTHINUS* (COLEOPTERA: CURCULIONIDAE) WITH THE INVASIVE WEED DALMATIAN TOADFLAX. Cale Davis[1,2,†]; Sharlene Sing[1]; David Weaver[1] [1]USFS – Rocky Mountain Research Station, Forestry Sciences Laboratory, Bozeman, MT; [2]Montana State University, Bozeman, MT

Abstract. Quantitative evaluations of biocontrol efficacy have relied on geostatistical interpolation methods such as kriging. However, such interpolation methods have proven to smooth insect density peaks. Contour maps from geostatistics produce visually attractive, but generally inaccurate, maps. An ideal biocontrol assessment would take into consideration the weed abundance and spatial distribution with respect to the biocontrol agent abundance and spatial distribution. SADIE (Spatial Analysis by Distance Indices) computes a clustering value v, which is a quantitative measure of whether a weed or biocontrol agent is part of a patch or gap. After computing clustering values for both weeds and biocontrol agents, SADIE then performs a species association analysis. *Mecinus janthinus*, a stem boring weevil, is identified as the best available biocontrol agent against Dalmatian toadflax. *Mecinus janthinus* has been released at a number of sites across Montana with high toadflax infestations. SADIE analyses will be performed on data from all the sites to assess the individual spatial distributions of both *Mecinus janthinus* and Dalmatian toadflax. Inter-species association analyses will be performed to evaluate same year and consecutive year association between *Mecinus janthinus* and Dalmatian toadflax. In addition, intra-species association analyses of *Mecinus janthinus* and Dalmatian toadflax will be used to assess spatial changes in the same species. Currently, SADIE analyses have been performed on eight sites. As expected, *Mecinus janthinus* observed in 2002 cluster near the release point. In 2003, *Mecinus janthinus* spread out to form a less aggregated arrangement. Significant inter-species association has also been observed in the 2002 observations. However, association declined in the 2003 as insects spread from the release point. [Paper Number 62]

GERMINATION ECOLOGY OF JOINTED GOATGRASS *(AEGILOPS CYLINDRICA)* AFFECTED BY INCUBATION TEMPERATURE. Lynn Fandrich[†,•]; Carol Mallory-Smith[•] Oregon State University, Corvallis, OR, 97331

Abstract. A better understanding of the persistence of jointed goatgrass seed in soil and its dormancy will lead to the development of more effective management strategies. Three populations of jointed goatgrass

were collected from winter wheat fields and grown together with the winter wheat variety 'Madsen' in nurseries at two Oregon locations. Germination responses of post-harvest and -30 C stored jointed goatgrass spikelets and wheat seed were recorded over 14 d at 5/5 15/10, 15/15, 25/15, 25/25 and 30/20 C day/night incubation temperatures and 12 h photoperiod. Since spikelets often contain two seeds, primary and secondary seed germination values were recorded. Primary jointed goatgrass seed germinated later, the germination rate was less rapid, and final germination percentages were lower than germination responses in non-dormant wheat seed. Primary seed germination percentages from three jointed goatgrass populations differed significantly at 30/20 and 25/25 C. Secondary seed did not germinate at 30/20, 25/25, or 5/5 C. Primary and secondary seed germination percentages were more rapid, higher, and similar for all populations when spikelets were imbibed under diurnal conditions involving a 15 C day or night temperature. Shallow, thermal dormancy in jointed goatgrass may prevent germination of freshly shattered spikelets until fall when temperatures are lower and moisture is available. Models to predict jointed goatgrass seed dormancy loss in the field will require germination data collected from several populations. Since final germination percentages in jointed goatgrass primary and secondary seed were less than 100%, additional research on factors regulating dormancy is needed. [Paper Number 67]

THE EFFECT OF NITROGEN AND POTASSIUM LEVELS ON THE RELATIONSHIP BETWEEN PURPLE AND YELLOW NUTSEDGES AND SOUTHERN ROOT-KNOT NEMATODES. Brian J Greenfield[†,*]; Jill Schroeder[*]; Stephen H Thomas; Leigh Murray New Mexico State University, Las Cruces, NM, 88003

Abstract. Previous research conducted at New Mexico State University has found a mutually beneficial relationship between purple and yellow nutsedges and southern root-knot nematodes *Meloidogyne incognita*. These studies were fertilized regularly according to crop management practices. A later study evaluated nutsedge response to the nematode in soil where the fertility was not maintained. The results of this study contradicted our original observations because the nematode decreased growth of both nutsedge species. We hypothesized that the beneficial relationship between yellow and purple nutsedge and root-knot nematode is dependent on maintaining soil fertility. Therefore, a greenhouse study was conducted during 2003 to examine the effect of nitrogen and potassium on this relationship. The design was a randomized complete block design with treatments arranged in a five (nitrogen) by two (potassium) by two (nutsedge species) by two (nematode) factorial. One tuber of either purple or yellow nutsedge was planted per pot and half of the pots were inoculated with root-knot nematode eggs. Pots were fertilized based on recommendations for chile peppers at 100, 75, 50, 25, or 0 percent of the recommended nitrogen rate divided into eight weekly applications of ammonium nitrate. Pots received either zero or 100 percent of the recommended rate of potassium, as potassium sulfate, at planting. After the eighth nitrogen application, pots were destructively sampled. Preliminary results indicate that potassium increased shoot and root biomass of yellow nutsedge. Shoot biomass from nematode infested plants treated with potassium was equivalent to nematode-free plants averaged across both species. Tubers were separated into categories by fresh weight into small (less than 0.05 g for yellow nutsedge, less than 0.31 g for purple nutsedge), medium (0.05 to 0.12 for yellow nutsedge, 0.31 to 0.91 g for purple), and large (greater than 0.13 g for yellow nutsedge, greater than 0.91 g for purple nutsedge. Potassium increased medium-tuber dry weights, but only at the 100 percent nitrogen level, when averaged across both nutsedge species. Potassium increased large tuber dry weights when averaged across all other treatment levels. Overall, nutsedge biomass increased at a greater rate for nematode-free plants as nitrogen levels increased compared to infested plants. It appears that potassium, or perhaps the interaction between potassium and nitrogen may affect the interaction between root-knot nematodes and these nutsedge species. [Paper Number 63]

NEMATODE AND MICROBIAL COMMUNITY RESPONSE TO GLYPHOSATE- RESISTANT CROPPING SYSTEM. Ms Konanani B Liphadzi[1,†]; Dr Kassim Al-Khatib[1,*]; Dr Curtis Bensch[2]; Timothy Todd[1]; Dr Charles Rice[1]; Anita Dille[1] [1]Kansas State University, Manhattan, KS, 66506; [2]Oklahoma Panhandle Research and Extension Center, Goodwell, OK, 73939

Abstract. Field experiments were conducted in 2001, 2002, and 2003 at Manhattan and Hays, Kansas to study the effect of glyphosate-resistant cropping system on soil nematode and microbial communities in both conventional and no-tillage environments. Crop rotation schedules were soybean-corn-soybean and corn-soybean-soybean. Herbicide treatments were conventional herbicide, glyphosate applied when weeds were 10 cm or 20 cm tall at a rate of 1.12 kg ai ha^{-1}. Soil samples for nematode assessment and microbial functional diversity were taken in spring and fall of each year. Soil microbial biomass carbon was measured monthly throughout the growing season. Overall nematode community was not altered by glyphosate-resistant cropping system when compared to conventional herbicide system at both locations. In both 2002 and 2003 growing seasons, the nematode communities were higher in conventional tillage than in no-tillage at Manhattan. Both soil microbial biomass carbon and functional diversity were not altered by glyphosate-resistant cropping system when compared to conventional herbicide system. The study clearly showed that nematode and microbial communities response to glyphosate-resistant cropping system was similar to that of conventional herbicide system. [Paper Number 70]

GROWTH AND DEVELOPMENT OF WILD OAT. Ms Krishona B Martinson[1,†]; Dr Beverly R Durgan[1]; Dr George O Kegode[2] [1]411 Borlaug Hall, 1991 Upper Bufford Circle, University of Minnesota, St. Paul, MN, USA, 55108; [2]NDSU, Department of Plant Sciences, 474B Loftsgard Hall, Fargo, ND, USA, 58105

Abstract. Wild oat has become an invasive and economically important weedy species in most cereal growing areas of the world, including the Red River Valley of Minnesota and North Dakota. Although wild oat can be controlled with herbicides, with increasing herbicide resistant populations and environmental concerns, understanding wild oat growth and development and environmental effects are key pieces of information needed for optimum and consistent control. The objectives of this experiment are to evaluate the growth and development of wild oats, determine if later emerging wild oat plants have an accelerated rate of growth compared to early emerging wild oat plants, and evaluate environmental effects on wild oat growth and development. Research plots were established at two locations in 2002 and 2003; Crookston, MN and Fargo, North Dakota to evaluate the growth and development of wild oat. Four emergence cohorts were selected; cohort 1 germinated in the initial week (one) of the experiment, cohort 2 in week two, cohort 3 in week three and cohort 4 in week four of the experiment. Plot size was 0.61 m x 0.61 m and the experimental design was a randomized complete block with six replications. In each cohort, ten individual wild oat plants were randomly selected from the natural population and numbered. On a weekly basis, individual plants were evaluated for height, leaf number on main culm, number of tillers and total leaves. Dates of flag leaf emergence and heading were recorded. Two weeks after heading, individual plants were harvested and potential seed production was calculated. Soil temperature, air temperature (maximum and minimum) and rainfall were recorded on a daily basis. Data were analyzed and means were separated with a LSD of $P = 0.05$. All four cohorts appeared to have a similar trend in growth. Based on biomass, wild oat in cohort 1 were the largest and wild oat in cohort 4 were the smallest. Cohort 1 and 2 had more potential seed production than cohorts 3 and 4. The later emerging wild oat plants grew as fast, or faster, and had a shortened growing season compared to the earlier emerging wild oat plants. The data also suggest that growth and development of wild oat may be predicted based on growing degree days. These results indicate that farmers must consider wild oat emergence cohorts during management. Early emerging wild oat plants are larger, potentially more competitive and produce more seed. However, later emerging plants, still have the potential to produce seed and, if left uncontrolled, theses wild oat plants will continue to increase the seed bank. [Paper Number 72]

MULTIPLE HERBICIDE RESISTANCE IN DOWNY BROME (*BROMUS TECTORUM*). Kee-Woong Park[†,*]; Carol Mallory-Smith[*] Department of Crop & Soil Science, Oregon State University, Corvallis, OR, U.S.A., 97331

Abstract. Studies were conducted to determine the efficacy of several herbicides on an ALS-inhibitor resistant downy brome biotype in which the mechanism of resistance is known to be herbicide metabolism. The resistant biotype was moderately resistant to the ALS-inhibitors, primisulfuron, sulfosulfuron, propoxycarbazone-sodium, and imazamox. Dose-response experiments showed that the resistant biotype also was moderately resistant to ethofumesate, clethodim, and terbacil, and highly resistant to the triazine herbicides, atrazine and metribuzin. The herbicides, propoxycarbazone-sodium, clethodim, and metribuzin, which are from three different classes, were applied in combination with the organophosphate insecticide, malathion. Malathion had a synergistic effect on propoxycarbazone-sodium and clethodim but not on metribuzin in the resistant biotype. As malathion has been shown to be an inhibitor of herbicide metabolism mediated by cytochrome P-450 in other weed species, this result suggests that cytochrome P-450 mediated herbicide metabolism probably is the mechanism of resistance for propoxycarbazone-sodium and clethodim but not for metribuzin. DNA sequence analysis of the *psb*A gene, which is the target site of PSII inhibitors, demonstrated a single amino acid substitution from serine to glycine in the resistant biotype at position 264 in the D1 protein. This research indicates that this downy brome biotype contains two different resistance mechanisms. The resistance mechanism for propoxycarbazone-sodium, clethodim, and ethofumesate is based on herbicide metabolism and the resistance mechanism for the PSII inhibitors is based on altered target site. [Paper Number 69]

APPLYING POPULATION GENETICS TO BIOLOGICAL CONTROL: CAN WE IMPROVE THE SAFETY AND EFFICACY OF INTENTIONALLY INTRODUCED ORGANISMS FOR THE CONTROL OF INVASIVE PLANTS?. Steven J. Rauth[†]; Dr. Ruth A Hufbauer Colorado State University, 200 West Lake, Fort Collins, CO, USA, 80523-1177

Abstract. Biological control, although risky due to potential non-target effects, is one of the most effective means of long-term control of invasive plants. Herbivorous insects used for biological control can vary in host use among populations. Typically, however, only a single population of a proposed biological control agent is included in host-range testing. This is due largely to logistical constraints and costs associated with effectively testing multiple populations. Here I propose a combination of population and ecological genetics as a preliminary step in the evaluation of variation among populations of potential biological control agents. I will use two weevils proposed for the biological control of garlic mustard (*Alliaria petiolata*). Genetic variation among populations can be assessed relatively quickly and easily with molecular markers (microsatellites), and then a subset of populations ranging from genetically distinct to not-significantly different will be examined experimentally for variation in ecologically relevant traits such as host use. This approach to selection of candidate agent source populations will facilitate testing multiple populations, resulting in safer and more effective biological control through the identification of populations most specific to the pest species. Despite how common biological control is, and the potential for enormous environmental benefits as well as risks, to my knowledge my research will be the first application of population genetic approaches prior to release of a biological control agent. [Paper Number 68]

YELLOW NUTSEDGE (*CYPERUS ESCULENTUS* L.) RESPONSE TO IRRIGATION AND NITROGEN FERTILIZATION. Charles A Rice[†,*]; Corey V Ransom[*] Oregon State University, Malheur Experiment Station, 595 Onion Avenue, Ontario, OR, USA, 97914

Abstract. Yellow nutsedge is a perennial weed common in irrigated row crop production in the Treasure Valley of eastern Oregon and southwestern Idaho. Yellow nutsedge is highly competitive and prolific in onion production and to a lesser extent in other crops grown in the valley. Two trials were conducted at the Malheur Experiment Station in 2003 to evaluate yellow nutsedge response to environmental factors.

The first trial was designed to evaluate both shoot and tuber production from a single tuber across three irrigation regimes and two nitrogen fertilization levels. Treatments were replicated three times. Soil water potential at an eight-inch depth was maintained at -20 kPa, -50 kPa, or -80 kPa by a high frequency automated drip system. These irrigation regimes were selected to represent soil moisture conditions similar to those in onion, sugar beet, and wheat production systems in the Treasure Valley. The two fertilization levels were split across irrigation main plots and consisted of nitrogen (46% urea) applied at either 100 or 300 kg ha^{-1}. Nitrogen fertilization had no significant (P=0.05) effect on yellow nutsedge shoot or tuber numbers. Significantly more yellow nutsedge shoots and tubers were produced in wetter treatments. An average of 2,968, 1,512, and 974 shoots were produced per plot from a single tuber in the -20 kPa, -50 kPa, and -80 kPa irrigation treatments, respectively. Tuber production was greatest with the -20 kPa treatment where 18,789 tubers were produced from a single parent tuber compared with 14,572 with the -50 kPa treatment and 7,110 with the -80 kPa treatment. The second trial was conducted to determine the depth from which a yellow nutsedge shoot can emerge in the field and to evaluate differences in time of shoot emergence as well as shoot and tuber production based on depth of germination. Ten yellow nutsedge tubers were buried per single container at depths of 5, 10, 15, 20, 25, 30, 35, 40, or 45-cm. Each depth was replicated four times. Containers were maintained at a soil water potential of -20 kPa with drip irrigation and dates of shoot emergence and numbers of shoots emerged were recorded. Yellow nutsedge shoot production was similar with parent tubers buried from 10 to 30-cm deep and tuber production was similar with parent tubers buried from 5 to 25-cm deep in the soil profile when maintained at a soil water potential of -20 kPa. [Paper Number 65]

SEED DORMANCY AND GERMINATION CHARACTERISTICS OF TWO ALKALIGRASS SPECIES: *PUCCINELLIA DISTANS* AND *PUCCINELLIA NUTTALLIANA*. Catherine S Tarasoff[1,†,•]; Daniel A Ball[2,•]; Sandra Frost[2,•]; Carol A Mallory-Smith[1,•] [1]#107 Crop Science Building, Oregon State University, Corvallis, OR, 97333; [2]Columbia Basin Agriculture Research Center, Oregon State University, Pendleton, OR, 97801

Abstract. Alkaligrass (*Puccinellia spp.*) is a nuisance weed within Kentucky bluegrass (*Poa pratensis*) grass seed fields through out the Grande Ronde Valley of Eastern Oregon. However, to plan effective weed management strategies we must first understand basic characteristics of weed seed biology. Basic characteristics of seed dormancy in two alkaligrass grass species (*Puccinellia distans* and *Puccinellia nuttalliana*) were analyzed to determine if afterripening (10, 30, 90, 180, and 365 days), stratification (5 days at 5C), potassium nitrate solution, or germination temperature (20C or 30C) had an affect on germination rates. Results indicated that an afterripening period of at least 365 days was required for both species before any treatment effect was significant. After such time, stratification combined with a germination temperature of 20C yielded the greatest germination results in both species. As well, to understand seasonal germination requirements, day and night temperature combinations were studied using a two-way thermogradient plate. Day and night temperatures on the plate ranged from approximately 5C to 40C at roughly 10C increments. Germination was calculated at 3 day intervals up to a total germination value at day 18. Both species prefered alternating day and nighttime germination temperatures of 10/30C. [Paper Number 61]

TECHNIQUES OF TOPOLOGICAL ANALYSIS FOR EXAMINING PURPLE AND YELLOW NUTSEDGE ROOT ARCHITECTURE. Ke Wang[1,†]; Leigh W Murray[2]; Jill Schroeder[2,•]; Stephen H Thomas[2] [1]Colorado State University, Fort Collins, CO; [2]New Mexico State University, Las Cruces, NM

Abstract. Root-knot nematodes are important plant parasites that attack nearly all crop and weed species. Much work has been done to examine root-knot nematode effect on plant above- and below-ground biomass. In order to have a better understanding of the interaction between southern root-knot nematode and nutsedge species, a non-destructive mini-rhizotron experiment was conducted to compare the geometric and topological properties of roots for purple nutsedge and yellow nutsedge in the presence or absence of root-knot nematode. The objective of this poster is to discuss how to apply the concept of

topological trees to compare root architecture, which can be described in terms of two extreme cases (herringbone and binary structures) and their intermediates. Data extracted from rhizotron root images include the topological parameters, magnitude (n), altitude (a), and total exterior pathlength (pe), and geometric measures of link counts and lengths, and root depth. We found Generalized Linear Models with Gamma distributions suitable for non-normally distributed length variables. Topological parameters and count variables were analyzed using Generalized Linear Models with Poisson distributions. Usual Analysis of Variance was used for root depth since this data was Normally distributed and hence satisfied the assumptions of Linear Models. We also used a simple linear regression model to obtain the topological index, which is the slope of regressing either log(pe) or log(a) on log(n) (denoted as pe-slope or a-slope respectively). The theoretical maximum value of a-slope is one for a perfect herringbone structure and the theoretical minimum value of pe-slope approaches one for a complete dichotomous structure. The results of our study showed presence of root-knot nematode had some effect on nutsedge root architecture. The presence of root-knot nematode reduced both link length and link numbers, especially in yellow nutsedge root systems. High values of topological indices indicated that both purple and yellow nutsedge favored a more herringbone-like root system, which implied that nutsedge root systems are adapted to poor soil environments where resources are scarce and patchy. We also discovered a potential problem with the regression analysis to obtain topological indices. Without forcing the intercept to be zero, we found that the fitted a-slope can be greater than the theoretical maximum of one with a negative intercept or can be less than one but with a positive intercept which is biologically impossible. [Paper Number 71]

SURVEY OF COMMON WATERHEMP RESPONSE TO PROTOX- AND ALS- INHIBITING HERBICIDES IN NORTHEAST KANSAS. Jeanne S. Falk[†], Douglas E. Shoup, Kassim Al-Khatib and Dallas E. Peterson, Kansas State University, Manhattan, KS.

Abstract. A population of common waterhemp (*Amaranthus rudis*) in northeast Kansas was confirmed resistant to protoporphyrinogen oxidase (protox)- inhibiting herbicides in 2001. In 2002, seed was collected in a 16 km radius from the confirmed resistant population to determine the extent of protox resistance in common waterhemp populations throughout this area. Common waterhemp seed from multiple plants was collected from 28 fields, including 20 soybean, five corn, two wheat stubble and one sorghum field. A composite sample of waterhemp seed from each field was germinated and grown under greenhouse conditions for herbicide screening. At 7 to 13 cm in height, eight common waterhemp seedlings were treated with 210 g ai ha^{-1} acifluorfen, 70 g ae ha^{-1} imazethapyr, or 1060 g ai ha^{-1} glyphosate. Plants were evaluated for visual injury at 1, 2, and 3 weeks after treatment (WAT). Common waterhemp plants from 10 out of 28 sites exhibited resistance to acifluorfen. These sites were randomly scattered throughout the sampling area. Protox resistant common waterhemp was initially injured by acifluorfen, however injured plants generally recovered within 2 WAT. These plants were stunted, but produced several branches. All twenty eight sites exhibited resistance to imazethapyr. In addition, all of the sites tested were susceptible to glyphosate. These findings show that protox- resistance is present in approximately 35% of the sites sampled and ALS- resistance is present in most of the waterhemp populations throughout sampling area. Therefore, herbicides with these modes of action may not be viable tools for common waterhemp control in northeast Kansas. [Paper number 164]

***ANTHEMIS COTULA* RESISTANCE TO ALS INHIBITORS.** Alejandro Perez Jones, Kee Woong Park, and Carol Mallory-Smith, Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331-3002.

Abstract. Suspected sulfonylurea resistant mayweed chamomile was collected in two sites (A and B) near Potlatch, ID. Both fields had been in winter wheat and had a long use history of sulfonylurea herbicides, such as chlorsulfuron and metsulfuron-methyl. Greenhouse and laboratory studies were conducted to determine if both collections were resistant to sulfonylureas herbicides. The plants were sprayed with chlorsulfuron + metsulfuron-methyl (0.7 – 336 g ai/ha) 13 days after planting using an overhead compressed air sprayer calibrated to deliver 187 L/ha. A nonionic surfactant was added to all herbicides

treatments. Aboveground biomass was harvested 3 weeks after herbicide treatment, dried at 70 C for 48 h and weighed. Biomass data are reported as percent of untreated control. The study was conducted twice. Resistance was confirmed in both collections. At 2.6 g ai ha^{-1}, biomass of the susceptible biotype was reduced by 85%, while the resistant biotypes were not affected. Since sulfonylurea herbicides inhibit the enzyme acetolactate synthase (ALS), an *in vitro* ALS assay was conducted to determine if a target site change was responsible for the resistance. The concentration of herbicide required to reduce *in vitro* ALS activity 50% with respect to control was approximately 300 times greater in resistant biotypes than that for the susceptible biotype, confirming that resistant biotypes posses a modified target enzyme with reduced herbicide binding properties. One region of the ALS structural gene known to vary in ALS resistant biotypes was amplified and sequenced. The resistant biotype (collection A) contained a single nucleotide substitution in Domain A, predicting a Pro to Ser amino acid change. This amino acid substitution is responsible for resistance to ALS inhibiting herbicides in mayweed chamomile. [Paper number 165]

GENERAL SESSION

PRESIDENTIAL ADDRESS -- WHAT IS A WEED SCIENTIST TODAY? Gil Cook, DuPont Crop Protection, Greenacres, WA

What Was a Weed Scientist?
- Early concept of weed science
- Factors influencing the development of weed scientists
  -University & USDA scientists
  -Industry representatives
- Contractor/consultants

Early Concept of Weed Scientists
- Weed scientists evaluated new herbicides
- Worked with crop protection companies to characterize products & obtain registration
- Advised growers on herbicide use
- Advised government agencies on product registration
- Trained graduate students to maintain & support their programs

Factors Influencing Changes in Weed Science
- Farmers started to grow monoculture crops and needed to control weeds
- Phenoxy herbicides were developed
- Multiple companies enter herbicide markets
- Many new chemistries were discovered
- Weed science research work with novel modes of action was needed
- Manufacturers conducted comprehensive screening to discover new herbicides
- Soil incorporated herbicides
- Selective herbicides
- Crop specialization in research & extension
- Product registration requirements evolved and changed
- Government regulations increased
- Sputnik changed perceptions
- Almost unlimited funding for research
- EPA & Government regulatory agencies
- Grass control herbicides
- Glyphosate
- Application technology
- Diversity adds new people to our field
    - We gain new talent, insights & ideas

- Environmental issues & concerns become more important
- New specific modes of action are introduced
- Weed resistance & invasive species becomes an important issue
- Herbicide tolerant crops emerge
- Universities reduce funding
- Basic manufacturers consolidate
- Reduced extension support
- Reduced influence on agriculture
- Large corporate farming
- Re-registration of crop protection chemicals reduces number of herbicides
- Research funding comes from grants
    - Funding dictates direction of research
- Industry personnel & funding are limited
    - Research dollars more focused
- High cost of product discovery & registration limits number of new compounds & crop uses
- Development & expansion of IR-4 helps direct & fund research for minor crops
- GLP opened up a new field for private researchers
- Internet & computers

University & USDA Weed Scientists
- Today herbicide screening is not a major part of the program
- Weed ecology, genetics, weed mapping, resistance management, modes of action, herbicide fate & environmental issues are just a few of the many projects undertaken by today's weed scientists

Industry Representatives
- Obtain new registrations & define use
- Help sales teams market products
- Advise growers & field men on how to use herbicides
- Work with government agencies
- Contract research
    - University & private researchers

Contractors & Consultants
- Contractors conduct efficacy, herbicide fate & GLP studies for product manufacturers
- Consultants
    - Advise growers on product use
    - Keep abreast of current research
    - Help manufacturer reps set up field work

Today's Weed Scientist
YOU
[Paper number 73]

RECOGNITION OF WEED PROBLEMS BY CONGRESS AND THE ADMINISTRATION. Rob Hedberg, Director of Science Policy, National and Regional Weed Science Societies, Washington, DC

Abstract not submitted. [Paper number 74]

ASSESSING THE ECONOMIC, ENVIRONMENTAL AND SOCIETAL LOSSES FROM INVASIVE PLANTS ON RANGELAND AND WILD LANDS. Celestine L. Duncan, John J. Jachetta, Vanelle F. Carrithers, Joseph M. Di Tomaso, Rodney G. Lym, Kirk C. McDaniel, Mark J. Renz, Peter M. Rice, Robert Hedberg, and Janet Clark.

A comprehensive literature review was conducted to summarize data on environmental, economic, and societal impacts of key invasive plants on rangeland and wildlands in the United States. Invasive species included in the literature review were those that are well established and are known or perceived to impact range or wildland sites. These included Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*), spotted knapweed (*Centaurea stoebe* ssp. *micranthos*), diffuse knapweed (*Centaurea diffusa*), yellow starthistle (*Centaurea solstitialis*), Russian knapweed (*Acroptilon repens*), hawkweed (*Hieracium sp),* purple loosestrife (*Lythrum salicaria*), leafy spurge (*Euphorbia esula*), Dalmatian toadflax (*Linaria dalmatica*), perennial pepperweed (*Lepidium latifolium*), sericea lespedeza (*Lespedeza cuneata*), downy brome (*Bromus tectorum*), medusahead (*Taeniatherum caput-medusa)*, saltcedar (*Tamarix spp.*), and tropical soda apple (*Solanum viarum*). Results of the literature review indicated that published quantitative information ranged from narrow to comprehensive. There was comprehensive information published on environmental impacts caused by downy brome, spotted, diffuse, and Russian knapweed, yellow starthistle, leafy spurge, purple loosestrife, and *Tamarix.* Economic impacts of most species were poorly documented. There were comprehensive economic analyses published on leafy spurge, *Tamarix*, and the knapweeds. For these species, economists established values for forage loss, injury to or displacement of livestock and wildlife, reduced wildlife-associated benefits, and/or damage to soil and water resources, to determine direct and secondary economic impacts at local or regional levels. For some species, agricultural costs were quantified, but environmental and societal costs were considered intangible and subjective and not included in the analyses. Justifications for management of many species are based on observed or potential impacts rather than quantified information. Results of the literature review indicted the need for additional quantitative data on economic and environmental impacts of lesser-studied species, and region-wide economic models to determine impacts of invasive plants on range and wildland sites. [Paper number 75]

GLYPHOSATE RESISTANCE REVIEW AND UPDATE. David Heering, Monsanto Company, St. Louis, MO

Abstract not submitted. [Paper number 76]

SUSTAINABILITY OF GLYPHOSATE RESISTANT CROPPING SYSTEMS. Robert Wilson, Steven Miller, Phillip Stahlman, Philip Westra, and Gail Wicks; Professors, University of Nebraska, Scottsbluff, NE; University of Wyoming, Laramie, WY; Kansas State University, Hays, KS; University of Colorado, Fort Collins, CO; University of Nebraska, North Platte, NE.

Abstract. Experiments were conducted at three locations: Scottsbluff, Nebraska, Fort Collins, Colorado, and Torrington, Wyoming from 1998 through 2003 to determine if glyphosate use patterns in glyphosate tolerant cropping systems influenced weed control by placing selection pressure on weed species, altered weed population dynamics, or lead to the development of glyphosate-resistant weeds. Experiments were designed as a two factorial split plot set in a randomized complete block design with four replications. Main plots were either continuous glyphosate tolerant corn or a rotation of glyphosate tolerant corn, sugarbeet, corn, sugarbeet, wheat, and corn. Sub-plots were glyphosate at 0.4 kg ha^{-1} applied postemergence twice each spring, glyphosate at 0.8 kg ha^{-1} applied postemergence twice each spring, a rotation of glyphosate at 0.8 kg ha^{-1} applied postemergence twice each spring followed the next year by a non-glyphosate treatment, or a non-glyphosate treatment each year. The seed bank was examined each year before crop planting. Weed density was measured before herbicide treatment, 2 wk after the last postemergence herbicide treatment, and at crop harvest when crop yields were also determined. After 6 yr of study at three locations no weed species have developed resistance to glyphosate. Over the 6 yr period

the weed population at Scottsbluff declined and shifted from a kochia (*Kochia scoparia* (L.) Schrad) and wild proso millet (*Panicum miliaceum* L.) dominated population to a predominately common lambsquarters (*Chenopodium album* L.) population. Common lambsquarters seed and plant populations increased to a greater extent in areas treated with the half rate of glyphosate and in the corn-sugarbeet rotation compared to continuous corn. For the first time in 2003, the increase in weed density in the half glyphosate treatments resulted in a 42% decrease in corn seed yield. At Torrington there was a shift from a grassy weed population to a predominately common lambsquarters and wild buckwheat (*Polygonum convoluulus* L.) dominated population. Common lambsquarters and wild buckwheat increased to a greater extent in plots treated with the half rate of glyphosate in the continuous maize rotation. Two weed management strategies; glyphosate at 0.8 kg ha^{-1} twice each year and alternating glyphosate at 0.8 kg ha^{-1} twice each year with a non-glyphosate treatment were both equally effective in reducing weed density. Experiments are continuing to determine if the use of reduced glyphosate rates has selected for common lambsquarters plants with enhanced tolerance to glyphosate.

Introduction. The introduction of glyphosate-tolerant crops has created new postemergence weed control opportunities for herbicides traditionally considered nonselective. In the United States, glyphosate-tolerant cultivars of corn (11% of the acreage), soybean (81%), cotton (32%), and canola (16%) are being extensively grown. In 2005 approval is also expected for glyphosate-tolerant sugarbeet and alfalfa. With the extensive acreage of crops being treated each year with glyphosate it is not unusual to expect the weed populations will shift and some weeds will develop tolerance to the herbicide. This has occurred with two weeds, horseweed (*Conyza canadensis* (L.) Crong) and ryegrass (*Lolium multiflorum* Lam.), in areas where glyphosate has been repeatedly utilized for weed control. These experiments were designed to measure if glyphosate use patterns in glyphosate tolerant cropping systems influence weed control by placing selection pressure on weed species, alter weed population dynamics, and lead to the development of glyphosate-resistant weeds.

Materials and Methods. Experiments were conducted at three locations: Scottsbluff, Nebraska, Fort Collins, Colorado, and Torrington, Wyoming from 1998 through 2003. Experiments were designed as a two factorial split plot set in a randomized complete block design with four replications. Main plots were either continuous glyphosate tolerant corn or a rotation of glyphosate tolerant corn (1998), sugarbeet (1999), corn (2000), sugarbeet (2001), wheat (2002), and corn (2003). Sub-plots were glyphosate at 0.4 kg ha^{-1} applied postemergence twice each spring, glyphosate at 0.8 kg ha^{-1} applied postemergence twice each spring, a rotation of glyphosate at 0.8 kg ha^{-1} applied postemergence twice each spring followed the next year by a non-glyphosate treatment, or a non- glyphosate treatment each year. The non-glyphosate treatment in continuous corn or the crop rotation utilized herbicides that had a different mode of action than glyphosate and would provide ≥ 95% weed control in the crop. In the spring the first application of glyphosate was applied when mean weed height was 7 to 8 cm and the second application occurred 2 wk later. The soil seed bank was examined in the same location each year before crop planting by collecting nine samples 5.7 cm in diameter and 16 cm deep in each plot. Each individual soil sample was elutriated so seeds could be separated from the soil by species. Three weed population counts were taken each season. The first count was taken before the first postemergence herbicide application, the second count was taken 2 wk following the final postemergence treatment, and the third count was taken prior to harvest. Weed counts were taken in the same location each year by counting individual plant species in three, 76 cm wide by 6 m long quadrants in each plot. Crop density and yield were determined each year by counting plant density and harvesting seed or roots from a 66 m^2 area in the middle of each plot.

Results. Over the 6 yr period the weed population at Scottsbluff declined and shifted from a kochia (*Kochia scoparia* (L.)) and wild proso millet (*Panicum miliaceum* L.) dominated population to a predominately common lambsquarters (*Chenopodium album* L.) population. Common lambsquarters plant density increased to a greater extent in areas treated with the half rate of glyphosate. From 2002 to 2003 common lambsquarters density increased 400% in the half rate glyphosate treatment. This trend did not occur where the recommended rate of glyphosate was applied twice each season, the alternating

recommended glyphosate and non-glyphosate, or the non-glyphosate treatment was used each year. Crop rotation also influenced common lambsquarters populations with weed density increasing faster in the crop rotation of corn and sugarbeet. In 2001, common lambsquarters was not controlled at the ≥ 95% level in sugarbeet, this trend continued when wheat was grown in 2002 and was also evident when corn was grown in 2003. A mean common lambsquarters density of 44 plants m^{-2} in the half rate of glyphosate resulted in a 42% reduction in corn seed yield. This was the first year (2003) that weed control treatment had an influence on crop yield.

The trend of increasing common lambsquarters populations in the half rate of glyphosate was also observed at Torrington, Wyoming in 2003 and at Fort Collins, Colorado in 2002. At Torrington there was a shift from a grassy weed population in 1998 to a predominately common lambsquarters and wild buckwheat (*Polygonum convolvulus* L.) dominated population in 2003. Wild buckwheat populations increased only where the half rate of glyphosate was utilized. The same trends in weed population dynamics occurred at three sites, in a similar manner, and over a similar time frame. The rate of glyphosate used in the cropping system was a critical factor in bringing about a weed shift. A low rate (which is ½ of the recommended rate) of glyphosate put more selection pressure in the weed population than a high rate (recommended rate) of glyphosate. Using the recommended rate of glyphosate was no different from alternating glyphosate every other year, or never using glyphosate.

Growers who are interested in using this technology need to be aware of the possibility of weed shifts, weed species that may initially have more tolerance to glyphosate, and the importance of glyphosate rate in bringing about a shift or selecting for glyphosate tolerance. [Paper Number 77]

WSWS: THEN, NOW AND THE FUTURE. Phil Stahlman, KSU Agricultural Research Center, Hays KS.

The agricultural industry is undergoing a period of unprecedented change driven by maturity of agricultural chemical markets and advancements in biotechnology. These changes are shifting the emphasis and product value away from crop protection chemicals to crop seeds genetically modified to resist insect attack and/or withstand low-cost, broad-spectrum herbicides. There also is movement to adopt integrated management practices with a goal of reducing pesticide use. Accompanying these changes are a weak economy and aging work force. Collectively, these factors have lead to company consolidation, downsizing, and refocusing, and retirements within both public and private sectors.

Another result of these changes is declining membership in regional and national pest management organizations and accompanying losses of experience, leadership, and institutional memory. The interests and membership base of the WSWS have always been more diverse than other regional weed science societies, but the WSWS is not immune to the changes taking place within the discipline. Thus, there is need to examine the purpose and function of the organization to asses its value to the membership, determine if changes are needed to maintain or enhance value, and to develop a vision for the future. To do this, it is important to understand recent trends within the organization.

This paper is a review of trends in a number of areas from 1986 through and including 2004, a period of 19 years. The data comes from the annual meeting proceedings and programs and is subject in some cases to my interpretation. For example, the title and subject matter of project sections changed during the period analyzed, so it was necessary to re-categorize papers from disbanded project sections of earlier years to the categories currently used. This was done based on the title and contents of the published abstract, but there can be no assurance that the author(s) would have categorized their papers as I have done. Therefore, the data is not absolute but rather charts trends. Also, some project discussion session topics were counted as an oral presentation when it seemed appropriate.

The major event of the WSWS is the annual meeting held the second week of March in most years.

Registration at the annual meeting has ranged from as few as 280 at Sacramento in 1995 to 431 in Boise in 1987. Interestingly, both the median and mean attendance for the 19-year period was 344. One-day, reduced-rate registrations for symposia are not included in these figures. The only meetings below 300 in attendance were in 1993, 1994, 1995, and 2003. Private sector attendance (e.g. industry and private consultants/contractors) declined from a high of 222 in 1986 to 129 in 2002, then dropped 33% to only 86 in 2003. There was a slight rebound to 99 in 2004. Except for 155 attending in 1987, members from academia numbered between 115 and 135 until 1996, and fell to 105 in 1995. That was followed by several years of steady growth to nearly 190 in 2002 and 2003, before declining to 160 in 2004. Attendance by members of government agencies has been relatively stable at around 40 ±10, except in years of invasive species symposia when attendance was significantly higher.

To determine geographic shifts in meeting attendance, annual attendance for each state was averaged over three five-year periods: 1986-1991, 1992-1997, and 1998-2003. Both on a numerical and percentage basis, California attendance has declined more than any other state followed by Washington. Other states with high percentage losses, but lower numerical losses include Oregon, Idaho, and Arizona. In contrast, North Dakota, Colorado, and New Mexico have experienced high numerical increases and Kansas and Oklahoma registered large percentage increases. Consistently, about 90% of those attending the annual meeting reside within the member states or provinces; most others are from corporate offices of companies headquartered outside the region.

Numbers of presentations, not including those in general session, have fluctuated widely from year to year, especially oral papers. There has been a big increase in the number of posters presented since 1997, and for the first time in 2004 there were more volunteered posters than papers (74 vs. 70). However, when symposia papers are included, oral papers outnumbered posters. Student oral presentations have averaged about 15 per year, but have ranged from as few as 6 to as many as 29. Six student posters were presented for the first time in 1993. Student poster numbers remained consistent through 1997, then increased steadily each year to 22 in 2004. There were 19 student posters in Colorado Springs in 1999, but only 11 in Tucson in 2000. On a percentage basis in the past 10 years, students have consistently presented 20 ± 8% of all volunteered papers and posters. These numbers clearly demonstrate the importance and contribution of students to the organization.

Volunteered presentations within the six projects have fluctuated widely between years. Oral presentations have been the preferred format though posters have become increasingly popular in recent years and now equal or surpass the number of oral presentation in some projects. In all years Weeds of Agronomic Crops has been the largest project and that project experienced a nearly 50% increase in the number of presentations in 1998 compared to earlier years; the higher numbers have been sustained. For the period 1995 through 2004, the percentage of presentations by project sections are as follows: Weeds of Agronomic Crops, 44%; Basic Sciences, 15%; Weeds of Horticultural Crops, 11%; Teaching and Technology, 11%; Weeds of Range and Forest, 10%; and Wetlands and Wildlands, 8%.

The WSWS Executive Committee and other individuals are engaged in discussions on how best to remain a viable and relevant organization of value to the membership. Current and past members of the Executive Committee completed a Benchmarking survey to assess and strengthen our organizational capacity by measuring how the way we do things compares to standard and best practices among non-profit organizations. The process helps organizations gain a perspective of their organizational development needs and challenges, prioritize those and helps develop a plan of action. Also, a membership survey was conducted at the annual meeting asking the following:

1) How many years have you been a member of the WSWS and what career stage are you currently in, i.e. Just beginning, early, mid-career, well established, or close to retirement?
2) How well is the WSWS meeting your needs at this stage of your career?
3) What does WSWS offer that is most valuable or useful to you?

4) What should WSWS offer that would be of high value or use to you?
5) How well does WSWS identify and cultivate new leaders and can this be improved?
6) Please identify any groups or categories of individuals who you believe are not represented or are underrepresented in WSWS. (Who needs to be part of this organization that isn't?)
7) What do you see as big challenges, opportunities and/or trends in Western North America weed management in the next 5 to 10 years?
8) What, if any, of the above in question 3 is critical for WSWS to be engaged in or working on?
9) Is there anything that you want to tell us that we didn't ask?

More than 200 surveys were turned in at the annual meeting. Responses were typed into a data base and summary and analysis are ongoing. [Paper number 78]

ORAL PRESENTATIONS

Section 1. Weeds of Range and Forest

WATER STRESS EFFECTS ON DIURNAL PHYSIOLOGY OF AFRICAN RUE. Kevin S Branum†; Dr. Laurie B Abbott; Dr. Tracy M Sterling* New Mexico State University, Las Cruces, NM, USA, 88001

Abstract. African rue was introduced into the United States in the 1920's, and now occurs in 7 western states. Rue is an aggressive perennial that tends to dominate in areas where it occurs. Once established it is persistent and difficult to manage. Knowledge of this plant's physiology is limited, therefore the effects of water stress on African rue diurnal physiology (photosynthesis, conductance, transpiration and leaf water potential) were evaluated on two populations under field and greenhouse conditions. Soil moisture levels in the field were manipulated using Dri-Water ® in the soil adjacent to individual plants to extend the period of available water. After thirty days, diurnal physiology was evaluated using a LiCor 6400 PSN system and a pressure chamber; measurements were repeated at thirty day intervals throughout the growing season. Under field conditions, photosynthesis was higher and leaf water potential was 1 to 2 MPa less negative among plants with supplemental moisture. To determine the role of environment versus genetic variation in stress response, seedlings from both populations were established in conetainers in a greenhouse. Seedlings were exposed to 5 d of water stress after which diurnal physiology was evaluated on well-watered and water-stressed seedlings. In the greenhouse, diurnal photosynthetic rates were higher and leaf water potential was on average 1 MPa less negative among watered plants. In water-stressed seedlings photosynthesis was similar at 7:00 but consistently higher among Holloman seedlings at 9:00, 11:00, 13:00, 15:00, and 17:00 hours. Further understanding of African rue's diurnal physiology should inform future management considerations. [Paper Number 115]

IMAZAPIC FOR CONTROL OF ANNUAL GRASSES ON DESERT RANGELANDS OF CENTRAL ARIZONA. MR Matthew Acton†; Dr John H. Brock* Applied Biological Sciences, Arizona State University East, 7001 E. Williams Field Rd., Mesa, AZ, USA, 85212

Abstract. Annual grass control plots by imazapic herbicide were installed at Cottonwood and Dugas, Arizona during 2003. The primary cool season annual grass of concern is foxtail brome, and a warm season annual grass, red sprangeltop was observed from summer treatments. Plots at Cottonwood were infested by foxtail brome and the Dugas site provided red sprangeltop observations. Imazapic was applied in January 2003 at Cottonwood by a backpack sprayer at rates of 2 to 12 fluid oz/ac in water with 0.5% non-ionic surfactant at 20 gallons per acre. In the foxtail brome test, a 1% treatment of glyphosate was also applied. At the Dugas site, imazapic treatments were applied on burned and non-burned plots in July, August and September 2003 giving pre-emegence, post seedling, and mature red sprangletop plants.

Glyphosate was not applied at Dugas; imazapic treatment rates and application were as described for Cottonwood. A herbicide dose response was noted for foxtail brome control at Cottonwood from visual ratings, with 12 oz/ac of imazapic having 6.6 on a 0 to 10 scale (0 = green, robust health; 10 = complete mortality) while glyphosate provided a 8.7 rating. Glyphosate provided a 99% reduction on foxtail brome biomass, while imazapic showed biomass (mortality) reductions of 36 to 83 percent. Pre-emergence treatements of imazapic controlled all red sprangletop plants in the July treatments at Dugas. Post-emergence August treatments on red sprangletop provided 44 to 81% mortality, while September treatments to mature annual red sprangeltop plants showed mortality in some plots, no mortality, and increases in plant numbers compared to control plots. [Paper Number 116]

WEED PREVENTION AREAS: PROTECTING MONTANA AGRICULTURE AND ENVIRONMENT FROM INVASIVE WEEDS. Kim M. Goodwin[1,†]; Roger L. Sheley[2,*] [1]Montana State University - Bozeman, Department of Land Resources and Environmental Sciences, 724 Leon Johnson Hall, Bozeman, MT, USA, 59717; [2]USDA - Agricultural Research Service, 67826-A Hwy 205, Burns, OR, USA, 97720

Abstract. Invasive weeds continue rapid spread into non-infested ecosystems. In relatively weed-free eastern Montana, invasive weeds are the single greatest threat to rangeland ecosystem stability, competitive agricultural outcomes, and rural economies. Invasive weeds seriously threaten biodiversity in this region, which is important in maintaining community stability for continued cattle production and sustaining high-quality rangelands most wildlife needs for survival. The protection of eastern Montana's healthy, mixedgrass prairie rangelands [Bluebunch wheatgrass – western wheatgrass mixedgrass (*Pseudoroegneria spicata – Pascopyrum smithii* herbaceous vegetation)] from rapid weed invasion is immediately needed. Long-term rangeland protection from weeds can be accomplished through the development of Weed Prevention Areas (WPAs), delineated as high priority, weed-free areas for prevention. Weed Prevention Areas follow the same cooperative, local-level strategy of Weed Management Areas where land managers within a geographic area work collectively to manage common weed problems. But cooperative, local-level WPAs guide a proactive approach where prioritized rangelands are aggressively protected and complex and costly weed problems are avoided. This pilot project is a joint program among MSU-Bozeman, MSU Extension Agents, county weed coordinators, governing weed boards, public land managers, and ranchers of eastern Montana. The project goal is to facilitate aggressive, long-term protection of healthy rangelands and critical zones where weeds are advancing from rapid and chronic weed spread, accomplished via the following objectives: (1) Implement a regional and local-level awareness campaign using a social marketing approach with a call to action to engage support of stakeholders. The amplified benefits of proactive weed measures, which accrue indefinitely, are recognized as necessary aspects of profitable ranching where the rangeland economic threshold of zero tolerance is reached; (2) Identify and delineate high-priority rangelands and critical zones where weeds are advancing and facilitate long-term protection via WPA development; (3) Maintain healthy, weed-free ecologic state of WPAs through stakeholder implementation of rancher-designed, WPA-specific integrated plans, formulated via a knowledge network approach. Each WPA plan has an education and adaptive evaluation component with specific prevention strategies based on identified pathways threatening the WPA, and systematic early intervention strategies to detect and rapidly respond to invasions, including the use of specially-trained point-source detector dogs, currently under investigation. Plans guide ecosystem management with a social aspect given rangeland management is strongly influenced by socioeconomic factors that often facilitate invasion. Plans also promote the maintenance of historic disturbance regimes, e.g., fire, to prevent or slow invasions by maximizing persistence of healthy native rangeland ecosystems; (4) Facilitate enhanced communication within and among WPAs through area-wide listserves and knowledge management systems of retrievable rancher knowledge; and (5) Secure incentives and permanent funding for WPAs. Reparation fees assessed on activities that play fundamental spread vector roles into WPAs are considered to address main invasion pathways comprehensively, internalize externalized costs to "biopolluters," and avoid reliance on reactive enforcement. Local-level WPAs address the widespread need for coordinated early detection/rapid

response by unifying producer groups that share common goals to protect threatened native plant resources and livelihoods from expensive and permanent weed problems, which pose unmanageable economic burdens on ranchers and seriously jeopardize rural economies and communities. This project is funded by the Center for Invasive Plant Management and the USDA Natural Resources Conservation Service. [Paper Number 117]

SUITABILITY OF THE SWISS STRAIN OF *LONGITARSUS JACOBAEAE* FOR THE BIOLOGICAL CONTROL OF TANSY RAGWORT IN MONTANA. Kenneth P Puliafico[1,†]; Jeffrey L Littlefield[1]; George P Markin[2] [1]Department of Entomology, 333 Leon Johnson Hall, Montana State University, Bozeman, MT, 59717; [2]USDA Forest Service, Rocky Mountain Research Station, Montana State University campus, Bozeman, MT, 59717

Abstract. The ragwort flea beetle, *Longitarsus jacobaeae* (Waterhouse) (Chrysomelidae) is considered to be the most important biological control agent for the suppression of tansy ragwort in the Pacific Northwest. However, repeated attempts to introduce these beetles into colder climates east of the Cascade Mountains have failed. A recent infestation of tansy ragwort in northwest Montana has rekindled the search for a cold adapted strain of the ragwort flea beetle. This is the first report of life history observations for naturally occurring populations of ragwort flea beetles in central Europe. Populations of *L. jacobaeae* from the mountainous regions of Switzerland are phenologically adapted to cold continental climates. Adult flea beetles emerge in late June and immediately start oviposition by mid-July. Egg laying continues throughout the summer and early autumn. Eggs enter a diapause phase and hatch in early spring after exposure to cold temperatures. Larvae initially feed in the leaves and then move to the root crowns to complete their development. Pupation occurs in the soil after the larvae leaves the plant. Host specificity tests revealed that larval development was completed only in the usual host plant, tansy ragwort. Tests included 12 plant species closely related to *S. jacobaea*, and focused mainly on eight previously untested North American native plant species. The demonstrated host specificity of the Swiss strain of ragwort flea beetle make them ideal candidates for the biological control of tansy ragwort. The flea beetles have a phenology that is suitable for release into Montana's tansy ragwort infested areas. [Paper Number 114]

MULTIPLE APPLICATIONS OF IMAZAPIC AT VARIOUS RATES FOR CONTROL OF DOWNY AND JAPANESE BROME (BROMUS TECTORUM) AND BROMUS JAPONICUS). Tom Whitson[1,†,*]; Jamie Foy[2]; Joe Vollmer[3]; Lise Foy[4] [1]Univesity of Wyoming, 747 Road 9, Powell, WY, USA, 82435; [2]Padlock Ranch, Sheridan, WY, USA, 82801; [3]BASF Research & Development, 2166 N 15th, Laramie, WY, USA, 82072; [4]U. W. Cooperative Extension Service, 224 S. Main Suite B10, Sheridan, WY, USA, 82801

Abstract. Downy brome and Japanese brome are highly competitive annual grasses in rangeland that often provide enough fine fuel for unwanted rangeland fires. Split applications of imazapic were applied to burned and unburned infestations on the Padlock Ranch near Sheridan, WY. to stands of downy and Japanese brome each month starting on April 5th and ending Oct. 7, 2002. Application rates were 0,2 oz (.031 lb/A) 4 oz (.062 lb/A) 6 oz (.093 lb/A) 8 oz (.124 lb/A) 10 oz (.155 lb/A) and 12 oz (.186 lb/A). Growth stages at each application were: April-preemergence to 1 leaf, May 6th - 4 to 7 leaf, June 6th-bloom, July 5th mature, Aug. 5-mature, Sept. 5-mature, Oct. 7-2 to 3 leaf. Evaluations were made the following year on Sept. 20, 2003. Perennial grasses (blue grama, western wheatgrass, bluebunch wheatgrass, slender wheatgrass, needleandthread) as well as downy and Japanese brome were clipped and combined while bluegrass was clipped and weighed separately from the Sept. 5, 2002 area. Downy and Japanese brome control was evaluated visually on Aug. 20, 2003 on all treatments. The minimum amount of imazapic required for nearly complete control for each application time was: April 5th-.062 lb/A, May 6-.093 burned area, .155 in non-burned area, June 6th-.062 lb/A in the burned area and .124 lb/A in the unburned area, July 5th-.093 lb/A in the burned area and .155 lb/A in the unburned area. After Aug. 5 applications were made only to areas previously burned. Aug 5th-.124 lb/A, Sept. 5-.062 lb/A, Oct.

7th-.124 lb/A. When species were clipped and combined by groups, discussed earlier, in the untreated check, downy and Japanese brome yielded 591 lb/A perennial grasses yielded 318 lb/A and bluegrass spp. yields were 536 lb/A. Percent downy and Japanese brome control and yields in the .031 lb/A application were 64%, downy and Japanese brome 87 lb/A, perennial grasses 923 lb/A, bluegrass spp. 261 lb/A. Applications of .062 lb. And .093 provided 93 and 94% downy and Japanese brome control, respectively with yields of perennial grasses averaging 835 lb/A and bluegrass yields averaging 58 lb/A. Applications greater than .124 lb/A provided 100% control of downy and Japanese brome with perennial grass yields averaging 730 lb/A and bluegrass species averaging 27 lb/A. Bluegrasses are generally undesirable on western rangeland because of their low protein and relative feed values. From Sept. 20 clipping samples at each application rate were analyzed to determine percent protein. Perennial grasses were suppressed in growth and had delayed maturity as application rates increased protein levels of perennial grasses in each application rate were 0 lb/A, 5.2%; .031 lb/A, 4.8%; .062 lb/A, 6.8%; .093 lb/A, 7.1%; .124 lb/A, 6.8%; .155 lb/A, 8.1%; and .186 lb/A, 8.0%. Samples of bluegrass clipped from the same application rates had protein levels of 2.3%, 3.3%, 3.5%, 3.4%, 2.6%, 3.5%, and 2.9%. Annual brome protein comparisons made at the 0, .031, .093, and .155 lb/A rates were 3.3, 4.7, 3.6, and 4.9%. Annual bromes were eliminated with imazapic rates above .124 lb/A while perennial grasses produced greater than twice those of the untreated check with 50% higher protein levels. [Paper Number 118]

Section 2. Weeds of Horticultural Crops

WEED CONTROL AND POTATO CROP RESPONSE TO LOW RATES OF SULFENTRAZONE AND METRIBUZIN APPLIED PREEMERGENCE AND POSTEMERGENCE. Brent R. Beutler[†,*]; Pamela J.S. Hutchinson[*] University of Idaho, Aberdeen, ID, 83210

Abstract. Sulfentrazone is a new herbicide for preemergence broadleaf weed control in potato (*Solanum tuberosum*, L.). By using sulfentrazone in tank mixtures with metribuzin it may be possible to reduce the rates of both herbicides while still providing effective weed control. Also, by using very low rates, it may be feasible to apply sulfentrazone postemergence alone or in combination with metribuzin, which is labeled for postemergence weed control in potato. Trials were conducted in 2002 and 2003 in Aberdeen, Idaho to evaluate the potential of the above mentioned herbicide uses. In all trials, weed infestations included redroot pigweed, common lambsquarters, kochia, hairy nightshade, and volunteer oat (*Avena sativa*, L.). In a preemergence trial, metribuzin was applied alone at 0.375 or 0.5 lb ai/A and sulfentrazone was applied alone at 0.047, 0.07, or 0.094 lb ai/A. Also, each rate of metribuzin was applied as a tank mixture with each rate of sulfentrazone. In 2002, the low rate of sulfentrazone provided less than 80% control for all weeds. In addition, the medium and highest rate of sulfentrazone both controlled volunteer oat below the 50% level. In 2003, volunteer oat control was less than 15% for all sulfentrazone rates applied alone. Also, kochia control was less than 85% for both metribuzin treatments and hairy nightshade control was less than 80% for both metribuzin treatments, the low rate of sulfentrazone, and both tank mixtures containing the low rate of sulfentrazone. All remaining treatments in both years provided greater than 85% control of all weeds present. In 2002 and 2003, total tuber and U.S. No. 1 tuber yields were higher than the weedy check for all herbicide treatments, however, there were no significant differences between herbicide treatments. In a postemergence trial, metribuzin was applied alone at 0.25 or 0.375 lb ai/A and sulfentrazone was applied alone at 0.012, 0.024, or 0.047 lb ai/A. In addition, each rate of metribuzin was applied as a tank mixture with each rate of sulfentrazone. In 2002 and 2003, broadleaf weed control was less than 85% and there was no measurable volunteer oat control for all sulfentrazone treatments applied alone. In 2003, hairy nightshade control was less than 70% with each metribuzin treatment and volunteer oat control was less than 75% with the low rate of metribuzin alone or tank-mixed with the low rate of sulfentrazone. In 2002, crop damage was visible one week after treatment for all treatments containing sulfentrazone with the most damage resulting from the high rate of sulfentrazone and its tank mixtures. At three weeks after treatment, there was less visible crop injury for all treatments. Injury for both metribuzin tank mixtures with the high rate of sulfentrazone was

significantly less than the crop injury for sulfentrazone applied alone, suggesting the possibility that metribuzin acted as a safener for the potato against sulfentrazone damage. However, there were no significant differences in tuber yield between any herbicide treatments. One week after application in 2003, visible crop injury was present for all treatments containing sulfentrazone, with the greatest injury again resulting from the high rate of sulfentrazone and its tank mixtures. At three weeks after application visible crop injury was still present for the same treatments at approximately the same levels with no visible evidence of metribuzin acting as a safener. However, total tuber yield was significantly less for all treatments of sulfentrazone applied alone than for any tank mixture treatments. [Paper Number 80]

PREDICTING HAIRY NIGHTSHADE BERRY PRODUCTION IN PEAS AND BEANS BASED ON TIME OF EMERGENCE AND HEAT UNITS. Rick A Boydston[1,†,•]; Ed Peachey[2,•] [1]USDA-ARS, 24106 N Bunn Road, Prosser, WA, USA, 99350; [2]Horticulture ALS 4035, Department of Horticulture, Oregon State University, Corvalis, OR, USA, 97331

Abstract. Hairy nightshade, *Solanum sarrachoides*, berries are similar in size, density, and color to processed peas and often contaminate peas and green beans reducing quality and increasing processing costs. Processors are able to remove nightshade berries smaller than 5 to 6 mm diameter by sieving. Studies were conducted in 2002 and 2003 at Paterson, WA and in 2003 in Corvallis, OR to determine the effect of hairy nightshade emergence date on potential for nightshade to produce berries larger than 5 to 6 mm diameter. In Washington, hairy nightshade required approximately 621 and 676 growing degree days $(GDD)_{base\ 4.4^\circ C}$ in 2002 and 2003, respectively, from emergence to produce berries 6 mm diameter. Emergence date had little effect on $GDD_{base\ 4.4^\circ C}$ required to produce 6 mm diameter berries. Germinable nightshade seed was obtained from berries of all size classes (< 3.5, 3.5 to 4.5, 4.5 to 6, 6 to 7, and > 7 mm diameter) collected at pea harvest. However, hairy nightshade berries in the three smallest size classes averaged less than one germinable seed per berry. In Oregon, hairy nightshade required 659 $GDD_{base\ 4.4^\circ C}$ from emergence to produce berries 5 mm diameter. Bean planting date from May 7 to June 17, 2003 had little effect on $GDD_{base\ 4.4\ C}$ required for hairy nightshade to flower or to produce 5 mm diameter nightshade berries. Hairy nightshade left season long did not reduce pea yield at the weed densities present in these studies. A simple model was developed to assist growers in making decisions for postemergence herbicide applications to prevent nightshade contamination in harvested peas. The model utilizes heat units required to mature peas, grower scouting for nightshade emergence date, and local air temperature data. [Paper Number 85]

COMPARISON OF OXYFLUORFEN FORMULATIONS FOR POSTEMERGENCE WEED CONTROL IN BROCCOLI AND CAULIFLOWER. Roger E. Gast[1,†,•]; Steven A. Fennimore[2,•]; James P. Mueller[1]; Jesse M. Richardson[1,•]; Richard F. Smith[3,•]; Barry R. Tickes[4,•] [1]Dow AgroSciences LLC, Indianapolis, IN, 46268; [2]University of California-Davis, Salinas, CA, 93905; [3]University of California Cooperative Extension, Salinas, CA, 93901; [4]Yuma County Cooperative Extension, Yuma, AZ, 85364

Abstract. **Paper not presented**. Seventeen replicated field trials were conducted in the central coast area of California and two in Yuma, Arizona during 2002-03 to investigate comparative differences between a 4 lb ai/gallon suspension concentrate (SC) and a 2 lb ai/gallon EC formulation of oxyfluorfen for postemergence weed control and crop tolerance. Natural broadleaf weed populations in direct-seeded and transplanted broccoli, and transplanted cauliflower cropping systems were tested. Treatments targeted the 3-4 leaf stage of direct-seeded broccoli or 2-3 weeks after transplantation at application rates ranging from 0.0625 to 0.5 lbs ai/acre. The majority of trials were conducted on direct-seeded broccoli. The SC formulation caused significantly less crop injury than the EC formulation at equivalent application rates. At a rate of 0.125 lbs ai/acre, the SC formulation caused only slight injury to direct-seeded broccoli, a rating 2.2 on average using a 0-10 scale, compared to marginally acceptable injury with the EC formulation that resulted in an average injury rating of 4.0. Several trials where crops were grown under mild (cool, cloudy) conditions tended to result in higher injury but in each case the crop out-grew affects

of SC treatments at a rates of 0.25 lbs ai/acre or less. Results were similar in terms of selectivity differences in transplanted crops, where there was also no significant difference observed in tolerance between broccoli and cauliflower. Broadleaf weed control with the EC formulation was expectedly greater than the SC at equivalent rates, however it did not reliably deliver effective weed control at rates that provided acceptable crop tolerance. The SC formulation at 0.125 lbs ai/acre provided effective control (>85%) of common purslane (POROL), little mallow (MAVPA), groundsel (SENVU), burning nettle (URTUR), wright groundcherry (PHYAC) and nettleleaf goosefoot (CHEMU). It also showed potential to control other species such as hairy nightshade (SOLSA), pigweed (AMARE) and common lambsquarters (CHEAL). Further research is necessary to define predictable levels of control for these and other species. These studies show that the SC formulation delivers significant improvement in crop selectivity compared to the EC, with potential to deliver effective weed control and acceptable crop tolerance at rates between 0.125 and 0.25 lbs ai/acre. [Paper Number 83]

DIMETHENAMID-P: EFFICACY AND POTATO VARIETY TOLERANCE. Pamela J.S. Hutchinson[1,†,*]; Corey V. Ransom[2,*]; Rick A. Boydston[3,*]; Brent R. Beutler[1,*] [1]Assistant Professor and Support Scientist I, University of Idaho, Aberdeen Research and Extension Center, Aberdeen, ID, 83210; [2]Assistant Professor, Oregon State University, Malheur Experiment Station, Ontario, OR, 97914; [3]Weed Scientist, USDA-ARS, Prosser, WA, 99350

Abstract. Dimethenamid-p is a new preemergence herbicide being developed for use in potato. Trials were conducted in Idaho, Oregon, and Washington in 2001, 2002, and 2003 to determine the efficacy of dimethenamid-p alone at 0.64 lb ai/A, and in tank mixtures with EPTC, metribuzin, pendimethalin, or rimsulfuron. The tank-mix partners also were applied alone. In Idaho, late-season control of hairy nightshade, common lambsquarters, and volunteer oat was improved with dimethenamid-p tank mixtures compared with control by dimethenamid-p or the tank mix partners alone. Redroot pigweed control with dimethenamid-p + EPTC or pendimethalin was greater than control with those three herbicides applied alone. Kochia control was improved with dimethenamid-p tank mixtures compared with all herbicides applied alone except metribuzin. Hairy nightshade control in Oregon trials was similar to control in Idaho trials. In Washington, dimethenamid-p alone generally controlled hairy nightshade as well as dimethenamid-p tank mixtures, and tank mixtures provided greater control than the tank mix partners applied alone. Treatments providing less weed control in these efficacy trials had lower U.S. No. 1 and total tuber yields than the weed-free controls and the tank-mixture treatments. Dimethenamid-p at 0.64 or 1.28 lb ai/A was applied preemergence to six potato varieties, Russet Burbank, Ranger Russet, Russet Norkotah, Shepody, Alturas, and Bannock Russet, in weed-free trials conducted in Idaho in 2002 and 2003 to determine tolerance. There was a significant year by herbicide rate by variety interaction. In 2002, early-season crop injury was <5% and not significant regardless of variety or dimethenamid-p rate. In 2003, the dimethenamid-p rate by variety interaction was significant. Dimethenamid-p at 0.64 and 1.28 lb ai/A resulted in 8 and 13% injury, respectively, to Alturas 2 weeks after treatment (WAT). Injury consisted mainly of stunting. The other varieties had no visible injury 2 WAT. By row closure approximately 6 WAT, little or no injury was evident on any variety. Early injury did not translate to tuber yield reductions. In 2002 and 2003, U.S. No. 1 and total tuber yields of each herbicide-treated variety were not less than tuber yields of the respective untreated variety controls. [Paper Number 81]

OPTIMIZING CULTIVATION IN POTATO USING WEED EMERGENCE TIMING. George O Kegode[1,†,*]; Douglas J Doohan[2]; Joel Felix[2]; Jerry Ivany[3] [1]North Dakota State University, George.Kegode@ndsu.nodak.edu, Fargo, ND; [2]Ohio State University, Wooster, OH; [3]Agriculture and Agri-Food Canada, Charlottetown, P.E.I., Canada

Abstract. Optimal timing of cultivation in potato was evaluated at Fargo, ND; Wooster, OH; and Charlottetown, PEI, Canada from 2001 to 2003 using, *WeedCast*, a computer model that predicts weed emergence. A split-plot arrangement of treatments in a randomized complete block design with cultivation time as the main plot and herbicide as subplot was used. Main plots were cultivated when the

model predicted 0, 15, 30, or 60% weed emergence for the most predominant species on the site. Subplots were either treated with metolachlor + metribuzin at 1.68 and 0.5 kg ai/ha, respectively, or left unsprayed. Subplots within the control, 0% predicted weed emergence, were cultivated only at layby. Otherwise, potatoes were grown using standard cultural practices as recommended by the respective extension services. Cultivation timing was predicted using *Solanum ptychanthum* and *Amaranthus retroflexus* in 2002 and 2003, respectively, at Fargo; *A. retroflexus*, *Polygonum pennsylvanicum*, and *Chenopodium album*, in 2001, 2002, and 2003, respectively at Wooster; and *C. album* at Charlottetown all years. In 2001, cultivation timing based on 15% predicted emergence of *A. retroflexus* (Wooster) and *C. album* (Charlottetown) resulted in better weed control and tuber yield. In 2002, cultivation at 30% predicted emergence of *S. ptycanthum* and *P. pennsylvanicum* provided the best weed suppression at Fargo and Wooster, respectively; whereas at Charlottetown, 15% predicted emergence of *C. album* resulted in the best weed control. In 2003, three cultivations done at 15, 30, and 60% predicted weed emergence provided the best weed control and lowest weed biomass yield when compared with two cultivations at 30 and 60% predicted weed emergence, or one cultivation at 60% predicted weed emergence. Cultivation alone did not adequately control all weeds, and at all three sites potato that was only cultivated tended to yield less than cultivation + herbicide treatments. We conclude that timing cultivation to 15% predicted emergence using Weedcast appears to be an effective tool for improving weed management in potato. [Paper Number 79]

EFFECTS OF SEVERAL HERBICIDES APPLIED TO NEWLY-TRANSPLANTED STRAWBERRY. Timothy W. Miller[†,*]; Brian G. Maupin Washington State University, 16650 State Route 536, Mount Vernon, WA, USA, 98273

Abstract. Strawberry production in the Pacific Northwest consists of transplanting in spring of year 1 and berry harvest during years 2 and 3. Good strawberry growth and effective weed control during the establishment year are of paramount importance to generate heavy fruit bearing in subsequent years. To that end, several herbicides were tested for crop safety and weed control when applied immediately following strawberry transplanting and again approximately one month later. All plots were hand weeded prior to the mid-season application. The greatest leaf area in August 2002 was produced on hand weeded strawberries or those treated with pendimethalin or azafenidin immediately after transplanting. Leaf area was greatest for the following combinations: hand weeding followed by (fb) azafenidin, azafenidin fb dimethenamid-p, azafenidin fb sulfentrazone, hand weeding fb sulfentrazone, and sulfentrazone applied twice. The only mid-season combinations resulting in >10% strawberry leaf injury were lactofen or flumioxazin fb azafinidin (9%), although leaf area was maximized by sulfentrazone, azafenidin, dimethenamid-p, and flumioxazin treatments at mid-season. In 2003, leaf injury resulting from early or late herbicide applications was not significantly greater than ratings for non-treated strawberry plants. Strawberry leaf area in August 2003 was maximized by early treatment with flumioxazin or by hand weeding; no mid-season treatment significantly affected leaf area. Several combination treatments resulted in excellent weed control by July 2002, but only hand weeding or pendimethalin applied early resulted in acceptable weed control by July 2003. Based on these data, mid-season application of certain herbicides to newly-planted strawberries holds promise for extending the period of acceptable weed control while not excessively slowing strawberry growth, although supplemental hand weed control will still be necessary in many cases. [Paper Number 84]

TILLAGE SYSTEM AND HERBICIDE PLACEMENT EFFECTS ON POTENTIAL LOSSES OF METOLACHLOR IN VEGETABLE ROW CROPS. R. Edward Peachey[†,*]; David Rupp; Ray Williiam; John Selker Oregon State University, Corvallis, OR

Abstract. Losses of moderately soluble soil-applied herbicides such as metolachlor may be exacerbated by conservation tillage systems. The objective of this project was to determine whether application of metolachlor to the tilled band in strip-tillage corn would significantly reduce vadose zone losses of metolachlor during the growing season compared to broadcast applications in strip-tillage in conventional

tillage systems. The effect of herbicide placement on potential metolachlor losses in two tillage systems was measured between and below sweet corn rows after metolachlor was either broadcast or banded over the row. Metolachlor at 4 lbs ai/A was applied with a backpack CO_2 sprayer and 20 GPA water. Soil water was collected with four porous suction-cup samplers in each plot, installed after corn planting and located between and under corn rows below the plow pan. Immunoassays were used to determine metolachlor concentrations. The average concentration of metolachlor in soil water from under and between rows was 5 times greater in strip-tillage than in conventional tillage plots over 4 sampling periods, ranging from 7 to 11 ppb in strip-tillage when herbicides were broadcast. Banding of metolachlor in strip-tillage corn reduced metolachlor concentrations by an average factor of 5, and a maximum of 7.8 at approximately one month after the herbicide was applied, more than compensating for the 3-fold reduction due to banding. Additionally, banding of metolachlor in strip-till plots reduced metolachlor concentrations in soil water collected from both between and under rows to levels of metolachlor found in the soil water of conventional tillage plots. The cause of the increased concentrations in strip-tillage is unclear. Infiltration rates in the conventional tillage plots were more than double those in the strip-tillage plots, based on 32 single-ring infiltration tests conducted during the irrigation season. [Paper Number 86]

WEED CONTROL IN LETTUCE WITH KERB 50W APPLIED THROUGH OVERHEAD SPRINKLERS. Jesse M Richardson[1,†,•]; Barry R Tickes[2,•]; Roger E Gast[3,•]; Rod A Dorich[3] [1]Dow AgroSciences, 9330 10th Ave., Hesperia, CA, USA, 92345; [2]Yuma County Cooperative Extension, 6425 W. 8th St., Yuma, AZ, USA, 85364; [3]Dow AgroSciences, 9330 Zionsville Rd., Indianapolis, IN, USA, 46268

Abstract. Over the past fifteen years, the practice of establishing lettuce under solid set sprinklers has become commonplace. The presence of sprinklers in the field has complicated the application and incorporation of Kerb (pronamide) herbicide. Prior to 2003, the only registered methods of applying Kerb to lettuce were by ground or aerial application. With sprinkler pipes in the field, ground applications could only be accomplished with extraordinary effort and aerial applications often resulted in overlaps and skips. In 2003, a 24(c) Special Local Needs registration allowing application of Kerb through sprinklers was approved in Arizona. Field trials were conducted in 2002 and 2003 to compare efficacy and crop safety of aerially-applied and sprinkler-applied Kerb. Side-by-side plots were established at five locations in Yuma County. Kerb was applied at rates of 0.6 to 0.75 lb a.i./acre. Individual plots were a minimum of 10 acres in size. Correctly timing the Kerb chemigation to match weed seed germination was one of the most critical factors in obtaining acceptable weed control. To minimize lettuce phytotoxicity and to maximize efficacy, applying the correct amount of water after chemigation was crucial. In general, applying 0.4-0.6 in of water after chemigating was optimal. Hand-hoeing costs in fields where Kerb was applied by sprinklers were lower than in those applied by aerial application. [Paper Number 87]

WEED CONTROL IN ALMONDS WITH TRIFLOXYSULFURON. Tim Tripp[1,†,•]; Mike Ensminger[2,•]; Tom Beckett[3,•]

Abstract. Almond orchard trials were conducted in winter of 2002-2003 at 3 sites in northern California (Ordbend, Hamilton City, and Glenn) to evaluate trifloxysulfuron sodium on several weed species that are increasingly difficult to control with glyphosate alone. One of the species evaluated, Italian ryegrass, has been documented as resistant to glyphosate by the University of California – Davis. Treatments consisted of trifloxysulfuron applied preemergence at 0.01 and 0.02 lb ai/A, trifloxysulfuron alone applied early postemergence at 0.01 and 0.02 lb ai/A, glyphosate alone early postemergence at 0.75 and 1.5 lb ae/A, paraquat alone early postemergence at 1.0 lb ai/A, and tank mixtures of early postemergence applications of glyphosate + trifloxysulfuron at 0.75 lb ae/A + 0.02 lb ai/A, paraquat + trifloxysulfuron at 1.0 + 0.02 lb ai/A, and paraquat + simazine at 1.0 + 1.0 lb ai/A. All foliar treatments of paraquat alone, trifloxysulfuron alone, and paraquat + trifloxysulfuron were applied with nonionic surfactant at 0.25% v/v. Weed control was evaluated by visual ratings at 1, 2, and 4 months after application. At Ordbend (early January application) and Hamilton City (early December application), paraquat + simazine at 1.0 + 1.0 lb ai/A provided excellent postemergence control (>95%) of both Italian ryegrass and redstem filaree at 2 months after application. Glyphosate at 0.75 lb ai/A did not provide adequate control of either Italian ryegrass or redstem filaree. Paraquat at 1.0 lb ai/A did not control filaree adequately but provided excellent control of Italian ryegrass. At both of these locations, the addition of trifloxysulfuron at 0.02 lb ai/A to either Paraquat or Glyphosate improved control of both filaree and ryegrass to >95% at 2 months after application and provided excellent residual control at 4 months after application. At 0.02 lb ai/A, trifloxysulfuron + 0.25% v/v nonionic surfactant provided control of 80-90% of 2-4 leaf Italian ryegrass. When applied preemergence, trifloxysulfuron at both 0.01 and 0.02 lb ai/A provided >95% residual control of Italian ryegrass and redstem filaree through 4 months after application. At Glenn, glyphosate + trifloxysulfuron at 0.75 lb ae/A + 0.02 lb ai/A, paraquat + trifloxysulfuron at 1.0 + 0.02 lb ai/A, and trifloxysulfuron at 0.02 lb ai/A all provided excellent foliar control of common mallow (cheeseweed) and >95% residual control through 4 months after application. [Paper Number 89]

HALOSULFURON USES FOR VEGETABLE CROPS IN TEXAS AND OKLAHOMA. Russell W. Wallace[1,†]; Lynn P. Bradenberger[2] [1]Texas A & M University, Agricultural Research & Extension Center, Route 3, Box 213AA, Lubbock, TX, USA, 79403; [2]Oklahoma State University, Dept. of Horticulture & Landscape Architecture, 360 Agricultural Hall, Stillwater, OK, USA, 74078

Abstract. Halosulfuron-methyl is an herbicide recently registered for many minor crops that has potential for wide uses in the Oklahoma and Texas vegetable industries. Field research was conducted during 2003 to evaluate halosulfuron efficacy and phytotoxicity in selected vegetables [watermelons (*Citrullus lanatus*), pumpkins (*Cucurbita pepo*), snap beans (*Phaseolus vulgaris*) and southern peas (*Vigna unguiculata*)]. All trials were conducted in replicated small plots at sites located in association with Texas A & M and Oklahoma State universities. In direct-seeded watermelons, bensulide applied preemergence (PRE) + early postemergence (EPOST) directed applications of halosulfuron (0.024 lbs ai/A) caused minor stunting (8% or less), but control of Palmer amaranth (*Amaranthus palmeri*) was excellent. Yields, however, were reduced 40% compared to the handweeded check. Ethalfluralin + clomazone (PRE) + halosulfuron (EPOST-direct) gave no injury to watermelons with moderate control (70%) of Palmer amaranth and no yield reduction. Halosulfuron applied PRE at 0.024, 0.032 and 0.048 lb ai/A with watermelons transplanted 0, 1, 3, 7 & 9 days after application (DAT) showed 21% or less crop injury, with no significant differences between timing or rate. Control of Palmer amaranth and carpetweed (*Mollugo verticillata*) was excellent and yields were not significantly different from the handweeded check. Halosulfuron applied PRE + EPOST at 0.024, 0.032 and 0.048 lbs ai/A in direct-seeded pumpkins showed significant early crop stunting (28 to 48%), though this was likely the result of heavy rainfall that moved halosulfuron down through the soil profile. By mid-August stunting was greatly reduced and was not different from the handweeded check. Pumpkin yields, though slightly reduced as the rate of halosulfuron increased, were not significantly different. Halosulfuron applied PRE at 0.024, 0.032 and 0.032 lbs ai/A to snap beans in Texas resulted in 14% or less crop injury (26 DAT), but when applied POST at the same rates caused 16 to 23% injury 16 DAT. Regardless of application timing or rate, yields were not significantly different from the handweeded check plots. In Oklahoma, PRE-and POST-applied halosulfuron had 13% or less stunting throughout the season. Control of Palmer amaranth and carpetweed was significantly better with halosulfuron applied PRE compared to when it was applied POST. Snap bean yields in Oklahoma were equivalent to the handweeded check. Finally, in both states, PRE-applied halosulfuron caused no visual injury to southern peas regardless of rate, however; POST treatments caused significantly higher injury (39 to 60%) 7 DAT, but this decreased to 10% or less by season's end. Yields, though slightly reduced with the POST applications, were not significantly different from the handweeded check. The results of these studies indicate the potential use for halosulfuron in vegetable crop production in Texas and Oklahoma; however, more research is needed to determine the best application timings, rates, and methods for these and other vegetable crops. [Paper Number 88]

CONTROL OF DODDER IN PROCESSING TOMATOES. Tom Lanini and Mario Miranda-Sazo. Dept of Vegetable Crops, University of California, Davis CA 95616

Abstract. Weed control in almonds is often accomplished using a combination of chemical and nonchemical methods. The tree rows (berms) are typically treated with a preemergence herbicide during the fall or early winter, with rainfall used for incorporation. A field trial was conducted in 2002 and 2003 to evaluate weed control and almond tolerance to trifloxysulfuron sodium. The predominant weeds present in these orchards included smooth brome (*Bromus mollis*), foxtail barley (*Hordeum jubatum*), redstem filaree (*Erodium cicutarium*), yellow starthistle (Centaurea solstitialis), prickly lettuce (*Lactuca, serriola*), Italian ryegrass (*Lolium multiflorum*), and field bindweed (*Convolvulus arvensis*). Overall, it appears that trifloxysulfuron sodium is slightly weaker on grasses, cheeseweed, and field bindweed than the thiazopyr/oxyfluorfen combination, although adding glyphosate improved the performance of trifloxysulfuron sodium. Trifloxysulfuron sodium alone was not very effective as a postmergence treatment, even though a surfactant was added. If weeds are emerged, a postemergence herbicide, such as glyphosate or paraquat, should be included to improve control. Trifloxysulfuron sodium plus glyphosate

was superior to the thiazopyr/ oxyfluorfen/glyphosate combination in controlling redstem filaree, yellow starthistle, and prickly lettuce, and the trifloxysulfuron sodium was superior to the thiazopyr/oxyfluorfen treatment for controlling yellow starthistle and prickly lettuce. Since yellow starthistle is such a large problem in the Western US, trifloxysulfuron sodium should be considered for use in non-cropland in addition to potential orchard applications. [Paper number 82]

Section 3. Weeds of Agronomic Crops

WEED CONTROL IN REDUCED TILLAGE COTTON PRODUCTION. Kwame O. Adu-Tutu[†,*]; William B. McCloskey[*]; Michael J. Ottman; Stephen H. Husman University of Arizona, Tucson, AZ, U.S.A., 85721

Abstract. Experiments were initiated at the University of Arizona Marana and Maricopa Agricultural Centers in the fall of 2001and 2002, respectively, to evaluate a weed-sensing automatic spot sprayer and to test postemergence herbicide weed control programs in a cotton and small grain double-crop rotation, conservation tillage project. The treatments were: (1) conventional tillage plots that were fallow in the winter followed by conventional tillage and cotton planting in April (early planting); (2) conventional tillage plots that were fallow in the winter and similar to treatment 1 were planted in May at the same time as treatment 4 (late planting); (3) no-till planting of a barley cover crop followed by a no-till early cotton planting; and (4) no-till planting of a Solum barley grain crop followed by a no-till, late cotton planting. Barley was planted in both minimum tillage treatments (3 and 4) in the fall and the cover crop (treatment 3) was killed in the spring using glyphosate. The barley grain crop (treatment 4) was harvested immediately prior to planting the late cotton. Roundup-ready cotton varieties were planted in all treatments. In general, weed control in the conventional tillage treatments was obtained using pre-plant incorporated herbicides (pendimethalin and prometryn), followed by a topical broadcast application of glyphosate, followed by cultivation operations, followed by handweeding, followed by a layby application of glyphosate tank-mixed with prometryn and carfentrazone-ethyl. Weed control in the reduced tillage treatments was generally obtained using a topical application of glyphosate, followed by a post-directed application of glyphosate, followed by a layby application of glyphosate tank-mixed with prometryn and carfentrazone-ethyl. The post-directed and layby applications were made under RedBall 410 conservation tillage spray hoods equipped with three 95 degree even flat fan nozzles. Two of the hoods were modified by installing three WeedSeeker weed-sensing, intermittent spray units (NTech Industries, Inc.) in each hood to automatically detect and spot-treat weeds in the furrows. This allowed comparison of the WeedSeeker spray units in two hoods and continuous spray nozzles in other hoods in terms of spray volume applied and weed control of predominant weeds. All spray hoods had 80 degree flat fan nozzles on single swivels mounted at the rear of the hoods to post-direct spray at the base of the cotton plants in the seed line. In 2002, the weed-sensing, automatic spray technology reduced herbicide spray volumes by 79% in the minimum tillage, Solum barley cover crop treatment, 74% in the minimum tillage, brittle stem barley cover crop treatment, and 91% in the minimum tillage, Solum barley grain crop treatment at Marana. Reductions in spray volumes in 2003 were 47% and 53% in the minimum tillage, Solum barley cover crop treatment when assessed in June and July 2003, respectively. At Maricopa, a 99% reduction in spray volume by the weed-sensing unit was obtained in the early-planted no-till cotton which was planted into a 3-in thick layer of crop residue. In contrast, there was no substantial reduction (6.9%) in the late-planted, no-till cotton following a barley grain crop because of volunteer barley germination. Weed control generally did not differ between the two spray technologies; however, control of annual sowthistle (*Sonchus oleraceus* L.) at Marana and sprangletop [*Leptochloa uninerva* (Presl) Hitchc. & Chase] at Maricopa was not as good with the weed-sensing technology as with conventional continuous spray technology. Timely herbicide application, higher boom pressure and larger spray volumes per acre that ensure better spray coverage may be necessary for effective control of these weeds. The postemergence herbicide programs in the reduced tillage systems were as effective in controlling weeds as the combined pre-emergence herbicides, the numerous cultivations, postemergence herbicides and hand-weeding used in the conventional tillage systems. [Paper Number 119]

NEW WEED MANAGEMENT STRATEGIES IN SUNFLOWER. Craig M. Alford[†,•]; Stephen D. Miller[•] Dept. of Plant Sciences, 1000 E. University Ave., Laramie, WY, USA, 82071

Abstract. Winter annual grass weeds in winter wheat have forced producers to implement crop rotations to help control these weeds. One of the crops producers have incorporated into their rotation is sunflower and they are looking for efficient ways to control weeds in sunflowers. Over the past several years studies have been conducted at the University of Wyoming Research and Extension Centers, Archer and Torrington, WY to investigate weed control strategies in sunflower. The research conducted included weed control in Imi-tolerant (imazamox 0.032 to 0.063 lb ai/ac) and tribenuron tolerant sunflower (tribenuron 0.008 to 0.024 lb ai/ac), fall applications of sulfentrazone (0.125 to 0.37 lb ai/ac) and flumioxasin (0.063 to 0.125 lb ai/ac), or narrow row sunflower production for increased competition with weeds. The row spacings tested were 15, 22 and 30 inch rows. Imazamox or imazamox plus imazapyr applications in Imi-tolerant sunflower caused no crop injury and provided excellent (> 90%) control of all weed species except dandelion (80%). Application of imazamox is tribenuron tolerant sunflower resulted in 2% crop injury. Tribenuron tolerant sunflowers exhibited good tolerance to tribenuron at all rates tested. Further, tribenuron applications provided excellent control of all broadleaf weed species except Canada thistle (70 to 77%). Slight injury (3 to 10%) was evident when tribenuron was applied to Imi-tolerant sunflower. Broadleaf control with fall applications of sulfentrazone was considerably more consistent (87 to 100%) than with fall applications of flumioxasin (30 to 87%). No crop injury was observed with either herbicide at any rate. The summer of 2003 was hot and dry and as a result sunflowers planted in 15 inch rows at 12,000 seed per acre produced the highest yields. Yields and sunflower head diameter tended to increase as row spacing was reduced from 30 to 15 inches, and plant populations reduced from 24,000 to 12,000 plants per acre.
[Paper Number 157]

MESOSULFURON (OSPREY) FOR GRASSY WEED CONTROL IN EASTERN WASHINGTON/NORTHERN IDAHO WINTER WHEAT. Monte D. Anderson[†,•] 16304 South Yancey Lane, Bayer CropScience, Spangle, WA, USA, 99031

Abstract. Mesosulfuron-methyl was conferred reduced risk status by EPA in September, 2002. Registration of mesosulfuron on winter wheat is anticipated in the spring of 2004 in time to allow the use of spring applications of Osprey Herbicide for control of important grass weeds. Wild oat, Italian ryegrass, interrupted windgrass, and downy brome will be targeted for this new active ingredient in eastern Washington and northern Idaho. Osprey is a 4.5% WDG formulation of mesosulfuron used at a rate of 10 g ai/ha for the control of wild oat and interrupted windgrass in winter wheat. A higher rate of 15 g ai/ha will be labeled for the control of Italian ryegrass and the suppression of most annual brome species. A non-ionic surfactant at 0.5% v/v plus a nitrogen source will be recommended both when Osprey is used alone or in tank mixture with other partners. The nitrogen source may be either UAN or AMS. When warm and dry conditions are present at application, methylated seed oil as the adjuvant may improve grass control, but only recommended under these conditions and without any tank mix partners.
[Paper Number 142]

BROADLEAF WEED CONTROL IN FIELD CORN WITH POSTEMERGENCE HERBICIDES. Mr Richard N Arnold[†,•]; Dr Michael K O'Neill; Mr Dan Smeal New Mexico State University Agricultural Science Center, P.O. box 1018, Farmington, NM, USA, 87499

Abstract. Research plots were established on May 14, 2003 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. Pioneer 34N44) and annual broadleaf weeds to postemergence herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were 4, 34 in rows 30 ft long. Field corn was planted with

flexi-planters equipped with disk openers on May 14. Postemergence treatments were applied on June 2 when corn was in the 4th leaf stage and weeds were small. All treatments had methylated seed oil and 32-0-0 applied at 0.5 and 1.0 percent v/v added to the spray mixture. Black nightshade, prostrate and redroot pigweed, and common lambsquarters infestations were heavy and Russian thistle infestations were light throughout the experimental area. Treatments were evaluated on August 13. No crop injury was observed in any of the treatments. All treatments except the weedy check gave excellent control of redroot and prostrate pigweed and common lambsquarters. Nicosulfuron plus rimsulfuron, DPX 79406, and nicosulfuron plus rimsulfuron plus diflufenzopyr plus dicamba applied at 0.035, 0.023, and 0.035 plus 0.09 lb ai/A and the check gave poor control of black nightshade. Russian thistle control was poor with nicosulfuron plus rimsulfuron, DPX 79406 and foramsulfuron applied at 0.035, 0.023, and 0.033 lb ai/A. [Paper Number 94]

POSTEMERGENCE APPLICATION OF PICLORAM IN GRAIN SORGHUM. Brent W Bean[1,2,†]; Matt W Rowland[1] [1]Texas Cooperataive Extension, Amarillo, TX; [2]Texas Agricultural Experiment Station, Amarillo, TX

Abstract. Studies were conducted annually from 2000 to 2003 to evaluate the crop safety and weed control effectiveness of postemergence applications of picloram with and without 2,4-D amine in grain sorghum. Studies were located at or near the Texas Agricultural Experiment Station Bushland, TX. Each test was randonmized in a complete block design with three replications. Applications were made using a tractor-mounted CO2 sprayer calibrated to apply 10 gal/ac. Rates of picloram evaluated ranged from 0.0625 to 0.25 lb ai/ac. Treatments were also applied with and without 0.25 lb ai/ac 2,4-D amine. Picloram did not cause any significant crop injury in any of the trials. Some crown-root deformation and lodging did occur when 2,4-D amine was added. Yield was not reduced due to applications of picloram. Control of Palmer amaranth varied among years. Control of other broadleaves such as velvetleaf and morningglory appeared promising in 2002. In 2003 bindweed control with the picloram treatments was not significantly improved over 2,4-D or dicamba alone treatments.
[Paper Number 103]

RELATIVE COMPETITIVENESS OF PALMER AMARANTH BASED ON EARLY SEASON GROWTH ANALYSIS IN CORN. Eric Blinka[†]; Anita Dille[*] Kansas State University, Manhattan, KS, 66506

Abstract. Relative competitiveness of plants can be examined through growth analysis. Leaf area ratio (LAR), net assimilation rate (NAR), and relative growth rate (RGR) are parameters used to describe early season growth. It is expected that these parameters would decrease over time due to production of less photosynthetically active plant material such as stem tissue and shaded leaves. Field studies were conducted to determine early season relative competitiveness of Palmer amaranth (Amaranthus palmeri) in corn through growth analysis. Monoculture Palmer amaranth and Palmer amaranth/corn mixture plots were established in 2002 and 2003. Six destructive harvests occurred each year to determine aboveground biomass and plant leaf area. Best fit regression models, means, and standard errors for LAR, NAR, and aboveground RGR were determined for Palmer amaranth. Plant biomass and leaf area were greater in 2003 than 2002 as a result of poor environmental conditions in 2002. General trends demonstrated that Palmer amaranth alone produced more biomass and leaf area in 2002 and 2003 than when Palmer amaranth was grown with corn. LAR was higher in 2002 than 2003 and was decreasing in time for both treatments in the two years. Overall NAR was higher in 2003 than 2002. NAR increased for both treatments in 2003 and for Palmer amaranth alone in 2002. Otherwise, NAR was decreasing for Palmer amaranth/corn mixture in 2002. Aboveground RGR of biomass was higher in 2003 than 2002. It remained constant for both treatments in 2003 at 0.16 (g/g/d) for Palmer amaranth alone and 0.15 (g/g/d) for Palmer amaranth/corn mixture. Aboveground RGR also remained constant for Palmer amaranth alone in 2002 at 0.11 (g/g/d), but was declining for Palmer amaranth/corn mixture beginning with 0.23 (g/g/d) and ending at -0.04 (g/g/d). Results demonstrated that Palmer amaranth was relatively competitive when grown as a

monoculture in both years and as a Palmer amaranth/corn mixture under adequate growing conditions, such as 2003.The relative competitiveness of Palmer amaranth decreased under stressful environmental conditions and when competition from corn existed. [Paper Number 99]

IMAZAMOX COMBINATIONS WITH UAN FOR FERAL RYE CONTROL IN CLEARFIELDTM WINTER WHEAT. Mark Boyles C Boyles[1,†,•]; Dr Tom F Peeper[1,•]; Dr. Cletus Youmans[2,•] [1]Oklahoma State University, Plant and Soil Science Dept., Stillwater, Okla, USA, 74078; [2]BASF Corp, Research Triangle Park, NC, USA, 27709

Abstract. Rye (*Secale cereale* L.) appears to have been cultivated for more than 2,000 years. It was widely distributed during the medieval period, particularly in Europe. Rye was brought to the western hemisphere by the English and Dutch who settled in the northeastern United States. Rye is an annual or winter annual grass that reproduces by seed. Rye in the United States is used mainly for a feed grain and as a cover crop to protect soil from erosion. In winter wheat, rye causes serious problems because it emerges as volunteer rye freely and the grain shatters readily. The shattered rye grain produces volunteer plants that thrive under adverse conditions and typically matures and shatters before wheat harvest. Rye is very difficult to control in winter wheat and its presence in wheat grain will result in dockage, grade reduction due to foreign materials and a decrease of wheat quality. A current control method is applying imazamox herbicide post emerge in CLEARFIELDTM winter wheat. The objective of this research was to evaluate different rates of liquid fertilizer (UAN 28-0-0) with labeled rates of imazamox applied both in the fall and spring to determine if overall rye efficacy in wheat could be improved. Four field studies were conducted between the years 2000 to 2003. Two studies were conducted during the 2000-2001 wheat season, one study during the 2001-2002 season and one study during the 2002-2003 season. Non-ionic surfactant at 0.25% v/v was applied with all treatments. Only minor wheat injury that was quickly outgrown was noted at each timing on all studies. Wheat injury was minor leaf burn with UAN and temporary stunting and chlorosis with imazamox. In the fall and spring of 2000-2001 imazamox was applied at 4 oz product per acre with 1.25, 50, 75 and 100% v/v UAN. In the fall the wheat was 3 leaf to four tillers and the rye was 2 leaf to four tillers. The spring application was on wheat 2 to 9 tiller and rye at 1 to 8 tillers. Results from fall applications (two locations) at harvest (150 DAT) showed that imazamox at 4 oz per acre with 1.25, 50, 75 and 100% v/v UAN provided 68%, 79, 78 and 63% rye control, respectively. Results from spring applications (two locations) at harvest (60 DAT) showed that imazamox at 4 oz per acre with 1.25, 50, 75 and 100% v/v UAN provided 50%, 73, 78 and 79% rye control, respectively. Wheat yields after cleaning at the only location harvested showed the check with 35 bushels. Fall applications of imazamox at 4 oz per acre with 1.25, 50, 75 and 100% v/v UAN provided 85, 84, 87 and 85 bushels per acre, respectively. Spring applications of imazamox at 4 oz per acre with 1.25, 50, 75 and 100% v/v UAN provided 81, 83, 91 and 89 bushels per acre, respectively. Rye seed per 10 grams harvested sample from fall applications showed the check with 241 seeds. Fall applications of imazamox at 4 oz per acre with 1.25, 50, 75 and 100% v/v UAN resulted in 36, 8, 11 and 20 rye seeds per 10 gram sample, respectively. Spring applications of imazamox at 4 oz per acre with 1.25, 50, 75 and 100% v/v UAN resulted in 37, 21, 9 and 7 rye seeds per 10 gram sample, respectively. [Paper Number 143]

APPLICATION TIMING EFFECT ON ITALIAN RYGRASS CONTROL IN WINTER WHEAT. Deena L Bushong[†]; DR Thomas F Peeper[•]; DR Case R Medlin Oklahoma State University, Department of Plant and Soil Sciences, Stillwater, OK, 74078

Abstract. Over the last decade, Italian ryegrass has become a major weed problem in hard red winter wheat production in Oklahoma, and has reduced the acreage harvested for grain. More than half of the wheat produced is grazed in the fall and then harvested for grain, which precludes the use of diclofop, because of its full season grazing restriction. Chlorsulfuron and a 5:1 premix of chlorsulfuron + metsulfuron are labeled for ryegrass suppression in wheat when applied preemergence (PRE). Control is variable because rainfall required for activation is erratic. If effective, an early POST application could

reduce the risk of control failure. Three field experiments were conducted in 2002-2003 to evaluate Italian ryegrass control. In October, Italian ryegrass was hand broadcast at 15 lb/acre and incorporated with light tillage, and winter wheat 'Ok 101' was seeded at 70 lb/acre. Chlorsulfuron at 0.248 and 0.375 oz ai/a and Chlorsulfuron + metsulfuron at 0.30 and 0.375 oz ai/a were applied PRE, 7, 10, 14, 21, and 28 days after planting (DAP). Diclofop and AE F130060 plus AE F107892 were applied 28 DAP. Crop injury was visible in treatments that were applied 28 DAP. The early POST treatments at the higher rates controlled Italian ryegrass as effectively as the PRE treatments. Grain yields were increased similarly by most treatments when compared to the untreated check. [Paper Number 93]

PERFORMANCE OF NEW ISOPHORONE-FREE SUGARBEET HERBICIDE FORMULATIONS. W. Dennis Scott[†]; Charles P Hicks; C. Gary Henniger; Kelvan R Luff; Mary D Paulsgrove; James J Cappy Bayer CropScience, P.O. Box 12014, 2 T.W. Alexander Drive, Research Triangle Park, NC, USA, 27709

Abstract. EPA issued a data call-in to manufacturers for the solvent isophorone which may result in the mandatory removal of it from use in pesticides. Isophorone is a key component in Progress, Betamix, and Betanex sugarbeet herbicides. In response to the data call-in Bayer CropScience has developed new formulations of Progress (desmedipham+ phenmedipham+ethofumesate), Betamix (desmedipham +phenmedipham), and Betanex (desmedipham) Herbicides that are isophorone-free. Greenhouse and field studies were conducted to compare the crop tolerance and efficacy of the current formulations of Progress, Betamix, and Betanex Herbicides to the new isophorone-free formulations of Progress, Betamix, and Betanex; Herbicides applied at multiple-low rates and micro-rates. Thirty trials were conducted at 19 locations across Colorado, Idaho, Michigan, Minnesota, Montana, Nebraska, North Dakota, Oregon, Wyoming using standard small plot design and methods. The isophorone-free formulations are 2x more concentrated than the current isophorone containing products. All three new formulations compared favorably in both efficacy and crop safety when tested side by side with their currently marketed counterparts. [Paper Number 126]

THE IMPACT OF A KILLED WHEAT COVER CROP ON CORN YIELD PER UNIT OF WATER APPLIED. Randall S. Currie[1,2,†]; Norman L. Klocke[1,2] [1]Southwest research and ext. center, Garden City, KS, USA, 67846; [2]Kansas State Univ., Manhattan, KS, USA

Abstract. A study was established in a 2 by 3 factorial arrangement of cover crop (with and without) and atrazine rate (0, 0.75 and 1.5 lb/a). A wheat cover crop was inserted between corn crops by planting wheat after corn harvest in October. A 1-inch irrigation was applied, to ensure uniform emergence if sufficient rain was not received. . Wheat was allowed to grow until the late boot stage, and then killed with a 1 lb/A a application of glyphosate. When the corn was approximately 2 to 4 leaf stage neutron probe tubes were installed. Soil water was then measured in 12 inch increments to a depth of 8 feet approximately every 14 days. Methods are further described in the proceedings Weed Science Society of America 41:132. Water use efficiency (WUE) or grain yield per inch of total rain fall and irrigation was calculated from these measurements. The experiment was repeated at three separate locations from 1999 and 2003, and it was further replicated by re-imposing the treatments on the same plots in three successive years. There were a total of nine location-year combinations. Although significant amounts or water were used to grow the wheat cover crop, in only 2 of 9 location-year combinations was WUE decreased. In 6 of 9 location-year combinations this WUE was increased with the use of the cover crop. These increases in WUE were achieved by reducing evapotranspiration (ET) during the growing season in 5 of 9 location year combinations from 1.5 to 3.4 inches. [Paper Number 140]

WEED CONTROL AND CROP RESPONSE TO SULFENTRAZONE IN A WHEAT- FALLOW CROPPING SYSTEM. . Edward S Davis[†] Land Resources and Environmental Sciences Department, Montana State University, Bozeman, Montana, USA, 59717-3120

Abstract. Kochia control in Montana dry land wheat production has become extremely difficult due to the occurrence of herbicide resistant kochia biotypes and 4-5 consecutive years of drought conditions. Sulfentrazone is a PPO inhibitor and has excellent activity on kochia including populations known to be resistant to sulfonylurea and auxin herbicides. Trials were established in the fall of 2001 and spring of 2002 to evaluate the efficacy of sulfentrazone on kochia and Russian thistle in fallow, and crop response of wheat following sulfentrazone applications of 2, 3, 4, and 6 oz product per acre. Kochia and Russian thistle control in fallow was optimal when applied in the fall at a rate of 3-4 ounces per acre. This application provided 95-100% control of kochia and Russian thistle through the middle of July. Sulfentrazone applied in the fall at 2-3 ounces per acre was safe on wheat planted in the spring but higher rates resulted in slight stunting and grain yield reduction. The degree of crop response appeared to be primarily influenced by soil properties and herbicide dose. [Paper Number 141]

WEED CONTROL IN IMAZAMOX TOLERANT SUNFLOWER. John C Frihauf[†,*]; Phillip W Stahlman[*] Kansas State University Agricultural Research Center, Hays, KS, 67601

Abstract. Two no-till field experiments were conducted near Hays, KS in 2003 to evaluate weed control and imazamox-tolerant sunflower response to imazamox treatments. No injury was observed in the first experiment; however, injury in the form of leaf chlorosis occurred in the second experiment. Weed control was visually estimated on a percent scale in the first experiment while the second experiment was maintained as weed free. Imazamox applied at 35 g ai/ha with non-ionic surfactant at the 4 or 6 leaf growth stages controlled tumble pigweed and palmer amaranth 68 to 83% within 10 days after treatment (DAT). Dimethenamid-P applied preemergence followed with imazamox at 35 g/ha imazamox plus non-ionic surfactant postemergence controlled tumble pigweed and palmer pigweed 93% and 70%, respectively, at 7 DAT. However, tumble pigweed and palmer amaranth control with these three treatments increased to 95 to 100% at 17 DAT. All other treatments resulted in 93 to 100% tumble pigweed and palmer amaranth control throughout the duration of the study. Sunflower yield of the first experiment did not differ among treatments. In the second experiment, sunflowers were treated with 70 g/ha imazamox plus non-ionic surfactant (NIS) or methylated seed oil (MSO) applied at multiple growth stages (2 leaf, 4 leaf, 6 leaf, 10 leaf, and heading). Leaf chlorosis of plants treated at the 6 and 10 leaf stages were influenced by growth stage while leaf chlorosis of sunflower treated at 14 leaf stage was influenced by a imazamox treatment by growth stage interaction. Imazamox plus either additive applied at 6 or 10 leaf stages caused 4% leaf chlorosis. Chlorosis was observed 6 days after treatment at the 6 leaf stage and 9 days after treatment at the 10 leaf stage; however, the plants completely recovered nine days later. Imazamox plus MSO applied at the 14 leaf stage caused 7% leaf chlorosis, but the plants completely recovered twelve days after treatment. Imazamox plus NIS applied at all stages did not cause leaf chlorosis. All treatments applied at 2 leaf and heading stages did not cause leaf chlorosis. Imazamox treatments in the second experiment did not affect sunflower yield, regardless of adjuvant or growth stage at application. [Paper Number 158]

WEED CONTROL AND CROP TOLERANCE OF PENOXSULAM IN WESTERN RICE. Dr. Alan E Haack[†,*]; Dr. Rick K Mann[*]; Dr. Roger E Gast[*] Dow AgroSciences, 9330 Zionsville Rd., Indianapolis, IN, USA, 46268

Abstract. Penoxsulam (DE-638) is a novel, broad-spectrum triazolopyrimidine sulfonamide herbicide being developed globally for rice weed control. In California field trials from 1998–2003, penoxsulam provided excellent control of early watergrass (*E.oryzoides*), annual arrowhead (*Sagittaria* spp), smallflower umbrellaplant (*Cyperus difformis*), waterplantain (*Alisma plantago-aquatica*) and ricefield bulrush (*Scirpus mucronatus*) when applied directly into water at 40 gr ai/ha. Rice has demonstrated

excellent tolerance to penoxsulam with a therapeutic index >4. Penoxsulam can be applied in sequential with cyhalofop, triclopyr, propanil, and thiobencarb to increase the weed control spectrum. [Paper Number 102]

RESPONSE OF 4 GLYPHOSATE RESISTANT AND 2 SUSCEPTIBLE LINES OF BENTGRASS TO SEED BURIAL DEPTH, LENGTH OF BURIAL AND LOCATION. Daniel M Hancock[†]; Carol Mallory-Smith[*] Oregon State University, Corvallis, Oregon

Abstract. Seed burial experiments were initiated in 2000 at Hermiston and Corvallis, Oregon. Seeds from five glyphosate-resistant transgenic creeping bentgrass and two nontransgenic bentgrass lines (Highland colonial bentgrass and SR1020 creeping bentgrass) were used. Bentgrass seeds were suspended at depths of 2.54, 17.78 and 30.48 cm in the soil. Seeds were removed every six months: May and November in 2001and 2002 at Corvallis and June and December 2001and 2002 at Hermiston. At Hermiston, the transgenic line, ASR 368, had a germination rate of 82% (6 mo), 53% (12 mo), 62% (18 mo) and 60% (24 mo), which was greater than all other bentgrass. At Corvallis, ASR 368 and SR1020 maintained high levels of germination throughout the first three seed removal dates. No differences were observed among lines at 24 months after burial. At Hermiston, ASR 368 seed deterioration increased from 2% at the 6-month removal to 24% at the 24-month removal. Seed deterioration in Highland and SR1020 increased from 8% and 14% at the 6-month removal to 51% and 57%, respectively, at the 24-month removal. At Corvallis, deterioration varied between lines for the 6-, 12-, and 18-month removals but at the 24-month removal no differences were detected between any of the lines with more than 75% of the buried seeds deteriorated. [Paper Number 123]

SPRING BARLEY, SUGAR BEET, AND POTATO FOLLOW CROP RESPONSE TO IMAZAMOX APPLIED FALL AND SPRING IN CLEARFIELD™ WHEAT. Jason R. Stroman[1,†,*]; Pamela J.S. Hutchinson[1,*]; Don W. Morishita[2,*]; Corey V. Ransom[3,*]; Brent R. Beutler[1,*] [1]Graduate Research Assistant, Assistant Professor, Support Scientist I, University of Idaho, Aberdeen Research and Extension Center, Aberdeen, ID, 83210; [2]Professor, University of Idaho, Twin Falls and Kimberly Research and Extension Centers, Twin Falls, ID, 83303; [3]Assistant Professor, Oregon State University, Malheur Experiment Station, Ontario, OR, 97914

Abstract.. Semi-arid and short-season growing conditions cause some herbicides to persist longer in the soil in the Pacific Northwest than in other areas. Imazamox is a new imidazolinone herbicide used in Clearfield™ wheat systems. Trials were conducted in Idaho and Oregon to determine the effects of fall- or spring-applied imazamox in Clearfield wheat, on spring barley, potato, or sugar beet planted one and two growing seasons after application. Fall and/or spring applications of imazamox at 0.032 to 0.16 lb ai/A were made to Clearfield winter or spring wheat. Although more time elapsed after fall than spring applications, follow-crops planted 18 months after fall treatments had greater injury and yield reductions than crops planted 11 months after spring-applied imazamox. Follow crops planted the second season after imazamox applications were not affected. Crop response to fall-applied imazamox may have been greater than to spring applications because less Clearfield wheat foliage was present at the fall-application timing causing more herbicide to contact the soil. More herbicide contacting the soil may have translated to a greater concentration available for subsequent damage to follow crops. Also, since no irrigation or major rainfall event occurred in the fall after imazamox applications, adsorption to soil may have been greater than soil adsorption of spring-applied treatments which were followed by irrigation shortly after application. Therefore, fall-applied imazamox may not have been as available for degradation during the Clearfield wheat growing season as spring-applied imazamox, and consequently, may have been present in higher concentrations when follow crops were planted. [Paper Number 95]

CARFENTRAZONE-ETHYL APPLIED ALONE AND IN TANK MIXES FOR TVM CONTROL OF KOCHIA AND OTHER WEEDS. Dr. Philip Westra[1]; Dr. Gary C. Cramer[2,†]; Richard D. Iverson[2] [1]Department of Bioagricultural Sciences and Pest Management, Colorado State University, Ft. Collins, CO, USA, 80523; [2]FMC Corporation, 1735 Market Street, Philadelphia, PA, USA, 19103

Abstract. Carfentrazone-ethyl is under on-going commercial development as Quicksilver™ for general Industrial Vegetation Management use where high level weed control is necessary. Weed resistance to triazine, ALS, and PGR herbicides in various weeds has complicated IVM weed control in different areas of the United States. Carfentrazone-ethyl represent a useful and important new herbicide mode of action for control of weeds including herbicide resistant biotypes. Research in 2003 showed that best control of kochia with carfentrazone-ethyl applied alone or in tank mixtures occurred when applied at rates of 10 or more gallons per acre (GPA). At 5 GPA, coverage can be difficult especially in dense stands of weeds in some IVM situations. Carfentrazone-ethyl applied at a minimum of 2 oz per acre was effective for kochia management. Best control was obtained on 2-4" kochia; control declined slightly when treatment was made to 12"-16" tall kochia. Carfentrazone-ethyl was equally effective on kochia that was resistant to traizine, ALS, and PGR herbicides. Tank mixtures of carfentrazone-ethyl with dicamba, glyphosate, or fluroxypyr were effective for kochia control. Excellent long-term weed control was observed where carfentrazone-ethyl was added to a mixture of glyphosate plus dicamba. In several detailed field and greenhouse studies, carfentrazone-ethyl provided the most rapid kochia burndown. [Paper Number 155]

COMMON MILKWEED CONTROL IN WHEAT. Brian M Jenks[†,•]; Denise M Markle[•]; Gary Willoughby[•] North Dakoata State University, Minot, ND, 58701

Abstract. Tribenuron and various tank mix partners were applied to wheat in June 2002 to determine the long-term impact on common milkweed densities. Visual control was estimated two months after application. These herbicide treatments were followed or not by a pre-harvest glyphosate application. Milkweed densities were counted just prior to herbicide application and one year later. Visual control of milkweed ranged from 50-81%, but was not consistent across the four replications due, in part, to varying time of weed emergence. The most encouraging observations came from the density counts in June 2003. All treatments reduced milkweed densities compared to the initial densities in 2002; however, treatments that received the pre-harvest glyphosate application had significantly lower milkweed densities in 2003. In a separate study, tribenuron, carfentrazone, and various tank mix partners were evaluated for common milkweed control and to determine the influence of milkweed size on sensitivity to herbicides. Colored plastic rings were placed around individual milkweed plants prior to herbicide application. Different colored rings were used to correspond to a given size. In general, milkweed control was similar across initial milkweed sizes at application time with possibly a slight trend for less control of larger milkweed (8-12"). Approximately, 20-40% of plants present during the growing season emerged after herbicide application. [Paper Number 90]

HOW SPRAY PARTICLE SIZES ARE AFFECTED BY NOZZLE TIP, PRESSURE, PESTICIDE AND ADDITIVES. Robert N Klein[†,•]; Jeffrey A Golus; Susan L Horne University of Nebraska, North Platte, NE, 69101

Abstract. Spray particle size affects both drift and efficacy of pesticides. Drift needs to be managed to acceptable levels because it may result in under or over application of chemicals and ineffective pest control. Drift may also cause losses and/or costly litigation if sensitive crops in adjacent fields are damaged, and cause unintentional contamination of foodstuffs from unacceptable pesticide residues. Drift may contribute to pollution of air and water resources, and may affect the health and safety of susceptible human and livestock populations. By obtaining maximum efficacy from the pesticide one may be able to reduce rates and/or improve performance.

A laser particle analyzer was used to determine the spray particle size and distributions of four kinds nozzle tips from Spraying Systems: Extended Range (XR)11002/4/6/8, Turbo TeeJet (TT) 11002/4/6/8,

Air Induction (AI) 11002/4/6/8, Turbo FloodJet (TF) 2/3/4 under various pressures. Some nozzle tips are affected more in particle size distribution by changes in pressure than others. Also, field research was conducted to measure spray drift and efficacy of nozzle tips. The air induction and turbo flood nozzles reduced drift with one of two formulations of glyphosate. In efficacy, one treatment was significantly better on weeds while another treatment was significantly lower. [Paper Number 107]

CULTURAL CONTROL METHODS FOR SMALL BROOMRAPE (*OROBANCHE MINOR*) MANAGEMENT IN RED CLOVER. Ryan D Lins[†,*]; Jed B Colquhoun[*]; Carol A Mallory-Smith[*] Oregon State University, Corvallis, OR

Abstract. Small broomrape is an obligate holoparasite that attaches to and draws water and nutrients from the roots of a variety of broadleaf plant species, including red clover (*Trifolium pratense*). Recently, infestations of this weed have been discovered in several red clover seed production sites in Oregon. Small brooomrape germination and attachment requires chemical signals from host plants. Certain plant species, called false hosts, stimulate germination without attachment. Wheat (*Triticum aestivum*) elicits such a response in small broomrape and therefore has the potential to be utilized as a cultural control method to reduce the small broomrape soil seed bank, while producing a saleable commodity. Growth chamber and greenhouse experiments were conducted to evaluate the affect of 8 wheat varieties on small broomrape germination. Germination ranged from 20% to 70%. The wheat variety 'Connie' and the triticale variety 'Bogo' germinated fewer small broomrape seeds than did other wheat varieties. In related experiments, 8 wheat varieties were grown in soil incorporated with small broomrape seeds. Plants were cut when wheat reached boot stage, and red clover was planted in each pot. In two studies only 2 small broomrape attachments occurred in pots previously planted to wheat. Pots not planted to wheat averaged 4.2 small broomrape attachments per red clover plant. These experiments demonstrate that wheat can be used as a cultural control method for small broomrape management. [Paper Number 101]

WILD OAT EMERGENCE. Ms Krishona L Martinson[1,†]; Dr. Beverly R Durgan[1]; Dr. Frank Forcella[2]; David Archer[2]; Dr. George O Kegode[3] [1]411 Borlaug Hall, 1991 Upper Bufford Circle, University of Minnesota, St. Paul, MN, USA, 55108; [2]NCSCRL, 801 Iowa Avenue, Morris, MN, USA, 56267; [3]Department of Plant Science, 474B Loftsgard Hall, NDSU, Fargo, MN, USA, 58105

Abstract. Wild oat is an economically important annual weed throughout small grain regions of the United States and Canada. Timely and more accurate control measures may be developed if a better understanding of emergence behavior is learned and a reliable model can be created. The objectives of this experiment were to evaluate the emergence of wild oat, and determine if wild oat emergence can be predicted using hydrothermal time. Research plots were established at two locations in 2002 and 2003; Crookston, MN and Fargo, North Dakota. Plot size was 0.61 M x 0.61 M and the experimental design was a randomized complete block with six replications. On a weekly basis, emerging wild oat plants were counted and then pulled. This process was repeated until wild oats stopped emerging. Wild oat emerged for four weeks at both locations in 2003 and at Fargo in 2002, and for six weeks at Crookston in 2002. Soil temperature, air temperature and rainfall were recorded on a daily basis. These and other weather data were used in the SHAW (Soil, Heat and Water) model to estimate soil water potential. The estimated water potential values, along with recorded soil temperatures, were converted to soil hydrothermal time using varying base water potentials and soil temperatures. A best-fit model was constructed of cumulative emergence and cumulative hydrothermal time. [Paper Number 91]

ROUNDUP READY® ALFALFA[1] PRODUCT CONCEPT AND CROP SAFETY. Carlos C. Reyes, Monsanto Compan, St. Louis, MO 63167

Abstract. Annual and perennial broadleaf weeds and grasses infest alfalfa fields across the United States, competing for nutrients, water, and sunlight. The presence of weeds in alfalfa impacts forage yield and quality. Today, alfalfa growers use a variety of herbicides and cultural practices (such as companion

crops) to control the weeds that impact stand establishment and forage quality. With a single herbicide, the Roundup Ready system has the potential to eliminate the need for companion crops as well as reduce the time required for weed management. Results to date indicate that during stand establishment the Roundup Ready system will enable growers to use select glyphosate agricultural herbicides over the top of Roundup Ready alfalfa from the cotyledon / unifoliate growth stage up to five days before cutting with no crop injury. Results in established Roundup Ready alfalfa indicate that growers will be able to apply select glyphosate agricultural herbicides over the top of the crop from initial regrowth after cutting up to five days before the next cutting with no crop injury. The Roundup Ready system will enable a wider, more flexible application window in both the seeding and subsequent years of the stand, and eliminate crop rotation limitations associated with use of persistent herbicides. ROUNDUP READY ALFALFA IS NOT APPROVED FOR SALE OR DISTRIBUTION IN THE U.S. GLYPHOSATE IS NOT REGISTERED FOR THIS USE. IT IS A VIOLATION OF FEDERAL LAW TO PROMOTE ANY UNREGISTERED HERBICIDE USE. Always read and follow herbicide label directions. Roundup Ready® is a registered trademark of Monsanto Technology LLC. [Paper number 137]

WEED CONTROL IN NEW SEEDINGS OF GLYPHOSATE RESISTANT ALFALFA. Robert G Wilson† University of Nebraska, Scottsbluff, NE, 69361

Abstract. Field studies were initiated near Scottsbluff, NE to compare the efficacy of different rates and timings of glyphosate for selective weed control in a spring seeding of glyphosate resistant alfalfa. Alfalfa 'RR01BC-1473' was planted in mid April and was in the unifoliate growth stage on May 9. Glyphosate was applied at 0.8, 1.3, and 1.7 kg/ha at either the unifoliate, second trifoliate, or fourth trifoliate growth stage. Half of the unifoliate and second trifoliate growth stage plots were also treated with a second application of glyphosate at either 0.8, 1.3, or 1.7 kg/ha, 2 wk following the first treatment. Imazethapyr, imazethapyr plus bromoxynil, imazamox, and imazamox plus bromoxynil were all applied at the four trifoliate growth stage. Alfalfa and weeds were harvested on July 7, August 4, and September 16. Postemergence applications of glyphosate caused a temporary yellowing of terminal alfalfa leaves, but leaf chlorosis disappeared in 7 to 10 d. Kochia was effectively controlled by one application of glyphosate at 1.7 kg/ha at all application timings. Common lambsquarters was more difficult to control and 90% or greater control was achieved only when glyphosate at 1.7 kg/ha was applied twice, once at the second trifoliate growth stage and again in 2 wk. Imazamox provided greater weed control than imazethapyr, but both herbicides provided poor control of ALS resistant kochia. The addition of bromoxynil to imazethapyr and imazamox improved weed control but increased early season crop injury. Alfalfa density in nontreated plots declined to 19 plants/m^2 by mid June, while alfalfa density was 60 plants/m^2 where weed competition was reduced by two applications of glyphosate starting when alfalfa was in the second trifoliate growth stage. Alfalfa yield in the nontreated after three cuttings was 2777 kg/ha, while alfalfa yield was 9520 kg/ha in plots treated with glyphosate at 1.7 kg/ha at the unifoliate growth stage and again 2 wk later. [Paper Number 138]

GLYPHOSATE TOLERANT ALFALFA MANAGEMENT: WEED CONTROL AND CROP TERMINATION. William B McCloskey†; Kwame O Adu-Tutu University of Arizona, Tucson, AZ

Abstract. Experiments were conducted to evaluate herbicides for weed control and stand termination in glyphosate-tolerant alfalfa at the University of Arizona Maricopa Agricultural Center (MAC) and at the University of California Desert Research & Extension Center in El Centro, CA. An experiment at MAC with conventional alfalfa (CUF101) in the fall-winter of 2001-2002 compared imazamox alone at 0.0312, 0.039 and 0.047 lb ai/A, imazethapyr at 0.094 lb ai/A, mixtures of 2,4-DB at 0.5 lb ae/A with imazamox (0.234, 0.312, 0.039, and 0.047 lb ai/A) or imazethapyr (0.094 lb ai/A), a mixture of imazamox (0.0234 lb ae/A) and imazethapyr (0.0472 lb ae/A), and a three component mixture of imazamox (0.0234 lb ae/A), imazethapyr (0.472 lb ae/A) and 2,4-DB (0.5 lb ae/A). The herbicides applications included methylated seed oil (MSO, 1 pt/A) and ammonium sulfate (AMS, 2.5 lb/A) and the applications were made at the 5 trifoliate leaf stage. The weeds evaluated in the experiment were prostrate knotweed (6 leaf), Sahara

mustard (*Brassica tournefortii*) (6 leaf), shepardspurse (8 leaf), annual bluegrass (7 leaf), annual sowthistle (5 leaf) and littleseed canarygrass (10 leaf). Broadleaf weed control was generally excellent 51 DAT ranging from 85 to 99% of the untreated control. In general, weed control obtained with either imazamox or imazethapyr was improved by mixing with 2,4-DB at 0.5 lb ae/A but crop injury (i.e., stunting early and reduced yield at first harvest) was increased. Canarygrass control was about 50% of the control in the imazethapyr treatments and (2,4-DB had no effect) and up to 70% of the control in the imazamox treatments. Annual blugrass control by imazamox and imazethapyr was very poor but it did not appear to be competitive with the alfalfa, was rapidly overgrown and was not evident at the first harvest. Imazamox at 0.0312, 0.039, and 0.047 lb ae/A stunted the alfalfa about 22 to 28% without 2,4-DB and about 52 to 55% with 2,4-DB one month after planting. Similarly, imazethapyr caused 30 and 43% stunting with and without 2,4-DB, respectively. The three component herbicide mixture caused 52% stunting. The stunting was not evident at the first harvest on 14 May 2002 when all treatments yielded the same except for the untreated control which yielded about 165% of the other treatments due to the presence of weeds in the hay. A second experiment was conducted at MAC in glyphosate-tolerant alfalfa. Glyphosate at two rates, 0.75 and 1.5 lb ae/A, and at two application timings, 3.5 trifoliate leaves (20 February 2002) and 9 trifoliate leaves (7 March 2002), was compared with imazethapyr (0.094 lb ai/A) or with imazamox (0.047 lb ai/A) alone or mixed with 2,4-DB (0.5 lb ae/A). Weeds evaluated were the same as those listed in the previous experiment. Treatments applied at the 3.5 trifoliate leaf stage resulted in better weed control than treatments applied at the 9 trifoliate leaf stage, particularly for imazamox and imazethapyr. In general, glyphosate applied at 0.75 and especially at 1.5 lb ae/A resulted in better weed control than imazamox or imazethapyr especially on canarygrass and annual bluegrass. Broadleaf weed control resulting from the imazamox and 2,4-DB tank mixture was comparable to the 1.5 lb ae/A rate of glyphosate but this treatment caused 69% stunting one month after the 3.5 trifoliate leaf stage application and reduced yield severely at the first (9 May 2002) and second (17 June 2002) harvests. Yields of the other treatments were similar except for the untreated control which contained weed biomass. Experiments were also conducted in the fall of 2002 to evaluate the efficacy of 2,4-D and dicamba alone or in combination for killing alfalfa since a commonly used tool, glyphosate, will not be effective for this purpose in glyphosate-tolerant alfalfa. Mecca II alfalfa regrowth was reduced 97% in disked plots compared to 58 to 78% in the no-till plots 15 to 62 days after herbicide treatment (DAHT). Tank mixes of 2,4-D and dicamba at rates totaling 1.12 or 1.68 kg ae/ha reduced Mecca II alfalfa regrowth by 91% 29 DAHT and were superior to dicamba alone (1.12 kg ae/ha), glyphosate (2.24 kg ae/ha) or paraquat (1.12 kg ai/ha). Thirty eight days after disking or 102 DAHT, there were 83% fewer emergent crowns in the herbicide plus disking treatments than in the no-till plots, and all herbicide treatments reduce the number of emergent crowns 90 to 97% relative to the unsprayed controls. Significant tillage by herbicide interactions indicated that several herbicide treatments were as effective in no-till plots as in disked plots for reducing Mecca II alfalfa regrowth and crown emergence. In another experiment conducted in glyphosate-tolerant alfalfa in which the entire field was disked 16 DAHT, there were 494, 1236, 1483, 3707 and 4942 emergent glyphosate-tolerant alfalfa crowns per hectare in 2,4-D and dicamba treated plots compared to 16655, 2871, 42616, 49421 and 55868 crowns per hectare in unsprayed plots 43, 53, 81,88 and 109 DAHT, respectively. Additional experiments were conducted in the fall of 2003 in glyphosate-tolerant alfalfa to evaluate lower rates of 2,4-D, dicamba and tank mixtures of the two herbicides at total rates of 0.56, 0.84 and 1.12 kg/ha disked 14 DAHT. There were 11015, 8934 and 5137 emergent crowns per hectare 63 DAHT (49 days after disking) in plots treated with total rates of 0.56, 0.84 and 1.12 kg/ha, respectively, compared to 25115 crowns per hectare following glufosinate (1.12 kg/ha) treatment or 68171 crowns in the untreated control. The results of these experiments indicate that disking alone provided up to 70 to 80% control of volunteer alfalfa and that combinations of disking and growth-regulator herbicides at rates above 0.84 kg/ha can provide excellent control of volunteer alfalfa. [Paper Number 139]

VARIABLE TRIFLUSULFURON, DESMEDIPHAM, PHENMEDIPHAM, AND ETHOFUMESATE RATES FOR WEED CONTROL IN SUGAR BEET. Don W Morishita[1,†]; Corey V Ransom[2,*]; Robyn C Walton[1]; Michael P Quinn[1,*]; Charles A Rice[2,*] [1]University of Idaho, Twin Falls, Idaho, USA, 83303-1827; [2]Oregon State University, Ontario, Oregon, USA, 97914

Abstract. A field experiment was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho and the Oregon State University Malhuer Experiment Station near Ontario, Oregon to evaluate using variable triflusulfuron and ethofumesate & desmedipham & phenmedipham (efs&dmp&pmp) rates for weed control in sugar beet. Growers and crop advisors frequently ask the following questions: 1) is it possible to control kochia with micro herbicide rates, 2) how high can micro herbicide rates be applied without significantly injuring the crop or reduce the yield, 3) is it better to raise the triflusulfuron rate or the efs&dmp&pmp rate for kochia control, and 4) what about using ethofumesate preemergence (PRE) or postemergence (POST) for kochia control? The experimental design at both locations was a randomized complete block with four replications. Individual plots were four rows by 30 ft. Soil type at Kimberly was a Portneuf silt loam with a pH of 8.1, 1.6% organic matter, and CEC of 16-meq/100 g soil. At Ontario, soil type was an Owyhee silt loam with a pH of 8.1, 2% organic matter, and CEC of 19 meq/ 100 g soil. Sugar beet (HM PM21) was planted at Ontario on April 4 at a 35,640 seed/A seeding rate, while 'HM 2984RZ' was planted at Kimberly on April 16 at a 57,024 seed/A. Kochia, redroot pigweed, common lambsquarters, and barnyardgrass were present at both locations. The Kimberly site also had annual sowthistle and green foxtail present while Ontario also had hairy nightshade. Herbicides were broadcast-applied with a CO2-pressurized sprayer calibrated to deliver 10 or 20 gpa using 8001 flat fan nozzles. Application timing at both locations included preemergence (PRE), cotyledon, 2 leaf, 4 leaf, 6 leaf and 8 leaf. Crop injury at Ontario was evaluated 23 and 51 days after last treatment was applied (DALT) followed by a crop injury and weed control evaluation 65 DALT. Crop injury and weed control at Kimberly were evaluated 42 DALT. The two center rows of each plot were harvested mechanically September 30 and October 7 at Kimberly and Ontario, respectively. Crop injury at Ontario ranged from 23 to 33% 23 DALT. The highest injury was with ethofumesate PRE followed by three sequential applications of triflusulfuron + efs&dmp&pmp + clopyralid, where efs&dmp&pmp rates increased from 0.33 to 0.675 lb ai/A. By 51 DALT, injury ranged from 10 to 29%, with the same treatment having the highest injury rating. At 65 DALT, no injury was observed. At Kimberly, crop injury 42 DALT ranged from 0 to 8%, but there were no differences among herbicide treatments. Weed control among all herbicide treatments at Ontario did not differ. At Kimberly, kochia control ranged from 64 to 95%. Common lambsquarters control ranged from 64 to 99%. Redroot pigweed control ranged from 81 to 100 % control with no significant difference among the treatments. Annual sowthistle control ranged from 93 to 100% and although a statistical difference was observed, the difference in control among treatments was not biologically significant. Green foxtail control ranged from 64 to 100%. Barnyardgrass control ranged from 95 to 100%. The majority of treatments that included ethofumesate applied PRE had better control. Sugar beet root yield at Ontario ranged from 21 to 47 ton/A. No differences were observed among herbicide treatments. Root yield at Kimberly ranged from 13 to 46 ton/A. The untreated check yield was significantly lower than all herbicide treatments. Among the highest yielding treatments was ethofumesate at 1.125 lb ai/A applied PRE followed by micro rate POST applications of efs&dmp&pmp + triflusulfuron + clopyralid + MSO or standard rate applications of the same herbicide combinations. [Paper Number 127]

CORRELATION OF HERBICIDE DISSIPATION WITH FIELD CHARACTERISTICS. Scott O'Meara[1,†]; Dale Shaner[2,•]; Phil Westra[1,•] [1]Colorado State University, Fort Collins, CO; [2]USDA Agricultural Research Service, Fort Collins, CO

Abstract. Precision weed control can greatly reduce herbicide application costs. Producing accurate weed maps in a cost effective manner is a major barrier to site-specific weed control. The high cost of intensive field sampling make it desirable to identify variables that affect weed population dynamics and are easily measured on a field-wide scale. Pre-emergent herbicide dissipation rates affect weed populations over the course of a growing season, but the relationship between dissipation rate and physical field properties are not well understood. This study was conducted to explore relationships between pre-emergent herbicide dissipation rates and soil electrical conductivity (EC), management zones, and nitrogen application rate. The study site was a furrow irrigated corn field in Fort Collins, Colorado. Field EC measurements were taken with a Veris unit, and color-infrared imagery was used to delineate light, medium, and dark management zones. A split-plot design was used with 0, 50, and 200 lb./acre nitrogen treatments in each management zone. Bicep II Magnum® (3.1 lb. atrazine/gal and 2.4 lb. metolochlor/gal) was applied pre-emergence to the entire field at 2.1 quarts/acre. Filter papers were used to measure herbicide levels at application, and soil samples were taken from each plot at 8 time intervals over a 100 day period after herbicide application. Herbicide residues were extracted from samples and quantified with GC/MS. Kd coefficients were calculated from 8 different EC zones using un-treated soil. Results showed an initial drop in herbicide concentration over 9 and 19 days after treatment followed by erratic increases and declines. There was a general increase in herbicide residues 54 days after treatment. Management zones, nitrogen application rates, and soil EC did not show a significant relationship with herbicide dissipation rate. Kd values were not significantly different. Filter paper residues showed coefficients of variation (C.V.) of 24% and 23% for atrazine and metolachlor, respectively. C.V. values for soil samples ranged from 17% to 133% for atrazine, and 18% to 113% for metolachlor. Although the relationship between herbicide dissipation rates and specific soil properties is well described, this study showed that there is a high degree of variability in herbicide dissipation across a given field. The filter paper C.V. values indicate that a large portion of this variation is in the application stage, and replicate analysis of samples indicates that analytical error was less than 10%. Because Kd values were essentially constant, sorption differences were not a source of variation in herbicide dissipation in this study. Given the variation in this study, it is unlikely that variable-rate herbicide application would be a feasible management choice unless soil herbicide levels can be more accurately controlled. [Paper Number 96]

LEGUME RESPONSE TO IMAZAPIC. Margaret M Rayda[†]; Stephen D Miller[•] University of Wyoming, Laramie, WY

Abstract. Studies were conducted in the Plant Science greenhouse facilities at the University of Wyoming to evaluate the tolerance of twenty-two legumes to four rates of imazapic (35, 70, 105 and 140 g ae ha^{-1}). Experimental conditions included a day time temperature of 20 ± 5 C and a night time temperature of 18 ± 4 C with a 14 hour photoperiod of 176 µmols $m^{-2}s^{-1}$. Plants were adequately watered and were never under moisture stress. Herbicide treatments were applied with a moving nozzle pot sprayer delivering 187 l ha^{-1} at 276 kPa to legume species in the two to three trifoliate leaf stage. Injury was evaluated at 7, 14, 21 and 28 days after treatment and plants harvested after the last evaluation. Two experimental runs were conducted at different times in the greenhouse. Runs were analyzed separately and combined when possible. Slimflower scurf pea was tolerant, exhibiting less than 10 percent injury at rates as high as 140 g ae ha^{-1}. Field pea *(Cv. Wyo Dunn)*, Twogrooved milkvetch and Wild licorice were moderately tolerant exhibiting injury less than 30 percent at rates as high as 140 g ae ha^{-1}. Drummond milkvetch and Silver lupine were moderately susceptible, exhibiting injury of 50 to 60 percent across the four rates. Yellow sweetclover and Grain lupine *(Cv. 2085 Lupine)* were extremely susceptible, with injury ranging from 70 to 100 percent depending upon rate applied. All other species fell into one of these four classes of tolerance based on percent dry weight reduction and injury. Injury generally increased as evaluation time after treatment increased. [Paper Number 100]

DRY EDIBLE BEAN DESICCANTS. Jerry Ries[†,•]; Richard Zollinger[•] North Dakota State University, Fargo; North Dakota State University, Fargo

Abstract. In 2002 and 2003, field research was conducted at three locations to evaluate plant leaf and vine desiccation on navy and pinto beans. In 2002, twelve registered and experimental herbicides were applied at recommended rates: diquat, paraquat, glyphosate-k, glufosinate, endothall, carfentrazone, lactofen, flumioxazin, ET-751, caprylic acid, and S-3100. From the research, seven of the most effective compounds were used in 2003 trials. In 2003, diquat, paraquat, glyphosate-ipa, glufosinate, endothall, lactofen, and flumioxazin were applied at recommended rates. All postemergence herbicides were applied with adjuvants at recommended rates. Navy bean sites were located at Hatton and Prosper, ND. At Prosper, only endothall and flumioxazin gave greater than 80% leaf desiccation 7 DAA. Diquat, paraquat, glyphosate-ipa, and glufosinate caused less than 80% leaf desiccation. Leaf desiccation in the untreated check was 64%. At Hatton, leaf desiccation was similar to Prosper for all treatments, although diquat, glufosinate and lactofen were slightly above 80%. Leaf desiccation in the untreated check was 49%. Diquat, endothall, and flumioxazin gave greater than 73% vine desiccation in Prosper 7 DAA. Vine desiccation in the untreated check was 15%. In Hatton, glufosinate, endothall, lactofen, and flumioxazin gave better than 76% vine desiccation, untreated check was 19%. Seed moisture was taken 7 DAA. At Prosper, seed moisture ranged from 11 to 16% in treated plots and 22% in the untreated check. Seed moisture at Hatton ranged from 12 to 34% moisture in treated plots and 13% in the untreated check due primarily to accelerated dry down from bacterial blight. However, endothall treatments in Hatton resulted in navy bean blemishes and discoloration, and not observed at other locations and varieties. Pinto beans were planted at Prosper and Hatton, ND. At Propser and Hatton, endothall and flumioxazin, caused more than 85% leaf desiccation 7 DAA. Leaf desiccation in the untreated check was 68% and 73% respectively. Endothall and flumioxazin, caused more than 45% vine desiccation at Prosper and greater than 53% in Hatton 7 DAA. Vine desiccation in the untreated check was 25% in Prosper and 43% in Hatton 7 DAA. At Prosper, seed moisture ranged 14 to 21% in the treated plots and untreated at 23% 7 DAA. Seed moisture in Hatton ranged 13 to 15% and the untreated at 18% 7 DAA. A complimentary study was conducted in Erie, ND, to evaluate endothall and flumioxazin with adjuvants in navy bean. Endothall plus ammonium sulfate with or without a methylated seed oil (MSO) + basic blend (BB) adjuvant did not affect leaf and vine desiccation. Flumioxazin applied at 0.048 lb ai/A with MSO + BB adjuvant did not increase dry bean desiccation compared to 0.032 lb ai/A. Endothall and flumioxazin consistently gave greater and more rapid desiccation at all locations than other herbicides.
[Paper Number 121]

ESTABLISHING THE FIELD BINDWEED MITE (*ACERIA MALHERBAE*) IN SOUTHWESTERN OKLAHOMA. Amber D. Roberson[†]; Dr. Tom F. Peeper Oklahoma State University, Stillwater, Oklahoma; Oklahoma State University, Stillwater, Oklahoma

Abstract. Field bindweed (*Convolvulus arvensis*) is a serious problem throughout Oklahoma, particularly in winter wheat. Currently, there are no herbicides in Oklahoma that provide complete control of field bindweed. One possible method of suppressing field bindweed is through biological control. The field bindweed mite (*Aceria malherbae*), native to Greece, was imported into the United States in the late 1980's for this purpose; however, they seem to spread very slowly. The mites feed along the midrib of the leaves forming galls as they feed. In a cooperative effort with county Agricultural Extension Educators, a project was conducted to establish field bindweed mite nurseries in ten southwestern counties in Oklahoma. The objective was to develop local nurseries as a source for further distribution of the mites. Mite infested field bindweed was collected from a fallow field in Goodwell, Oklahoma, transplanted into pots and transported to the release sites. Releases were performed by placing a pot into the ground next to a healthy bindweed plant and tying the two plants together with plastic coated wire. The sites were monitored over the summer of 2003. Eight of ten locations have early indications of success. The sites

will be evaluated in the spring of 2004 to determine whether the mites over-wintered. [Paper Number 122]

IMPACT OF WEED CONTROL IN CORN AND BARLEY ON WEED POPULATIONS IN SUGARBEETS. Gustavo M Sbatella[†]; Stephen D Miller[*] Dept. of Plant Sciences, 1000 E. University Ave., Laramie, WY, 82071; Dept. of Plant Sciences, 1000 E. University Ave., Laramie, WY, 82071

Abstract. Weed seed that persist in the soil compose the seed bank and are the main source of weed infestations in agricultural fields. Weed seed bank dynamics are complex and cultural practices as well as crop rotation, tillage or herbicides, impact the composition. In 2002 and 2003 a study was conducted at the Research and Extension Center, Torrington, WY to establish the impact of different weed control treatments in corn or barley on weed populations in sugarbeet. The seed bank was sampled during three different periods, S1 after planting of corn and barley, S2 after harvest of both crops and S3 prior to sugarbeet harvest. Seeds were separated from soil using an elutriator and viable seeds counted under a dissecting microscope. Total seed counts and predominate species counts were compared between sampling periods for each treatment independently. Common lambsquarters, hairy nightshade and redroot pigweed accounted for 90% of the seed in the soil seed bank.
No significant changes were observed in the total number of seeds between S1 and S2 for any of the crops or treatments. Conventional herbicide treatments in sugarbeet reduced the total number of weed seeds following all barley treatments. Different levels of response were observed when glyphosate was used in sugarbeet after corn. In the overall period the total number of seeds was reduced significantly in barley mainly due to the impact on redroot pigweed and hairy nightshade. The relative abundance of common lambsquarters increased when barley was the previous crop.
[Paper Number 125]

SILVERLEAF POVERTY WEED BIOLOGY AND CONTROL IN DRYLAND CROPS. Brien Henry[1,†]; Alan Helm[2]; Phil Westra[2,*] [1]USDA/ARS Central Plains Resource Management Resource Unit, Akron, CO; [2]Colorado State University Cooperative Extension, Holyoak, CO; [3]BSPM Dept. Colorado State University, Fort Collins, CO

Abstract. Silverleaf povertyweed, *Ambrosia grayii*, is a deep-rooted perennial that is increasingly becoming a problem in dryland agricultural systems in Eastern Colorado. This weed is also called lagoon weed because of its propensity to grow in low lying areas that often have saturated soils. As tillage decreases and the reliance on burndown application of herbicides increases, weeds with an extensive root system that can withstand typical herbicide application rates have an advantage and can develop into troublesome species. Studies to control this weed were conducted at three locations, two near Holyoke, CO and one near Planter, CO. Clopyralid applied at two rates 0.25 and 0.5lb ai/A and picloram also at 0.25 and 0.375 lb ai/A were not effective treatments providing at best 31% control at 8 weeks after application, WAA. 2, 4-D and banvel treatments containing at least 1.5 lb ai/A and 1 lb ai/A, respectively, controlled silverleaf povertyweed 95% or greater at 8 WAA. This weed was sensitive to formulation of glyphosate with Engame and Roundup Ultramax both at 1 lb ea/A providing 33 and 84% control, respectively. Population counts in the spring of 2004 will determine the effectiveness of tankmix partners in the 2, 4-D and banvel treatments [Paper Number 156]

(-) CATECHIN: A POTENT BROADLEAF BIOHERBICIDE FOR USE IN MONOCOT CROPS. Phil Westra[1,†,*]; Scott Nissen[1,*]; Dale Shaner[2]; Jorge Vivanco[3] [1]Bioagricultural Science and Pest Management Dept. Colorado State University, Fort Collins, CO; [2]USDA/ARS Water Management Research Center, Fort Collins, CO; [3]Dept. of Horticulture and Landscape Architecture, Fort Collins, CO

Abstract. The (-) isomer of catechin, shown to be secreted into the soil by the roots of spotted knapweed (Centaruia maculosa) is a potent totally organic herbicide. Records indicate that spotted knapweed was introduced from Eastern Europe into North America in the early 1900s, likely as a contaminant in crop

seed. It is commonly reported that spotted knapweed kills or seriously limits the growth of other plants growing in the vicinity of spotted knapweed infestations. (-) catechin has been shown to be a potent bioherbicide when used against broadleaf plants as a foliar spray. The addition of adjuvants appears to enhance the activity of (-) catechin. At rates as low as 0.05 kg/ha, broadleaf plants such as hairy nightshade, pigweed, velvet leaf, lambsquarter, kochia, sunflower, sugarbeet, field bindweed, Canada thistle, common milkweed, dandelion, alfalfa, Siberian elm, and black medic exhibit a strong growth response that mimics the combined responses seen with PGR and ALS herbicides. Symptoms include rapid and severe epinasty, split epidermis near the soil surface, callous formation, "bubbled" leaves, bright yellowing of growing points, and a strong disruption of the normal heliotropic response in plants. This strong post-emergent herbicidal activity has been demonstrated in both greenhouse and field trials. Trials have included rates as high as 0.40 kg/ha with apparent good monocot safety in plants such as corn, wheat, oats, Kentucky bluegrass, and fescue. (-) catechin also exhibits strong soil herbicidal activity when applied pre emerge to weeds, but this interaction appears to be more complex. (-) catechin is patented by Colorado State University and is being developed in conjunction with CSU researchers in weed science, horticulture, and chemistry. [Paper Number 120]

FITTING CLEARFIELD WINTER WHEAT INTO DIVERSE GREAT PLAINS CROPPING SYSTEMS. Alan Helm[1,†,•]; Dr. Philip Westra[2,•]; Reginald Sterling[2,•] [1]Colorado State University Cooperative Extension, Holyoke, CO; [2]Department of Bioagricultural Science and Pest Management, Colorado State University, Fort Collins, CO, 80523

Abstract. In the fall of 2002, Colorado State University released the adapted commercial ClearfiedTM variety "Above" to wheat producers in Colorado and surrounding states. At the same time, Agripro released the variety AP CL 502, which it licensed from the CSU breeding program, in Kansas and other areas of the wheat belt. In 2002, 70,000 acres of Clearfield wheat were planted. In the fall of 2003, 130,000 acres of Above wheat were planted in Colorado. The rapid and successful launch of Clearfield wheat in Colorado resulted from a unique collaboration among scientists from Colorado State University, BASF, and the Colorado Wheat Research Foundation which is managed by Colorado wheat producers. Above wheat was developed in a lengthy breeding process initiated with the mutagenesis of a French wheat, Fidel, in the 1980's. This research was initiated by American Cyanamid with the result that this technology now belongs to BASF. Initial backcrossing of the resistance gene into American wheat was conducted at Texas A&M. Clearfield wheat is not a GMO wheat. The Clearfield wheat system is built on the strong winter annual grass control provided by imazamox (Beyond herbicide). Imazamox also provides good control of selected broadleaf weeds. Clearfield wheat resistance to imazamox allows for the application of herbicide rates which selectively control jointed goatgrass, downy brome, cheatgrass, and feral rye when applied postemergence to the weeds. Although the launch year occurred in a severe drought in Colorado, weed control with imazamox was very good and grower satisfaction was high. Above proved to be an excellent agronomic variety, ranking in the top 3 of all wheat varieties entered in uniform variety trials across Colorado. This is the first technology to emerge that provides wheat producers with the possibility of selective control of a broad range of grass weeds in wheat. Awareness of the possible development of ALS herbicide resistant weeds has prompted all scientists in this program to develop a grower stewardship program that should prolong the utility of this important new weed management technology in wheat. Long-term research is evaluating the importance of such stewardship recommendations [Paper Number 145]

NITROGEN, ADJUVANT, AND APPLICATION TIMING EFFECTS ON IMAZAMOX EFFICACY IN WHEAT. Anthony D. White[†,•]; Patrick W. Geier[•]; Phillip W. Stahlman[•]; John C. Frihauf[•] Kansas State University, Agricultural Research Center-Hays, 1232 240th Ave., Hays, KS, USA, 67601

Abstract. In 2002-2003, field experiments were conducted near Hays and Colby, KS to evaluate the effects of 28% urea-ammonium nitrate (UAN), adjuvants, and application timing on imazamox efficacy

in Clearfield winter wheat. In one experiment, no application timing by herbicide treatment interaction occurred at Hays or Colby, nor was the main effect of herbicide treatment (UAN rate) significant at Hays. Fall-postemergence (fall-POST) treatments were 28 to 37% more efficacious on blue mustard, downy brome, and jointed goatgrass than spring-postemergence (spring-POST) treatments at Hays. Flixweed control was 82% regardless of application timing. At Colby, jointed goatgrass was controlled better with fall-POST treatments compared to spring-POST treatments, though differences between timings decreased as the season progressed. Imazamox controlled jointed goatgrass better early in the season when UAN rates were 5% v/v or more compared to 1% v/v, however no differences were observed later in the season. Yields did not differ between treated and nontreated wheat at Colby. Wheat treated fall-POST or spring-POST at Hays yielded 51 and 28% more grain than nontreated wheat, respectively. In a second experiment, imazamox at 35 or 53 g/ha controlled flixweed and jointed goatgrass 94% or more regardless of adjuvant, rate, or UAN concentration at Hays. Blue mustard and downy brome control was variable (59 to 91%) and no clear trends were evident. Jointed goatgrass control was best with imazamox at 53 g/ha, when methylated seed oil was the adjuvant, or when Quad 7 rates exceeded 0.25% v/v. Yields did not differ between treated and nontreated wheat at Colby. However, herbicide-treated wheat at Hays yielded 21 to 34 bu/A more than nontreated wheat. [Paper Number 144]

INFLUENCE OF HERBICIDES AND APPLICATION TIMING ON WEED CONTROL AND CROP SELECTIVITY IN ALFALFA AND ALFALFA-ORCHARDGRASS MIXTURES. Rob Wilson[1,†]; Steve Orloff[2,*] [1]University of California Cooperative Extension, Susanville, CA; [2]University of California Cooperative Extension, Yreka, CA

Abstract. High quality alfalfa and alfalfa-grass mixtures are popular hay commodities in California due to a growing dairy industry and expanding horse hay market. Field experiments were established at multiple locations in Northern California to determine the efficacy of several herbicides applied at different times for winter annual weed control in established alfalfa or alfalfa-orchardgrass mixtures. Weed control in mixed alfalfa-grass stands is problematic, as herbicides must be safe to both species. One experiment compared herbicides applied in late February to mixed stands of alfalfa and orchardgrass. Herbicides were applied when shepherdspurse, tumble mustard, and tansy mustard were 2 to 5 inches tall, alfalfa had 0.5 to 1.0 inch of re-growth, and orchardgrass had 2 to 4 inches of re-growth. Metribuzin at 0.45 lb ai/A plus a non-ionic surfactant (NIS)(0.25% v/v), imazethapyr at 0.063 lb ai/A plus a methylated seed oil (MSO)(1% v/v), and hexazinone at 0.25 to 0.375 lb ai/A plus NIS displayed acceptable selectivity to alfalfa and orchardgrass causing less than 10% crop injury 2 months after treatment. Imazethapyr plus MSO was the only treatment to provide acceptable crop safety and over 85% control of all weed species. Another experiment examined the efficacy of herbicides applied in November, February, or mid-March in established alfalfa. Alfalfa was dormant at the November and February application and had 1 to 3 inches of re-growth at the mid-March application. In general, hexazinone at 0.5 lb ai/A plus NIS, metribuzin at 0.45 lb ai/A plus NIS, and diuron at 1.4 lb ai/A plus NIS gave the best weed control when applied in February compared to November or mid-March. Hexazinone and metribuzin also caused less alfalfa injury when applied in February or November compared to mid-March. Adding paraquat at 0.313 lb ai/A to metribuzin during the February or mid-March application improved control of hare barley compared to using metribuzin alone. Imazamox at 0.039 lb ai/A plus MSO applied in mid-March provided over 85% control of hare barley, black mustard, shepherdspurse, and redstem filaree. Most mid-March herbicide treatments especially metribuzin plus paraquat and diuron plus paraquat caused a significant reduction in first cutting alfalfa yield compared to untreated plots. Treatments that resulted in the best combination of weed control and minimal alfalfa injury were hexazinone or metribuzin plus paraquat applied in February or imazamox applied in mid-March. [Paper Number 154]

WISDEM: A MODEL FOR PREDICTING WEED SHIFTS OVER TIME. John R Withrow Jr.[1,†]; Dr. Stephen Canner[2,•]; Dr. Lori Wiles[3,•]; Philip Westra[1,•] [1]Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO, 80523; [2]EcoSys Data Services, P.O. Box 65, Canton, NY, 13617; [3]Water Management Research Unit, U.S. Department of Agriculture, Agriculture Research Service, Agricultural Engineering Research Center, Colorado State University, Fort Collins, CO, 80523-1325

Abstract. The next generation version of a decision-aid model developed by Wiles, Dunan, and Canner is presented as an ecologically-based approach to weed management and potential weed shifts in Roundup Ready crops. The model, known as WISDEM, allows for the concurrent presence of multiple weed species, diverse crop rotations, multiple herbicide applications and tillage practices, and complex seasonal weed emergence patterns. It is, thus, introduced as an effective weed management decision-making tool specifically for selecting optimal weed management products and optimal application timings. In this forum the above model is summarized, and the model results are compared with recent weed population data in Roundup Ready crops. [Paper Number 97]

HOW TO MODEL MULTI-YEAR, MULTI-SITE, SPATIALLY-EXPLICIT WEED SHIFT DATA. John R. Withrow Jr.[1,†]; Dr. Philip Chapman[2]; Dr. Philip Westra[1,•] [1]Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO, 80523; [2]Department of Statistics, Colorado State University, Fort Collins, CO, 80523

Abstract. A weed shift data set exists that spans five research sites and six years. The data is spatially-explicit and shows densities of multiple weed species under different herbicide treatments and rotations of Roundup Ready corn, sugarbeets, and wheat. The process of analyzing the above data has resulted in both a study in statistical methods and in weed population shifts. This discussion will focus on the statistical methods. These techniques, though presented in a fashion geared to a nonstatistical audience, will include a short introduction to repeated measures analysis as well as some important considerations when using log transformations with weed population data. In particular the latter issue will describe a significant analytical danger that can potentially manifest itself in results that are contradictory or misleading, and a technique for avoiding this danger will be presented in detail. [Paper Number 98]

CANADA THISTLE CONTROL IN TRIBENURON (EXPRESS) RESISTANT SUNFLOWER. Rich Zollinger[†,•]; Jerry Ries[•] North Dakota State University, Fargo, ND, 58105

Abstract. Field research was conducted at two locations in 2003 to evaluate control of Canada thistle from tribenuron applied postemergence at two rates, two timings, and with different adjuvants in tribenuron (Express) resistant sunflower. Tribenuron was applied at 0.016 lb/A to 1 to 4 inch Canada thistle with nonionic surfacant (NIS), basic pH blend (BB), petroleum oil (PO), methylated seed oil (MSO), NIS+organosilicone surfactant (OS), MSO+OS, MSO+water conditioning agent (WCA), and MSO+BB adjuvants. All adjuvants were applied at recommended rates. At 15 days after treatment (DAT), except for cessation of growth, Canada thistle exhibited little effect from all herbicides treatments. At 30 DAT, herbicide injury was apparent but the greatest affects were observed at 42 DAT. Tribenuron, regardless of adjuvant, exhibited significant season-long Canada thistle control (72 to 94%). Order of herbicide enhancement from adjuvants was:
MSO+BB>BB=MSO>PO=NIS+OS>NIS=NIS+WCA>NIS+OS. In a separate trial, tribenuron was applied as two sequential application each at 0.012 lb/A to 1 to 4 inch and 2 to 10 inch Canada thistle, respectively, with NIS, BB, PO, MSO, MSO+WCA, and MSO+BB adjuvants. Canada thistle control was from 79 to 95% and the order of herbicide enhancement from adjuvants was the same listed for tribenuron applied once. [Paper Number 159]

WEED CONTROL IN TRIBENURON-METHYL TOLERANT SUNFLOWER. Curtis R. Thompson[1], Alan J. Schlegel[2], Phillip W. Stahlman[3], and John C. Frihauf[3]. Associate Professor, Professor, Professor and Assistant Scientist. [1]Southwest Area Extension, Kansas State University, Garden City, KS, [2]Southwest Research Extension Center, Kansas State University, Tribune, KS, and [3]Agricultural Research Center – Hays, Kansas State University, Hays, KS.

Abstract. Field experiments were conducted near Tribune and Hays, KS to evaluate weed control in tribenuron-methyl tolerant sunflower. Two experiments evaluated weed control and crop tolerance to postemergence-applied tribenuron at four rates (0.125, 0.188, 0.25, and 0.5 oz ai/a) applied singly and sequentially at three sunflower growth stages (4 to 6-leaf, 8 to 10-leaf, and bud). In the Hays experiment, imazamox was applied at 0.5 oz/a at the 4 to 6- and 8 to 10-leaf stage. At 42 days after treatment (DAT) Tribenuron at 0.125 oz applied at the 4-leaf stage of sunflower at Tribune gave 70% Russian thistle control while all other treatments controlled Russian thistle 90% or higher. Kochia control was more variable and generally less than 80% with all rates and times. The exception was the sequential treatment of tribenuron at 0.5 oz/a controlled kochia 87%. The inadequate kochia control in part was due to a mixed population of ALS-resistant kochia. At Tribune, redroot and tumble pigweed were very rate responsive to tribenuron; best control of each species was with tribenuron 0.5 oz/a rate. In the Hays experiment at 47 DAT, no singly applied tribenuron treatment controlled Palmer amaranth more than 58%. Sequential treatments controlled more Palmer amaranth than single applications giving 68 to 78% control. Imazamox at 0.5 oz ai/a was no more effective on Palmer amaranth than tribenuron. Sunflower showed slight chlorosis 3 to 5% when tribenuron was applied at the bud stage in the Tribune experiment and at the 6 to 8-leaf stage in the Hays Experiment. In both experiments plants recovered within 10 DAT and were not stunted. In the Hays experiment imazamox at 0.5 oz/a injured sunflower 30 to 40% 11 DAT and 10 to 25% 46 DAT and yields reduced as much as 57%. A third experiment was conduced north east of Garden City Kansas to evaluate tribenuron and imazamox tolerance when applied to 4 to 6-leaf tribenuron tolerant sunflower. No crop injury was observed from Tribenuron. Imazamox at 0.5 and 0.75 oz/a injured sunflower 30 and 40% 3 DAT. Injury increased to 42 to 62% 10 DAT. Yields were reduced 58 and 77% by imazamox at 0.5 and 0.75 oz/a when compared to the tribenuron treated sunflower. The tribenuron tolerant sunflower variety tested in these experiments were not tolerant to imazamox. [Paper number 160]

Section 4. Teaching and Technology Transfer

TEACHING CALIBRATION OF SPRAYERS (ALSO SEEDERS). Robert N Klein[†,•] University of Nebraska, North Platte, NE, 69101

Abstract. Applying the correct rate of a product is an important part of obtaining good results with both seeders and pesticide sprayers. With seeders, too little seed reduces crop yields and increases weeds while too much seed increases costs and may reduce yields. With a pesticide application, too little product can mean poor control, while too much can mean crop injury, extra costs and possible residue on the crop and/or carryover. Many methods can be used to calibrate sprayers, including the ounce calibration and formula-based methods. With the ounce calibration method, 1/128 of an acre is sprayed and the spray is collected. When measured in ounces, the amount collected would be equal to the number of gallons applied per acre since there are 128 ounces in a gallon. Other methods involve using formulas which need to be remembered or recorded for easy use. These methods also may require converting some of the information you have. The methods discussed here are simple relationships and do not require remembering formulas. However, you do need a general understanding of cross multiplication. The important thing is to be consistent: if you put an item on the top of an equation on one side, the same item also goes on the top of the other side. [Paper Number 108]

PAMS - A FRAMEWORK FOR INVENTORYING CHEMICAL AND NON-CHEMICAL PEST MANAGEMENT. Dr. Dudley T. Smith[†,*]; Dr. Rodeny L. Holloway Dept of Soil and Crop Sciences, Texas A&M University, College Station, Texas, 77843-2474

Abstract. Pest management in the U.S. has involved a diversity of strategies and tactics, largely driven by needs/interests in entomology and insect control. Weed science has received nomial consideration in assessments of IPM practices, with little external consideration of non-chemical practices and a prevaling perspective of an over-dependence on herbicides to mega-manage weed populations. A PAMS model, developed by Dr. Harold Coble, weed scientist at NCSU, intriged us as a rational way to review weed management and herbicide use practices, particularly since PAMS is increasing being used by NASS and other federal agencies to summarize chemical and non-chemical pest control practices in U.S. crops. The PAMS model involves four complementary strategies, which may pertain to specific fields, cropping systems, or broader applications. "Prevention", the first line of defense, includes practices of keeping pests from infesting a crop or field, such as using weed-free seed. "Avoidance" includes practices when infestations may already exist but pest impacts can be avoided by some cultural practice or scheduling, such as cultivar selection for earliness or mowing. "Monitoring" focuses on pest ID and scouting so that subsequent measures are based on economic and prevailing biological factors at the time pest infestations occur during the season. For example, low populations of weeds with crop seedlings early in the season impose major losses but are not important once a crop canopy is established or the critical weed-free period has passed. "Suppression" involves major interventions once other strategies are surpassed and may involve non-chemical (such as cultivation) and chemical methods. Decisions of when and what to spray (herbicide selection factors) are farmer-controlled suppression tactics. Since the adoption/awareness of PAMS in weed management has been low, we wanted to review several prior pest management assessments and surveys of farmer practices to see how well the PAMS framework displayed and inventoryed weed management tactics. From a 1996 assessment of farmer practices in Texas cotton, five non-chemical and six herbicide-related practices were neatly displayed by the PAMS model, ranging from advanced knowledge of weed problems to scouting, actionable thresholds, and criteria for herbicide selection. Results from a 1998 survey of weed management in the three southwestern peanut states, the PAMS framework was similarly useful in reviewing farmer strategies and tactics, ranging from the use of field maps of weeds, use of cultivation, timing of herbicides, and weed ID and targeting of herbicides. Peanuts require unique measures to protect against pests when placed in storage to reduce contamination after harvest and before processing. PAMS provided a sequencial means of documenting a wide array of cultural and chemical methods to handle insect, weed, and vertebrate pest management practices used on 96% of the southwestern peanut crop. These and other examples will be presented in tabular form. [Paper Number 104]

PULSE WIDTH MODULATION TO CONTROL SPRAY DROPLET SIZE FOR INCREASED EFFICACY AND SPRAY DRIFT MINIMIZATION. Robert E Wolf[†,*] Kansas State University, 229 Seaton Hall, Manhattan, KS, USA, 66506

Abstract. For normal agricultural spray operations the flow rate and the consequent volume of application (GPA) are typically regulated through adjustments in pressure, speed, or by changing to a different nozzle orifice size. As pressures are adjusted through a given orifice size the spray droplet size will also change. With today's abundance of spray machines with electronically controlled applications systems, pressure variations can occur rapidly as application speeds change, thus changing the quality of the spray equally as often. Even though the pressure changes are beneficial to maintaining calibrated spray rates, a dramatic change in the spray droplet size emitted from the spray system occurs. For instance, to double the flow from a given orifice, a four-fold pressure increase is required. Thus, in field spraying situations with electronic controllers, doubling the speed of application requires doubling the flow to maintain the calibrated rate, increasing the pressure four-fold, resulting in dramatic changes in spray droplet size. Technology is available to alleviate the problems associated with this scenario. A system utilizing pulse width modulation (PWM) for controlling droplet size while varying application volumes, speeds, and

pressure is currently available commercially (Capstan Ag Systems, Inc., Topeka, KS). By maintaining the application volume while adjusting spray pressure, operators are able to manipulate droplet size to meet changing wind and weather conditions or protect sensitive downwind areas. It is also possible to adjust application volumes without changing nozzles or adjusting pressure. This technology can also help maintain pattern uniformity when slowing in turns, for corners, and on hills preventing over-application at lower speeds and reducing under-application during acceleration. PWM utilizes a valve system which consists of an electronically actuated solenoid valve coupled to the inlet of the spray nozzle to provide a variable-duration, pulse spray emission. PWM could modulate flow without distorting droplet size or spray pattern uniformity over a 10:1 flow adjustment while maintaining a constant pressure. With the inclusion of PWM for flow control, the speed and pressure affects are minimized, eliminating major variations in droplet size. Thus, high-pressure scenarios normally producing smaller spray droplets with higher drift potential are minimized. Providing a more uniform droplet spectrum should increase field efficacy while drift is minimized. The application of crop protection products is an important step in the growing of agronomic crops in our countries economy. A better understanding of PWM should provide the application industry, which includes growers, commercial applicators, agrochemical companies, scientists, and extension personnel with the information necessary to make the best choices regarding this technology for the application of crop protection products. Future EPA label directives will require applicators to adhere to spray droplet standards (ASAE-572) during application as a means to improve efficacy and minimize drift into sensitive areas. Management of spray droplet size is a critical issue in the search of accurate and efficient crop protection application systems.
[Paper Number 106]

Section 5. Wildlands and Wetlands

IMPACTS OF MOWING AND BUD DESTRUCTION ON YELLOW STARTHISTLE ROOT DYNAMICS AND FLOWERING. Dr Stephen F Enloe[1,†,•]; Dr David Spencer[2]; Dr Mike Pitcairn[3,•] [1]University of Wyoming, Laramie, WY, 82071; [2]USDA-ARS, Davis, CA, 95616; [3]CDFA, Sacramento, CA, 95832

Abstract. Yellow starthistle is a serious pest of rangelands, wildlands, and roadsides in California, Oregon, Washington, and Idaho. While herbicides and prescribed fire can be effective control measures that completely kill yellow starthistle plants, two other widely used techniques are mowing and classical biological control, which generally do not kill yellow starthistle plants, but only reduce seed production. While mowing typically reduces shoot growth and subsequent seed production, the six insects released for biological control only reduce seed production by attacking the developing yellow starthistle flower heads. One of the most effective insects released is the hairy weevil (*Eustenopus villosus*) which damages and kills emerging buds in the late spring and early summer. However, very little is known concerning the impacts of either control measure on yellow starthistle root dynamics. Our objective was to compare the impacts of late spring and early summer bud destruction and shoot mowing on yellow starthistle shoot growth, reproduction and root dynamics. We erected 12 heavy duty PVC columns, 3 m high and 0.46 m in diameter. We installed clear plastic 5 cm diameter mini-rhizotron tubes at 30 cm increments at depths from 30 to 270 cm horizontally down the center of each column. The columns were filled with topsoil and fully irrigated to field capacity. Yellow starthistle seeds were planted in the center of each column in early January. Following emergence, the seedlings were thinned to one per column. The twelve columns were divided into three treatments with four replicate columns per treatment. The treatments were an untreated control, plants clipped to a four inch height at the bolting stage three consecutive times (May 1, May 28, and June 30) and plants with all flower buds destroyed weekly for eight weeks throughout May and June. For each of the mini-rhizotron tubes, we examined a total of 24 1.8 x 1.4 cm quadrats along its upper surface every 14 days from January through October. This was 2,592 quadrats per sample date. If roots were present, we recorded a digital image. Root image analysis software was used to calculate root length density and size class of the roots. Soil moisture measurements were also taken at the same depths as the mini-rhizotron tubes throughout the experiment. At the final harvest (October 4), we determined plant dry

weight and counted the number of developed and undeveloped flowers present. We also measured the diameters of the developed flowers. Yellow starthistle roots reached the deepest sampling depth (2.7 m) by March 5, when they were about 12% of maximum abundance and the plant was at 15% maximum height (rosette stage). The first flowers were observed when plants were about 50% of maximum height in mid-May. At this time roots were approximately at their maximum abundance. Mowing produced shorter plants while bud damage only reduced plant height slightly. Root abundance decreased and root longevity was reduced by both treatments. Aboveground biomass was significantly reduced by mowing, but not by bud damage. The relative proportion allocated to flower production was not affected by either treatment compared to the controls. The number of fully developed flowers at harvest was reduced 67% by mowing but was not affected by bud damage. Resources were redistributed from root to flower production. Mowing reduced mean flower diameter by 6% while bud damage caused a 14% reduction. These impacts on total number of developed flowers and flower diameter resulted in 76% and 21% reductions in estimated seed number per plant for mowing and bud destruction, respectively. These results indicate that yellow starthistle can strongly compensate for damage done by late spring and early summer defoliation and bud destruction and that additional techniques may need to be used for successful control. [Paper Number 162]

DISPERSAL OF YELLOW STARTHISTLE CAN BE PREDICTED FROM PLANT COMMUNITY SUSCEPTIBILITY. Fei Tian[1]; Bahman Shafii[2]; Timothy Prather[3,†]; William Price[2]; Chris Williams[1]; Larry Lass[3] [1]Division of Statistics, College of Science, University of Idaho, Moscow, ID, USA, 83844; [2]Statistical Program, Idaho Agricultural Experiment Station, 875 Perimeter Drive, College of Agricultural and Life Sciences, University of idaho, Moscow, ID, USA, 83844; [3]Department of Plant, Soils and Entomological Sciences, College of Agricultural and Life Sciences, University of Idaho, Moscow, ID, USA, 83844-2339

Abstract. Modeling dispersal of invasive plants will aid development of strategies for management. Resources available for management of invasive plants continue to be limited so priority can be assigned to areas with potential for rapid spread and areas with slow to no spread potential can be addressed later. Modeling useful for decision making must incorporate explicit field conditions of the areas of interest. A geographic information systems (GIS) model was developed to predict dispersal of yellow starthistle using estimates of survival to produce seed and ability to move. Estimates were derived from a published yellow starthistle occurrence model that used slope and aspect to predict likelihood of occurrence in canyon grasslands of northern Idaho. Survival to seed production and seed movement were parameterized into a GIS network analysis model. Network models typically are used for vehicle transportation routing and urban planning for location of fire and police stations to minimize response times to emergencies. Instead of stop signs and speed limits we utilized survival and movement to determine how yellow starthistle moved across the landscape. The network consisted of a 20 m grid overlaid on a three dimensional GIS layer containing information on slope, aspect and elevation. The survival and movement functions used these data elements in the network model. Candidate models were developed using yellow starthistle location data collected in 1981 and 1987. Models with promise were selected based on residual analysis that compared the predicted spread in 6 years from the 1981 data to the actual 1987 perimeter. Two candidate models performed well and were selected for validation in a second area that consisted of multiple infestations. The predicted shape and location of the infestation was consistent with the actual shape and location of the infestation. The model predicted slow movement through areas not susceptible to invasion by yellow starthistle and faster movement through areas susceptible to invasion. Network models are promising and should allow use of actual field conditions to model the dispersal of invasive plants. These models can be run for simulated infestations over actual topography to determine where infestations are likely to establish and spread allowing land managers to adjust management to effectively deal with invasive species. [Paper Number 163]

COMPARISON OF ROOT DEVELOPMENT BETWEEN *LEPIDIUM LATIFOLIUM* AND *LEYMUS TRITICOIDES*. Mark J Renz[1,†,•]; Bob B Blank[2] [1]New Mexico State University, Department of Extension Plant Sciences, P.O. Box 30003, MSC 3AE, Las Cruces, NM, 88003; [2]USDA-ARS, Exotic and Invasive Weed Research Unit/ Reno, 720 Valley Road, Reno, NV, 89512

Abstract. Perennial pepperweed is an invasive herbaceous perennial that has been spreading throughout the western United States. Creeping wildrye has been observed to be resistant to invasions of perennial pepperweed. This study measured root development of these species and evaluated if establishment from various methods altered development. Treatments were replicated four times and consisted of perennial pepperweed established from seeds or root fragments and creeping wildrye established from seeds or plugs. For each treatment two propagules were planted in clear rhizotron pots 30 cm wide by 90 cm long and grown in a greenhouse for 130 days. Perennial pepperweed roots developed more rapidly than creeping wildrye with two to three times greater root lengths throughout growing period. While perennial pepperweed dry root weight was only greater than creeping wildrye when planted from seeds, root distribution varied between species. Creeping wildrye concentrated the majority of its roots in the top 25 cm with two times greater biomass in the top 25 cm compared to perennial pepperweed. Perennial pepperweed roots were evenly distributed throughout the soil with similar biomasses between all depths. Results indicate that pepperweed has the ability to rapidly develop a deep root system throughout the soil profile. This appears to give it a competitive advantage in arid areas where access to deep soil moisture is critical. Creeping wildrye may resist invasion by perennial pepperweed by developing dense roots in the upper levels of the soil, preventing the establishment of perennial pepperweed. [Paper Number 161]

Section 6. Basic Science

THE INHERITANCE OF A DICMABA RESITANCE/TOLERANCE TRAIT IN KOCHIA SCOPARIA. David Belles[†,•]; Scott Nissen[•]; Phil Westra[•]; Sarah Ward Bioagricultural Science and Pest Management Dept. Colorado State University, Fort Collins, CO

Abstract. Experiments were conducted to determine the inheritance of dicamba resistance in an inbred kochia population. Dicamba resistance in kochia is not absolute with resistant plants showing some epinasty and stunting but no chlorosis or necrosis. Susceptible plants show severe epinasty, and chlorosis and die within two weeks. Dicamba susceptible (S-7710) and dicamba resistant (R-9425) plants that had been self pollinated for 6 and 7 generations, respectively, to obtain 90 % homozygosity for resistance were crossed (S-7710 x R-9425). Inheritance of resistance was characterized by examining the F_2 segregation pattern. F_2 plants and plants from the parent R and S populations were treated with 280 g ha-1 dicamba when they were 2 to 4 cm tall. Fourteen days after treatment an initial examination of the plants revealed the presence of intermediate phenotypes in the F_2 population. Therefore, plants were scored as R (resistance level the same as the treated resistant parent population), S (total plant necrosis), and I (intermediate, more epinasty and stunting than R plants but no tissue necrosis). R, I, and S plants did not segregate consistently in a 1:2:1 ratio in the F_2 generation. A χ 2 homogeneity of ratio test was significant indicating significant variation between F_2 families. Dicamba resistance in kochia is not due to a single nuclear gene and does not consistently fit simple modified hybrid ratios for a two gene system. At least two genes interact to produce the dicamba resistance phenotype observed in this kochia population. F_2 populations did segregate in a 3:1 ratio of non-chlorotic to chlorotic phenotypes indicating the ability of the resistant plants to delay senescence only may be under the control of a dominant allele while more genes are involved in the other resistance phenotype characteristics.
[Paper Number 124]

HERBICIDE RESIDUE IN SEED POTATOES; RESIDUE, YIELD AND QUALITY CONSIDERATIONS. William T. Cobb[1,†,•]; Robert E. Thornton[2]; Edward P. Driskill Jr.[2] [1]Cobb Consulting Services, Kennewick, WA, USA, 99336; [2]Washington State University, Pullman, WA, USA, 99164

Abstract. During the spring of 2001, several commercial potato growers in Washington and Oregon experienced abnormal growth characteristics from several commercial potato seed lots. Abnormal growth characteristics observed included all eyes breaking dormancy simultaneously, multiple shoots from a single eye and branching of shoots to form a candelabra effect prior to emergence. Herbicide residue in the seed tubers was one of the more popular theories postulated to explain the symptoms observed in the shoots from the seed pieces prior to emergence. Preliminary herbicide residue samples were taken from the symptomatic seed tubers and analyzed for residues of several herbicides. All tests were negative for herbicide residue. However it became quickly evident, that there was little if any scientific evidence to show whether herbicide residues below the limit of analytical detection in potato seed tubers could produce symptomology in the shoots or in the tops of the plants themselves. Beginning in the fall of 2001, a two year study was initiated to link known rates of exposure of particular herbicides to tuber residue levels and resultant shoot and plant top symptomology. Herbicide residue levels in the daughter seed tubers of potato plants exposed late in the growing season to glyphosate, glufosinate or tribenuron + thifensulfuron were monitored at harvest, prior to planting the following spring and periodically during the subsequent growing season. The daughter tubers from the herbicide treated plants were also planted and symptom development, plant morphology, yield and quality were monitored season long. Two potato varieties were used in the trial: Norkotah and Russet Burbank.
[Paper Number 151]

RAPID ASSAY OF PLANT RESPONSE TO PROTOPORPHYRINOGEN OXIDASE (PROTOX) INHIBITING HERBICIDES. Jeanne S Falk[†]; Kassim Al-Khatib; Dallas E Peterson Kansas State University, 2004 Throckmorton Hall, Manhattan, KS, United States, 66506

Abstract. Protoporphyrinogen oxidase (protox)-inhibiting herbicides are an integral part of conventional soybean cropping systems. Resistance to protox-inhibiting herbicides was confirmed in a population of common waterhemp near Sabetha in northeast Kansas in 2001. The common approach to confirm protox resistance is to treat plants with selected rates of protox-inhibiting herbicides in the field or greenhouse. These methods can be both time consuming and costly. In order to quickly confirm resistance, a rapid assay is needed. Two procedures were tested for the rapid assay of soybean, wild mustard, and common waterhemp response to protox-inhibiting herbicides. Procedure 1 consisted of submerging discs cut from leaf tissue in solutions containing different concentrations of acifluorfen, fomesafen, and sulfentrazone and were incubated under a light intensity of 980 μmol m^{-2} s^{-1} for 3 hours. In procedure 2, the entire leaf was sprayed until runoff with solutions of acifluorfen, fomesafen, and sulfentrazone with concentrations equivalent to 0.0625, 0.125, 0.25, and 0.50 times the use rate dissolved in 187 L ha^{-1}. The use rates were 420 g ha^{-1}, 420 g ha^{-1}, and 279 g ha^{-1} for acifluorfen, fomesafen, and sulfentrazone, respectively. After herbicide treatment, leaves were cut into discs and placed in a petri-dish on filter paper. Leaf discs were incubated at a light intensity of 245 μmol m^{-2} s^{-1} for 6 hours. Then leaf discs were submerged in aqueous solution and incubated in darkness for 2 hours. In both procedures herbicide damage was determined by measuring electrolyte leakage from leaf discs compared to total electrolytes in the leaf discs. Response from procedure 2 for all three herbicides was related to whole plant injury. In procedure 1, the response for acifluorfen and fomesafen was also related to the whole plant response to these herbicides. However, the response of sulfentrazone was not well correlated with the whole plant response. The study showed the procedure consisting of treating entire leaves with protox herbicides is more applicable to screening for resistance to protoporphyrinogen oxidase-inhibiting herbicides due to the similar patterns between electrolyte leakage and whole plant injury. [Paper Number 146]

POLLEN-MEDIATED GENE FLOW AMONG WHEAT CULTIVARS IN THE PACIFIC NORTHWEST. Bradley D Hanson[1,†,*]; Carol A Mallory-Smith[2,*]; Donald C Thill[1,*]; Robert S Zemetra[1]; Bahman Shafii[1] [1]University of Idaho, Moscow, ID; [2]Oregon State University, Corvallis, OR

Abstract. Cross pollination between wheat cultivars has not been a major concern for wheat producers in the past. However, with the need to ensure adequate purity of traditional wheat classes and with the introduction of genetically modified (GM) wheat, data are needed on the frequency and distance that pollen-mediated gene flow can occur in wheat. This information will be useful in developing 1) isolation distances necessary to maintain predictable degrees of genetic purity in wheat, and 2) practices to manage pollen mediated gene flow in wheat. Field experiments were conducted in the Pacific Northwest states of Oregon, Idaho, and Washington to determine the potential for pollen-mediated gene flow between winter wheat cultivars. Each experiment was designed as a Nelder wheel with 16 equally spaced rays extending away from a central pollen source. The central pollen source was a 0.17 ha plot of blue-aleurone wheat. Each of the 16 rays was 45 m in length and contained two rows each of an early- and late-flowering soft white wheat cultivar. Samples were collected at 1.8 m intervals along each ray and the grain was examined to identify blue seeds, which indicated successful hybridization with the pollen source. At the Clyde, WA location harvested in 2001, 17 out of 832 samples examined had at least one blue seed. The maximum distance that gene flow (0.08% of the seeds examined) was observed was 22 m from the pollen source. At the Athena, OR location in 2001, 66 out of 832 samples had at least one blue seed. The maximum distance that gene flow (0.08%) was observed was 42 m from the pollen source. At the Athena location, one ray had blue seeds in 24 out of 52 samples for an estimated 0.02% of the seeds along the ray arising from cross-pollination. Only three blue seeds were found in 802 samples at the 2002 Moscow, ID location with a maximum distance of 29 m from the pollen source (0.04%). Although putative blue seeds from the 2003 experiments currently are being verified by greenhouse grow-out, preliminary results indicate only one blue seed in 818 samples at the Lewiston, ID location (9 m from pollen source, 0.03%). Preliminary data from the 2003 Moscow, ID location indicates 12 out of 827 samples had blue seeds (maximum distance = 16 m from pollen source, maximum outcrossing = 0.06%). Pollen mediated gene flow in these experiments generally was in the direction of the prevailing wind during pollination and tended to occur more often at the sites with lower temperature and higher humidity during pollination. The maximum distance that gene flow was detected was 42 m, and the percentage of outcrossing was generally less than 0.1% of the total seeds in a sample. Isolation distances currently used in wheat cultivar development may need to be revised to ensure genetic purity of new cultivars and to meet market specified purity standards for the grain. [Paper Number 148]

RELATIONSHIPS OF NATIVE AND INTRODUCED DIFFUSE AND SPOTTED KNAPWEED INFERRED FROM CPDNA. Ruth A Hufbauer[1,†,*]; Aaron K Jackson[1]; Rene Sforza[2]; Robin A Marrs[1] [1]Dept. of Bioagricultural Sciences and Pest Managmenet, Colorado State University, Fort Collins, CO, USA, 80523-1177; [2]USDA-ARS-EBCL, Campus International de Baillarguet,, CS90013 Montferrier sur Lez, 34988 St-Gely du Fesc, France

Abstract not submitted. [Paper Number 153]

POPULATION GENETIC STRUCTURE OF PAMPASGRASS AND JUBATAGRASS IN CALIFORNIA, AS REVEALED BY MICROSATELLITE MARKERS. Miki Okada[1,†]; Riaz Ahmad[2]; Marie Jasieniuk[3,*] [1]University of California-Davis, Davis, CA; [2]University of California-Davis, Davis, CA; [3]University of California-Davis, Davis, CA

Abstract. Pampasgrass, *Cortaderia selloana*, and jubatagrass, *C. jubata*, are perennial grasses native to South America that are currently aggressive wildland invaders in California. They are closely related and morphologically similar but have contrasting breeding systems. Pampasgrass is gynodioecious, thus outcrossed, whereas, jubatagrass consists of only female individuals that propagate by seed asexually by apomixis. Both species were introduced into the state about the same time: pampasgrass in the mid 1800's

by the horticultural trade and jubatagrass probably in the late 1800's. They have been spatially expanding in natural habitats since the 1950's. Infestations of pampasgrass are found in coastal areas of southern California and inland areas in both northern and southern California. Jubatagrass is predominantly found in coastal areas of northern California. We sampled cultivars and ornamental plantings of pampasgrass and wild populations of both species in California, and used nuclear microsatellites to assess patterns of genetic variation. Most alleles found in wild pampasgrass populations match those found among cultivated plantings. However, each wild pampasgrass population contains more genetic variation than any single cultivar, consistent with our hypothesis of hybridization as a genetic cause for the evolution of invasiveness. There is variation among wild pampasgrass populations in the level of genetic variation. In contrast, jubatagrass populations in California appear to consist of a single clone. [Paper Number 152]

ALLELOCHEMICAL EXPRESSION IS DECREASED IN HYBRIDS OF INVASIVE *CENTAUREA* SPP. Robin A Marrs[1,†]; Dr. Ruth A Hufbauer[2]; Dr. Harsh Pal Bais[3]; Jorge M Vivanco[3]
[1]Graduate Degree Program in Ecology, Colorado State University, Fort Collins, CO, United States, 80523; [2]Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO, United States, 80523; [3]Department of Horticulture and Landscape Architecture, Colorado State University, Fort Collins, CO, United States, 80523

Abstract. Non-indigenous species become ecologically injurious when they displace native species in the areas they invade or alter patterns of productivity in an ecosystem. It is still fundamentally unclear which attributes enable benign pioneers to become aggressive invaders. In some cases hybridization or allele frequency shifts result in altered invasive ability. *Centaurea maculosa* and *C. diffusa* (Asteraceae, spotted and diffuse knapweed) are native to Eurasia and have become highly invasive in North America, causing ecological and economic damage. These species have infested millions of hectares of rangeland and wildland since their introduction and are capable of invading undisturbed plant communities. Several different mechanisms may facilitate this displacement, including allelopathy. These invaders each exude a phytotoxic compound into their rhizosphere; *C. maculosa* exudes (-)-catechin while *C. diffusa* exudes 8-hydroxyquinoline. Each species is immune to the effects of its own exudate but is susceptible to the other species' toxin. Interestingly, the two species are capable of hybridization. Hybrid individuals have an intermediate morphology, but little is known of their ecology and physiology. Which exudate(s) do hybrids produce? To address this question, seeds were collected from a hybrid swarm population in Hood River, OR, where maternal morphologies ranged from "pure" *C. maculosa* to "pure" *C. diffusa*, with all gradations in between. Maternal plants were grouped into five categories depending on how many characters they shared with either "pure" species. Three offspring from five plants in each of the five categories were assayed for production of (-)-catechin and 8-hydroxyquinoline. Results demonstrate that plants produce either one exudate or the other. The more closely a plant resembled *C. maculosa* the more (-)-catechin its offspring produced. Likewise, plants morphologically similar to *C. diffusa* produced more 8-hydroxyquinoline. Hybrids produced only trace amounts of either chemical, possibly indicating that hybrids may be less of an invasive threat than either parent species. [Paper Number 147]

DO YELLOW MUSTARD AND SPRING CANOLA RESPOND THE SAME TO ALS-INHIBITING HERBICIDES? Traci A Rauch[†,*]; Donn C. Thill University of Idaho, Moscow, Idaho

Abstract. Many ALS-inhibiting herbicides used in wheat in the Pacific Northwest can persist in the soil and injure rotational crops. Yellow mustard and spring canola are two common rotational crops in the Pacific Northwest. Space and funding often limit the number of crops that can be planted in a field rotational crop study. Yellow mustard is often used in rotational crop studies because it is more insect-tolerant and competitive with weeds than spring canola, thus requiring fewer management inputs. However, yellow mustard and spring canola may respond differently to ALS-inhibiting herbicides. Greenhouse studies were conducted to evaluate yellow mustard and spring canola response to imazamox, flucarbazone, mesosulfuron, proproxycarbazone, and sulfosulfuron. The experimental design was a

randomized complete block with five replications. Pots filled with potting soil were seeded with 'Idagold' yellow mustard or 'Sunrise' spring canola and herbicides were applied preemergence the following day. Each herbicide was applied at nine rates from 1/128X to 2X (1X being the highest labeled rate). An untreated check also was included. Above ground biomass from each pot was collected two weeks after spraying, and plants were dried and weighed. Crops were compared separately for each herbicide and biomass was expressed on a per plant basis as a percentage of the untreated check. Flucarbazone and imazamox reduced yellow mustard and spring canola biomass similarly. At the three highest rates of mesosulfuron, yellow mustard biomass was reduced 36% compared to 19% for spring canola. Sulfosulfuron (five highest rates) reduced yellow mustard and spring canola biomass 40 and 27%, respectively. Across all rates, proproxycarbazone reduced spring canola and yellow mustard biomass 33 and 25%, respectively. Yellow mustard and spring canola responded differently to simulated soil residue of some ALS-inhibiting herbicides. [Paper Number 150]

TRACKING GENE FLOW FROM IMAZAMOX RESISTANT CLEARFIELD WHEAT TO CONVENTIONAL WHEATS AND GOATGRASS. Dr. Philip Westra[1,†,*]; Scott Nissen[1,*]; Pat R. Byrne Jr.[1]; Dale Shaner[2] [1]Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO, 80523; [2]USDA/ARS Water Management Research Unit, Ft. Collins, CO, 80526

Abstract. Eighteen sites in eastern Colorado were sampled for conventional wheat grain in fields adjacent to fields of Above ClearfieldTM wheat; four of these sites also yielded jointed goatgrass samples. Each conventional wheat field yielded samples collected at multiple distances from the Above pollen source field starting at the interface between the varieties. These eighteen sites yielded a total of 133 individual wheat grain samples which were hand harvested, bagged, and brought to CSU for hand threshing in a stationary grain thresher. Each sample yielded an average of 1.5 kg of clean wheat seed. A total of 195 kg of seed was collected in late June and early July. Greenhouse testing of the grain has begun by planting an average of 150 seeds per 12" by 24" by 2" deep flats in commercial Metro Mix potting soil. When the wheat seedlings are 4-5 inches tall, they are sprayed with Imazamox at 3 oz/acre + MSO + liquid nitrogen. Approximately 2 weeks after treatment, all plants are clipped within 1" of the soil surface with an electric hedge trimmer. This rate and adjuvant combination kills all susceptible plants, while allowing the injured heterozygote plants to resume partial growth, and the Above control plants to grow as if they had been untreated. By 1 month following treatment, any surviving plants are clearly identifiable with this system. To date, the testing of 17,500 seeds from representative samples has yielded 20 heterozygous surviving plants. These plants will be grown to maturity and used for DNA analysis to verify the parent background of these plants. A significantly ramped up greenhouse testing program was initiated in January, 2004. This has produced a planting of an additional 25,000 seeds. Plants from these seeds will be included in the greenhouse spray program within 2 weeks, and on-going testing, including field testing, will help determine the degree of gene flow from Clearfield wheat to conventional wheats. [Paper Number 149]

SALTCEDAR SYMPOSIUM

DISTRIBUTION, BIOLOGY AND ECOLOGY OF SALTCEDAR. Joseph M. DiTomaso, Weed Science Program, Department of Vegetable Crops, University of California, Davis, CA

Abstract. Eight species of Tamarix were first brought to North America in the1800s, from southern Europe or the eastern Mediterranean region. Many of the species escaped cultivation and by the 1920s invaded about 4,000 ha of riparian habitat in the southwestern United States. By 1987, it was estimated to have increased to at least 600,000 ha. Today they are a serious problem in all of the southwestern states with their range extending as far north as Montana and Washington and as far east as Texas. Although not as problematic, some species of Tamarix can be found in the eastern and northcentral US, as well as some southern states, including Georgia, Louisiana, Arkansas, and the Carolinas. A review of the biology and

ecology of saltcedar was published in 1998 (DiTomaso, J.M. 1998.Impact, biology, and ecology of saltcedar (Tamarix spp.) in the southwestern United States. Weed Technol. 12:326-336). The success of saltcedar in the southwest can be attributed to several factors related to its growth habit, reproduction, water usage, ability to tolerate highly saline conditions, and redistribution of salt from deep in the soil profile to the soil surface. The flowers produce small, numerous, and tufted seeds that can be carried long distances by wind or water. The seeds, however, have a short period of viability, and must come in contact with suitable moisture within a few weeks of dispersal. Unlike obligate phreatophytes, such as willows and cottonwoods, saltcedar is a facultative phreatophyte and is often able to survive under conditions where groundwater is inaccessible. The high evapotranspiration rates of saltcedar can lower the water table and alter the floristic composition in heavily infested areas. Mature plants are tolerant to a variety of stress conditions, including heat, cold, drought, flooding, and high salinity. Saltcedar is not an obligate halophyte but survives in areas where groundwater concentrations of dissolved solids can average 8,000 ppm or higher. In addition, the leaves of saltcedar excrete salts that aredeposited on the soil surface under the plant, inhibiting germination and growth of competing species. In addition to its impact on native vegetation, large saltcedar infestations can negatively effect invertebrate communities and also reduce wildlife habitat. [Paper number 128]

COMPETITIVE OPPORTUNITIES FOR NATIVE PLANTS: AN ARGUMENT FOR ECOSYSTEM-LEVEL MANAGEMENT Anna Sher, Assistant Professor (University of Denver, Dept of Biological Sciences) and Director of Research, Herbaria, & Records (Denver Botanic Gardens, RHR department)

Abstract. Ecosystems are often made vulnerable to invasion when disturbance regimes are altered; any change may create conditions inhospitable to natives, thereby opening a niche for invasion. The invasion by *Tamarix ramosissima* along dammed and channeled rivers may be such an example, since reduction in flooding prevents establishment by native tree species, including cottonwood, *Populus deltoides* subsp. *wislizinii* (Salicaceae). Although this problem suggests management by reinstating flooding, flooding carries the risk of promoting more *Tamarix* that will also germinate after flooding; establishing *Populus* seedlings must therefore potentially compete against co-establishing *Tamarix*. Fortunately however, research findings suggest that the success of *Tamarix* is not due to superior competitive ability as a seedling. Studies of field populations have found that *Tamarix* seedlings can have high mortality rates and slow growth rates in areas where native species' seedlings are dense. It was found, in fact, that seedling density was a more important factor than soil nutrients, salinity, or texture for explaining growth or mortality patterns of *Tamarix*. The hypothesis that *Tamarix* is a poor competitor against native *Populus* as a seedling has been further tested with two pot studies. These experiments varied both relative density of the two species to each other, as well as total density. These studies found that, as observed in the field, aboveground growth of *Tamarix* is strongly suppressed by the presence of other seedlings, especially by *Populus*. In contrast, competitive effects of *Tamarix* against *Populus* could only be seen at very low *Populus* densities. Competitive interactions were also tested across different soil types and with either a drawdown of the water table (indicative of a healthy riparian hydrograph) or a stagnant but shallow water table. *Tamarix* was competitively suppressed in every substrate tested, with the weakest response in sand with no drawdown, where growth of *Populus* was poorest. Together, these results suggest that stream flow management that promotes *Populus* establishment could also aid in controlling *Tamarix* invasion across a range of substrates by creating an opportunity for competitive displacement by the native. [Paper number 129]

SALTCEDAR CONTROL AND WATER SALVAGE ON THE PECOS RIVER, TEXAS. Charles R. Hart, Ph.D., Texas Cooperative Extension, Rangeland Ecology and Management, Texas A&M University, Fort Stockton, Texas

Abstract. Saltcedar trees have virtually destroyed much of the native habitat needed by certain animals, birds and plants along Texas Rivers. Saltcedar has the ability to change the physical environment giving

the plant a competitive advantage over native trees and shrubs. This occurs through increased surface soil salinity, lowered soil water potential, depressed water tables, and increased fire and flood frequency. The Pecos River stretches over 300 miles in Texas before emptying into the Rio Grande near Langtry. Most of this river mileage is armored with dense, mature stands of saltcedar that have created a monoculture. From 1999 through 2003, over 10,000 acres of saltcedar have been treated along the Pecos River and its tributaries using Arsenal (Imazapyr) herbicide. Applications with helicopter using state-of –the-art application technology have resulted in 85-90% mortality of saltcedar trees. Monitoring programs have focused on salinity monitoring, estimates of water use by saltcedar and subsequent water salvage following control. Water use by saltcedar is monitored using the stem flow method and water salvage is estimated with shallow groundwater monitoring wells in a paired plot analysis. Estimates of total water loss along the Pecos have ranged from 3-7 feet per year between 2001 and 2003. Methods used for estimating water salvage are reviewed and preliminary numbers are presented. [Paper number 130]

ADPATIVE RIPARIAN RESTORATION FOLLOWING CONTROL OF SALTCEDAR. John P. Taylor[1] and Kenneth D. Lair[2], [1]U. S. Fish and Wildlife Service, P. O. Box 1246, Socorro, NM 87801; [2]U. S. Bureau of Reclamation, P.O. Box 25007, D-8220, Denver, CO 80225-0007.

Abstract. Revegetation following saltcedar (*Tamarix ramosissima*) control is important to stabilize soils and to avoid reinfestation or invasion by other exotic species. Factors influencing restoration include flooding potential, depth to groundwater, and key soil parameters such as surface and subsurface texture, pH, sodium adsorption ratio (SAR), electrical conductivity (ECe), and major nutrients. At the Bosque del Apache National Wildlife Refuge, NM, an understanding of these factors ultimately drives the selection of saltcedar control strategies. Sites with flooding potential rely on natural regeneration for revegetation. Such areas require site disturbance provided through mechanical saltcedar control or a control program that includes mechanical control. Xeric sites without flooding potential require artificial revegetation. Site disturbance should be minimal in these areas to prevent erosion and discourage competitive weed growth and the invasion of exotic herbaceous species such as *Lepidium latifolium* and *Acroptilon repens*. Chemical saltcedar control using imazapyr, glyphosate, or triclopyr herbicides are often combined with burning or shredding to minimize ground disturbance. Sites with low environmental stress can be effectively revegetated with tree poles and tallplant planting. Revegetation can be difficult however, on harsh sites with high environmental stress. Research is currently focused on the study of revegetation strategies and technological approaches on harsh study sites on the Rio Grande (near Socorro, NM - 2002) and the Colorado River (near Cibola, AZ - 2003). This interagency research on biological control and restoration of saltcedar infestations is funded by the Cooperative State Research, Extension and Education Service (CSREES) and the Initiative for Future Agriculture and Food Systems (IFAFS). Technical approaches include: soil surface and rhizosphere manipulation methods to facilitate removal of standing dead biomass, increase precipitation capture, improve soil moisture retention, and create micro-sites exhibiting lower salinity and increased protection from environmental extremes for improved seed germination; salinity remediation using HydraHume™; seeding methodologies, including use of seed coating techniques; and mycorrhizal inoculation methods. [Paper number 131]

BIOCONTROL OF SALTCEDAR. David J. Kazmer, Saltcedar Biological Control Consortium and USDA-ARS-NPARL, Sidney, MT.

Abstract. The saltcedar biological control program has been the subject of much controversy over the past 30 years owing to numerous conflicts of interest. The most controversial issue of late involves the southwestern willow flycatcher (*Empidonax traillii extimus*), a federally endangered species that nests in saltcedar in parts of its range in the southwestern U.S. In late 1998, the U.S. Fish & Wildlife Service (USFWS) approved an experimental release program for the first biological control agent of saltcedar, the leaf beetle *Diorhabda elongata deserticola*, at 10 sites 200 or more miles away from flycatcher nesting sites in saltcedar. Field cage releases of 2 ecotypes of the leaf beetle, one from Fukang, China and the other from Chilik, Kazakhstan, were made in 1999 and, following further USFWS approval, open field

releases were made starting in 2001. The beetles have overwintered successfully since 1999 at sites in CO, NV, UT and WY but either failed or overwintered poorly in CA, TX, and other sites in NV. At sites where the beetles have overwintered well, dramatic increases in beetle population density were observed from 2001-2003. These increases were accompanied by equally dramatic defoliation of entire shrubs over significant acreages. While it is unlikely that single bouts of extensive beetle defoliation will significantly affect mature saltcedar infestations, future research will determine if repeated bouts of defoliation will occur, what the impacts of repeated defoliation will be, and whether or not young *vs.* mature saltcedar infestations are differentially susceptible to beetle attack. Failure of the beetles at the other sites may be due to a less preferred host species (*T. parviflora*), high mortality rates caused by ants and other predators, and, at the more southerly latitudes, short summer daylengths that cause the Fukang and Chilik ecotypes to enter reproductive diapause in summer rather than fall. *Diorhabda* ecotypes with different daylength requirements for entering diapause have been identified and the first of these that is expected to survive at southerly latitudes was released in fall 2003 in NM and TX. Because the Fukang and Chilik ecotypes appear unable to persist at latitudes where the southwestern willow flycatcher nests in saltcedar, it is likely that a broad release program for these ecotypes will begin in 2004 at more northerly latitudes. Please note that the above abstract summarizes work done by a large number of U.S. and Eurasian researchers participating in the Saltcedar Biological Control Consortium. [Paper number 132]

GENETICS OF SALTCEDAR John Gaskin[1], Dave Kazmer[1], and Pat Shafroth[2]
[1]USDA ARS NPARL, Sidney, MT [2]USGS MESC, Ft. Collins, CO

Abstract. The control of an invasion can often be enhanced by a thorough knowledge of the identity, origin, population structure, or phylogenetic relationships of the target organism. Analysis of genetic data at different taxonomic levels is a powerful tool in collecting this important information about damaging plants species. Examples of genetic studies of saltcedar (*Tamarix* spp.) are highlighted here, showing advances in our understanding of these invasions, and how the results are being applied to control efforts. At the family level, large scale phylogenetic projects are allowing more accurate risk assessments of biological control non-target effects. At the species level, molecular systematic investigations are helping identify relationships between invasive congeners, and detecting morphologically cryptic species and hybridization events, potentially changing the focus of associated control programs. At the population level, genetic analysis will allow the explicit characterization of invasive taxa, allowing inclusion of many diverse invasive genotypes in biological control host-specificity tests; illustrating horticultural contribution to invasion through gene flow; discovering primary methods of reproduction and spread of invasives; and often pinpointing native origins of invasive genotypes for future collections of biological control agents. [Paper number 133]

SOIL SALINITY AND DEMOGRAPHIC CHARACTERISTICS OF SALTCEDAR INVASIONS IN NORTHCENTRAL WYOMING [1]Courtney Ladenburger, [2]Dave Kazmer, and [1]Ann Hild
[1]Department of Renewable Resources, University of Wyoming, Laramie WY [2]USDA-ARS-NPARL, Sidney MT

Abstract. Saltcedar (*Tamarix* spp.) is an exotic, invasive shrub of riparian corridors in the western United States. Salt exudates from *Tamarix* leaves promote soil salinization as leaf litter accumulates. Revegetation of *Tamarix*-invaded sites depends on knowledge of soil conditions. *Tamarix* stands in northcentral Wyoming were selected to determine the relationship of saltcedar stand structure and age to soil salinity, pH, and nutrients. In general, salinity of surface soils (0-5 cm) was greater and pH was lower than in deeper soils. Surface soils (0-5 cm) beneath *Tamarix* had greater salinity and lower pH than soil in interspaces. *Tamarix* were aged through annual ring counts. Surface soils directly beneath *Tamarix* shrubs had greater soil salinity, nitrate and phosphate, and lower pH under older *Tamarix* plants. Spatial distribution of higher salinity and lower pH within invasions is of consequence for successful revegetation following *Tamarix* control, especially in older stands. [Paper number 134]

TAMARISK MAPPING IN THE WEST AND THE IMPORTANCE OF COALITION BUILDING. Eric M. Lane, Colorado Department of Agriculture, Lakewood Colorado.

Abstract. Professional weed managers and natural resource professionals throughout the West have endeavored to map tamarisk (*Tamarix aphylla, T. chinensis, T. parviflora, T. ramosissima*) in a variety of habitats and landforms, at a variety of scales, and utilizing a broad array of techniques. These techniques include ground and aerial surveys that hand-chart the extent and distribution of local populations to remote-sensing platforms that collect digital imagery (natural color, color infrared, hyperspectral) with differing spatial and spectral resolutions. While higher resolution digital imagery can be successfully interpreted to identify large, monotypic stands of tamarisk, there is as of yet no cost-effective means to detect incipient infestations of young, sparse stands. Recent mapping efforts have turned to developing maps that depict the distribution and abundance of tamarisk across the western United States. As such efforts determine the extent of tamarisk establishment, it will become more apparent that any resource efficient solution to the region wide problem will require that federal, state, and local governments build a well-integrated coalition with the private sector to facilitate a coordinated effort to rebuild western riparian communities. Such a coalition may be greater than the sum of its parts, especially with respect to the acquisition and direction of resources that will be necessary to achieve a commonly shared vision of tamarisk management and ecosystem recovery in the West. [Paper number 135]

STATUS OF FEDERAL LEGISLATION ON TAMARISK AND RUSSIAN OLIVE CONTROL AND RESTORATION. Timothy J. Carlson, Tamarisk Coalition

Abstract: Congress is currently moving two bills through the House and Senate, H.R. 2707 and S.1516 respectfully, that would provide significant funding for tamarisk and Russian olive demonstration projects for control and riparian revegetation in the West. These demonstrations will be used as research platforms to help answer critical questions on water availability and quality, changes to habitat, and changes to biodiversity. The bills would also provide funding for bio-mass utilization and the development of long-term management and funding options. U.S. Departments of Interior and Agriculture will have lead responsibilities under the proposed legislation. [Paper number 136]

SUPPRESSION OF YELLOW OLD WORLD BLUESTEM (*BOTHRIOCHLOA ISCHAEMUM*) WITH HERBICIDES. Keith R. Harmoney[1], Phillip W. Stahlman[1], and Karen R. Hickman[2]. Range Scientist, Weed Scientist, and Grassland Ecologist. [1]Kansas State University Agricultural Research Center,Hays, KS and [2]Dept. of Biology, Fort Hays State University, Hays, KS.

Abstract. Old world bluestems (OWB) (*Bothriochloa spp.*) have been useful as grasses for soil stabilization and pasture production when seeded as monocultures. However, OWB have escaped into native rangelands in regions of Kansas. This invasion has potential to displace native vegetation to the point of exclusion. The objective of this study was to quantify the efficacy of nine herbicides for suppression of OWB. Herbicides were tested during 2001 and 2002 in a randomized complete block experiment on an established stand of yellow OWB [*Bothriochloa ischaemum* (L.) Keng.] that had invaded native vegetation. At 9 weeks after treatment and at the end of the growing season at first frost, plots treated with imazapyr at 1.40 kg ai/ha had 95% and 85% lower OWB plant frequency than the untreated plots, and plots sprayed with imazapyr and bromacil at 7.84 kg ai/ha had much lower OWB tiller densities than the control plots. Tillers producing seedheads were reduced by all herbicides in 2001, but only imazapyr and bromacil reduced end-of-season seedhead production in 2002. Visible herbicide control ratings were closely related to end-of-season yield (R= -0.97). Imazapic at 0.16 kg ai/ha, glyphosate at 3.36 kg ai/ha, sulfometuron at 0.21 kg ai/ha, bromacil, and imazapyr controlled OWB 54-94%. Old world bluestem suppression may allow other vegetation to establish from remnants or when seeded in OWB stands during the year of herbicide application or the year following application. Split applications, altered timing of application, or varied rates of herbicides that exhibited OWB suppression may further improve efficacy. [Paper number 8]

EDUCATION AND REGULATORY SECTION
SOIL ORGANIC MATTER SYMPOSIUM REPORT
Monte Anderson, Chairperson

The Education and Regulatory Section conducted a Symposium on Soil Organic Matter on Wednesday, March 10. Five speakers provided diverse viewpoints on this topic. Diversity in our society is what keeps our organization healthy, and this is just what we had in our symposia. Our session ran a bit long, but those attending got to learn about organic matter from the soil science and weed science perspectives, along with regulatory aspects. Attendance was good with 50 people signing in, but dropped off once the saltcedar symposium started about half way through.

Thanks go to Bill Cobb for providing the framework and idea, as well as his willingness to allow different viewpoints on a subject that is very important to him and his consulting occupation. I believe his recommendation to standardize testing for soil organic is good, particularly for getting herbicide manufacturers to require a designated depth of sampling to determine organic matter for herbicide rate recommendations. The use of speakers outside of our typical weed science discipline added to our understanding of organic matter, organic matter testing, and how those results can relate to herbicide effectiveness. As an example from the weed science perspective, we clearly desire to know the mode of action for each herbicide used to control a particular weed, thus soil scientists wish to know what depth and technique are used for soil organic matter determination. The experiences from a manufacturer on the herbicide Balance was an excellent test case of how a manufacturer "balanced" the need for effective weed control versus managing crop response of that new herbicide, utilizing organic matter to help deal with the issues experienced in its initial use. Having a Colorado Dept of Ag person fill in for a planned EPA person out of Washington DC was informative in understanding how Colorado handled the Balance registration. We learned that a Section 3 label is more of an "advisory" issue for regulating than state issued 24c labels; 24c's are a more "enforceable" issue when herbicide use rates don't match up with rates on the label. Environmental issues catch EPA's attention to a much larger degree than a manufacturer's rate recommendations based on soil characteristics. All together, this symposium increased our appreciation and understanding of soil organic matter. The budget for the Education and Regulatory Section is normally $1000, but an additional $200 was requested and approved by the WSWS board. We did not have enough complimentary rooms at the hotel for our invited, non-member speakers, thus a total of $1180.22 was spent providing airfare (794.30) and hotel (385.92).

A planned EPA speaker from Washington DC was unable to attend our Soil Organic Matter Symposia to provide the Regulatory View Point on this topic. However, we were able to have someone attending the WSWS meeting speak with us from the local view. Laura Quakenbush, Pesticide Regulatory Coordinator with the Colorado Department of Agricutlure gave a presentation on Colorado's viewpoint on organic matter as well as results from a survey of regulatory views from surrounding states. She revealed that states generally are concerned about environmental issues, not a herbicides's efficacy or crop tolerance or how soil organic matter is determined. A 24c label for a herbicide is more enforceable than a Section 3 label when it comes to adhering with label statements, involving parameters such as soil texture, soil organic matter, and herbicide rates. Organic matter is not likely a top priority for state agencies in regulating herbicides.
Summaries of presentations follow.
Submitted by Monte Anderson, Chairman of Education and Regulatory Section.

THE VIEW FROM THE FIELD – THE PRACTICAL SIDE. William T. Cobb, Cobb Consulting Services, Kennewick, Washington.

Abstract: Many soil active herbicide labels contain some type of statement pertaining to soil organic matter as it relates to either herbicide crop safety or weed control efficacy. None of the labels reviewed specified sample depth or a laboratory method for organic matter determination, yet all contain the warning that use of the product in a manner not specified on the label is violation of state and federal law. A review of the scientific literature on soil active herbicides reveals that most studies looked at soil organic matter at varying depths; common depths at which soil organic matter was examined was: two, three, four and six inches; ten centimeters was a very common depth. In many of these scientific studies, multiple methods were used to determine soil organic matter including Walkley-Black (both colorimetric and ICP), loss on ignition (LOI) and the use of a carbon analyzer. Soil test organic matter determinations basically serve two main functional purposes in agriculture: 1). To estimate nitrogen fertilizer requirements of the crop by using soil organic matter estimated nitrogen release (ENR) calculations and 2). To comply with pesticide label restrictions. In the practical world of production agriculture, the former far overshadows the latter. The two purposes obviously have different sampling and determination requirements, but the information is most often used interchangeably between the two purposes. Soil organic matter values are sometimes gleaned from NCRS County Soil Survey maps, even though those values were never intended to be site specific. State and federal regulatory involvement in recommending or specifying soil organic matter depth and determination methods range from non-existent to spotty efforts to enforce label soil organic matter restrictions. Even the definition of soil organic matter itself varies between users of the term and is often controversial.

SOIL ORGANIC MATTER: THE HERBICIDE REGISTRANT VIEW POINT. Mark A. Wrucke, Technical Service, Bayer CropScience, Farmington, MN.

Soil organic matter is defined as that fraction of the soil composed of anything that once lived and generally ranges from 1-6% of the soil volume by weight. The high surface area of organic matter provides many adsorption sites for herbicides to bind making it an important factor determining herbicide rates with many soil applied herbicides. Many (all amides) but not all soil applied herbicides have rate recommendations based in part on soil organic matter. Herbicide rate tables generally consider the soil textural group and soil organic matter content to determine recommended rate. These tables have been developed based on hundreds of data points to provide optimum weed control and minimal crop response. Considerable concern exists for the sampling methodology and analysis techniques used to determine the impact of soil organic matter on herbicide rate. Standardization of sampling and analysis methods would provide a more level platform from which product comparisons could be made. Cation exchange capacity has been utilized to recommend herbicide rate but acceptance by growers was limited. Isoxaflutole was introduced into corn in 1999 with rate recommendations based solely on soil texture and time of application. Crop response issues prompted a review of the data and major revisions to rate recommendations on the label. Although organic matter and pH are not highly correlated to crop response, both factors have been added to rate recommendation tables for isoxaflutole. Both factors help to define more vulnerable soils which require reduced rates or elimination of the product. Consideration of these factors has helped to reduce crop response issues to an acceptable and manageable level. Soil organic matter is one factor well recognized by growers that provides a convenient means of differentiating herbicide rates.

SOIL ORGANIC MATTER AND HERBICIDE PERFORMANCE – THE ACADEMIC AND RESEARCH APPROACH. Jerry Weber, Crop Science Dept., North Carolina State University, Raleigh, NC (jerry_weber@ncsu.ed)

Soil organic matter (SOM), organic matter (OM), or humus are synonymous terms that refer to the organic portion of the soil mass, excluding straw, mulch and other undecomposed matter on the soil surface. It is found mixed with inorganic soil components such as sand, silt, and clay in the surface "tilled" portion of the

soil profile. Soils are normally tilled to a depth of 15 cm (6 inches) but the tilled region may range from 0 to 30cm (12 inches). Below the highly mixed tilled soil region the soil profile consists of horizontal layers referred to as horizons developed over eons of time and composed mainly of sand, silt and clay. OM is composed primarily of two fractions, materials with recognizable chemical characteristics such as carbohydrates, proteins, waxes, resins, etc., and a fraction of decomposed, highly reactive, dark colored, amorphous, aromatic and aliphatic polymeric substances referred to as the humic fraction. The humic fraction is composed of four major components; small amounts of fulvic acid (FA) that are soluble in water, dilute acid or alkali; large amounts of humic acid (HA), that are soluble in alkali but not in acid; small amounts of humin, that are insoluble in acid, alkali, or organic solvents; and small amounts of hymatomelanic acid, that are soluble in alcohol and alkali but not in acid. The humic fraction is composed primarily of carbon (C , 40 to 60 %), oxygen (O, 30 to 50 %), hydrogen (H, 3 to 7 %), nitrogen (N, 0.8 to 5.5 %), and sulfur (S, 0.1 to 3.6 %) and is the result of decomposed plant, animal, and microbial remains that range in age from 600 to 1300 years old.

OM has both aliphatic and aromatic structure with carboxyl, hydroxyl, and amino functional groups that give the polymer cation and anion exchange properties and high surface area that has both hydrophilic (water loving) and lipophilic (fat loving) sites that are highly sorptive to water and organic chemicals like herbicides, respectively. OM is the soil constituent most highly correlated with binding and reducing the bioactivity (weed control performance) of herbicides, followed to a lesser extent, for most chemicals, by colloidal clay (primarily the expanding type minerals). Soil pH also influences the binding and bioactivity of weakly acidic and weakly basic herbicides, such as the sulfonylurea (chlorimuron for example) and s-triazine (atrazine for example) compounds, respectively.

Binding of herbicides by soil colloids regulates their volatilization, mobility, and biological availability (bioactivity), which in turn regulates weed control performance and longevity (persistence) of the chemicals. Most herbicide application rates depend on a soil test of the field for % OM content, soil texture (primarily for clay content), and soil pH to normal tillage depth for the field (6 - 12 inches). Soils with higher contents of OM and/or clay and lower pH levels require higher rates of herbicide than soils with lower OM and/or clay contents and higher pH levels for effective weed control. Simple mathematical equations have been developed for making optimum herbicide rate recommendations based on the soil tests, with particular reference to the OM content. OM content of soils may be determined by several different methods, including the most popular Walkley-Black chromic acid oxidation (titration or colorimetric) method, hydrogen, peroxide (H_2O_2) oxidation, or ashing (trapping and measuring CO_2 or gravimetrically by weighing the sample before and after ashing). Since OM is composed of 40 to 60 % C, some laboratories determine the carbon content of soil samples by subjecting the soil sample to wet or dry combustion whereby all forms of C, including organic C (in organic matter) and inorganic C (in carbonate minerals) is converted to CO_2 which is trapped and measured. In soils containing Ca and Mg carbonates (high lime soils), the mineral carbonates must first be removed by treatment with HCl in order to determine the organic C content, since carbonate minerals do not bind most pesticides. The humic matter (HM) content of soils is also determined in some laboratories (NC) by extracting the HM fraction using a solvent comprised of NaOH (alkali), EDTA (chelate), and alcohol (polar organic solvent) (NEA).

Weed control performance by herbicides has been inversely correlated with % OM, % OC and % HM content of soils (% weed control decreases with OM, OC, or HM content in the soil). Unfortunately, soil test laboratories have not standardized their methods for determining %OM, % OC, or % HM, nor do they exchange soil samples with other laboratories for comparison purposes. We have sent uniformly mixed samples of 19 soils to 10 laboratories and have found % OM content to vary by from 0 to 200 %. This problem was solved to a great extent by one agricultural chemical company, by having all farm field soil samples sent to one laboratory and all herbicide rate recommendations based on the tests from that lab and correlated with the companies weed control performance as measured in field trials. Tables 1 and 2 illustrate the variety of soil test results for % OM or % HM in 0 to 6 inch depth, uniformly mixed soil samples.

Mean % OM determinations of the 19 soils by the five laboratories using the chromic acid oxidation-titration method (TX, AR, MN, IN, A & L) were in general agreement with values determined by the three laboratories that used the chromic acid oxidation - colorimetric method (NE, NCD, NY) with % OM increasing from soil No. 1 to No. 19 (Table 1). Values were higher from one laboratory than another and followed the sequence: A & L = NY > IN >MN > NCD > AR = NE > TX. Standard errors increased with OM content and followed the sequence: 0.3 to 1% ± 0.25%, 1 to 2 % ± 0.30 %, 2 to 3 % ± 0.45 %, 3 to 4 % ± 0.50 %, 5 to 6 % ± 0.60 % and 6 to 9 % ± 1.8 %. OM content also varied with soil color and followed the sequence: White = 0.7 to 1.5 %, red = 0.3 to 3.3 %, gray = 1.7 to 4.6 %, and black = 5.1 to 9.0 %. OM content also varied with soil texture and followed the sequence: Sand and loamy sand = 0.7 to 1.3 %, sandy loam and silt loam = 1.5 to 5.3 %, and loam = 1.6 to 9.0 %.

The ashing method of determing OM content of the soils was quite variable among the three laboratories (AL, S&P, and NCS) (Table 2) and provided values that were substantially higher than the chromic acid oxidation methods for the red and black soils, probably because oxides in clay minerals and metallic oxides and carbonate minerals which were present were also lost in the combustion process along with OM.

The extraction of HM with t he alkali/chelate/alcohol solvent mixture resulted in much lower values than the OM values obtained by the other methods for the very low OM containing red soils and moderate OM containing white and gray soils, but equal values for the high OM containing black soils (Table 2). The % HM/% OM ratio ranged from 0.17 to 0.26 for the red soils, with the exception of the soil No. 16 from Brazil, to 0.31 to 0.88 for the white and gray soils to, 0.93 to 1.05 for the black soils. Herbicide bioactivity (weed control performance) has been correlated with both OM and HM contents of the soil to about the same degree.

One method that was not included in these comparisons was the determination of organic carbon (OC) content using a carbon train. The method involves determining the total carbon (TC) content of a soil sample by dry or wet combustion, trapping the liberated CO_2 in suitable reagents and measuring it titrimetrically or gravimetrically. For soils containing carbonate minerals (high lime soils), the inorganic C must first be removed by treatment with dilute HCl. The instrumentation is expensive and the procedure somewhat tedious. Herbicides are not inactivated by C in the soil, with the exception of freshly added C from burning mulch or activated C used to inactivate herbicide carryover. They are inactivated by the colloidal OM polymer referred to as humus and to a lesser extent by expanding clay minerals and in the case of acidic herbicides by metallic hydrous oxides. For any of the OM, HM, or OC methods to be useful in making herbicide rate recommendations, laboratories will need to standardize their methods, exchange soil samples for comparison purposes, and utilize quality control measures, something I've advocated for over 30 years.

Table 1. OM content of soils as determined by chromic acid oxidation.[1]

Soil No.	Series Color[2]	Text[3]	Source	TX	AR	MN	IN	A&L	Mean	Std. error	NE	NCD	NY	Mean	Std. error
1	Davidson-r	c	NC	0.4	0.2	0.3	0.4	0.4	0.3e	±0.1	0.2	0.9	0.4	0.5e	±0.3
2	Augusta-w	ls	NC	0.4	0.9	0.8	0.6	1.7	0.9e	±0.3	0.7	0.5	1.0	0.7e	±0.2
3	Norfolk-2-w	s	NC	0.3	1.0	0.8	0.5	1.9	0.9e	± 0.4	0.6	0.5	0.9	0.7e	±0.2
4	Norfolk-1-w	s	SC	1.4	1.0	1.5	1.0	1.5	1.3de	±0.2	0.9	1.4	1.3	1.2de	±0.2
5	Tunica-w	sil	MS	1.2	1.5	1.3	1.5	1.8	1.5d	±0.2	1.1	1.4	2.7	1.7d	±0.6
6	Cecil-2-r	sl	NC	0.7	1.4	1.3	2.5	2.3	1.6d	±0.6	1.1	1.7	1.6	1.5d	±0.2
7	Falaya-g	sicl	TX	1.5	1.5	1.7	1.9	1.8	1.7d	± 0.1	1.5	1.6	2.1	1.7d	±0.2
8	Appling-r	l	NC	0.7	1.7	1.9	1.1	3.2	1.7d	±0.7	1.4	1.4	2.1	1.6d	±0.3
9	Fincastle-g	sil	IN	1.6	1.9	1.8	1.9	2.3	1.9d	±0.2	1.6	1.6	2.2	1.8d	±0.3
10	Earle-g	c	AR	1.8	1.9	1.9	1.9	3.7	2.2d	±0.6	1.6	1.6	2.1	1.8d	±0.2
11	Goldsboro-g	sl	NC	1.1	2.7	1.9	1.9	3.7	2.3d	± 0.8	1.8	1.2	2.4	1.8d	±0.4
12	Rains-g	sil	NC	1.7	2.8	2.3	2.8	3.6	2.6d	±0.5	2.7	1.7	2.7	2.4d	±0.4
13	Cecil-1-r	sl	NC	2.3	2.7	2.6	2.8	3.0	2.7cd	±0.2	2.5	3.8	3.5	3.3cd	±0.5
14	Lynchburg-g	sl	NC	1.6	3.1	3.0	2.5	4.3	2.9cd	±0.7	2.5	2.5	3.5	2.8cd	±0.4
15	Portsmouth-g	sl	NC	3.6	4.0	4.0	4.8	5.9	4.5bc	± 0.7	4.6	4.4	4.8	4.6bc	±0.2
16	Brazil Ox-r	c	Brazil	5.5	4.8	4.3	4.5	3.9	4.6bc	±0.4	4.7	4.4	5.3	4.8bc	±0.3
17	Drummer-b	sil	IL	5.6	4.9	4.8	5.6	5.6	5.3b	±0.6	4.7	4.6	5.9	5.1b	±0.6
18	Cape Fear-2-b	l	NC	4.2	4.0	7.3	11.3	9.9	7.3a	±2.6	6.2	8.7	12.0	9.0a	±2.0
19	Cape Fear-1-b	l	NC	8.0	6.3	7.2	11.1	6.0	7.7a	± 1.5	8.0	6.5	9.9	8.1a	±1.2
			Mean	2.3b	2.5b	2.7ab	3.2ab	3.5a	2.8ab	±0.6	2.5b	2.6b	3.5a	2.9ab	±0.5

[1]Titration method: Texas A & M Univ.; Univ. of Arkansas; Univ. of Minnesota; Purdue Univ.; A & L Lab., Inc., Memphis, TN; respectively; Colorimetric method: Univ. of Nebraska; North Carolina Dept. of Agric.; and Cornell Univ.; respectively. Means followed by the same letter are not significantly different (5%).

[2]Soil series name and surface soil color; b = black, g = gray, r = red, w = white.

[3] Texture: c = clay, l = loam, s = sand, si = silt

Table 2. OM and HM contents of soils as determined by ashing and NaOH/EDTA/Alcohol extraction:

Soil no.	Soil series	AL	S&P	NCS	Mean Ashing	Std. error	NCD	NCS	Mean	std. error
		----------(% OM)----------					----------(% HM)----------			
1	Davidson	0.7	2.2	7.0	3.3d	±2.5	0.0	0.1	0.1e	±0.1
2	Augusta	1.2	0.5	0.5	0.7e	±0.3	0.3	0.5	0.4e	±0.1
3	Norfolk-2	0.5	0.4	0.6	0.5e	±0.1	0.3	0.2	0.3e	±0.1
4	Norfolk-1	1.7	1.8	1.8	1.8de	±0.1	1.0	0.4	0.7de	±0.3
5	Tunica	2.7	3.0	4.9	3.5cd	±0.9	0.7	0.3	0.5e	±0.2
6	Cecil-2	1.5	0.9	6.2	2.9d	±2.9	0.3	0.2	0.3e	±0.1
7	Falaya	3.6	5.4	6.5	5.2c	±1.0	1.1	0.7	0.9de	±0.2
8	Appling	1.9	1.0	0.9	1.3e	±0.4	0.3	0.2	0.3e	±0.1
9	Fincastle	3.4	3.6	4.4	3.8cd	±0.4	1.3	1.1	1.2de	±0.1
10	Earle	6.2	9.1	8.5	7.9b	±1.2	1.7	0.5	1.1de	±0.5
11	Goldsboro	2.1	1.3	1.5	1.6de	±0.3	1.0	0.7	0.8de	±0.2
12	Rains	2.6	2.8	3.8	3.1d	±0.5	1.5	1.8	1.6d	±0.1
13	Cecil-1	5.2	9.9	8.9	8.0b	±1.9	0.6	0.5	0.5e	±0.1
14	Lynchburg	2.4	1.9	2.1	2.1de	±0.2	1.5	1.9	1.7d	±0.2
15	Portsmouth	4.8	3.9	5.2	4.6c	±0.5	4.0	3.9	4.0c	±0.1
16	Brazil Ox	8.3	6.4	23.3	12.7a	±7.1	1.2	2.1	1.6d	±0.4
17	Drummer	9.3	8.5	9.8	9.2b	±0.5	5.7	6.9	6.3b	±0.6
18	Cape Fear-2	7.6	9.7	14.5	10.6a	±2.6	7.4	8.7	8.0a	±0.6
19	Cape Fear-1	17.9	12.8	8.2	13.0a	±3.3	7.0	8.2	7.6a	±0.6
	Mean	4.5b	4.5b	6.2a	5.0ab	±1.4	1.9c	2.0c	2.0c	±0.2

[1]Ashing (total C): Auburn Univ.; Ashing (gravimetric): Soil & Plant Labs., Inc., Santa Clara, CA; North Carolina State Univ., respectively; NaOH/EDTA/Alcohol extraction: North Carolina Dept. Of Agric.; North Carolina State Univ.; respectively. Means followed by the same letter are not significantly different (5%).

SOIL CARBON/ORGANIC MATTER, HOW AND WHERE. Don Horneck.

Soil Carbon (C) is measured by three primary methods, combustion, oxidation with Chrome (Cr) and by loss on ignition (LOI). Both combustion and oxidation are direct methods of measurement where LOI is indirect. The assumption used to convert carbon to organic matter (OM) is that all OM is 58% C. All methods do not measure organic matter with the same precision or accuracy. Research shows that the

linear regression line slope between LOI and Cr to be 0.57 to 1.04 depending on soil type and LOI temperature. Intercepts vary similarly though correlation coefficients are high for individual or combined data sets. Most data sets correlating Cr and combustion show a slope approximating one with and intercept near zero. Herbicide applications are made based on soil organic matter. Soil OM varies by method and soil depth. Surface OM levels are higher than soil depths of 15 and 30 cm. Sample depth is based on a regional convention accounting for crop and climate. Herbicide applications based on soil organic matter levels must account for method that was used to analyze the soil sample and the depth that the sample was taken from. Without these specifications the organic matter definition becomes meaningless.

PROJECT 1: WSWS RANGE AND FOREST – DISCUSSION SESSION
Chairperson: Tim Prather, University of Idaho

Topic: Risk Assessment Methods

Joe DiTomaso (UC-Davis) presented information about "Criteria for Categorizing Invasive Non-native Plants of Greatest Ecological Concern," a program developed by the California Invasive Plant Council (Cal-IPC) to categorize and prioritize invasive plant management projects in the state. California IPC has had a weed list for many years, but when people started using it to develop policy, it became clear that it was necessary to develop a more defensible, documented list and "transparent protocol." Cal-IPC is now evaluating 300 plant species according to impacts on native species and ecosystem processes, invasive potential, and ecological amplitude. The evaluation committee is compiling published information, as well as anecdotal and observational – clearly noted as such. Evaluated plants are put into one of five categories: high, medium, and low impacts, "red alert," and "considered but not listed." The program and ranking information are available at www.cal-ipc.org. DiTomaso noted that it is not appropriate to use the list to indicate economic impacts, management costs, agricultural weeds, and species not yet introduced to California.

Following the presentation, discussion centered on the suitability of this ranking system for other states. States with ecosystems similar to California's could easily adapt portions of the Cal-IPC program. It was noted that Australia and New Zealand have comprehensive invasive plant assessment systems. Other states are interested in incorporating the California-Nevada system into their assessment programs and with respect to efficiency could utilize the prior work from California and Nevada and then make available their new documentation on the same or new species.

It was also noted that the ecological impacts of management tools should be assessed as well. Much of these data (particularly regarding mechanical control) is available in the historical literature. Herbicide risk is well-documented. The NEPA process requires impact documentation for everything done on federal lands.

The discussion topic for 2005 will be Long-Term Weed Management Planning. It will include the planning process in light of desired plant communities and land uses. John Brock will give a presentation. Janet Clark (Center for Invasive Plant Management, Montana State Univ.) and Michael Carpinelli (USDA-ARS, Burns, OR) will serve as chair and vice-chair, respectively.

PROJECT 2: WEEDS OF HORTICULTURAL CROPS
Chair person: Tim Miller

Topic: EPA, manufacturers, and IR-4 points of view regarding potential registrations for horticultural crop

The horticultural crop discussion session began at 1:30 p.m., March 10, in the Cherry Creek Room. The topic was "EPA, manufacturers, and IR-4 points of view regarding potential registrations for horticultural crops". Tim Miller introduced Fred Salzman (IR-4, Rutgers) the chair-elect for the horticultural section, who also represented IR-4 in the discussions. The format for the discussion was short presentations from representatives of various manufacturers on active ingredients of interest to horticultural researchers and current and pending labels for those products. They also answered many general and specific questions regarding those products. Presenters included Tom Beckett of Syngenta Crop Protection, who gave information regarding s-metolachlor (Dual Magnum) and mesotrione (Callisto); Bart Brinkman of BASF, who discussed dimethenamid-p (Outlook), pendimethalin (Prowl H_2O), and imazamox (Raptor), as well as answering questions on bentazon (Basagran, now owned by MicroFlo); Sam Tutt of FMC Corporation, who presented information on sulfentrazone (Spartan) and carfentrazone (Aim); Todd Mayhew of Valent, who presented information on flumioxazin (Spartan or Chateau) and clethodim (Select); Roger Gast of Dow AgroSciences answered questions on pronamide (Kerb) and oxyfluorfen (Goal), with and answered questions on clopyralid (Stinger) and thiazopyr (Visor); and Larry Tapia of DuPont mentioned that DuPont had purchased Griffin and will be maintaining labels for their products. Discussion was excellent among the attendees, with good information provided by the manufacturers and IR-4.

At the conclusion of the session, Pat Clay (University of Arizona) was elected as project chair for 2006.

PROJECT 3: WEEDS IN AGRONOMIC CROPS REPORT
Chairperson: Jeffrey E. Herrmann

Topic: Roundup Ready Alfalfa – It's Fit in Western Agriculture

On Wednesday afternoon, March 10th, the Weeds of Agronomic Crops Project 3 met and conducted its discussion session. The title of the discussion was 'Roundup Ready Alfalfa – It's Fit in Western Agriculture'. Over the course of the session, a maximum of 60 people were in attendance.

In order to introduce relevant points of discussion for the topic, three speakers were contacted to present information and research data on the following; Carlos Reyes, Monsanto Company, product concept, Bob Wilson, University of Nebraska, weed control and crop safety, and Bill McCloskey, University of Arizona, stand take-out and volunteer management. Each presenter was given 15 minutes and a short question and answer period was allowed after each speaker.

At the conclusion of the last speaker, a general discussion session was held. Discussion and questions on product concept were pertaining to alfalfa quality, yield potential, disease and nematode resistance, export markets, grower acceptance, cost of trait to grower, and registration timeline. Concerning weed control and efficacy, Dr. Wilson presented data from 2003 that showed some yellowing following glyphosate applications, however its was generally less than 10% and short-lived. Heavy weed pressure and multiple germination flushes for common lambsquarters and kochia resulted in the need for 2 glyphosate applications for satisfactory control of these species. Dry weight yields of crop and weeds supported weed control data.

Stand take-out results of Roundup Ready Alfalfa and conventional alfalfa were presented by Dr. Bill McCloskey. He showed good to excellent efficacy with 2,4-D and dicamba combinations applied post harvest. Tillage after application was of some benefit.

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PROJECT 4: TEACHING AND TECHNOLOGY TRANSFER
Chairperson: Jed Colquhoun

Topic: Passing the Hat: Cost Recovery in Extension Weed Science Programming

Attendance estimated at 35 to 50 people.

Nationally, very few extension programs were not faced with funding cuts to their programs in the past few budget cycles. Many land-grant institutions and extension services are facing the same question: how do we adapt how we are doing business to survive well into the future with less public funding? The objective of the discussion section was to identify alternative funding mechanisms for extension weed science programs, and to discuss the appropriateness of those mechanisms.

Discussion of worldwide-privatized extension. Internationally, several extension systems have undergone some degree of privatization. Examples of privatized systems that were discussed included Canada, England, China, and Chile. In England, privatized extension includes all points in the food supply chain from the farmer to the supermarket. Initial clients after privatization were corporate farmers that were looking for a competitive company that was not an arm of government. Several small farmers were lost from the educational system, as they could no longer afford or would not pay for services that had previously been free of charge.

Several successes and failures were observed from the international privatized extension examples:

Successes:

- Reduced governmental costs
- Increased focus on topics that are most critical to production and growers
- Local control of extension's direction
- Pay for what you get, and nothing more

Failures:

- Loss of access by small farmers/minor crops
- Fragmented expertise
- Topics ahead of curve not addressed but might be valuable e.g. environmental issues

The Oregon Statewide Hands-on Weed Workshops. These workshops were presented as a test-case for cost recovery in extension weed science programs. The workshops were conducted as a value-added program with live plant samples, hands-on field training, and personalized eduction by crop, location, and needs. Enrollment was limited to maintain a personal experience with educators. In general, the workshops were successful in recovering the majority of production costs (excluding educator salary), and were well-received by the clientele. In the discussion section, the workshops were used as a starting point for discussion of several pertinent questions.

The discussion questions included:
Is cost recovery by a public entity ethical or appropriate?
Participants suggested that if state taxes or extension appropriations had been cut, then cost-recovery was appropriate. The idea of a "service area" has been poorly received in some states where extension services have been free of charge. In other areas, charging for programs has been traditional, and growers/clientele don't seem bothered by it.

Is cost recover feasible practically and economically?
The consensus was that if the programs were reasonable in price, and most importantly included a meal, then they would be economically practical.

What should requirements include for fee-based programming?
Several participants indicated that we are somewhat privatized already. We are selling a brand in the name of the university, and as an unbiased source of information that cannot be matched elsewhere. In some states, commodity groups now largely fund cooperative extension and applied researchers, and therefore can be seen as a semi-privatized group. As public funding for universities decreases, the consensus was that extension agents and researchers will be asked to support a larger portion of their programs and salaries, and will have no choice but to do the work that pays bills, at the cost of work that might be more timely or useful to clientele. In Canada, for example, private agronomists and consultants have assumed a large portion of traditional extension applied research and teaching.

Are we going to cannibalize each other?
Unfortunately, most participants felt this was the future. There is a limited pot of resources, and how will they be divided among participants that rely on those resources for their sustainability?

Suggestion for next year's discussion: update on cost recovery from participants.

2005 Officers of Project 4:
Chairperson: Cheryl Wilen, University of California
Chair-elect: Ralph Whiteside, Utah State University

PROJECT 5: WEEDS OF WETLANDS AND WILDLANDS
Chairperson: Rita Beard

Topic: Economics of Invasive Plant Species, Making the Economic Argument.

There were 43 people in attendance at the discussion group.

This discussion topic was designed to foster an indepth discussion of economic s and invasive plants following the presentation at the general session. Celestine Duncan briefly reviewing the salient points from her talk at the general session. We briefly reviewed the factors commonly considered in determining economic costs invasive plants, market and nonmarket costs. This would include such factors as control costs, ecological costs and health impacts associated with invasive plants and the like.

The group was asked to consider the following questions:

1. What are the underlying principals of economic theory and invasive biology?
2. Can we utilize these principals to understand and predict economic costs for species and/or group of species
3. Is our current approach giving us the results and concepts? And are they targeting the appropriate audience?

The first part of the discussion concerned the validity, origins and accuracy of the papers and numbers they contain for economic costs. The origins of many of these numbers are unclear, the origin of some of these numbers is unclear even to the authors, some appear to be unsubstantiated and few appear to be an accurate representation. Many of the numbers appear to inflate the economic costs. The group spent considerable time discussing the accuracy and origins of the economic numbers and factors which may contribute to the summation of economic costs.

Some pointed out that there are so few economic figures good or otherwise and that these numbers continued to be quoted. Others pointed out that because there are so few figures, they continue to be used as the foundation for other economic analyses furthering the problem with credible numbers on economic costs.

The group spent a considerable time discussing possible explanations that would account for these high numbers. Some reasons for these high costs may be: some species are very costly to treat, some acres are very costly, cost of application, treating in remote sites, the vast areas that have been infested, loss of land values, the problem of computing non market cost such as loss of hunting opportunity, costs to agencies of environmental analysis and planning. Many of the group felt some of the figures had been highly inflated maybe by as much as 4.5 billion dollars. While these large numbers may have good shock value, many in the group thought that they lead to a loss of creditability with the audiences we are trying to address, lawmakers, policy makers and government officials. Many in the group thought that the loss of creditability in the long term would be more detrimental than any benefit gained from the shock value of high economic costs. The group agreed that we need more and better values economic costs and analyses. Some of the direct economic costs have been well substantiated; loss in land values to farmers, direct cost to agencies for planning analysis and control. While the nonmarket costs have not been as well researched and documented.

There were a number of ideas on items that should be considered in economic analysis: Should extrapolate and expand from existing data.

Should update analysis that have already been completed like the Montana and North Dakota studies with updated numbers

Should assess costs on an ecosystem basis

Address environmental costs: costs to forests, rangelands and wetlands

Costs to multiple uses and users

Include indirect market costs: loss of beef production, decline
Costs of delaying treatment: higher treatment costs, increased infestation
Include total costs of control programs such as overhead and planning costs
Should include restoration cost
Include costs of developing treatments, research, and biological control agents
Include the cost of prevention and develop models for predicting the benefits of prevention programs even if these prevention programs are costly
Quantify avoidance costs
Include costs for weeds that increase fire frequencies: cost of fighting those fires, increase costs of rehabilitation and restoration, environmental costs of modified ecosystems, biodiversity
Should include maintenance cost (annual monitoring and treatment cost, not just the initial treatment costs)
Cost of multiple applications
Costs of erosion, stream bank stability and the resulting increase costs to landowners
Costs to water quality and quantity like in the case of salt cedar
Clearly identify and keep track of what we are spending on control of invasive species.
Highlight or discredit erroneous figure on costs and discourage their use, e.g. during pier review for publication.
Would be helpful to have mechanisms to track

Conclusions: Need to develop economic have credible costs for market and non-market costs. We have a better most defensible argument instead of *crying wolf* with inflated costs. We do not need to develop costs for each species. The impacts of one species can be used as surrogates for others. We need to encourage grants for economic modeling and encourage participating in the current round grants for economics and invasive species. While economic costs are an important consideration, the costs of obtaining this information should be commensurate with the benefit refinement of these figures will achieve. There are segments of the public and officials that will be more swayed by the environmental rather than the economic argument. The group had such a lively discussion and it was suggested that the discussion continue next year, with the addition of an economist to help lead the discussion.

PROJECT 6: BASIC SCIENCES
Chairperson: Kirk Howatt

Attendance at the paper presentations ranged from 20 to 60 individuals. Papers related to pollen-mediated gene flow in wheat drew the largest audiences. Maximum attendance during the discussion session was 45, but total attendance was higher because audience members came and went during the session. A mailing list is available. The general theme of the discussion session was plant biology, which was examined through two topics: allelochemicals and seed germination.

Topic 1: Discovery and evaluation of allelochemicals: catechin case-study.
Jorge Vivanco and Scott Nissen, Colorado State University.

Many plants exude substances such as sugars, amino acids, and secondary metabolites into the soil rhizoshpere. Plants may do this for several reasons as the exuded materials, especially secondary metabolites, serve several functions.

Spotted knapweed is capable of invading a biologically diverse ecosystem and remaining as the primary species after a few years. It was reasonable to conclude spotted knapweed was exuding a substance that had herbicidal qualities. A study was conducted *in vitro* to examine the effect of knapweed root-bathing solution on germinating seeds. Knapweed seedlings were allowed to grow in nutrient solution for 30 days. Thirty days may not be necessary to obtain biologically active amounts of allelochemicals, but it was suggested that it is important to concentrate as much chemical as possible when conducting preliminary

examinations. Some metabolites may not be produced until the plant reaches a certain physiologic age. Knapweed seedlings were removed and the solution was diluted from 20 to 80% with water. Substantial injury was observed of plants in 20% bathing solution, and at 40% bathing solution plants were dead.

Fractional distillation with HPLC data isolated the peak responsible for the herbicide effect. The substance was identified as catechin and later confirmed to be (-)catechin. The seedlings also produced (+)catechin, which was found to have antimicrobial activity. It was speculated that (+)catechin may extend the soil persistence of (-)catechin by reducing microbial degradation. Root hairs of susceptible species burst when exposed to (-)catechin. This is followed by cell death along the stele tissue.

The specific biosynthetic pathway of catechin has not been completely identified, but it is a product of the flavonoid pathway. Root herbivory resulted in a 325% increase in catechin production while shoot herbivory did not change catechin exudation. This indicates an induced synthesis mechanism which is not characterized at this time. Very low concentrations of catechin have been found in knapweed roots, but the compound has not been detected in other tissues. The metabolite presumably is exuded almost immediately on production. Established spotted knapweed does not express injury from (-)catechin around the roots, but germinating seedlings are susceptible to damage. This appears to be a mechanism by which established plants minimize competition from new cohorts. The mechanism of exudation or exclusion is not known.

Diffuse knapweed produces 8-hydroxyquinoline and Russian knapweed produces 7,8-benzoflavone, each secondary metabolite has proposed allelopathic effects. The plant-chemical relationship is very specific, however, with diffuse and Russian knapweed being susceptible to catechin, and so on. The species have been known to hybridize, but the production of secondary metabolite is reduced, and the hybrid only produces one allelochemical that is consistent with predominant phenotypic character.

Catechin is released to the soil environment for natural biological activity, but it was found to produce effects following foliar application as well. Kochia, pigweed, common lambsquarters, and hairy nightshade exhibited more injury than barnyardgrass in the greenhouse. Sunflower expressed symptoms similar to ALS-inhibitors in a field experiment. Use rates for soil or foliar applications and adjuvant enhancements are the focus of continued research.

Topic 2: The role of seed bank dynamics and germination.
George Kegode, North Dakota State University and Krishona Martinson, University of Minnesota.

It is difficult to quantify specific processes in the seed bank dynamic network because of the artificial nature of studying processes in the soil. Seed rain and seedling emergence are fairly tangible components, but amount of seed subject to dormancy, death, predation, and degradation are problematic values to determine. The question was asked whether seed extractions from soil were representative or meaningful. While seed extractions may indicate species that are present and not germinating under current conditions, seed bank population estimates often grossly underestimate the total seed bank population. On the other hand, relying on seedling counts is primarily useful in the current conditions and may ignore species that did not emerge in existing cohorts.

One of the current modeling goals is to predict the time to maximum emergence of a species. Post emergence herbicide applications may be timed to control a given percentage of the total germination for the season through such germination models. For example, timing herbicide application when 80% of the total expected emergence has occurred may provide a balance between controlling all weeds and limiting early season competition.

Models based on calendar days or growing degree days often do not predict emergence patterns very precisely. A model that incorporates temperature and available soil moisture into hydrothermal time

produced consistent sigmoid-shaped curves for wild oat germination at two locations over two years. By using local temperature and moisture information the model may be more robust than previous germination predictors. Base temperature and moisture thresholds are presumed to be species specific, but the end program is an Excel-based spreadsheet that growers could use and insert local weather station data.

One limitation is the availability of temperature data at specific germination depths for different species. On-farm weather stations would likely not be sophisticated enough, but many government weather centers provide temperatures at the surface and one depth at least. Another potential problem is predicting multiple flushes in arid environments during successive rain events, especially for very shallow germinating weeds. More work is needed with several species in different environments to validate the use of hydrothermal time.

Project 6 Officers for 2005:

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Chair-elect: Todd Pester
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WSWS Business Meeting
August 1 & 2, 2003
Double Tree Hotel, Colorado Springs, CO

Attendees: Gil Cook, Wanda Graves, Jill Schroeder, Phil Stalman, Dan Ball, Monte Anderson, Charlie Hicks, Scott Nissen, Lisa Boggs, Nelroy Jackson, Kassim Al-Khatib, Mike Edwards, Rod Lym and Pete Forster

Call to Order: President Gil Cook called meeting to order at 1:05 p.m.

Gil gave brief description of the agenda and the way the meeting will be run and suggested that in the interest of time each board member will be responsible for making their assigned reports, but only if something that has changed since the last meeting.

Minutes: Pete Forster
Motion made by Nelroy Jackson to approve the minutes from the executive board meeting on March 9th. Phil Stalman seconded. Motion passed unanimous.

Motion made by Nelroy Jackson to approve the minutes from the executive board meeting on March 13th. Jill Schroeder seconded. Motion passed unanimous.

Financial report: Wanda Graves
Two reports were presented, one from April 2002 to March 31, 2003 and one from April 2003 to present. Balance on March 31, 2003 was $197,292.11. Current balance (through July 28, 2003) is $234,503.22. There may be some additional expenses from the Hawaii meeting, but none that Wanda is aware of at this time. Hotel in Hawaii was good to work with, but the meeting was expensive. We spent almost twice what we took in at the meeting for registration. There are still a few issues to be worked out with the IRS. Wanda has her doubts that we was ever see the $500 again.

Motion made by Phil Stalman to accept the financial report. Seconded by Jill Schroeder. Motion passed unanimously.

There was a discussion about Wanda's salary and the changes with her becoming an employee. Wanda explained the figures. Nelroy clarified that only half of the social security and Medicare should be a part of Wanda's salary. Numbers will be corrected. This has the executive board's approval as was discussed at the March board meeting.

Immediate Past President report: Jill Schroeder

IRS Audit: I assisted Wanda Graves to complete the audit requirements. This consisted of helping with the application for tax-exempt status. The work is complete; at this time we are waiting for notification that the audit is final and for (hopefully) a refund of our $500 application fee for tax exempt status (see Wanda's report). I am available if Wanda needs anything else to complete these requirements.

Operating Guide: I agreed to serve on a committee chaired by Steve Miller to revise the operating guide as a result of the changes in the Constitution and By-Laws approved by the membership in March. We have not taken any action at this time.

Committee Contacts: I contacted the Fellows and Honorary Members, Sustaining Members, and Nominations Committee Chairs to let them know that I am the board contact for their committees.

Retiree Reception for the 2004 meeting: I plan to put an announcement in the newsletter requesting information on retirees for the 2004 meeting. I would appreciate recommendations regarding other avenues to request this information so that we do not miss anyone at the reception next year.

Discussion:
Committee is asking for recommendations and requesting information on retirees. Request was made for board members to pass on information on retirees.

Fellows and Honorary Members Report: (Jill)
Committee is asking for nominations and for information and recommendations on sustaining members.

Program, Poster & Local arrangements: Phil Stahlman

Awards Committee Report

A Call for Nominations of all award categories will be published in the next Newsletter. Please take the time to nominate deserving individuals.

There is one carryover nomination for Outstanding Weed Scientist Award – Public Sector.

Submitted by Phil Stahlman

Program Committee Report

Call for Papers. The Call for Papers and Directions for Electronic Submission will be published in the next newsletter.

General Session. Rod Lym suggested Teresa Gruber, Executive Vice-President of CAST, be considered as a general session speaker. No other suggested topics or guest speakers have been received from the membership. I propose two other topics for Board consideration and discussion. One is a review and examination of Forest Service no-burn policy and resulting implications on invasive weeds and forest health. It might be difficult to find someone from within the Forest Service to speak candidly and publicly about this. The other topic is the current status and prevention of glyphosate resistant weeds. I have a couple possible speakers in mind. Other suggestions are welcomed.

More than one comment has been received that in consideration of increased Canadian membership, that Rob Hedberg's annual Washington Update should be scheduled at a time other than the General Session.

Symposia. A symposium on saltcedar management has been proposed by Alex Ogg and suggested Steve Dewey as a possible organizer. Steve indicates there is considerable interest in saltcedar in Washington DC, but declined my invitation to organize a symposium on the subject. Steve, Alex and Phil Westra met at the WSSA Board Meeting in Kansas City this past weekend and discussed possible symposium topics and speakers. I await their input and will pursue this if the Board approves.

What's New in Industry? Vince Ulstad with BASF has agreed to continue coordinating this session.

Sponsored Functions. Because Gus Foster, long-time coordinator of this activity currently is out of the industry loop, he is passing this responsibility to Mike Edwards of DuPont. Gus graciously offers to assist Mike as needed.

Submitted by Phil Stahlman

Discussion:
Program: discussed possible topics for general session. Nelroy also suggested Invasive species act. Board consensus is to keep Rob Hedberg's annual Washington update in the general session.
Symposia: Discussed saltcedar management as a topic. Phil moved that we include the saltcedar symposium in the 2004 meeting, second by Kassim. Unanimous.
Discussion about the amount of money available for people on the program. (2002 minutes – $750 per symposium).

Recommendation from Scott that we group resistance management papers as there may be interest from some other groups that will be in Colorado Springs at the same time we are holding our meeting

Responsibility for the social functions for the 2004 meeting will be passed on to Mike Edwards (was Gus Foster).

Discussion about poster boards (left in Hawaii) no report

Local arrangements committee: Scott Nissen
We will tour the facility today. Meals for the meeting can be arranged with short notice, the hotel will be flexible. Wanda will review the contract to make sure there are no potential problems. Section chairs should provide and be responsible for the computer in their session. It was suggestion that students be asked to help with loading the papers (1-2 assigned to each room). Discussed about having papers sent (on CD) a week before the meeting. Discussed having a master computer at the meeting (Phil Stalman and Dan Ball will address). Gil has asked Tim Miller to handle local arrangements for Vancouver. It was suggested that we ask someone from Canada to co-chair the meeting in Canada. Tim Tripp and Tom Lanini have volunteered to serve as the local arrangements team for the Reno meeting.

Section Chair Report: (Dan Ball)
Has not received all the information from George Beck (last years report).
Discussed how to best handle the abstracts and having them available when needed.

Student Paper Judging: (Kassim Al-Khatib)

Action items (from March meeting): Student's winning 2 awards. Manual reads that students may participate in both poster and paper contests.
Discussion: Do we have too many papers? Should we limit it so the students can only compete in one of the contests? (Could present both but only compete in one). Do we want to limit the number of students by making this rule?
According to the manual - Students can participate in both contests.

Suggestion to split the sessions further and make 3 or 4 sessions, making it less papers for each judge.

Discussion about how many sessions we should split into – (3 to 4) so judges don't have to sit through so many papers.

Committee recommends increasing the amount financial support for the graduate students from 10 to $25 per night, for a maximum of three nights.
Motion made by Kassim Al-Khatib, second by Monte Anderson.
Discussion: Wanda- She only pays when a letter come from the professor requesting support for their students. Nelroy: This should go to the finance committee for a recommendation.
Motion was made by Rod Lym to table the motion. Seconded by Scott Nissen. Motion passed unanimously.

Action Item: Gil Cook will take this to the finance committee and send their response and recommendation to the board for a vote.

Committee recommends increasing the cash awards to $150 for first place, $100 for second place and $75 for third place. Motion to do so made by Kassim Al-Khatib second by Nelroy Jackson. Motion failed.

Should we have an undergraduate contest? Some are competing in the graduate contest.
Action Item: Committee to investigate and come back to the board with a recommendation.

Placement Committee Report: Dan Ball
The placement committee will conduct a survey this fall to determine how they might better serve the society.
How would we suggest sending out the survey?
Motion made by Dan Ball to send via listserve and put it in the November newsletter and to add a question - do we need a placement committee? Seconded by Phil Stahlman. Motion passed unanimously

Education and Regulatory: Monte Anderson
Reviewed past topics.
Recommendations for: 1)Soil Organic Matter Symposia - Unanimous Board approval of this topic.

Public Relations: Monte Anderson
No report

Education: Monte Anderson
Education Committee Report
Distance Education Subgroup

Prepared by
Drs. Scott Nissen, Tracy Sterling, and Deana Namuth

Review: The objective of this Education Committee subgroup was to develop web based Weed Science educational materials that could provide classroom, extension/outreach, and self-directed learning opportunities in herbicide mode of action, herbicide resistant weed management, and weed ecology. Lessons were developed with grant funds from the American Distance Education Consortium (ADEC). The initial proposal was administered by Dr. Deana Namuth (University of Nebraska-Lincoln), a distance education specialist. The weed science modules are part of a large plant science website call the Library of Crop Technology, hosted by the UNL. In 2002, the WSWS Board of Directors agreed to provide the funding necessary to host a "mirrored" site that would appear as part of the WSWS website. This mirrored site would highlight the "Weed Science Education Module" as the main user interface, but would provide access to the Library of Crop Technology as a secondary layer. The ideas was to drive learners interested in Weed Science topics to the WSWS website and increase the societies visibility. In addition, one of the primary missions of the WSWS is education and these lessons will provide many educational opportunities for those interested in Weed Science.

Accomplishments: A number of individuals from five different universities have spent considerable time and effort developing these electronic modules. Authors are listed below:

Dr. Anita Dille, Kansas State University
Dr. Alex Martin, UNL
Dr. John Markwell, UNL
Dr. Scott Nissen, Colorado State University

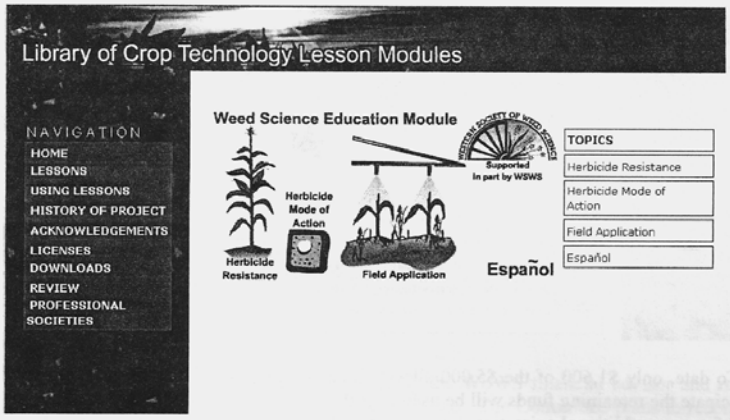
Dr. Carol Mallory-Smith, Oregon State University
Dr. Tracy Sterling, New Mexico State University

Dr. Deana Namuth and her distance education team provided the animations and distance learning experience that was needed to turn text and story boards into distance education modules. The animations can be downloaded to allow educators total flexibility in how this information is used for a variety of different learning styles.

The Library of Crop Technology database has been provided to the new web hosting service after many emails between Vlad Pigin (new hosting service) and Ashu Guru (UNL DEAL web specialist). Ashu has suggested that 0.5 GB be made available for the material and this appears to have been accomplished. At the present time only 0.2-0.3 GB may be occupied, the additional space will allow for future expansion, both from the Weed Science and Crop Technology side. Updates and additions will be made by UNL and will automatically update the "mirrored" WSWS site. All that remains is for the Crop Technology database to be unzipped and the WSWS Weed Science Education Modules will be up and running.

A hot button on the WSWS website will provide the following interface.

On the right hand side under **TOPICS**, learners will be able to see a variety of lessons categorized by Herbicide Resistance (two lessons), Herbicide Mode of Action (10 lessons) and Field Application (currently with one lesson). By clicking on the topic the individual lessons will appear with a brief summary and a printer friendly download hot button. On the left side the **DOWNLOADS** hot button will provide learners and educators access to animations that are used in each lesson without the supporting text. Dr. Sterling has provided considerable leadership to make sure that most if not all the information is translated into Spanish to expand the potential user base. Clicking on the **Espanol** hot button will provide most of the lessons translated into Spanish.



Lesson Title currently available includes the following:

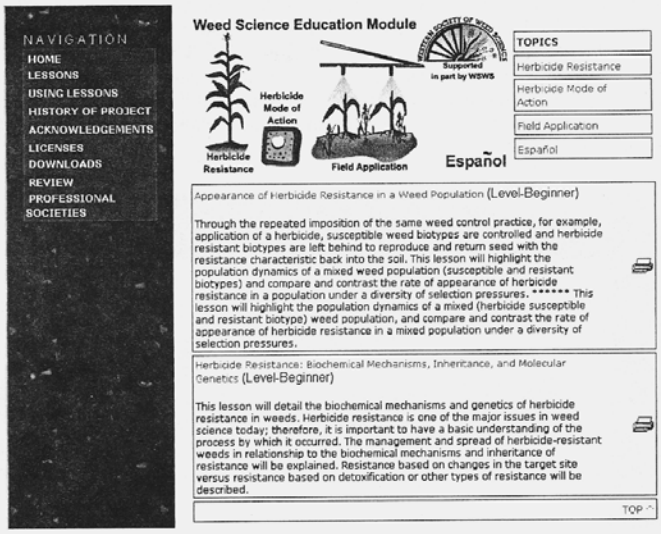
Herbicide Resistance
-Appearance of Herbicide Resistance in Weed Populations
-Herbicide Resistance: Biochemical Mechanisms, Inheritance and Molecular Genetics

Herbicide Mode of Action
-Auxin and Auxinic Herbicide Mechanisms of Action, Parts 1 and 2
-Herbicide Metabolism
-Foliar Absorption and Phloem Translocation
-Root Absorption and Xylem Translocation
-Herbicides That Act Through Photosynthesis
-Inhibitors of Aromatic Amino Acid Biosynthesis
-Inhibitors of Branched Chain Amino Acid Biosynthesis
-Plant Pigments and Photosynthesis
-The Interaction of Light with Biological Molecules

To be completed;
-Fatty Acid Biosynthesis Inhibitors

Field Applications
-Practical Applications of Herbicide Physiology

Example of what learners and educators will see when they click a **TOPIC** hot button such as **Herbicide Resistance.**



Budget: To date, only $1,600 of the $5,000 allocated has been spent. Those of us involved with this project anticipate the remaining funds will be used over the next year to complete and update lessons and to provided for some additional animation development. Others will be encouraged to contribute to these lessons and develop additional lessons in the future.

Discussion:
Comments from Rod Lym - Noxious weed course: only had one this year. Went very well. Will be held at a new location next year in Montana.

Report from Scott Nissen on Website. Have only spent $1,600 of the $5000 that the board had approved. Is moving along. We have a number of lessons available but they are not all on the same level. Would like to have both introductory and advanced courses. Should be up and running by the end of the month.

End for the day.

Start again at 7:30 Saturday
Aug. 2
Call to order by Gil at 7:40

Financial Report: Pete Forster
WSWS

Report of the Finance Committee to the Executive Board's Annual Summer Meeting on August 1, 2003

1. The Finance Committee met at the annual conference in March and via telephone in June and July to review quarterly investment reports and to develop recommendations pursuant to projects assigned by the Executive Board. The Treasurer's records and accounting books were audited at the March meeting. It is the Finance Committee's opinion that both the Treasurer and Investment Advisor are operating according to the WSWS Investment Policy Guidelines and Objectives.

2. As communicated to the Executive Board in March, $25,000 were transferred from the Merrill Lynch Money Market to the checking account (Newark) to pay hotel expenses, student reimbursement, and miscellaneous charges (shipping costs, speaker expenses, etc.) associated with the 2003 meeting in Hawaii.

3. Based on June 2003 YTD information, the Merrill Lynch mutual funds and fixed asset accounts balances were $106,943.13 and $96,998.21, respectively. The June YTD, combined value of these two accounts was $203,941.34, a 7.4% cumulative gain on total investments.

4. As of July 10, 2003, the money market savings account (Newark) had a balance of $3,817.25 and the checking account (Newark) $27,719.17.

Other Issues Addressed by the Finance Committee in 2003

1. Management of WSWS investments: The WSWS financial advisor recommends, based on the uncertainty of the market, that funds in the WSWS portfolio not be re-distributed at this time and that the market be evaluated again this Fall to determine whether a re-distribution is warranted.

Recommendation

The Finance Committee supports the proposal made by the WSWS financial advisor and recommends that changes in the WSWS portfolio not be made at this time. The Committee plans to reconvene again with the financial advisor this Fall to assess the status of the accounts and determine at that time whether re-distribution of investments should be made.

2. On June 27, Stanley Cooper – the WSWS financial advisor - left Merrill Lynch and joined the firm, RBC Dain Rauscher. As a result, the WSWS has the option of moving its investments with Stanley to RBC Dain Rauscher, or continuing to work with Merrill Lynch.

The following points highlight the important issues to be considered in making the decision whether or not to move the WSWS portfolio to RBC Dain Rauscher.

- In a comparison of fee structures, the cost of doing business is less with RBC Dain Rauscher than with Merrill Lynch.
  Equities: RBC:1.25% Annual Fee vs. ML:1.5% Annual Fee
  Fixed Assets: RBC: No Ann. Fee vs ML: $300 Ann. Fee
- Exit fee (ie. for transferring investments from Merrill Lynch to RBC) would be paid by RBC Dain Rauscher.
- No tax consequences with a move to RBC, since the Merrill Lynch investments can be transferred to RBC intact - none of the investments need to be sold.
- Stanley Cooper has a solid history with the WSWS and understands the Society's investment goals, guidelines, and objectives.

Recommendation

The Finance Committee recommends that Stanley Cooper continue as the financial advisor for the WSWS and that the Society's investments be transferred from Merrill Lynch to RBC Dain Rauscher.

3. As required by the IRS audit, Wanda will become an employee of the WSWS. Wanda has filed an application for employer status in California and has received an employer account number.

The Executive Board decided in March that Wanda's salary not be negatively impacted as she transitions to an employee of the WSWS. Based on the available information, the Finance Committee is unable to make a recommendation at this time concerning Wanda's salary. Additional guidance is needed from the Executive Board concerning the intended outcome of a salary adjustment.

With respect to anticipated deductions, available estimates of the deductions are provided below.

Deductions:

Taxable Social Security Wages: $1,300 x 12.4% =		$161.20
Taxable Medicare Wages: $1,300 x 2.9% =	$37.70	
Estimated California Taxes:		$101.0
Total Deductions		$299.90

(Estimated deductions from discussions between Wanda and her CPA).

4. Based on the increasing cost of conferences and the conducting of the Society's business, the Executive Board decided in March to increase the registration fee for the WSWS conference. The Finance Committee compared the WSWS registration fees with that of the other regional societies and the WSSA, and makes the following recommendations (see attached spreadsheet comparing the fees of the different weed science societies).

Recommendation

- Increase general WSWS Registration Fee from $75 to $90 (pre-conf.) and from $105 to $120 (at-conf.). Justification: Increased Registration Fee addresses higher conference expenses and is still considerably less than that charged by the NCWSS and SWSS.

- Increase student WSWS Registration Fee from $0 to $25 (pre-conf.) and from $15 to $40 (at-conf.). Justification: Registration fee pays for the meal at the Awards Luncheon and instills a sense of responsibility and contribution to the Society.

- Maintain spouse Registration Fee at $25. Justification: Pays for the meal at the Awards Luncheon.

- Increase Annual Membership Fee from $15 to $20 (only for members not attending the conference. The Annual Membership Fee is included in the conference Registration Fee for those attending the conference.)

Discussion:
Wanda Graves – Fees will increase from Merrill Lynch.

Nelroy Jackson made the motion to accept Finance Committee's recommendation to change from Merrill Lynch to RBC Dain Rauscher. Seconded by Phil Stahlman. Motion passed unanimously.

Rod Lym made the motion to accept and modify the Finance Committee's recommendation to increase registration fees from $75 to $95 (pre-conf.), from $105 to $125 (at-conf.), spouse's registration fee from $25 to $30 and annual membership fee from $15 to $25. Seconded by Kassim Al-Khatib. Motion passed unanimously.

Necrology: Pete Forster
WSWS Necrology Committee
Report to the WSWS Board
August 2003, Colorado Springs, CO

Chairman: Martina Murray, Committee: Lynn Fandrich, Tom Whitson

The Necrology Committee has not been notified of the death of any WSWS members or friends since the last committee report in March, 2003. The passing of Don Burgoyne was acknowledged at the time the last report was presented, but no additional information was available at that time. With Gil Cook's assistance, we have obtained a copy of Don's obituary and I am recording it in this report.

Donald L. Burgoyne

Donald L. Burgoyne died Jan 18, 2003. He was 80. Born October 12, 1922, in Ida Grove, Iowa, Don served as a medical corpsman in World War II. He earned his Master's degree from Iowa University in plant physiology. He worked for DuPont Agrichemical Division for 35 years. A devoted family man and friend to many, Don loved to dance. He was an avid golfer and swimmer and loved Dixieland Jazz. He was also a volunteer at Kaiser Santa Teresa Hospital. He is survived by his sisters Virginia Brockman and Marie Stookey; son Douglas and his family in Los Angeles; daughter Leah Dowty of Santa Cruz; grandchildren Kyle Burgoyne and Mariete Dowty; niece Denise Burgoyne; and nephew Michael Burgoyne and his family. He was preceded in death by his wife of 54 years, Margene Burgoyne. The family asks that any donations be made to Live Oak Ag Boosters; PO Box 594; Morgan Hill, CA 95046.

Respectfully submitted,

Martina W. Murray

CAST: Rod Lym
Travel expenses that are covered by CAST may be eliminated and this will need to be addressed by the WSWS as we may have to cover he additional cost incurred by the CAST representative.

Jill Schroeder made the motion that the WSWS cover all of the expenses associated with travel to the CAST Meetings (any expenses that are not covered by CAST). Seconded by Dan Ball. Motion passed unanimously.

WSSA Report: Nelroy Jackson
Report to the WSWS Summer 2003 Board Meeting on WSSA Activities

The WSSA summer Board of Directors meeting was held at the Westin Crown Center hotel in Kansas City July 26/27, 2003.

1. The first 6 hours were devoted to working on the WSSA Strategic Plan, including small group discussions. The result was identification of the top priorities, goals and objectives for the short-term (6 to 12 months) and long term (3 years). The results will be collated and distributed to the Board soon. The most important item is 'redesign of the website'. Small groups may continue to work in-between formal board meetings.

2. WSSA did not lose money on the Jacksonville meeting.

3. The New York meeting in 2006 will be at the Marriott hotel in Times Square.

4. XID/WSSA project: Approved the use of 'Intriguing world of Weeds' for the second phase of the XID project. Very few photographs have been sent in for phase 2. WSSA will be given 1000 CD's from phase 1, which is due for release on January 2, 2004. The Board voted to ask XID to release the CD's earlier, before the IPINAMS conference and NCWSS meeting.

5. Approved using $3000 for setup and printing costs for CD for the Dow AgroSciences-sponsored project on 'assessing the economic, environmental and societal losses from invasive plants on rangeland and wildlands.

6. WSSA agreed to market Joe DiTomaso's new Aquatic weeds book.

7. The state of WSSA archives at Iowa State University will be looked into.

8. Agreed to change the wording in the WSSA constitution to allow for e-mail votes and teleconferences.

9. The Board agreed to let the Executive committee complete the negotiations on the final employment agreement for the Director of Science Policy. New language will be written for the regional societies to use in their constitution and by-laws re this position.

10. Cody Gray participated in the board meeting as a graduate student representative.

11. Agreed to have a category for 'invasive weeds' on the membership renewal form.

12. Membership is still declining, and the Endowment fund is not growing at a good rate.

Submitted by Nelroy Jackson
August, 2003

Discussion:
Question that was raised based on the WSSA report. Do we as a board need to get together (a little early for the next meeting) and come up with a vision for the WSWS.

Discussed the need for a facilitator to assist with the meeting/discussion. May need to decide what it is we really want to accomplish at this meeting – set goals for the meeting.

Action Item: Gil Cook to set up a committee to look into this and come up with a recommendation.

Rod Lym - This should not be a responsibility of the board, but a team that is assigned (to keep continuity), as the board members change each year. Should include workshops taking advantage of expertise that is in the Society. Members must be a cross section of the entire organization and have the responsibility/authority to implement the plan.

Decision to assign a committee to head this up: Team members: Kassim Al-Khatib, Jill Schroeder, Lisa Boggs and Mike Edwards. Propose to have a workshop at the 2004 meeting to get inputs and feedback. Goal for workshop is to come back to the board with a recommendation and the direction to go forward with this.

WSSA-Will not have a spouses program in the future.

Legislative Committee: Nelroy Jackson
Board affirmed what is in the bylaws. Will not be changed.
Publications: Nelroy Jackson

WSWS EDITORIAL COMMITTEE REPORT
AUGUST 2, 2003

Progress Report (Joan Campbell and Traci Rauch, co-editors)

Currently, the 2004 Call for Research Progress Reports is being updated. Changes will be made to clarify previously vague directions. Call will be included in September Newsletter and be posted online by October.

Newsletter Report (Don Morishita, editor)

The last newsletter was sent in May 2003 and the next newsletter will be sent in September 2003. Please have all items to Don Morishita by August 30, 2003.

Proceedings Report (Joan Campbell, editor)

Proceedings will be mailed out in August. Printing costs are not yet available, but the book is larger so we can anticipate an increase in cost. We must increase our emphasis to have complete, timely submissions of information to the Proceedings Editor for the book to be published in a timely manner.

Recommendation

Add Traci Rauch as Co-editor. Two editors will help expedite publication and eliminate a break in procedure if one or the other can not carry out duties.

Website Report (Joan Campbell, editor)

A contract with Intelsys was signed and they were paid $2250.00. The web site has been redesigned and is ready for uploading to the new server. We are awaiting the completion of the Mode of Action course transfer before bringing it online. At this time, the web editor is responsible for loading all information onto the site as the redesigned site allows updating directly by the web owner and does not require a web master. This is a lot of work and help would be appreciated. Neal Hageman has volunteered to help manage content so that we can keep the site up-dated.

There will be an increase in cost over the initial contract that we have with Intelsys:

1. $8.95 per month increase for hosting due to a larger size requirement for the Mode of Action course. We had 250 MB disk space and 2 GB disk transfer which was increased to 500 MB disk space and 5 GB disk transfer. (Joan paid the first month so that the project would not be held up any longer.)

2. A maintenance and support package needs to be purchased so that we can maintain the course and also this will help with any other support we need on the web site. The 2 hours/month package is $39.95/month or $399/year.

3. There is an undetermined amount for writing the forms for online submission. This is not yet complete and will be billed at a rate of $25/hour.

Recommendations:

1. Add Neal Hageman to web site committee/editorial committee.
2. Approve the increase in cost of the site which will be $506.40 for increase space and maintenance package, and an unknown amount for online submission coding.

Action Item:

Approve recommendations listed in Proceedings and Website reports.

Respectfully submitted,
Joan Campbell

Discussion:
Board has already approved the extra money for the increased space.

Do we need to have 3 people/positions (Progress report, Proceedings report & Website report)? Website is taking increasingly more time. Do we need to have at least 3 people working in these positions.

Recommendation from Nelroy Jackson for Gil Cook and Phil Stahlman to work through these issues. Go back to the bylaws and determine if we need to have 3 people in the 3 positions. Is this is too much for them to handle themselves. Rod Lym suggested 3 Editors in 3 separate locations.

Gil will visit with Joan and determine if she wants help with these responsibilities and if so, in what areas.

Question about a report on the "Weeds of the West". Need to get a written report from Tom on what is happening with the Weeds of the West and what all is involved in this publication.

Need to find out (from Joan) what the status is for the listserve.

Herbicide Resistance: Kassim Al-Khatib

Crop Diversity in Rotations Can Help Manage Resistant Weed Populations (Central Great Plains)

Resistance in weed species is a key issue in weed management. Producers are seeking strategies to either avoid development of resistance or to minimize population growth of resistant biotypes now present.

One strategy is to diversify the crop rotation by adding crops with different growth periods. Crop diversity provides more opportunities for producers to control targeted weed species and prevent seed production. The impact of this strategy can be quantified by mathematical models that monitor weed populations across time.

One such model has been developed for jointed goatgrass. Components of the model include seed survival in soil, seedling emergence, seed production per plant, and removal of seed with grain at harvest. The model represents average growth conditions for jointed goatgrass with a no-till system in the Central Great Plains.

With this model, we predicted changes in jointed goatgrass population when summer annual crops such as corn and proso millet were added to a winter wheat-fallow rotation. We also compared two management systems in winter wheat, a conventional system comprised of a short-stature cultivar planted at 40 lbs/acre with N fertilizer broadcast before planting, and a competitive system comprised of a taller cultivar, higher seeding rate (65 lbs/acre), and N placement near the seed. A competitive canopy can reduce jointed goatgrass seed production per plant 45%.

Our simulation started with one jointed goatgrass plant in winter wheat. After 12 years, jointed goatgrass density in winter wheat-fallow (W-F) was 4610 plants (see Table below). In contrast, adding two summer annual crops to the rotation (W-C-M-F) eliminated jointed goatgrass, whereas adding spring wheat to W-F reduced population growth six-fold. The difference in densities between W-C-F and W-SW-F reflects jointed goatgrass establishment and seed production in spring wheat. The later planting date with corn enables producers to control jointed goatgrass before they produce seeds. Growing winter wheat two years in a row, as in W-W-C-M, eliminates the effect of summer annual crops on jointed goatgrass population.

Table. *Population growth of jointed goatgrass across 12 years, as affected by crop rotation. The simulation started with one jointed goatgrass plant infesting the first winter wheat crop in each rotation.*

	Winter wheat canopy	
Rotation	Conventional	Competitive
	plants	plants
W[a]-F	4610	144
W-SW-F	806	16
W-C-F	6	0
W-C-M-F	0	0
W-W-C-M	4260	118

[a] Abbreviations: W – winter wheat; F – fallow; SW – spring wheat; C – corn; M – proso millet.

Increasing the competitiveness of winter wheat further minimizes population growth of jointed goatgrass. Note that jointed goatgrass density in W-F was 32-fold less with a competitive canopy (4610 vs. 144).

Our simulation demonstrates the impact of crop management on weed resistance. If a resistant jointed goatgrass plant developed, it would not maintain a viable population in W-C-M-F. In contrast, the resistant population would increase dramatically in rotations comprised mainly of winter wheat.

Written by the WSWS Resistant Plants Committee

Dan Ball (Daniel.Ball@orst.edu) Mike Ensminger (Mike.ensminger@syngenta.com)
Donn Thill (dthill@uidaho.edu) Steve Seefeldt (sseefedlt@pw.ars.usda.gov)
Carol Mallory-Smith (Carol.Mallory-Smith@orst.edu)
Kirk Howatt (khowatt@ndsuext.nodak.edu)
Mary Corp (Mary.Corp@oregonstate.edu)
Jim Harbour (james.d.harbour@usa.dupont.com)
Randy Anderson (randerson@ngirl.ars.usda.gov)

Member At-Large Report: Kassim Al-Khatib
Student Education Enhancement:
It is very difficult to find hosts for this program. Discussion around feasibility of the Industry companies being able to do this.
Issues: Liability, time involved, money.
What if we designed the program so each company has the responsibility for a year (ie. Syngenta 2004, Monsanto 2005…).
Do we need to ask the students to apply and make it some type of contest? Should the students be expected to pick up a part of the expenses?
(Jill Schroeder) – Are we missing other areas of support? (Range lands, noxious weeds…)
Suggested that we have a roundtable discussion at the 2004 meeting to address the issue.

Recommendation is to send this back to the committee and ask them to come up with a proposal and bring the recommendation back to the board.

Site Selection: Gil Cook
No report yet

Nominations: Gil Cook
Motion made by Nelroy Jackson that we allow $1000 for secretarial help for the President and President-Elect. Seconded by Jill Schroeder. Motion passed unanimously.

Next board meeting Monday, March 8 2004.

Old Business
Student Night Out – We will need to have a new representative to replace Lisa.

New Business
Request to the site selection committee, that we ask for complimentary rooms for the summer meeting as a part of the package.

Meeting comments:
In the future, all reports that are e-mailed will not be available as paper copy at the meeting.
Phil Stahlman made the motion to adjourn the meeting at 11:15. Seconded by Scott Nissen. Motion passed unanimously.

WSWS Business Meeting
March 8, 2004
Double Tree Hotel, Colorado Springs, CO

Attendees: Gil Cook, Wanda Graves, Jill Schroeder, Phil Stahlman, Dan Ball, Monte Anderson, Charlie Hicks, Scott Nissen, Lisa Boggs, Nelroy Jackson, Kassim Al-Khatib, Mike Edwards, Rod Lym, Pete Forster, Phil Banks, Corey Ransom, Vince Ulstad, Martina Murray, Doug Schoup, Phil Westra, Steve Dewey, Steve Miller, Drew Lyon, Craig Alford

Call to Order: President Gil Cook called meeting to order at 8:00 a.m.

Minutes: (Pete Forster)
Minutes have previously been sent to all board members for review.

No comments on minutes from Summer Board meeting or additional minutes.
Motion to accept minutes: Jill Schroeder, 2nd Nelroy Jackson. Motion passed (unanimous).

Financial report: (Wanda Graves)
Reviewed financial report.

Motion to accept the report: Nelroy Jackson, 2nd Phil Stahlman. Motion passed (unanimous).

Immediate Past President report: (Jill Schroeder)

WSWS Annual Board Meeting
March 8, 2004
Past President Report

Board Benchmarking and Member Survey: I served as a contact with CAST/ICL to promote the participation of WSWS in the Shared Leadership Workshop. I participated in conference calls regarding how WSWS can proceed to address the changes in our discipline, participated in the benchmarking survey and conference calls to discuss the results, and served as a collection point for input on the member survey that will be conducted at this annual meeting. I intend to help Vanelle Carrithers with survey activities at this meeting.

Operating Guide: I agreed to serve on a committee chaired by Steve Miller to revise the operating guide as a result of the changes in the Constitution and By-Laws approved by the membership in March. Roland Schirman, committee member, initiated activity in February to begin to collect revisions to the operating guide.

Committee Contacts: I contacted the Fellows and Honorary Members, Sustaining Members, and Nominations Committee Chairs to let them know that I am the board contact for their committees.

Retiree Reception for the 2004 meeting: I put announcements in the newsletters requesting information on retirees for the 2004 meeting. I got few responses so am not sure what to expect at the reception. I am concerned that other meetings were scheduled to conflict with the reception this year. This reception is the only evening activity of the organization and should not have other activities scheduled to conflict. I am also concerned that Monsanto will not be as eager to host the reception if other activities are scheduled at the same tome. I hope that this does not happen again.

Fellows and Honorary Members Report: (Jill Schroeder)

Western Society of Weed Science
Fellows and Honorary Members Committee Report
March 1, 2004

Committee members: Charlotte Eberlein (Chair), Jeff Tichota, Frank Young

The committee received a total of six nominations for the 2004 Fellow Award, three for the Public Sector Award and three for the Private Sector Award. Committee members reviewed nomination packages and ranked nominees in each category. The following individuals were selected as Fellows of the Western Society of Weed Science:

Public Sector – Dr. Don Morishita, Professor of Weed Science, University of Idaho

Private Sector – Dr. Phil Banks, President, Marathon Agricultural and Environmental Consulting, Inc.

Both individuals have contributed significantly to WSWS and have positively influenced weed science on a regional and national scale. They represent the highest standards set by the Society in leadership and contribution.

One nomination was received for Honorary Member and the committee unanimously recommended that the award be presented to:

Doug Schmale, Dryland Wheat Producer

Doug has made major contributions to agriculture and weed science in the western United States. He is a very active member of the National Jointed Goatgrass Steering Committee, which annually reviews proposals and allocates $350,000 in USDA Special Grant Funding to goatgrass projects. He also has been active in the National Wheat Growers Association and the Nebraska Wheat Board, and is a member of the Central Great Plains Research Station Customer Focus Group. He has presented both oral and written testimony to both the House and Senate Ag Committees on farm bill priorities and crop insurance.

The committee will continue to encourage nominations for Fellow and Honorary Member Awards through the *WSWS Newsletter* and by personal contact

Sustaining Members: (Jill Schroeder)

WSWS Committee Report
Sustaining Membership Committee
Annual Meeting 2004

The WSWS Sustaining Member committee consists of Steve Eskelsen (2005) Chair, Dennis Tonks (2006), and Lynn Fandrich (2007).

Summary of Activities:

1. Fourteen sustaining members as of March 3, 2003 contributed $4,400 in member dues for the year 2004, as follows:

Agriliance LLC, AGSCO, Inc., Arvesta Corporation, BASF Corporation, Bayer CropScience, Bellspray Inc., dba R&D Sprayers, Dow Agrosciences, DuPont Crop Protection, Marathon-Agricultural & Environmental Consulting, Inc., Monsanto Company, PBI-Gordon Corporation, Syngenta Crop Protection, Inc., Valent USA Corporation, Wilbur-Ellis Company

2. All 2003 sustaining members and prospective sustaining member were contacted by email to determine their interest in becoming sustainable members. Those that showed interest were sent letters via email (with attached invoice). Follow-up phone calls were made to those who showed interest but did not respond within a reasonable time.

Committee Reports: (Pete Forster)

Finance Committee: (Phil Munger)

Report of the Finance Committee to the Executive Board

Annual Meeting – March 8, 2004

1. The Finance Committee met in 2003/'04 via teleconference, most recently in mid- February, to discuss recommendations from the WSWS financial advisor regarding the Society's investment portfolio.

2. As of December 31, 2003, the balances in the RBC Dain Rauscher fixed income and equity accounts were $75,828 and $148,841, respectively, for a combined value of $224,669. This represents a $9.5K (4.4%) annual gain and a somewhat higher $14K (6.7%) quarterly gain on total investments. Since December 31, 2003, the combined value of the Society's investments has increased approximately $5K to $229,658 (balance on 02/26/04).

3. As of February 26, 2004 the balance in the money market savings account (Newark) was $50,569 and the balance in the checking account (Newark) was $22,400.

Recommendation

The Finance Committee met with Stanley Cooper, WSWS Financial Advisor on February 9, 2004 to review the WSWS investments and determine whether reallocation of assets, based on the Society's investment policy guidelines*, was warranted (allocation of assets as of 1/26/04: equities – 60.6%, fixed income – 39.4%). Under current market conditions, Stanley recommended that assets not be re-allocated until there is a greater variance from the Society's investment guidelines and/or changes in the marketplace dictate a re-distribution (eg. an adjustment in interest rates).

The Finance Committee agrees with Stanley's proposal and recommends that assets not be re-allocated at this time.

Activities of the Finance Committee in 2003/'04

The Committee recommended that Stanley Cooper be retained as the WSWS Financial Advisor and that the Society's investments as a result, be transferred from Merrill Lynch to RBC Dain Rauscher. – Approved by Executive Board in August 2003.

Recommended increases in the general and student WSWS Conference Registration and WSWS annual membership fees. – Approved by Executive Board in August 2003.

Based on Stan Cooper's recommendation, proposed in October that $22K be transferred from the WSWS fixed income account to the equities account in order to align asset allocation with WSWS investment guidelines*. – Approved by Executive Board on October 16, 2003.

* WSWS investment policy guidelines: 65% fixed income and 35% equity allocation.

Respectfully Submitted,

Philip H. Munger
Finance Committee, Chair

Discussion:
Introduced Stan Cooper. Pointed out that Stan cooper had suggest we keep allocations as they are for now (60:40) vs. what the guidelines call for (65:35).
Motion to accept report: Nelroy Jackson, 2nd Jill Schroeder. Motion passed (unanimous).

Investment Status: (Stan Cooper)

Gave brief description of why he left Merrill Lynch and moved to RCB Dain Rauscher and gave a brief background on RCB Dain Rauscher. Went through the report he hand out and gave some insight is happening in the stock market and why he feels his recommendations are valid. Recommends we stay the course we are on.

Necrology: (Martina Murray)

WSWS Necrology Committee Report
Colorado Springs, CO
March 2004

Committee: Martina Murray (Chair), Carol Mallory-Smith, Steve Watkins, Tom Whitson

The Necrology Committee has been notified of three deaths of WSWS members or friends since the 2003 annual meeting. The passing of Don Burgoyne was acknowledged at the 2003 meeting, but no additional information was available at that time. We would like to celebrate the lives and recognize some of the contributions and accomplishments of these scientists. Our thoughts and prayers are extended to the families of Donald Burgoyne, Charles Scifres, Joseph Wayne Whitworth, and Wood Powell Anderson. *(Writeup is located at the back of the Proceedings)*

Motion to accept the report: Monte Anderson, 2nd Kassim Al-Khatib. Motion passed (unanimous).

Program Report: (Phil Stahlman)

Program Committee Report
2004 Western Society of Weed Science Business Meeting
Colorado Springs, CO March 8, 2004
Program overview. The program includes six oral presentations in the General Session, 74 volunteered posters, 70 volunteered papers, What's New in Industry session, two symposia on Soil Organic Matter in the Education and Regulatory Section and on Saltcedar, and discussion sessions for each of the six projects. In response to complaints that placing all student papers in one section as opposed to placing

them in appropriate project sections reduces the content and interest in individual projects, this year student papers were placed in the appropriate project sections. No more than four and usually three student papers were scheduled in succession to give judges more time to write constructive comments on score sheets and to facilitate their moving between sections. Four papers/posters were withdrawn after the program was printed. Section chairs were successful in recruiting replacement oral papers to prevent unscheduled breaks in those sessions. Breakdown of poster and paper sessions by project and student/non-student presenter follows.

Projects	Posters Total	Graduate Student Contest	Undergraduate Student Contest
1. Range & Forest	15	5	1
2. Horticultural Crops	5	0	0
3. Agronomic Crops	34	6	1
4. Teaching & Technology	4	0	0
5. Wetlands & Wildlands	3	0	1
6. Basic Sciences	13	6	0
Total	74	17	3

Projects	Oral Papers Total	Graduate Student Contest
1. Range & Forest	5	2
2. Horticultural Crops	11	0
3. Agronomic Crops	39	13
4. Teaching & Technology	4	0
5. Wetlands & Wildlands	3	0
6. Basic Sciences	8	3
Total	70	18

Discussion Topics for each of the Projects are as follows:

Project 1: 1) How should risk assessment of invasive plant species be conducted? 2) Description of a risk assessment system for California and Arizona

Project 2: EPA, manufacturers, and IR-4 points of view regarding potential herbicide registrations for horticultural crops

Project 3: Roundup Ready alfalfa – how it fits western U.S. agriculture

Project 4: Passing the hat: cost recovery in extension and Weed science programs

Project 5: 1) Understanding the economics of invasive plant species management 2) Implementing ecological approaches to managing invasive plants

Project 6: 1) Discovery and evaluation of allelochemicals: catechin case study
2) The role of seed bank dynamics and germination

Issues.

1) Three individuals are known to submitted titles that did not get recorded, were deleted or overwritten. Two agreed to switch to poster and one declined; they are not listed in the program. In a couple other instances substitute posters are being presented in place of poster that were withdrawn.

2) One U.S. Forest Service employee withdrew her paper because she did not received confirmation and learned too late that it was accepted to obtain travel authorization. The Call for Papers states contributors will not receive mailed notification of paper acceptance; rather, they were instructed to check the program on-line.

3) The Range & Forest discussion session and the Wetland & Wildlands presentation and discussion sessions were scheduled at the same time on Thursday morning. It was brought to my attention that many of the same people attend both projects, thus the scheduled time was in conflict. After consulting both Project Chairs and several others, the Range & Forest discussion session was rescheduled for Tuesday afternoon. A handout listing this and other program changes will be handed out at the registration desk and announced in the General Session.

4) Meeting rooms for some session could be tight. Having all posters displayed for two days requires twice the space and limited meeting room flexibility. Also, after the program was printed it was learned that room capacities provided by the hotel did not allow for podium, screen, or wider spacing between chairs and rows to facilitate coming and going. Thus, actual set up capacities are two-thirds or less than listed capacities.

Submitted by Phil Stahlman

Discussion;

Discussed the overall program and that he had made the decision to put the student papers back into the section they belonged to and spread them out the make it easier on the judges. 4 papers have been withdrawn after program was printed. 3 undergraduate students will be participating in the undergraduate paper contest.

Issue 1) Biggest headache was the paper submission format. Three people submitted, but the reports were not received. This does need to be address in the future.

Issue 2) Rod Lym asked if we should be sending a conformation of paper acceptance.

Issue 3) Nelroy Jackson suggested that draft program be sent out for suggestions and comments from a selected group. Time issues/constraints may not allow for this. This would need to be a selected group and have a background in the program issues. Kassim Al-Khatib – should the project chairs be involved in the process?

Gil Cook: Undergraduate student award – should the awards be the same as for the graduate students award?

Poster session: Posters will be up for both days.

Pre-registration: 289

Gil Cook comments: Program chairman is a position that may need someone (a paid position) involved on a continuing basis to keep some continuity so things aren't as apt to fall through the cracks. Phil Banks – Suggested that the election be held earlier so that the incoming people be able to attend the summer board meeting to obtain a better understanding of the responsibilities. Gil – this may be helpful for other positions that have responsibilities with other organizations (WSSA …).

There is a decline in the number of papers for Colorado Springs vs. Hawaii.
Motion to accept the report: Nelroy Jackson, 2nd Rod Lym. Motion passed (unanimous).
Poster Committee: (Jed Colquhoun)

2004 Western Society of Weed Science Business Meeting
March 8, 2004 Colorado Springs, CO

Poster Committee Report
Jed Colquhoun, Chair

1. Seventy-two posters will be displayed in the Pueblo/Teller/Park rooms. All posters will be displayed at the same time, in contrast to previous years. Authors of odd-numbered posters will be present on Tuesday from 7:45 to 9:15 AM, and authors of even-numbered posters will be present on Wednesday from 7:45 to 9:15 AM.

2. Poster set-up will be on Monday from 4:00 to 10:00 PM, and removed on Wednesday evening from 6:00 to 8:00 PM.

3. Scott Nissen will transport the 51 WSWS easels to Colorado Springs, as well as 75 to 80 foamboards. Phil Stahlman has borrowed an additional 25 to 30 easels from WSSA, and will transport those to Colorado Springs.

4. A decision needs to be made concerning poster equipment transportation for Vancouver in 2005. Easels (and possibly foamboards?) could be shipped from Colorado Springs to Oregon State University for storage, and driven to the 2005 meeting. Other arrangements/suggestions are welcome.

5. Brenda Waters will rotate off the poster committee in 2004. Therefore, a new member and a new chair should be chosen at the 2004 meeting. Jed Colquhoun (2005) and Tony White (2006) are current committee members.

Discussion:
Do we need to have a central location for the foamboards on a regional basis. Would storing them be feasible or do we need to purchase boards when shipping does not seem cost effective. Will address this issue at the summer board meeting.

Motion to accept the report: Phil Stahlman, 2nd Jill Schroeder. Motion passed (unanimous).

Publications: (Phil Stahlman)

Newsletter Report: (Phil Stahlman)

Publications Committee
Newsletter

The WSWS newsletter was published four times in 2003. Effort was made in 2003 to include news information from around the West. Emails were sent to representatives at universities in each member state, public agency personnel (USFS, BLM, state departments of ag), and private industry representatives in an attempt to increase news reports of issues and events in the west. This had been met with some success, but more participation is desired.

As our Society members become more computer proficient, I would like the Board of Directors to consider changing the newsletter format from hardcopy to electronic form. This could help reduce costs to the Society.

I am with this report, submitting my resignation as the newsletter editor, but would be willing to do the April newsletter, if necessary.

Don Morishita

Discussion:
Don Morisita will need to step down from this position. Should we announce that we need a new person to take on the publication chair position

Research progress report: (Phil Stahlman)

Research Progress Report
Co-Editors: Traci Rauch and Joan Campbell

To encourage more contributions to the Research Progress Reports, the indices have been combined into a Keyword Index (except author). This index allows better referencing of reports on topics like resistance, biocontrol, gene flow, mechanical control, etc. which were not included in the past. The Keyword Index also includes: crop, weed, herbicide common name and trade name.

To increase readability in the tables, the font size was increased from 8 to 10 pt with the option of reducing the size as low as 8 pt if necessary (for fit).

Omnipress printed 325 copies of which 150 copies were sent to the meeting site and the remaining copies were sent to Wanda Graves. The total cost including shipping was $2320.00.

Project 1 - 12 reports
Project 2 - 15 reports
Project 3 - 50 reports
Project 4 - 1 report
Project 5 - 1 report
Project 6 - 3 reports

The number of reports submitted was down from last year (118 in 2003 and 82 in 2004). We would like to encourage people to contribute to the Research Progress Report. There were no submissions from the following:
Alaska, Hawaii, Kansas, Nebraska, Nevada, Oklahoma, Texas, Alberta, British Columbia, Saskatchewan

Discussion:

With the decline in the number of submissions, is the Research progress report something we need to re-evaluate. Is it still an important function? Gil Cook-Could we switch this function to the website? Scott Nissen – Do we make any money on this or is it a break even. Wanda Graves - not really, it is provided as a service.

Motion to accept the report: Jill Schroeder, 2nd Nelroy Jackson. Motion passed (unanimous).

Proceedings report: (Phil Stahlman)

WSWS Proceedings Report
March 2004

Abstracts have been downloaded from the website. Several additional abstracts have been received by the authors for inclusion. Project Chairs and moderators have been asked to report any additions or withdrawals to the Proceedings Editors to enable an accurate publication.

Other reports and photographs to be included in the Proceedings should be sent electronically to the editors by April 12, 2004. The editors need to have all items submitted by the deadline to allow a complete, timely publication of the Proceedings.

Omnipress will be printing the Proceedings again this year.

Respectfully submitted,
Joan Campbell and Traci Rauch
Proceedings Editors

Discussion:
Motion to accept the report: Monte Anderson, 2nd Kassim Al-Khatib. Motion passed (unanimous).

Weed of the West: (Phil Stahlman)

Table until Thursday meeting when Tom Whitson will be available.

Local Arrangements: (Mike Edwards & Scott Nissen)

Discussion:
Brief outline of set-up. Things are going well. Any issues that come up will this week be taken care of as they come up.
Scott Nissen – Brief outline on salt cedar symposium and the handling of the one-day registration. This session will be video taped and made available for some unable to attend.
Phil Stahlman: This issue with walk-ins causes a problem for scheduling.
Nelroy Jackson- we need to have WSWS applications available to encourage new membership.

Motion to accept the report: Nelroy Jackson, 2nd Phil Stahlman. Motion passed (unanimous).

Kassim introduced Doug Schoup grad student rep to board

CAST Report: (Rod Lym)

CAST Report to WSWS

Rod Lym, CAST Representative
March 8, 2004

The fall meeting of the CAST Board of Directors was held in September 2003 in Portland, OR. CAST is still struggling financially but did, end 2003 in the black (the first time in 3 years). The CAST staff and executive board have worked very hard to cut costs and increase income. The largest reason for the loss of income is the consolidation of companies. Each time companies combine one less check comes into CAST from a former donor without an increase from the now combined corporation. In order to offset these losses, CAST continues to contract Aoutside@ projects. Also, a committee has been formed to consider closing either the Washington D.C. or Ames office. Steve Halloran, CAST membership director, left CAST last fall and has not been replaced.

1. CAST conducted a bench marking survey prior to the Fall 2003 board meeting. Two major efforts to come from this meeting was the need for CAST to write an annual plan of work and a fund raising plan. Dick Stuckey, former CAST Executive Vice-President agreed to Chair the fund raising effort.

2. CAST recently added 3 new membership levels. Individual membership dues increased by $10 and retired members by $5 in 2004. The dues structure is as follows with the new categories underlined: Individual Members - $60/calendar year, Retired Members - $30/calendar year, Student Members - $25/calendar year, Century Club Members - $100/calendar year, Friends of CAST- $250/calendar year, President's Club - $500/calendar year, Millennium Club - $1,000/calendar year, Lifetime Members - $2,500 contribution or pledge

3. Last fall I reported CAST was discussing dropping all reimbursement for travel to the board meetings. This idea was not well received as several board members receive no reimbursement by their society for travel to the CAST board meetings. Currently, CAST will maintain the reimbursement to the board meetings equal to the amount the representative society pays for membership.

4. In response to heightened concern about the safety of fresh fruits and vegetables following recent outbreaks of food-related illness, CAST is releasing a commentary on the subject. The article briefly describes steps the fresh-produce processing industry is taking to decrease microbial contamination on products and lists actions consumers can take to enhance the safety of fresh produce they eat at home. This article is available at the CAST web site and may be reproduced and distributed

5. In January, CAST released an issue paper, *Intervention Strategies for the Microbiological Safety of Foods of Animal Origin*, which examines current intervention strategies as they are practiced at the farm, production, processing, and retail levels. This paper can also be viewed at the web cite.

6. The CAST spring board meeting will be held 18 to 20 March in Washington, DC. Please let me know of any issues you would like me to address at the meeting. As your WSWS rep., I currently Chair of the National Concerns Committee. Also, Jill Schroeder is the WSSA rep and Kassim Al-Khatib is the North Central Weed Sci. Soc rep to the CAST board.

Discussion:
Scott Nissen - how have we done in getting WSWS members to join CAST? Jill Schroeder - we need to make it know that members receive a copy of the reports (they are very good).

Motion to accept the report: Kassim Al-Khatib, 2nd Jill Schroeder. Motion passed (unanimous).

Student Paper Judging: (Kassim Al-Khatib)

DATE OF PREPARATION: February 25, 2004
COMMITTEE MEMBERS:
Kassim Al-Khatib, Chair (2003, 2004)
Kirk Howatt (2005)
Vanelle Carrithers (2006)
SUMMARY OF PROGRESS:

Graduate Paper and Poster contests. There are 18 graduate student papers and 19 graduate student posters entered in the contests at the 2004 WSWS meeting. There are two sections in each of the paper and poster contest. There are 20 judges line up for the contest with five judges per section. First, second, and third place winners for each section of the poster and paper contest will be selected.

Undergraduate Poster Contest. The 2004 undergraduate poster contest will be on experimental base and the committee will evaluate if we will continue with undergraduate contest. We have three students in the contest and three judges will evaluate these posters. Only one winner will be selected in the undergraduate contest.

RECOMMENDATION FOR BOARD ACTION:

Since the submission process for the WSWS has gone to web based, the instruction of copies of student paper abstracts to be sent to the student paper chair has been dropped from the call for papers. We have obtained copies of the abstract from the proceeding editor in second week of February. The student paper

judging committee would like the WSWS board to consider adding a provision to the operating guide indicating how the chair of this committee should obtain student abstract in the future.

BUDGET NEEDS

The contest awards budget for 2004 is $1,000 for 1st , 2nd , and 3rd place award in each poster and paper section and 1st place award for undergraduate contest ($100 for 1st place, $75 for the 2nd, and $50 for 3rd place in each section).

NAME OF THE PERSON PREPARING THIS REPORT:

Kassim Al-Khatib

Discussion:
Decision was made to reduce the number of judges for the papers and posters. Was seven reduced to five.
Nelroy Jackson – Do we need to increase the amount of the awards? Would like to have this issue address at the summer board meeting.
Discussion about undergraduate student awards: Jill Schroeder – The most important thing about doing this is that the students get feedback and that it is presented in a positive manner.
Ideal situation is to have more time between student presentations.

Action item: Re-evaluate undergraduate program at the summer meeting.
Action item: Re-evaluate the amount of the awards.

Motion to approve the report: Phil Stahlman, 2nd Jill Schroeder. Motion passed (unanimous).

Placement Committee: (Traci Sterling)

PLACEMENT COMMITTEE REPORT
WSWS BOARD MEETING
March 8, 2004
COLORADO SPRINGS

CHAIR: Tracy Sterling
COMMITTEE MEMBERS:
Curtis Thompson, past-chair
Pam Hutchinson

The placement forms ('Positions Available and Positions Desired') were revised and made available to members through the WSWS newsletter (November issue). Positions available from the 2004 WSSA meeting notebooks were provided by Steve Fennimore (Chair, WSSA Placement Committee).

Because of the reduced number of entries in the 'Positions Desired' and 'Positions Available' notebooks (three and six in 2003, respectively), the committee conducted a survey during Fall 2003 to ascertain how this committee might better serve the membership. Thirty-eight surveys were returned and tallied; the tallied results are attached.

In general, two-thirds of the respondents felt the Placement Committee was needed. Only five and 13 out of the respondents used the 'Positions Desired' and 'Positions Available' notebooks, respectively. There was overwhelming support for a 'List of Potential Jobs or Candidates' on the web and a 'List of Web Sites for Job Searches'. The respondents were split (50:50) in their desire for providing the notebooks or a Placement room at the meeting. Interest for reviewing CVs was minimal. The Websites which the

respondents found useful included: ASA, WSSA, University Web Sites, ESA, Chronicle of Higher Education, USA Jobs, ASHS, WSWS. The respondents suggested that the notebooks might be replaced by the WSWS Website as long as the offerings were kept up to date and employers posted current position openings. The respondents also suggested that the WSWS web site include a 'Job seeker/Resume' page. One respondent suggested the committee should 'be more productive. Solicit and explore job openings from the entire spectrum of potential employees'.

The committee's goals for 2004/2005 are:

1. Provide the Placement notebooks and room at the 2004 WSWS meetings (there was two job announcements for posting and one applicant posting as of March 1, 2004),

2. Work with the WSWS web master to:

a. Post positions available
b. Post job seekers
c. Set up links to other sites with Job Postings,

3. Survey Placement Committees from other Weed Science Societies (WSSA, SSWS, NEWSS, NCWSS) and/or other Professional Societies (ESA, ASA, ASHS) to probe other approaches to this issue,

4. Consider disbanding this committee.

We thank Tim Miller, as an unofficial member, for his contributions to this committee over the past year. Gil Cook appointed Pam Hutchinson as the chair for 2004/2005. Bill Kral has agreed to serve on the committee to replace Curtis Thompson.

Discussion:
Jill Schroeder – We will keep this in place for this year and discuss this with the other societies to see how they are handling this thing.
Has the use of this service become outdated due to internet use. Should we be looking at providing a different type service tied to the website that would list sites to go to look for employment opportunities? Should we also consider offering job interview skill opportunities.

Action Item: Should we discontinue the placement service?
Action Item: Do we need to re-evaluate what the role of this committee?

Motion to approve the report: Nelroy Jackson, 2nd Phil Stahlman. Motion passed (unanimous).

Education & Regulatory Report: (Monte Anderson)

Education and Regulatory Section Report
March 1, 2004

Chairman: Monte Anderson Chair-Elect: Charlie Hicks

The Education and Regulatory Section will be having a Symposium on Soil Organic Matter on Wednesday morning, March 10. This is a topic presented to the WSWS board previously by Bill Cobb, and will represent views from many aspects, including academic, a herbicide manufacturer, and a commercial consultant. A speaker from EPA to give their viewpoint was planned, but unfortunately scheduling conflicts prevented someone coming from Washington, DC. We will have two university

speakers, Jerry Weber from NC State, and Don Horneck from OR State, give background information on how organic matter is determined, how it varies among testing methods, and how that affects herbicide recommendations from an academic perspective. Mark Wrucke with Bayer CropScience will review how a manufacturer responded to herbicide interactions with organic matter with several herbicides. Bill Cobb of Cobb Consulting Services will provide the commercial consultant's perspective in how fertilizer recommendations can be quite different than herbicide rate recommendations based upon the same soil test, and depending on how that soil test was conducted and tested.

The invited speakers from the two universities were provided airfare and hotel accommodations along with complimentary registration. The WSWS board provides $1000 in support of costs associated with the Education and Regulatory Section, and most of this went towards the airfare costs of these non-WSWS members. In case we do not have sufficient complimentary rooms from the hotel, a board request was made and granted for up to $200 additional for hotel rooms.

Discussion:
Jim Kedrick (discussion session) cancelled and this slot will be fill by a presentation from Laura Quackenbush

Motion to accept the report: Jill Schroeder, 2nd Phil Stahlman. Motion passed (unanimous).

Public Relations: (Kai Umeda)

Kai Umeda - chair
Mark Ferrell, Brad Hanson, Milt McGiffen, Bill Cobb
WSWS Public relations committee report - March 8, 2004

A press release dated January 30, 2004 announced the 57th Annual Meeting of the WSWS (see attached) and distributed by e-mail to:

WSSA Newsletter
American Society for Horticultural Science
Agronomy Society of America
North American Weed Management Association
FICMNEW listserve
Farm Press
Meister Publishing
Yuma Daily Sun
Columbia Publishing (Carrot Country, Potato Country, Onion World)
Farm Progress Publishing (California Farmer, Western Farmer-Stockman)
Metrofarm radio
AgOnline (Successful Farming)
Advanstar (Landscape Management and Golfdom)
Associated Press
Colorado Springs Gazette

Continuing education hours requests for various state licensing requirements for attendees were submitted to: Arizona, California, Colorado, Idaho, Montana, Nebraska, New Mexico, Oregon, Utah, Washington, and Wyoming. Certified Crop Advisor (CCA) certification and Society for Range Management certification were applied for this year.

Requested from local arrangements chair that CEU sign-in area be located near the registration desk with two 6 or 8 ft tables.

Phil Banks and I will photograph traditional officers and awards recipients following luncheon.

Discussion:
Motion to accept the report: Nelroy Jackson, 2nd Kassim Al-Khatib. Motion passed (unanimous).

Education: (Scott Nissen)

WSWS Business Meeting
March 8, 2004

Education Committee Report
Distance Education Subgroup

Prepared by
Drs. Scott Nissen, Tracy Sterling, and Deana Namuth

Review: The objective of this Education Committee subgroup was to develop web based Weed Science educational materials that could provide classroom, extension/outreach, and self-directed learning opportunities in herbicide mode of action, herbicide resistant weed management, and weed ecology. Lessons were developed with grant funds from the American Distance Education Consortium (ADEC). The initial proposal was administered by Dr. Deana Namuth (University of Nebraska-Lincoln), a distance education specialist. The weed science modules are part of a large plant science website call the Library of Crop Technology, hosted by the UNL. In 2002, the WSWS Board of Directors agreed to provide the funding necessary to host a "mirrored" site that would appear as part of the WSWS website. This mirrored site would highlight the "Weed Science Education Module" as the main user interface, but would provide access to the Library of Crop Technology as a secondary layer. The ideas was to drive learners interested in Weed Science topics to the WSWS website and increase the societies visibility. In addition, one of the primary missions of the WSWS is education and these lessons will provide many educational opportunities for those interested in Weed Science.

Accomplishments: The WSWS website now has "NEW Weed Science On-Line Lessons". Individuals from five different universities have spent considerable time and effort developing these electronic modules. Authors are listed below:

Dr. Anita Dille, Kansas State University
Dr. Alex Martin, UNL
Dr. John Markwell, UNL
Dr. Scott Nissen, Colorado State University
Dr. Carol Mallory-Smith, Oregon State University
Dr. Tracy Sterling, New Mexico State University

The Library of Crop Technology database was provided to the new web hosting service. Ashu Guru (UNL DEAL web specialist) has suggested that 0.5 GB be made available for the material and this was accomplished. Additional space will allow for future expansion, both from the Weed Science and Crop Technology side. Updates and additions are being made by UNL and will automatically update the "mirrored" WSWS site.

Dr. Deana Namuth attended the WSSA meeting in Kansas City and presented a paper entitled "Creation of peer-reviewed online herbicide modes of action lessons and animations for public education". Her presentation reviewed the process of developing the modules now hosted on the WSWS website.

Budget: To date, $3,700 of the $5,000 allocated has been spent. Those of us involved with this project anticipate the remaining funds will be used over the next year to complete and update lessons and to provided for some additional animation development. Others will be encouraged to contribute to these lessons and develop additional lessons in the future.

Discussion:
Online lessons are now available – not sure how much it is being used. Did incure some additional expenses. Would like the link to be more prominent on the website. How can we further expand the site.

Motion to accept the report: Monte Anderson, 2nd Kassim. Motion passed (unanimous).

Noxious Weed Short Course: (Monte Anderson)

NOXIOUS WEED SHORT COURSE
COMMITTEE REPORT
March 5, 2004

TO: WSWS Executive Committee

FR: Celestine Duncan, chairman

The Noxious Weed Short Course sponsored by the WSWS will held at Chico Hot Springs Resort located in Pray, MT, April 26th through 29th, 2004. We are only offering one session this year because of conflicts with instructor and conference center schedules. Currently the course is filled (40 people) with 26 people on a waiting list and 4 registered for 2005. Participants include USFS, BLM, National Park Service, Fish and Wildlife Service, Dept. of Transportation, and County Weed Coordinators.

Instructors include: Dr. Rod Lym, Dr. Steven Enloe, Dr. Steve Dewey, Dr. Jim Jacobs, Dr. Fabian Menalled, Monica Porkorny, and Celestine Duncan representing the Western Society of Weed Science. Gilbert Gale (USFS), Dr. Bret Olson (MSU), Marilyn Marler (MCWD) and Melissa Brown, will also assist with the course.

Current weed short course budget is $31,155.00 with additional revenue that needs to be paid for registration. Expenses will be slightly greater this year because of cost of the conference facility. Please give me a call if you have questions.

Discussion:
These courses have been very well attended – we need to push WSWS membership from the people attending the meetings.
WSWS sponsorship of these courses needs to be made more prominent.

Motion to accept the report: Nelroy Jackson, 2nd Phil Stahlman. Motion passed (unanimous).

WSSA Report: (Nelroy Jackson)

Report of the WSWS Representative to the WSSA March 2004

The 2004 annual meeting in Kansas City was successful. The program went smoothly with posters, papers and symposia. The glyphosate symposium was very heavily attended. Attendance at the meeting was down from previous years. The Invasive Plant Workshop was attended by about 40 people, which was much less than expected. It could have been advertised better within NAWMA.

There is concern about declining attendance and membership. Regular membership was down to 1108 in 2003 from 1247 in 2002. Journal subscriptions are down from 643 to 557 for 2003. The membership committee will be revitalized, and Jill Schroeder will chair a new Strategic Planning committee.

WSSA is in sound financial condition. Rob Hedberg's status has been converted from that of a contractor to that of an employee. The BOD approved a raise and bonus for the Director of Science Policy. A special committee for the Graduate student organization will be appointed.

The New Officers elected were: Vice-President--Dale Shaner, Secretary--Don Morishita and Member-at-Large--John Jachetta. The summer board meeting will be July 24/25 in Honolulu.

Both the Asia-Pacific Weed Science Society and the Australian Weed Science Society want to have some joint programming with WSSA for the 2005 meeting in Honolulu. Carol is considering some program changes – more symposia, longer papers with time for discussion.

The newsletter will be published electronically only, on the WSSA website, from the October 2004 issue. A new journal for Invasive plant species is being researched. Weed calendars for 2005 will be published [they are a good marketing tool]. Sales of the XID CD's have begun.

John Lydon gave the USDA-ARS report for Del – no changes.

The IPINAMS conference was very successful with 800 attendees, addresses from senior federal management, a surplus to WSSA. A Proceeding is planned to be published in November 2005.

Nelroy Jackson

Discussion:
Bonus to Rob Hedberg is based on the amount of money he helps to raise.
Phil Westra - Success in the WSSA is due in a great part to the efforts of people like Nelroy Jackson - Seconded that Rob Hedberg is a huge asset.
Jill Schroeder – About strategic planning issue – coordination of WSSA and other affiliates (WSWS NCWSS …) Where are the societies going as memberships and interest declines. Did this discussion come up? Nelroy Jackson – not that he was aware of. Jill feels that the organizations need to come together on these issues.

NAWMA and ISAC: Some of the members will be leaving these committees. These Committees are making progress and gaining recognition.

Motion to accept the report: Phil Stahlman, 2nd Jill Schroeder. Motion passed (unanimous).

Legislative: (Jeff Koscelny)

Western Society of Weed Science
Legislative Committee Report
March 2004 Executive Board Business Meeting
Colorado Springs, CO

Committee members:
Jeffrey Koscelny, Chair
Roy Reichenbach, Past Chair
Dawn Rafferty, Member

The WSWS legislative committee provides input and guidance to the Director of Science Policy with regards to issues that might impact the society. The chair of the WSWS legislative committee also serves as a member of the WSSA Washing D.C. Liaison Committee. The activities of the committee during 2003-2004 were as follows:

- Requested clarification from the WSWS Executive Board regarding the operating guide for the legislative committee.
  - Background:
    - At the annual meeting in March 2002 in Salt Lake City, UT, the committee updated the operating guide for the legislative committee extending the length of terms of committee members and more accurately describing the duties of the committee and the chair.
    - The Executive Board met at the end of the March 2002 annual meeting and rejected the new operating guide.
    - The committee was operating under the assumption that the Executive Board had approved the new operating guide since notification was not received it had been rejected.
  - Requested Executive Board Action at the August, 2003 business meeting:
    - To determine whether the operating guide developed in 2002 was accepted or rejected.
    - The Executive Board determined that the updated operating guide for the legislative committee was rejected in 2002.

- Committee provided input the Rob Hedberg, Director of Science Policy regarding the following topics:
  - Key positions to promote during the 5th National Weed Awareness Week held in Washington, DC on February 22-27, 2004.
  - Provided input regarding a special APHIS project to explore glyphosate tolerant bentgrass.
  - Provided input regarding the setting of research priorities within the NRI grant programs for submission from the WSSA.
  - Discussed putting together a 5 year business plan for the Director of Science Policy.
  - Discussed ways for the societies to reach out to other scientific groups.

Executive Board Action items:
- Review and accept new operating guide for the WSWS legislative committee (attached). If accepted by the board, update the following:
  - Constitution and By-Lays / Article VIII – Standing Committees / Section 16
  - WSWS Operating Guide Chapter II / Duties of Committees and Editors / Legislative Committee.
- Review WSWS current contributions to funding the Director of Science Policy and consider yearly increases for next five years to help meet rising costs.

OPERATING GUIDE

LEGISLATIVE COMMITTEE

The Legislative Committee consists of a Chair, appointed to a two-year term with an additional year as past-chair, and two other members appointed to two-year terms. The term of the Committee members shall be established to expire alternately on a two-year cycle, so that at least two members continue over each cycle. After serving as Chair, she/he will become the Past-Chair for one year to provide advice, council and assistance to the Chair, and will act as the Vice-Chair when the Chair is not available. The WSSA Representative is the Executive Committee contact for this committee. The President of WSWS may appoint special consultants to the committee to provide expert guidance as required.

The Chair shall:

(1) Attend the WSSA meeting each year or arrange for an alternate if unable to attend.
(2) Serve as a member of the Weed Science Society of America (WSSA) Legislative Regulatory Committee.
(3) Serve as a member of the WSSA Washington, D.C. Liaison Committee.
(4) Serve as Past-Chair after completing one year as Chair.

The Legislative Committee shall:
(1) Report new information received from the WSSA Legislative Regulatory Committee and the Washington, D.C. Liaison Committee to the WSWS President in a timely manner.
(2) Keep the Executive Committee informed about the activities of the WSSA Director of Science Policy in Washington, D.C. and inform the Society membership of legislative issues through the WSWS newsletter.
(3) To stay current on legislative issues, the Committee will develop contacts and dialogue with national and regional organizations such as Western Weed Coordinating Committee, North American Weed Management Association, Invasive Noxious Weed Advisory Council (INWAC), Invasive Weed Awareness Coalition, and others.
(4) Provide scientific information, concerns and opinions to INWAC and other organizations that meet with and educate congressional and administration representatives.
(5) Utilize the Society membership expertise to deal with issues that are not familiar to the committee members.
(6) Inform the Director of Science Policy, WSSA, of significant WSWS issues as they arise.
(7) Forward records, including the Operating Guide, to the new Chair, within six weeks after the annual meeting.

Clarified that operating guide had never been approved so it was requested and approved.

Action Item: Presented the proposed operating guide for the Legislative committee and asked for the board's approval – this makes the responsibilities and terms more clear.

Discussion:
Laison committee will require that a business plan be developed – to evaluate pay of reps.

Summary: Only the WSWS is maintaining membership, all other societies numbers are decreasing. The request is that the WSWS make a bigger payment (to cover Rob?)

Action Item: Table the decision until the summer board meeting to allow for additional information/clarification on recommendation for additional support (funding).

Motion to accept the report: Monte Anderson, 2nd Jill Schroeder. Motion passed (unanimous).

Research Section Report: (Dan Ball)

Research Section Chair Report
Dan Ball, 2003 Research Section Chair

Contact has been maintained with chairpersons for the six WSWS research projects. They were contacted via email in July to review responsibilities their project sections, again prior to the December 1st deadline to finalize discussion topics, and finally again in early March to remind them of their responsibilities. Discussion topics were developed; session moderators, projectionists, etc. have been assigned. The 2004 program reflects the topics for discussion and session moderators. Session chairpersons will be loading

PowerPoint presentations the evening prior to their respective sessions. Session chairs have been asked to make backup copies of presentations in case of computer problems.

Session chairs have also been reminded to take minutes of their respective discussion sessions, obtain a list of participant names and addresses, select a 2005 chair-elect for their discussion session, and submit a final report of discussion session activities to Joan Campbell within two weeks after WSWS annual meeting.

Mick Mickelson, chair-elect for project #3 (Agronomic Crops) has resigned due to a change of employment from Montana State University and moved to Iowa where his wife has taken a position with Pioneer HiBred.

Typically, the Research Section Chair has been responsible for coordinating the editing and indexing of the annual Research Progress Report. This year the responsibility has been completely assumed by Joan Campbell and Traci Rauch. Their involvement with and commitment to compiling the Research Progress Report is gratefully acknowledged. The following table lists the names and contact information for the six 2004 project chairs and chairs-elect:

2004 WSWS Research Project Chairs and Chairs-Elect:

Project #	Title	2004 Chair	2004 Chair-Elect
1	Weeds of Range and Forest	Tim Prather PSES Department University of Idaho Moscow, ID 83844 208-885-9246 tprather@uidaho.edu	Janet Clark MSU Dept LRES P.O. Box 173120 Bozeman, MT 59717 406-994-6832 cipm@montana.edu
2	Weeds of Horticultural Crops	Tim Miller WSU-Mt Vernon 16650 State Route 536 Mt Vernon, WA 98273 360-848-6138 twmiller@wsu.edu	Fred Salzman IR-4 Project 681 US Hwy 1 South North Brunswick NJ 08902 732-932-9575 ext. 625 salzman@aesop.rutgers.edu
3	Weeds of Agronomic Crops	Jeff Herrmann Monsanto 3478 North 2983 East Twin Fall, ID 83301 208-736-7294 jeffrey.e.herrmann@monsanto.com	TBA
4	Teaching & Technology Transfer	Jed Colquhoun Oregon State University 337 Crop Science Bldg. Corvallis, OR 97331 541-737-8868 jed.colquhoun@oregonstate.edu	Cheryl A. Wilen University of CA UC Cooperative Extension 5555 Overland Ave. San Diego, CA 92123 858-694-2846 cawilen@ucdavis.edu
5	Wetlands & Wildlands	Rita Beard U. S. Forest Service 2150 Centre Ave. Ft. Collins, CO 80525 970-295-5745 rbeard@fs.fed.us	Jodie Holt University of CA Botany & Plant Sciences Riverside, CA 92521 909-787-3801 jodie.holt@ucr.edu
6	Basic Sciences	Kirk Howatt North Dakota State University 470-F Loftsgard Hall Fargo, ND 58105 701-231-7209 khowatt@ndsuext.nodak.edu	Tracy Sterling New Mexico State University MSC 3BE Las Cruces, NM 88003 505-646-6177 tsterlin@nmsu.edu

Discussion:
Phil Stahlman– Will session chairs please record peak number of attendees for future reference use for meeting room set-up?

Motion to accept the report: Nelroy Jackson, 2nd Kassim Al-Khatib. Motion passed (unanimous).

Rob Hedberg:
Discussion:
Change in his employee status – Is now an employee of the WSSA. He does still consider the local societies a major part of his responsibility.
Brief discussion about the financial expenses of the position. Will develop a business plan for the future. Concern is that to much emphasis will be put on bringing in revenue and that they will lose focus on important issues.
Past year accomplishments: Increased visibility of the society through conferences (NEWA? And ?)
National invasive weed awareness week was a great success, keying on early detection and rapid response.

Discussion: Phil Stahlman – what has to happen to get things moving to create these new positions? We all need to be working to keep this issue in front of university and ask them to help influence the decision making process.

Rob thinks the salt cedar bill pass this year and also hopefully the Craig bill.

Motion to accept the report: Phil Stahlman 2nd Jill Schroeder. Motion passed (unanimous).

Web Report: (Joan Campbell)

WSWS Website Report
March 2004

The WSWS website was completely redesigned by a different company, Intelsys, summer 2003 for a cost of $2250. The site uses a Content Management System which does not require html coding.

New online submission forms for annual meeting papers were loaded Fall 2003 and along with some changes to photographs on the site cost $3195.95 (159 hours at $20.00 per hour).

The Weed Lessons developed by the Education Committee through Univ. of Nebraska are mirrored on the WSWS site.

Some delays in getting the website online have been corrected. The DNS registration was in the name of our former web designer. It is now in the name of WSWS. The former hosting company was sold and no longer exists. We are now hosted by cihost.com which is a larger, more reliable company with great technical service.

Tony White critiqued the site and offered some good advice. Continual input on site design is necessary to help keep information on the site easily accessible.

Online paper submissions worked quite well. The server at the hosting company was down on November 25, 2 days before the Thanksgiving holiday and many authors were trying to submit titles before the December 1 deadline. The deadline was extended to December 10 to accommodate authors who were impacted.

Abstract submissions also worked well. A few authors missed the deadline and some forgot their logon name and password.

Recommendations

1. Changes that should be made include:

A. Notification by email every time an author adds or changes data on the database. Some authors were unsure if their abstract was submitted.
B. Notification that the paper was accepted. Some authors did not know that their paper was accepted and did not have prior approval to travel to the meeting.
C. Stronger explanation that two papers must have two separate login names. Some authors overwrote their first paper.
D. Mailing list replies need to be routed to the web editor.
E. Minor wording changes and grammar correction.
F. Improved site maintenance by web editor.

Cost estimate for programming these changes has been requested from Intelsys for changes A through E.

2. Consider an ad hoc committee for the website.

Action items

1. Approve changes to website after cost estimate is received.
2. Approve committee.

Respectfully submitted,
Joan Campbell

Discussion:
In 1997 we first developed a Web Site and to date we have actually paid very little for this service. Last year the decision was made to go to a company that could provide much better support, but this will cost more money. To really develop this will take someone with time and not necessarily a lot of web site knowledge. The list-serve is not really operating properly and needs to have some improvements made to it.

Online submission: Steve Miller – submitted paper title and got a conformation that it was received, but in fact the paper did not get submitted. Phil/Joan – the case may be that a second submission (submitted more than on paper) overwrote the first submission. Joan will look into this and try to figure out what happened, this seems to be a unique case.

Nelroy Jackson– Wanted to clarify that items that are to go on the listserve should be sent to Joan. Yes- but she feels there need to be some clarification /guidelines as to what can be posted.

Action Item: Approve changes to website after cost estimate is received.

Action Item: Approve committee - Would like to have a committee where each person would have some responsibility. Would like to have a list of proposed committee member responsibilities. Ideal would be to have some continuity. Proposal is that the editor position be maintained and a committee will be formed. What should this committee look like?
Solution for now is that the Adhoc committee will meet with Joan and come up with a proposal for the summer board meeting. We may want to think about offering some type of incentive to the editor. Joan would like to give up the website editor responsibility. She is willing to continue until a replacement can be found.

Motion to accept the report: Jill Schroeder, 2nd Monte Anderson. Motion passed.

Web Adhoc Committee: (Gil Cook)

Member-at-Large Report: (Kassim Al-Khatib)

Member At-large Report
Kassim Al-Khatib
March 2004

The student Education Enhancement Program may face deactivation or cancellation. Lack of hosts, cost, time, and liability are major issues facing the program. We recognize the hard time the chemical industry experienced that result in difficulties in finding host for students. However, the program is very useful to provide students with learning opportunity that students usually do not get in the class room or through their research project. The board in the last meeting acknowledges the importance and benefits of this program.

It is clear that continuation of the program is difficult and some adjustments need to be made such as downsizing the program or adopt a new program that benefit students. For example, a short term internship with industry or government can enrich student learning experience. The board also needs to look at the possibility to provide partial funding to student Education Enhancement Program. Other regional Weed Science Societies fund their student Education Enhancement Program. For example, NCWSS provide $6,000 to support the NCWSS inter colligate student contest. The SEE committee in coordination with the board needs to modify the program considering the current and future conditions, liability, cost and time.

Student Educational Enhancement: (Tim Tripp)

Student Education Enhancement Report
Tim Tripp – March, 2004

Report of the Student Educational Enhancement Committee for the March, 2004 meeting of the Western Society of Weed Science.

At the summer board meeting, it was recommended that the SEE program should be re-evaluated in terms of several factors including costs, liability, objectives, measurements against objectives, and time commitment.

Most of the concerns were centered around cost, time, and liability.

Cost – Available funding for programs such as SEE are increasingly difficult to find in both the private and public sectors.

Time – As companies and universities reduce the number of employees, the responsibilities for the remaining employees increase past the saturation point. Fewer managers see the need for their reports to spend time during the field season performing tasks other than those considered essential. One expressed concern is how beneficial a week would be for a student when they are passed from host to host because none of the hosts have enough time to spend adequately with the student.

Liability – Although the traditional application form states that "No liability or insurance is placed on WSWS", a concern is that in an age of litigation such a statement does not protect the host or probably not even protect the society.

The following recommendations were proposed:

Determine the degree of true liability of both the society and the hosts. Determine the likely risks and possible preventative measures such as waivers. If the society can clear the legal uncertainties, then:

Determine the extent of interest in the SEE program among hosts, students, advisers, and the board. One possible approach would be to conduct a simple survey. If the survey determines that there is still genuine interest, then:

Re-evaluate the objectives of the program. Originally the program was established when both companies and universities were hiring actively. One unstated objective of the program was to be part of the interview process - familiarity and exposure for both the student and the potential employer. With most companies and universities significantly scaling back on budgets and employee numbers, the purpose and objectives of the SEE program should be re-evaluated.

Explore sources of funding. It has been proposed that the society should consider creating an endowment (the proposed amount was $20,000) to support the SEE program. Regardless of the number of students participating, the fund would not be expected to do more than supplement the support provided by the host and adviser. Some funding would likely still be required from the host and/or the student/adviser.

The following options for the future of the SEE program were proposed:

1). Continue as in the past with no modifications.

2). Continue the program with modifications such as funding from the society, different objectives and goals, selection process, or other changes.

3). Allow the program to go dormant until the demand increases or the current obstacles are removed.

4). Discontinue the program.

At the summer board meeting, apparently the board preferred option 2. Consequently the following actions are recommended:

1). Establish a source of funding for the SEE program.

2). Create a set of objectives and goals for the SEE program.

3). Since funding will likely be limited, establish a selection process based upon the objectives and goals to distribute the funds available each year.

Discussion:
Addition (from Tim): 4) Committee should be populated with graduate students.
Jill - We need to look other options/directions to other areas of interest outside of Industry. Discussion around issues with hosting a student (cost/tight budgets, time issues, liability). Students feel there is a great opportunity with this program. Do we need to have students on this committee?

Action Item: Table the decision until other we have the other recommendations.

Motion to accept the report: Dan Ball, 2nd Phil Stahlman. Motion passed.

Herbicide Resistance: (Randy Anderson)

Herbicide Resistant Plants Committee Report
Randy Anderson, Chair
WSWS Herbicide Resistant Plants Committee

At the 2004 annual meeting, our committee will present a poster, "*Guides to help producers manage weed resistance*". The poster describes two fact sheets, written by the committee, that explain biological principles related to weed resistance. The fact sheets are available for the public via the publication section of the WSWS web page. The poster also describes an extension bulletin, written by scientists at the University of Idaho, which explains factors related to soil persistence of herbicides. The fact sheets and extension bulletin will help producers with long-term planning of weed management.

During the 2004 WSWS meeting, our committee will discuss the possibility of developing a template for field day handouts. The template will help extension specialists explain the cause of resistance and summarize tactics for resistance management. If completed, the template would be available for public use via the WSWS web page.

We do not have any specific requests for the WSWS executive committee.

Discussion:
Dan Ball pointed out the fact sheets are on the Web Page.

Motion to accept the report: Monte Anderson, 2nd Kassim Al-Khatib. Motion passed (unanimous).

Committee Reports: (Gil Cook)

Nomination: (Neal Hageman)

Nominations Committee Report
WSWS Business Meeting
March 8, 2004

I want to thank the committee members who participated on the Nominations Committee this past year: Steve Miller (past chairman), Bill McCloskey (new member), and Jill Schroeder (past WSWS President)

We had an excellent slate of candidates for this year's election. I want to thank all the nominees who were so willing to get involved and serve the WSWS.

There were 107 ballots submitted by the deadline of January 15, 2004.

Following are the winners of the 2004 election:

President Elect
Phil Banks, Marathon-Ag/Environ Consulting, New Mexico

Secretary (two-year term)
Vince Ulstad, BASF, North Dakota

Research Section Chair-Elect
Corey Ransom, Oregon State University

Education & Regulatory Section Chair-Elect

Tim Miller, Washington State University

Respectfully submitted by
Neal Hageman
2004 Nominations Committee Chair

Motion to accept the report: Nelroy Jackson, 2nd Phil Stahlman. Motion passed (unanimous).

Awards Committee: (Phil Stahlman)

Awards Committee Report
2004 Western Society of Weed Science Business Meeting
March 8, 2004 Colorado Springs, CO

1. The Call for Nominations for Distinguished Achievement Awards was mailed to the membership along with the September Newsletter, Call for Papers, and other notices. It also was posted on the website. The committee neglected to identify deserving candidates and solicit persons to nominate them.
2. Only three nominations were received, each for a different category, and the committee was in unanimous agreement that all three nominees were worthy of recognition. There were no nominations for Early Career-Public Sector, Weed Manager, or Professional Staff categories.
4. The three Distinguished Achievement Awardees for 2004 are:
   Dr. Joseph M. DiTomaso – Outstanding Weed Scientist – Public Sector
   Dr. Ron P. Crockett – Outstanding Weed Scientist – Private Sector
   Mr. Jim Vandecoevering – Outstanding Weed Scientist – Early Career, Private Sector
5. Awards Committee Chair for 2004-05 is Marvin Butler, Oregon State University. The current chair will remain on the committee for one more year and a new member will be appointed to replace Paul Ogg, who rotates off the committee.

Recommendations: The committee should make a concerted effort to identify deserving individuals and arrange for persons to nominate them.

Submitted by Phil Stahlman
2004 Awards Committee Chair

Motion to accept the report: Dan ball, 2nd Jill Schroeder. Motion passed (unanimous).
Site Selection Committee: (Steve Dewey)

Site Selection Committee Report
March 8, 2004
Steve Dewey, Jesse Richardson, Traci Rauch

States targeted for 2007 WSWS meeting locations were Arizona, New Mexico, California, Idaho, Oregon, Kansas, Nebraska, Missouri, and Oklahoma. Kathy Tatom, of HelmsBriscoe, solicited information from numerous hotels and forwarded tentative bids from what she considered to be the top 13 options. The list was narrowed to:

City	Hotel	Dates	Rates & Fees	Comments
Portland, OR	DoubleTree-Columbia R.	Mar 2-9	$ 89 single/dbl	free parking and shuttle
Portland, OR	Hilton & Exec Tower	Mar 2-9	$ 109 single/dbl	$18/day parking fee
Costa Mesa,	Hilton Costa Mesa	Mar 3-9	$ 129s / $	high food/beverage, $10

CA			144d	parking
Tulsa, OK	*DoubleTree-Downtown*	*Mar 3-8*	$ 77 single/dbl	low attendance concern

Carol Mallory-Smith toured the two Portland hotels and reported that both were very acceptable (location, size, meeting room arrangement, etc.). The Hilton is more centrally located in the city (downtown), but the guest rooms cost $20 more than at the DoubleTree, and there is an additional $18 per day parking fee. Pillars in some Hilton meeting rooms do not appear to pose a visibility problem. She reported that the DoubleTree might be a little cramped if WSWS attendance increases substantially by 2007, but at this point is very adequate in size. Additional restaurants, a mall, and other shopping facilities are located within walking distance of the DoubleTree.

Tom Peeper visited the Tulsa DoubleTree and was very impressed with the facility and staff. The meeting room numbers, sizes, and arrangement are good. Ownership of the hotel has recently changed, with a major renovation to be completed by 2006. The hotel is 10-15 minutes from the airport and the hotel offers free shuttle service. Guest room rates are very reasonable, as are food and beverage prices. While attending the WSSA meetings in Kansas City, I asked several SWSS members for their opinion about Tulsa as a potential meeting site. In each case, their opinion was somewhat negative. They felt the hotel was fine, but that there was little else to attract our members to Tulsa. They cautioned that attendance would be down significantly if we chose Tulsa. There was also concern than the cost of air travel might be higher than to bigger cities. However, I see many internet prices for roundtrip tickets from Salt Lake are less than $280.

Jesse Richardson toured the Costa Mesa Hilton and reported that the California Weed Conference met there several years ago when it was a Red Lion hotel. The facilities are very adequate, but prices for hotel food and beverages are nearly double compared to the other locations. (Examples: 1 dozen cookies = $35 at Costa Mesa and $19 at Tulsa. Dinners range from $35-60 at Costa Mesa, $19-30 at Tulsa, and $23-32 at Portland). The hotel has offered a 10% discount on F/B, but prices are still high. Jesse feels there are fewer outside attractions in Costa Mesa compared to Portland, and that attendance might be low (similar to the Tucson meetings, but better than if held at Tulsa). Another concern is that San Diego is WSSA's first choice for their 2007 meeting location.

Action Needed At This Meeting: Selection by the Board of the 2007 meeting site.

Discussion:
Dan Ball thought the Portland Sites were good locations. May be some safety issues with the Double Tree. Several people felt that there are advantages to the Hilton site.
Steve pointed an over-site, that he had look into availability for the first week in March and it may need to actually be the 2nd week of March.
Carol said that even though more expensive, overall she would say there were more advantages to the Hilton site due to the location and the fact that is more suited to conferences.

Motion to choose the Hilton in Portland pending availability by Dan Ball, 2nd Jill Schroeder. If not available the committee will present alternatives at the Thursday meeting. Motion passed.

Old Business:

New Business:

Don Morishita Proposed Student Contest (Weed Contest)

Propose hosting a Contest in Idaho falls 2006. Is asking the board to help sponsor this event. NCWSS provides $6,500.
Discussion:
Jill Schroeder - NCWSS is considering ways to include those interested in Invasive Species, would that component included? Yes that is the plan.
Phil Stahlman: Do you have an idea of travel distances? Looking at 14 institutions within a reasonable distance. (<1500 miles?)
Kassim Al-Khatib - Requires a lot of work (up to 50 volunteers and about $15,000). Diverse farming systems in the West may present problems.
Phil Banks - It does not need to look like it does everywhere else.
Jill - This does give students a broader view of cropping systems and could actually be an educational enhancement opportunity.
Suggested that Don attend the North Central contest.
Consider if there are other Universities that would be willing to host the contest.

Return to tabled student enhancement committee. Needs to be handled as a separate issue.

Action Item: Proposal for Don to bring a formal proposal to the summer board meeting.

Motion to bring the tabled issue on Student Enhancement back up for discussion: Phil Stahlman, 2nd Kassim Al-Khatib. Vote 5 to 3.

Action item: For the committee to create a set of objectives and goals for the SEE program and a projected cost affiliated with that program.
Motion made by Jill Schroeder, 2nd by Phil Stahlman. Motion passed (unanimous).

Benchmarking: (Phil Stahlman & Vanelle Carrithers)

Vanelle went over and explained the information about the workshop. This was an informative presentation at this time. No action is required by the board at this time.

Future for the Weed Science Societies
Nelroy Jackson asked for more information from Phil Stahlman and Phil Banks about the Presidents Breakfast at WSSA dealing with the future of Societies. We in the west are in (at least for now) a better position that any of the other regions. Most of them are considering some significant changes.
Nelroy asked if there was a plan for communication among the presidents prior to the next WSSA meeting. Nothing formal, but there is a channel established they may lead to better communication.

Motion to adjourn at 4:25 PM by Phil Stahlman, 2nd Nelroy Jackson. Motion passed (unanimous).

(Minutes submitted by Pete Forster)

WESTERN SOCIETY OF WEED SCIENCE
Post Conference Board Meeting
11 March, 2004

Present: P. Stahlman, S. Nissen, D. Lyon, D. Ball, C. Ransom, K. Howatt, C. Hicks, G. Cook, M. Edwards, T. Miller, K. Al-Khatib, D. Shoup, J. Schroeder, W. Graves, P. Banks, V. Ulstad, N. Jackson, V. Carrithers, M. Anderson, P. Forster.

The main purpose of this meeting was to:
1) debrief following the annual conference just concluded
2) pass leadership from outgoing committee and board members to the incoming members
3) draft the initial agenda for the summer board meeting.

Phil Stahlman opened the meeting at 11:50 AM. He welcomed new board members:
Phil Banks as president-elect
Vanelle Carrithers as member-at-large
Drew Lyon as research section chair
Corey Ransom as research section chair-elect
Charlie Hicks as education & regulatory chair
Tim Miller as education & regulatory chair-elect
Vince Ulstad as secretary

Steve Miller has stepped down from the position to which he was appointed by Jill Schroeder for reviewing the operating manual. Jill will step into that responsibility temporarily to work on reviewing the operating manual.

Meeting Review:

Phil Stahlman asked for any comments people had heard about the conference:

Dan Ball brought up that since presentations are designed in PowerPoint and are brought to the meeting by on CD's by the presenters, to be loaded the night before the respective session, section chairs should not have to seek presenters out to make sure they get their presentation loaded. Section chairs had some presentations given to them only minutes before a session this meeting. Communication needs to improve to presenters in getting the presentations in and loaded. Two suggestions were made to improve the process:

- the WSSA procedure—presenters send their presentations to the section chair by a set time ahead of the meeting. Presenter could email to the chair, send CD in the mail, or park the presentation on a website to be downloaded as a PDF.
- the NCWSS procedure—at registration desk, CD's are placed in an appropriate box & section chairs retrieve the contents of their session from the registration desk.

Phil Stahlman asked whether this takes board vote, or if it is up to the program chair or section chair. Phil Banks asked Drew Lyon & Charlie Hicks to decide between themselves on the submission procedure they would recommend and communicate that to the board at the summer meeting. Discussion could then be held by the board, a procedure agreed upon and session leaders then notified. It is also important to emphasize the guidelines in the call for papers as to standardized/approved PowerPoint versions that are to be used for presentations.

WSWS has four long patch cords from the computers to the projectors so we do not need to rent them from meeting facilities. They will be stored with the easels and availability needs to be communicated to the section chairs & local arrangements committees so as to avoid potential rental costs.

As a reminder to all, the operating guide indicates that outgoing chairs are to pass their committee files to the incoming chairs.

Doug Shoup indicated that several students were not aware of the Student Educational Enhancement Program (SEEP) and the program may need to be publicized more. Discussion brought out that we have had more applicants that hosts. This interface between awareness, interest, and placement is an ongoing area for improvement. Faculty members need to notify their students of the program. The SEEP committee will be suggesting guidelines & procedures for enhanced efficiency of the program and its workings. It is important to have hosts available even before students sign up.

Nelroy Jackson indicated the Saltcedar symposium was excellent, with 27 walk-in registrations. Previous invasive species symposia have been very successful and WSWS should build upon that attraction. A suggestion was made to highlight one invasive species each year and build on the success of these focused symposia. Vanelle Carrithers & Phil Banks indicated that it is under consideration already for next year.

Nelroy Jackson commended Phil Stahlman on his presentation at the general session & suggested that copies be provided to the board & others that express interest. The data which Phil reviewed should be archived for future planning and update. Phil intends to bring everything current through the 2004 meeting and post the data on the website and in the proceedings. Other regional societies and WSSA are interested in the data & format.

Phil Stahlman indicated that a government employee gave insight as to why government employee attendance often drops off at meetings--that government per diem rates relative to the hotel room costs are a big factor. Also, going out of the United States for meetings may be an issue. Discussion was held on whether international students may not be able to go to the Canada meeting due to VISA's and travel restrictions. Phil Banks indicated that a special effort will be made to communicate the travel requirements into Canada for all members well prior to next year's meeting.

An effort should be made to invite the Canadian Weed Science Society members to next year's meeting in Vancouver, BC.

Scott Nissen relayed comments from some members that the general session was not as special as in the past in that content was less than one would expect for a society's general session. By not having keynote speakers or celebrity-type personalities, it does not have the draw that a general session may be expected to have. Phil Banks asked for input on speakers and topics for next year. Many keynote speakers do some gratis speeches if contacted well in advance.

Scott Nissen indicated that the session on Weeds of Wetlands and Wildlands, with only 3 papers, should it have been augmented with more papers. Posters on applicable subjects could have been converted to papers, to round out the session.

Kassim Al-Khatib indicated this was first year of undergraduate student contest and that the three entrants did an excellent job. There is nothing in the operating guide about this contest, so he posed the question as to what should be done for next year. He asked whether WSWS offers both an undergraduate paper and poster contest, given the limited number of entrants. He also pointed out that graduate student paper judges requested more time between judged papers so as to finish thought and comments on each paper properly and equitably between papers. Many were rushed as student papers were often put back-to-back.

Kassim indicated that while the number of graduate student posters has been going up, this trend may not continue. Some schools charge their students for printing of posters, which can get expensive to a project. Thus, may we expect a reversion to oral papers rather than posters?

Phil Stahlman had an industry member express concern about the trend to more student posters over papers and the implication that it is hard for people to judge potential job candidates on oral speaking skills when they are not making oral papers presentations.

The question was asked about a student competing in both the paper and poster contests. If they are only to compete in one or the other, they need to be notified about selecting one or the other. The operating guide needs to clarify any decisions. Also, the protocol for deciding ties should be clarified and included in the operating guide. This is an action item for that committee to clarify.

Phil Banks moved to continue the undergraduate poster contest and make it a permanent contest of the WSWS. Gil Cook seconded the motion. Discussion was held. Rules would need to be specified, but would be similar to those for the graduate student poster contest. The entrants will need to be enrolled as an undergraduate student at the time of contest. The motion passed on voice vote.

Student night out was an overwhelming success this year.

Summer Board meeting plans:

Tim Miller called the Hyatt Regency hotel in Vancouver to inquire about meeting facilities for the dates of July 30 and 31, 2004. They have a large group in until noon on July 30, thus the summer board meeting would not be able to convene at that site until 1:30 PM on July 30, 2004. Phil Stahlman asked if we need extra time to work with survey data gathered at this meeting. Discussion was held on going into the evening of the summer meeting rather than the next afternoon of the meeting. Considerations of Sunday travel by meeting too late into Saturday were a concern to some. Consideration of moving to the following weekend doesn't fit all schedules. Phil will recheck his schedule & possibly move the meeting to Aug. 6 & 7. Gil suggested checking on suites or other venues in that hotel to keep the dates as scheduled. Phil Stahlman will work with Tim Miller on the available options and get back to everyone with the final dates for the summer meeting.

Nelroy Jackson asked about getting complimentary hotel rooms for the summer board meeting, even though the contract is signed. Tim Miller will check into it and this feature will be added as a negotiation point for future site selection.

Phil Stahlman indicated that the society had 8 free hours of consultation from ISL, a consulting firm. He asked if the board anticipates need to contract for additional consulting time from ISL. Jill Schroeder asked about the specifics of what Phil thought we would need—having Pam come in to meet with the board & facilitate the evaluation process, would phone consultation be appropriate, etc. Vanelle Carrithers suggested some consultation time to prepare for a meeting and then have Pam come to a meeting of the board. Additional costs would need to be determined. Barbara Rushmore is the individual with whom WSWS would need to explore costs for Pam's services. Phil Stahlman asked for permission from the board to explore the costs, options, etc. and report back to the full board. Phil Banks indicated that we should anticipate a full discussion of the society's future and that the presidents and designated representatives of all regional weed science societies may be asked to come to a meeting prior to the next WSSA meeting in Honolulu. Nelroy Jackson moved & Gil Cook seconded to authorize Phil Stahlman, Jill Schroeder, and Vanelle Carrithers to talk directly with Barbara Rushmore about costs and details of further consultation and meeting with the board at the summer meeting. Motion passed without discussion on a voice vote.

Site Selection:

The 2007 meeting could be held the second week of March at the Portland Hilton. The parking garage is not owned by the hotel, so would have to negotiate directly with the owner for reduced parking rates. Kathy Tatum, of Helms Briscoe, will approach the hotel about complimentary rooms for summer board meeting. The board confirmed the motion made at the meeting of March 8, 2004 to set the 2007 meeting at the Portland Hilton from March 13 to 15. A local arrangements chair has not yet been identified but Phil Banks will approach Carol Mallory-Smith and Jed Colquhoun about chairing the committee.

Gil Cook had been asked, by some members, about going back to southern California for a meeting. Those comments will be passed on to the site selection committees. Southern California tends to be very expensive for meetings. Nelroy Jackson suggested that if the society wants to go there for a meeting, a year should be picked, a site selected, and, if costs are too high, the society should consider subsidizing the cost. If demand is there, the cost can be worked out by negotiations, selecting venues that keep costs down, etc. Nelroy is willing to help a site selection narrow down venues.

Outstanding Action items:

Weeds of the West:
Phil Stahlman reviewed Tom Whitson's report on Weeds of the West. Scott Nissen reminded the board that Joe DiTomaso is publishing an excellent & comprehensive book, which may well replace some of the demand for Weeds of the West. Scott cautioned about having another publication run and then ending up with a big inventory, which may be slow to move. Jill Schroeder suggested postponing a decision on another printing until this summer to see what happens with inventory. Upon Tom Whitson's arrival at the meeting to review his report, the following policy and procedure guidelines, submitted by Tom Whitson, are added to the minutes:

Weeds of the West Policies and Procedure

The publication has always been printed by Grand Teton Lithography, 132 West Gill Avenue, Box 4391, Jackson, WY 83001 (307-733-8600). From the beginning, the publisher has worked cooperatively with the Society and has done an excellent job. The company has a talented graphics design team and the most current color digitized equipment to ensure a quality book. The editor has worked closely with the

printer over the years to make the arrangement a win-win for both the company and the Society. The editor and/or a representative of WSWS should continue that relationship by meeting periodically with Grand Teton Lithography to renew contracts and prepare for reprints. Prices vary per printing depending on quantity but the Society has always maintained approximately a $2.00 per copy gross profit. Shipping costs from the bindery are the only expense taken from the Society's profit.

Prior to each printing, university publications offices are contacted for prepublication orders. The procedure allows each institution to save approximately $1.00 per copy in freight charges if they order at least 900 copies. Once the book is printed, the next procedure involves storage and distribution. Large orders, one pallet of 900 copies, or more are shipped directly from the book bindery, as contracted through and directed by Teton Lithography. The remainder of the books printed are shipped to the University of Wyoming for storage and distribution. The University has generously agreed to store the books at no charge, a considerable savings for the Society. University of Wyoming also distributes and maintains inventory records of the book through UW Extension Bulletin Room (307-766-2115), again at no cost to the Society. The editor has coordinated the storage and distribution, again as a service to the Society. Books are sold to universities or distributors who individually determine where they sell and how much they charge. Accounts are maintained by the UW College of Agriculture. Monies are sent to the Society when at least 2,000 copies have been sold.

When the inventory drops below 3,000, a decision needs to be made about reprinting. Approximately three months notice is required for the printer to produce new copies. Revisions and updates to the book are determined by the Weeds of the West book committee.

When use of photos from the book are requested, two policies apply. For-profit groups are charged $100.00 per photo and credit must be given to the publication. Non-profit use for educational purposes (no more than 10 photos) carries no charge, but again, they must credit the publication. No photos may be copied or used on the web.

(end of report)

Historically, sales have been about 1000 copies / month. Currently, sales are about 500 copies per month. Tom has obtained a cost estimate for reprinting, although the bid, received last November, has expired. Current inventory is about 7,600 copies. Tom estimates that inventory will be sold out before the end of the year.

Phil Stahlman asked about delaying a reprint decision until the summer meeting so as to track the rate of sales rate. Current inventory will safely cover us until mid-summer. Gil Cook moved to delay the reprint decision until the summer board meeting. Drew Lyon seconded the motion. Phil Stahlman pointed out that the bids quoted for reprinting expired last November. Vanelle Carrithers asked about the publication/printing schedule for Joe DiTomaso's book. Jill Schroeder asked about the wholesale cost of Weeds Of the West. For a pallet volume (900 copies) the wholesale price is $14/copy. Otherwise, the wholesale price is $18/copy. Retail prices vary from $25 to $30. The motion passed on a voice vote.

Dan Ball brought up an email he received from the Youth Conservation Corps in Malheur County, Oregon, inquiring about complimentary copies of Weeds Of the West for use as textbooks in their training. Tom Whitson will check into the inventory to see if there are any that can't be sold due to flaws, etc. Tom did not feel we could donate some without setting a significant precedent. Gil Cook felt that if we start if with one county, it could escalate into a significant profit loss.

Brian Jenks has expressed interest in serving as the webmaster. Tony White has also expressed interest.

Nelroy Jackson suggested that Phil Stahlman, as president, fill all committee slots as soon as possible, and send out the list of committee members to the board as soon as possible. Phil is about half done with the process and will complete it soon. Phil will make an effort to getting as many new members involved as possible.

No other business was brought to the attention of the board.

Phil Stahlman declared the meeting adjourned at 1:19 PM.

Respectfully submitted,
Vince Ulstad
Secretary

Western Society of Weed Science Financial Statement
April 1, 2003 through March 31, 2004
Year-End Report

CAPITAL

2002-2003 Balance Forward	$197,292.11
Current Income (Loss)	80,556.34
	$277,848.45

DISTRIBUTION OF CAPITAL

RBC Dain Rauscher Funds	$227,701.97
Money Market Savings (Newark)	48,288.88
Checking (Newark)	1,857.60
	$277,848.45

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INCOME

Registration & Membership Dues	$30,812.00
Proceedings	5,175.45
Research Progress Report	3,421.70
CAST Referral Program	50.00
Noxious Weed Control Short Course	20,555.00
Weeds of the West Publication	58,524.50
2004 Sustaining Membership Dues	4,800.00
Annual Meeting Refreshment Break Contribution	3,000.00
WSSA 2004 Calendars	90.00
Bank Interest (Newark)	32.25
RBC Dain Rauscher Interest	41,590.40
IRS Tax Exempt Application Fee Refund	500.00
	$168,551.30

April 1, 2003 through March 31, 2004

EXPENSES

Office Supplies & Equipment	$ 900.02
Postage, Mailing Permits, Box Rental, UPS Shipping	2,386.97
Telephone, Internet Service	1,593.77
Website Maintenance	4,264.00
Weed Science On-Line Lessons	3,525.00
WSSA Director of Science Policy	7,300.00
WSSA Representative Summer Board Meeting Expenses	409.15
Proceedings Editor Airline & Room (annual meeting)	747.88
CAST Representative Board Meeting Expenses	746.39
CAST 2004 Membership Dues	569.00
Tax Accountant	300.00
Franchise Tax Board	10.00
IRS Tax Exempt Application Fee	500.00
IRS Tax Adjustment	3.91
IRS Employee Taxes	2,409.40
California Employment Development Taxes	627.15
California Continuing Education Application Fee	135.00
Printing	
Newsletters	1,026.71
2003 Proceeding	2,675.00
2004 Research Progress Reports	2,320.00
Program agendas – 2004 meeting	747.07
Stationary (letterhead/envelopes)	269.54
Noxious Weed Control Short Course	15,573.02
Weeds of the West	960.00
WSSA Calendars	90.00
Student Awards & Meeting Travel Subsidy	1,744.47
Business Manager	12,615.58
Refunds – Registration Fees	475.00
Business Records Storage	912.00
Executive Board & Committee Meetings	3,123.10
Meeting Guest Speaker Expenses	3,071.03
Awards Luncheon	7,261.80
Awards Plaques	335.20
Audio Visual Rental for Annual Meeting	4,601.30
Refreshment Breaks – Annual Meeting	3,766.50
	$87,994.96

2004 HONORARY MEMBER AWARD
Doug Schmale

Doug Schmale is a dryland wheat producer who farms 4600 acres in Nebraska and Colorado. Over the years, he has actively worked with ARS and university research and extension systems in both states. He attends field days, serves on advisory boards, including the ARS Customer Focus Group for the Central Great Plains Research Station, participates in professional society meetings, and scours the literature, including extension publications, research reports and web sites, for information that will make him and his fellow farmers more efficient and productive producers.

Doug had made major contributions to agriculture and to weed science in the western United States. He has been very active in the National Wheat Growers Association, a commodity group that influences much of the western region's agriculture. He is a member of the Nebraska Wheat Board, which annually provides over $1 million for wheat research, market development, and national farm policy development. As a Wheat Board member, he was instrumental in obtaining funding for a laser droplet analyzer for use by Dr. Robert Klein's ARS research program on improving pesticide application technology. Doug also is a very active member of the National Jointed Goatgrass Steering Committee. He helps establish research priorities, reviews all research projects, and is part of the team that annually allocates approximately $350,000 in USDA Special Grant Funding to goatgrass projects throughout the West. He is known for his keen analytical mind, his excellent proposal reviewing skills, and his creative suggestions for improving proposals. Doug also has helped improve the research reporting process for the National Jointed Goatgrass Program by suggesting that every report on field projects include a section entitled "Recommendations to Producers". This requirement has helped keep researchers focused on how their work will help producers manage jointed goatgrass in winter wheat cropping systems.

In addition, Doug serves as a voice for agriculture in Washington, DC. He has presented both written and oral testimony to the House Agriculture Committee, and he has served as a panelist on the Senate Agriculture Committee's Risk Management Round Table. The result of his work with the Senate Ag Committee was legislation that provided significant improvements in crop insurance for farmers.

Doug has given meritorious service to Weed Science and to Agriculture in the West and is highly deserving of the Society's Honorary Member Award.

2004 FELLOW AWARD
Dr. Phil Banks

Dr. Phil Banks received his B.S. and M.S. degrees in Agronomy from Oklahoma State University and his Ph.D. in Agronomy, with an emphasis in Weed Science, from Texas A&M University. He began his Weed Science career at the University of Georgia where he held a teaching and research position from 1979 to 1990. In 1990, he moved to New Mexico and started Marathon Agricultural and Environmental Consulting, a contract research and consulting firm that is well-respected throughout the US.

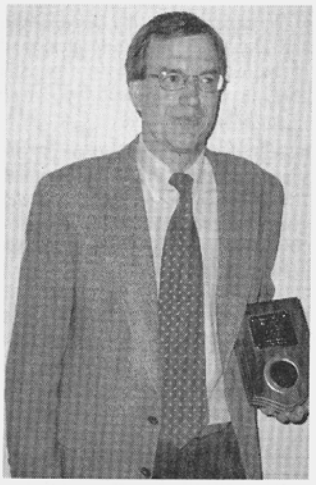
Dr. Banks has served WSWS in several capacities, including Chair of the Education and Regulatory Section, and member of numerous committees such as Local Arrangements, Herbicide Resistant Plants, and the Ad hoc Constitution and Operating Procedures Committee. He is also a Sustaining Member of WSWS and has hosted a student in the Student Educational Enhancement Program.

In addition to his work with WSWS, Dr. Banks has been very active in both the Southern Weed Science Society and WSSA. He served in several offices in SWSS, including President, and on numerous committees. At the national level, he has served on the Board of Directors as Member-at-Large and as CAST rep for WSSA. He also has been a reviewer for both *Weed Science* and *Weed Technology*, and has served as Associate Editor for *Weed Technology*. Phil has authored or co-authored 51 refereed journal articles and four books or book chapters.

Dr. Banks has a long history of training and supporting graduate students. He has served as major professor for 13 Masters students, eight Ph.D. students, and five Master of Plant Protection students. He taught Weed Science classes at both Texas A&M University and the University of Georgia, and guest lectures on a regular basis at New Mexico State University, where he is an Adjunct Professor.

In addition to his impressive record of service, Phil has always taken the time to mentor his colleagues. He's never too busy to listen to concerns and share his insight.

Dr. Banks has an outstanding record of accomplishments and service to WSWS, the discipline of Weed Science, and his colleagues.



Doug Schmale, Honorary Member

Phil Banks, Fellow

2004 FELLOW AWARD
Dr. Don Morishita

Dr. Don Morishita is a Professor of Weed Science at the University of Idaho. He received his B.S. in Environmental Health from Utah State University and his Master's and Ph.D. in Weed Science from the University of Idaho. He began his career in academia as a weed scientist for Kansas State University, and later moved to the University of Idaho, where he has been the Cereals and Sugarbeet Extension Weed Specialist for the past 14 years.

Don has a long history of outstanding service to the Western Society of Weed Science. He has held every major elected position in the Society including President, Secretary, Research Section Chair, and Education and Regulatory Chair. He is currently the *WSWS Newsletter* Editor and he has chaired or served on numerous projects and committees, including the Publications Committee where he dedicated countless hours to helping revise *Weeds of the West*. Don has authored or co-authored 32 WSWS presentations and abstracts, and over 200 research reports.

Along with his service to WSWS, Don has been active in WSSA and was just elected Secretary. He has been a reviewer for both *Weed Science* and *Weed Technology*, and he has served on the Extension Committee, the WSSA Retreat and Strategic Planning Committee, and the Graduate Student Activities Committee. Don is active in the Idaho Weed Control Association as well, where he has served in several elected positions, including President. He received the IWCA Weed Worker of the Year in 1996 in recognition of his many contributions to weed management in Idaho.

In addition to his excellence as an Extension Weed Specialist, Don is also an exceptional teacher. He is highly regarded not only by the students in his Introductory Weed Science course, but by the farmers, fieldmen, and colleagues in his Extension seminars, workshops, and shortcourses, and by the children in his 4-H club. Whether he is in the formal classroom situation or out in the field, Don has the uncanny ability to use the occasion to educate his audience about weeds and weed science.

Don's professionalism, leadership ability, and great sense of humor are admired and respected by all with whom he works.

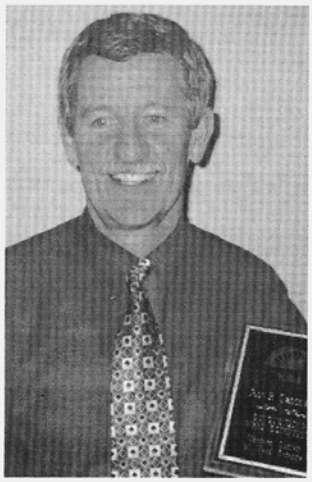
Outstanding Weed Scientist - *Private Sector*
Ron P. Crockett

Ron Crockett started working with Monsanto almost 25 years ago. During those 25 years, Ron has worked cooperatively with colleagues from industry, universities, and producers to establish many research and development projects related to glyphosate, other Monsanto herbicides, biotech crops, and management of noxious and invasive weeds. In 1994, Ron won Monsanto's Distinguished Development Award, the highest award given to field researchers. Ron's work involves field research, decision making on the usefulness of products, training programs for use of products in various markets, and customer inquiries about product performance.

Ron has conducted cooperative or independent research in all of the western states, including Alaska. He has been a liaison between Monsanto, EPA, the State Department of Agriculture, and the end users. Ron has helped the natural resources industries in the Pacific Northwest maintain their economic and environmental viability by assuring that data on efficacy and environmental impact was done and that state and federal agencies were aligned with the use. Ron's work in *Spartina* has been responsible for the restoration of 1000's of acres of tidal wetlands for shorebird usage and prevented the devastation of one of the most important estuaries in North America. The National Audubon Society recently classified the *Spartina* invasion of Willapa Bay as the nation's second largest threat to shore bird habitat.

Ron's current territory stretches from the western United States all the way to the Mississippi River. He has injected incredible energy, innovation, and enthusiasm into his endeavors in weed science and has exceptional knowledge about a broad range of vegetation and habitat management needs. He has worked with herbicide use in crops, forestry, aquatics, rangeland, tree growth regulation, habitat management and restoration, industrial and rights-of-way, turf, and evaluation of glyphosate-tolerant turf and tree species. His recommendations for pre- and post-planting applications formed the backbone of label language that is still in use today.

Don Morishita, Fellow



Ron Crockett, Outstanding Weed Scientist

Outstanding Weed Scientist - *Public Sector*
Joseph M. DiTomaso

Joe DiTamaso began working as a Cooperative Extension Specialist at the University of California in Davis seven years ago, but his career in weed science began over twenty years ago. Joe's research has ranged from basic biology and ecology of weeds to that of developing sustainable systems for rangelands and wildlands. Joe has trained many weed science graduate students and is currently serving as the major advisor for six PhD students and nine M.S. students.

He has been a member of the Center for Invasive Plant Management Science Advisory Council since 2001 and is very active in California Exotic Pest Plant Council by serving on the board and program committee, serving as vice-president, and serving as president in 2001-2003. Joe's peers and the University of California have recognized him with a distinguished service award and two promotions.

During the early part of Joe's career, his work on taxonomy and herbicide physiology culminated in over 45 publications and book chapters. Since going to UC Davis he has authored or co-authored 28 refereed publications, 60 extension publications, nine teaching publications, and three websites. He led the development of the Weed Research and Information Center, serving as its director and its associated website. He started two University of California Weed Short Courses and was co-founder of the Sierra Cascade Intensive Vegetation Management Cooperative. He is also co-editor of the Herbicide Handbook of the Weed Science Society of America.

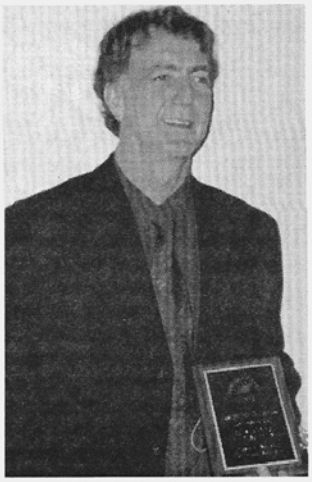
Several years ago Joe dedicated a sabbatical to photographing plants for two books he has submitted for publication. Joe also initiated a calendar of California weeds to educate the people on weeds and their impact on the environment.

Joe is competent in the laboratory, the field, and behind the microphone. Joe addresses every research project with a systems approach; including studies on weed biology; environmental influences on weeds and herbicide performance; and cultural, biological and chemical control methods. With the integrated approach, he has been able to find solutions for managing some the most difficult to control weeds in California. Examples include yellow starthistle, pampas grass, perennial pepperweed, and Tree of Heaven. The results of his research have had a major influence of weed management practices in California.

Outstanding Weed Scientist - *Early Career*
Jim Vandecoevering

Jim Vandecoevering has worked in the agricultural industry since 1995. His primary responsibilities are technology transfer from research to sales and marketing, product label expansion, and liaison to university and contract researchers. He has made complicated information accessible and understandable in settings such as formal sales or end-user training sessions, or individually with sales representatives, consultants, retail ag dealers, university researchers and extension personnel, or growers. Jim has involved various commodity groups and growers so that correct labels were written and best recommendations for use in multiple environments were given. Jim has developed over 70 technical information bulletins, and presentations and training modules on crop protection products for use in many crops.

Jim lives in Idaho, but has a working territory that includes Washington, Oregon, Idaho, Montana, Utah, Wyoming, and Colorado. This is a very large area to service, but Jim does it well, often going above and beyond the call of duty. He has been a major contributor and member of Pacific Northwest sales districts that received the award for Top Sales District - Worldwide. His interaction with weed scientists in the West deals a lot with 'minor crops', such as alfalfa, dry beans, dry peas, lentils, onions, potatoes, sugar beets, and other crops grown from seed. Minor crops can be more challenging than working with major crops and requires all-around knowledge of the crops agronomically and economically, a good understanding of the current market, and the ability to communicate the need for a particular herbicide to product managers. Through Jim's efforts there have been label expansions for many older and newer products for these minor crops. Without him as a champion for the use of these herbicides on minor crops, we could very well not have labels for many of them.

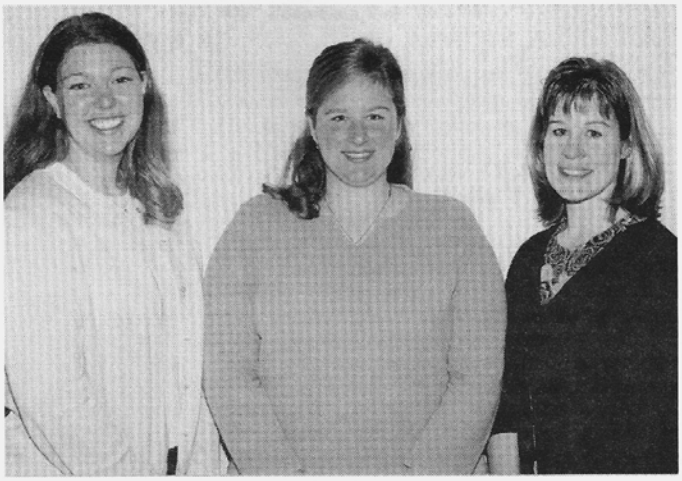


Joseph DiTomaso, Outstanding Weed Scientist

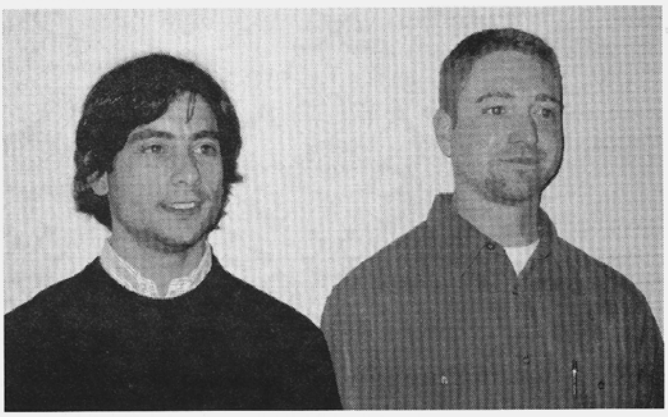
Jim Vandecoevering, Outstanding Weed Scientist

2004 PRESIDENTIAL AWARD OF MERIT
Joan Campbell

Joan Campbell received the 2004 Western Society of Weed Science President's Award. The award is in recognition for leadership and commitment to the WSWS. Joan started the WSWS website in 1997 and has been the web editor since that time. She is also Proceedings and Progress Report coeditor for the society.

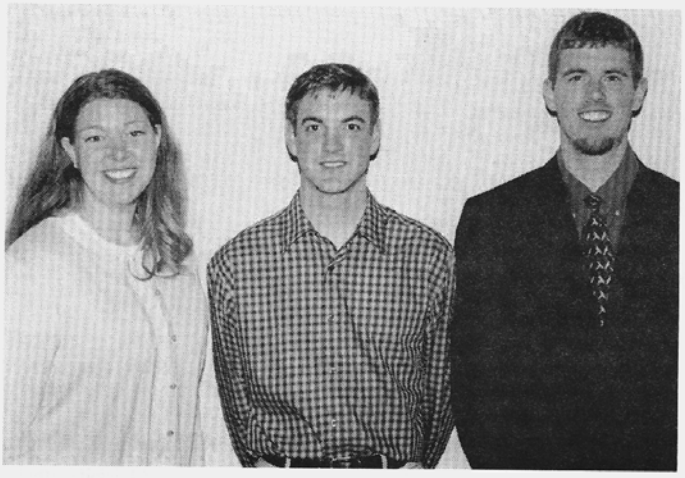


Graduate student poster group A. Jeanne S. Falk, Kansas State University (L)Krishona L. Martinson, University of Minnesota (middle), Lynn Fandrich, Oregon State University (R)



Graduate student poster group B. Leandro D. Perugini, Kansas State University (L) Scott O'Meara, Colorado State University (R). Brian D. Thrift, Montana State Univ. (not pictured)

Graduate student oral presentation group Krishona Martinson, University of Minnesota (L)
Margaret Rayda, University of Wyoming (middle). Eric Blinka, Kansas State University (R)



Graduate student oral presentation group. Jeanne S. Falk, Kansas State University (L)
David Belles, Colorado State University (middle), Bradley Hanson, University of Idaho (R)

Undergraduate student poster. Jon-Joseph Q. Armstrong, Kansas State University

WSWS officers for 2004 (front L to R) Wanda Graves, Business Manager-Treasurer; Phil Stahlman, President; Charlie Hicks, Education and Regulatory Section Chair; Rod Lym, CAST representative; (back row L to R) Phil Banks, President-elect; Gil Cook, Immediate past president; Nelroy Jackson, WSSA representative; Vanelle Carrithers, Member-at-large; Drew Lyon, Research Section Chair; Vince Ulstad, Secretary.

Phil Stahlman accepting WSWS Presidential Hoe from outgoing president Gil Cook

Wanda Graves, WSWS Business Manager-Treasurer receiving appreciation gift from outgoing president Gil Cook with WSWS President Phil Stahlman looking on.

WSWS Necrology Committee Report

Committee: Martina Murray (Chair), Carol Mallory-Smith, Steve Watkins, Tom Whitson

The Necrology Committee has been notified of three deaths of WSWS members or friends since the 2003 annual meeting. The passing of Don Burgoyne was acknowledged at the 2003 meeting, but no additional information was available at that time. We would like to celebrate the lives and recognize some of the contributions and accomplishments of these scientists. Our thoughts and prayers are extended to the families of Donald Burgoyne, Charles Scifres, Joseph Wayne Whitworth, and Wood Powell Anderson.

Donald Burgoyne
Donald Burgoyne died January 18, 2003, at the age of 80. Mr. Burgoyne served as a medical corpsman in WWII and then earned his master's degree in plant physiology from Iowa University. He worked for DuPont Agrochemical Division for 35 years, and served as WSWS president in 1974. He loved Dixieland Jazz and loved to dance, and also enjoyed golfing and swimming. He was preceded in death by Margene, his wife of 54 years, and is survived by two children and two grandchildren.

Charles J. Scifres
Dr. Charles J. Scifres passed away on July 28, 2003, at the age of 62 of an apparent heart attack. At the time of his death, he was Texas A&M associate vice chancellor, associate dean of the College of Agriculture and Life Sciences and deputy director of the Texas Agricultural Experiment Station. Dr. Scifres earned bachelor's and master's degrees from Oklahoma State, and was awarded a doctorate in agronomy (weed science and grazing lands) from the University of Nebraska in 1969. He began his professional career at Texas A&M University, rising from assistant professor to full professor in seven years, and was named the first Thomas M. O'Connor Professor of Range Science. He moved on to Oklahoma State University in 1987 to head the Department of Agronomy, and became Experiment Station associate director in 1990. He joined the University of Arkansas in1994 to become dean of the Bumpers College and the Division of Agriculture's associate vice president. In 2001, he returned to the Texas A&M system. Dr. Scifres' honors included a Faculty Distinguished Achievement Award for Research, Distinguished Performance Award in Team Research, and an Outstanding Achievement Award from the Society of Range Management. He was a Fellow of the Weed Science Society of America. He is survived by his wife Julia, two children and four grandchildren.

Joseph Wayne Whitworth
Dr. Joseph Wayne Whitworth passed away in early September 2003, from complications of cancer at the age of 80. He had served in Africa and Italy during WWII with the 3448th Army Ordinance Company and attended college on the G.I. Bill, receiving his bachelor's and master's degrees in agronomy from Utah State University. He worked for the USDA's rubber division from 1951-1952, until he was appointed to the faculty at New Mexico State University. He took leave from NMSU to earn his doctorate in agronomy from Washington State University in 1961. He retired from NMSU after 33 years of teaching and research. Dr. Whitworth was active in the WSWS, serving as president in 1983, and was named a Fellow of the WSWS in 1981. Dr. Whitworth was an active member of The Church of Jesus Christ of Latter Day Saints. He enjoyed hunting, and growing things was his greatest joy. He is survived by his wife of 56 years, Leona, and his nine children, 38 grandchildren, and 10 great-grandchildren.

Wood Powell Anderson
Wood Powell Anderson passed away September 25, 2003. Mr. Anderson worked for New Mexico State University for 26 years, conducting research of weed management in cropland and on ditch banks, and teaching two weed science courses. Prior to his hire at NMSU, Mr. Anderson worked in weed control in crops with Agricultural Experiment Stations in eastern Oregon, and central and eastern Washington.

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Mike Edwards (2007)

Education
Carol Mallory-Smith, Distance Education
Scott Nissen, Chair, Distance Education
Tracy Sterling, Distance Education
Celestine Duncan, Weed Shortcourse

Student Educational Enhancement
Steve Fennimore (2005)
Susan Kelly (2005)
Bill Kral, Chair (2006)

Student Paper Judging
Kirk Howatt, Chair (2005)
Vanelle Carrithers (2006)
Steve Enloe (2007)

Sustaining Membership
Steve Eskelsen (2005)
Dennis Tonks, Chair (2006)
Lynn Fandrich (2007)

Member Survey – Ad Hoc
Jill Schroeder
Vanelle Carrithers
Phil Stahlman

Web Site – Ad Hoc
Joan Campbell
Neal Hageman
Tony White (Chair)
Mike Edwards
Brian Jenks
Margaret Rayda