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**PREFACE**

The Proceedings contain the written summary of the papers presented at the 2005 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, Scotch broom (*Cytisus scoparius* (L.) Link ), by Sandra Robbins. Other photography by Kai Umeda and Phil Banks.

Proceedings Co-Editors: Joan Campbell and Traci Rauch

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## POSTER PRESENTATIONS

### PROJECT 1: WEEDS OF RANGE AND FOREST

**MICROBIAL COMMUNITIES OF PERENNIAL PEPPERWEED** Debra A. Boelk\* and Joseph DiTomaso, University of California, Davis. (no abstract) [1]

**YEARLY CHANGES IN DALMATION TOADFLAX AT ARCHER, WY.** L.L. Boggs, Southwestern Oklahoma State University; D. A. Claypool, and S. D. Miller, University of Wyoming

Dalmation toadflax (*Linaria dalmatica*) is a herbaceous perennial that infests rangelands and other disturbed areas. It can quickly colonize disturbed soils and greatly reduces grass and forage crop production. A widely adaptable plant, toadflax is difficult to control once it is established.

A study to locate and map established dalmation toadflax plants was initiated at the Archer Research and Extension Center (AREC) seven miles east of Cheyenne, WY in June 2001. Toadflax plants were mapped, using GPS, in June/July of 2001, 2002, 2003 and 2004. ARCview™ was used to analyze the GPS data. This analysis showed fluctuations in number of toadflax plants from year to year. However, overall toadflax plants decreased in number significantly during the 4-year period. Patch number exhibited a significant decrease over the 4-year period, although patch area showed no significant changes. Several factors appeared to influence patch area, including drought (60 to 75% of normal rainfall three out of the four years), overgrazing by sheep and herbicide application. Picloram or imazapic generally provided good control of treated plants. [3]

**EFFECT OF FIRE AND IMAZAPIC APPLICATION TIMING AND RATE ON MEDUSAHEAD AND DESIRABLE SPECIES.** Michael F. Carpinelli, USDA-ARS, Burns, OR

Medusahead is an introduced, winter-annual grass covering millions of acres of the semiarid West. It forms exclusive stands that burn readily, thereby resisting establishment of desirable species. Without fire, establishment of desirable plants may be impeded by medusahead litter. With or without fire, medusahead control is key to establishing desirable vegetation. Imazapic is an effective herbicide for pre- and post-emergent control of medusahead, but more information is needed on its effects on desirable species. This study investigated the relationship between imazapic application rate and timing on medusahead, seeded desirable species, and unseeded (pre-existing) desirable species on burned and unburned rangeland in SE Oregon. At each of two sites, a four-acre portion of an existing medusahead infestation was burned in June 2003. On burned and unburned areas at each site, imazapic was applied monthly at rates of 0, 0.5, 1, 1.5, 2, 2.5, and 3 oz ai/A between August and November 2003 in a randomized strip-plot design replicated three times. In November 2003, monocultures of seven desirable species were drill-seeded across the imazapic treated areas. Data were collected in summer 2004. Burning increased imazapic efficacy on medusahead, especially for the earlier application dates and lower rates. Burning reduced production of medusahead, seeded desirable species, and unseeded desirable species by about 2.5, 2, and 3.3 times, respectively, compared to the unburned treatment. Seeded desirable species generally had highest production at 0.5 and 1 oz ai/A on burned and unburned sites, respectively. Unseeded desirable species had highest production at 0 oz ai/A. [4]

**COMPATIBILITY OF TWO HERBICIDES WITH *CYPHOCLEONUS ACHATES* AND *AGAPETA ZOEGANA*, TWO ROOT INSECTS INTRODUCED FOR BIOCONTROL OF SPOTTED KNAWWEED.** Jim Story\*, Montana State University, Western Agricultural Research Center, Corvallis; and Robert Stougaard, Montana State University, Northwestern Agricultural Research Center, Kalispell.

Field studies were conducted during 2002-2004 to assess the compatibility of two herbicides, 2,4-D and clopyralid, with a root weevil *Cyphocleonus achates*, and a root moth *Agapeta zoegana*, introduced for biocontrol of spotted knapweed in Montana. Both herbicides were applied in the fall and at the spring rosette stage. In 2003, both herbicides reduced knapweed density by about 98 percent regardless of application time. In 2004, fall applications of 2,4-D and clopyralid resulted in 76 and 91 percent knapweed mortality, respectively, compared to 86 percent knapweed mortality by both herbicides in spring 2004. In 2003, the number of live larvae of both insect species was significantly lower in treated plots than in controls, and larval numbers of each insect species were similar between herbicides. Larval numbers of *C. achates* were not different between application times in 2003, while *A. zoegana*

numbers were significantly higher in spring 2003 than in fall 2002. In 2004, the number of live *C. achates* larvae was significantly lower in treated plots than in controls in the fall application, but there was no difference between treated plots and controls in the spring application. Overall, larval numbers of *C. achates* were significantly lower in fall applications than in spring in 2004, but larval numbers were similar between herbicides at both application times. There was no treatment effect for *A. zoegana* in 2004, and larval numbers between herbicides and application times were similar. Fall applications of both herbicides are not compatible with the two insects, but spring applications may be compatible if delayed until later in the spring. [5]

**INVASIVE WEED CONTROL WITH DIFLUFENZOPYR PLUS DICAMBA AND COMBINATIONS WITH OTHER AUXINIC HERBICIDES.** Dan Beran and Joe Vollmer, BASF Corporation, Des Moines, IA and Laramie, WY.

Diflufenzopyr is an auxin transport inhibitor that can enhance the activity of auxinic herbicides that are commonly used for controlling broadleaf invasive weeds. Diflufenzopyr is commercially available in a formulation that combines dicamba and diflufenzopyr at a 2.5 to 1 ratio. A series of research and demonstration trials were conducted to evaluate the efficacy of dicamba and diflufenzopyr on annual, biennial, and perennial invasive weeds. In studies conducted in the western U.S. on annual and biennial weeds, dicamba and diflufenzopyr was effective in controlling yellow starthistle, diffuse knapweed, and kochia when applied at 0.175 and 0.263 lb ai/A. The addition of 2,4-D to the dicamba and diflufenzopyr treatments did not result in increased kochia control when evaluated 10 weeks after application. In studies conducted in the central U.S. on biennial thistles, dicamba and diflufenzopyr applied at 0.088 lb ai/A rate was effective in controlling musk thistle in both the rosette and early bolt growth stages. In contrast, control of plumeless thistle in the bolt stage required 0.175 lb ai/A of dicamba and diflufenzopyr, or tank mixtures with picloram at 0.063 lb ai/A. In studies conducted on perennial invasive weeds, dicamba and diflufenzopyr at the 0.175 lb ai/A rate increased the control of leafy spurge when combined with picloram at 0.125 or 0.25 lb ai/A. Similarly, the combination of dicamba and diflufenzopyr plus clopyralid resulted in greater Canada thistle control than clopyralid applied alone. [6]

**QUANTIFYING INVASIVENESS OF PLANT POPULATIONS.**

Bruce D. Maxwell\* and Lisa J. Rew, Montana State University, Bozeman.

The focus for determination of invasiveness for management considerations should be placed on populations or meta-populations segregated by environments rather than on species across their entire range of distribution. In addition, weed scientists and land managers need objective methods to quantify the relative invasiveness of different population within specified management areas so that the populations can be prioritized for management. Using the definition that an invasive population is one that is consistently increasing in density and/or spatial extent. Plant population growth can be characterized in many ways, but we have chosen two ways that are sensitive to detecting growth, are simple to gather the data, and require a minimum amount of data and thus are time efficient. We will describe methods using density methods here and our field experience is limited to a few perennial herbaceous species. Density is the number of plants per unit area. Many perennial species have vegetative shoots (ramets) thus density is the number of shoots per unit area. Temporal population growth rate is the change in population density ( $N$ ) over the change in time ( $t$ ) =  $\delta N/\delta t$  thus  $\delta N = N_{t+1} - N_t$ . For an objective assessment of invasiveness we establish the null hypothesis that a population is, on average, stable with regard to density change so that there should be an equal number of samples increasing in density as there is decreasing in density and that the magnitude of those changes should be in equal proportions. That is, a frequency distribution of  $\delta N/\delta t$  should be centered on 0 and there should be equal proportions of  $\delta N/\delta t$  values on the negative side and positive side of the distribution. In addition, if one had a random set of densities and compared those with a second set of random densities from the same range their difference ( $\delta N/\delta t$ ) would be a normal distribution with a mean and median of 0. Thus, the specific interest of this analysis is to detect trends away from the normal distribution of  $\delta N/\delta t$  from samples within the population. This can be accomplished with a statistical test and a set of descriptive statistics for the  $\delta N/\delta t$  distribution that can be easily calculated in Microsoft Excel. If the observed distribution is not different from the null (normal expected) distribution then one cannot conclude that the population is invasive. If the observed distribution is significantly different from the expected normal distribution then the center of the distribution and the direction of the trend in the distribution can be quantified with the median and skew, respectively. Four additional statistics associated with the  $\delta N/\delta t$  distribution were combined with the previous two to create an invasiveness index. The magnitude of the invasiveness index serves as a measure of priority for management. Populations with large positive Index values should be higher priority for management than those that are negative or near 0. [7]

**INTEGRATED MANAGEMENT OF MEDUSAHEAD IN CALIFORNIA RANGELAND.** Guy B. Kyser\*, Joseph M. DiTomaso, University of California, Davis; Morgan P. Doran, Neil McDougald, and Ronald N. Vargas, University of California Cooperative Extension.

We studied integrated management of medusahead using burning, imazapic, and reseeding with native plants on foothill rangeland in California. In spring 2002 we established trials in Fresno and Yolo counties; each site had nine treatments in 27 one-quarter acre plots. Treatments were applied in 2002 and 2003. Treatments included burning followed by imazapic (1 and 2 oz ae/A at Fresno, 1 and 3 oz ae/A at Yolo), imazapic followed by burning, 2 yr of burning, 2 yr of imazapic, and combinations with reseeding. Burns were conducted in summer after most plants had senesced but before medusahead seed maturation. Reseeding and imazapic application were performed in fall. In 2002, 2003, and 2004 we conducted vegetation surveys (for cover and biodiversity) and forage harvests in April, followed by surveys in summer before burning. Reseeding treatments largely failed to establish. All other treatments reduced both medusahead cover and total grass cover. Low rates of imazapic left a better grass stand than did high rates but gave weaker control of medusahead. Two yr of imazapic usually gave excellent control of medusahead. However, two yr of burning produced the most consistent combination of medusahead control with acceptable impact on other grasses. Broadleaf forage (legumes and filaree) cover was highest in plots burned for two years, followed by plots which were treated the first year and burned the second year. Forb cover was highest following imazapic treatments because treated plots became dominated by tolerant composites. Imazapic treatments also resulted in increased bare ground relative to controls. [8]

**SYNTHESIS OF EFFECTS OF FOREST HEALTH RESTORATION ACTIVITIES ON NON-INDIGENOUS PLANT SPECIES.** Mara Johnson\*, Lisa Rew, Bruce Maxwell, and Fabian Menalled, Montana State University, Bozeman; Deborah McCullough, Michigan State University, East Lansing; and Matthew Kelty, University of Massachusetts, Amherst.

Forest management objectives have become increasingly diverse; they now include such varied goals as providing for timber production, biodiversity, watershed integrity, as well as recreational activities. Recently, the restoration of natural fire regimes has become a key forest management objective throughout the United States. Combinations of thinning and prescribed burning have been suggested as management activities that could facilitate the restoration of natural fire regimes while avoiding catastrophic wildfires. While these activities may meet some forest management objectives they may also interfere with others. Thinning and prescribed burning as types of disturbances could result in introductions or expansions of non-indigenous species (NIS). The authors performed a systematic literature search on the effects of forest management activities on NIS in the forests of the United States and synthesized the results. The results indicated that although numerous studies have been conducted on the effects of prescribed burning on NIS occurrence, distribution and impact in grasslands and shrublands, there is a lack of such information in forests. Neither is there much information concerning forest thinning and NIS. A thorough search of the published literature indicated that only preliminary information is available on the effects of these activities on NIS occurrence and distribution. In the majority of the studies, thinning resulted in initial increases of NIS occurrence and density followed by declines. Less information was located on the effects of prescribed burning when it was not being used specifically to control NIS. In most instances prescribed burning was associated with short-term declines of NIS that had been present prior to burning and repeated burning resulted in impeding the spread of NIS but not affecting its dominance. The effect of such disturbances on the native and non-native species will vary not only with forest type but also due to subtle interplay between environmental variables and particulars of the activity. As forest restoration activities accelerate in the United States, it is critical to record and assess the indirect effects or consequences of these activities on the landscape to ensure the ultimate goal of a healthy forest is not being undermined. [9]

**INVASIVE HAWKWEEDS IN THE PACIFIC NORTHWEST.** Linda M. Wilson\*, University of Idaho, Moscow, and Susan C. Turner, British Columbia Ministry of Forests, Kamloops, BC.

Invasive hawkweeds (*Hieracium* spp.) are among the most troublesome weeds in British Columbia. They arrived in British Columbia as recently as the last four decades, probably from the northern expansion of infestations in Washington and Idaho. There are about 10 species of invasive hawkweeds in British Columbia. The majority belong to subgenus *Pilosella* and include meadow hawkweed, *H. caespitosum*, orange hawkweed, *H. aurantiacum*, mouse ear hawkweed, *H. pilosella*, king devil hawkweed, *H. floribundum*, tall hawkweed, *H. piloselloides*, and

whiplash hawkweed, *H. flagellare*. A new species, yellow devil hawkweed, *H. glomeratum*, was found in southeastern British Columbia in 2002. This was the first report of this species in North America. Three species belong to subgenus *Hieracium* and include wall hawkweed, *H. murorum*, smooth hawkweed, *H. laevigatum*, and New England hawkweed, *H. sabaudum*. Species identification is difficult because of a high degree of morphological variation and possible hybridization among invasive taxa. Rapid spread of hawkweed has been possible because much of the land in British Columbia is considered susceptible to invasion by these aggressive weeds. Control of hawkweeds with herbicides is feasible, but is often hampered by rough terrain and inaccessible infestations. Alternative control solutions, including biological control, are being investigated. To this end, the forest and agriculture ministries of British Columbia, together with the Idaho Department of Agriculture and the Montana Noxious Weed Trust Fund, are primary sponsors of the Hawkweed Biological Control Consortium. [10]

**ELK, WOLVES AND WEEDS IN THE GREATER YELLOWSTONE ECOSYSTEM.** Amanda Morrison\*, Bruce Maxwell and Scott Creel, Montana State University, Bozeman.

Yellowstone elk respond to the presence of wolves on a time scale of hours to days, and a spatial scale of kilometers, with strong effects on habitat use. Elk are likely to occupy open grassland sites where there is an abundance of introduced weedy grasses in the absence of wolves, but leave these favored foraging sites in the presence of wolves and shift into coniferous forest, presumably to benefit from protective cover. A strong shift in elk habitat selection is likely to alter diets or energy budgets as well as relaxing selective pressure against native grass species because the elk have selectively used the natives over the non-native grasses. Thus, wolves may be decreasing the invasive potential of several non-native weedy grasses by forcing elk out of the grasslands and into the forest. Assessing these responses will be an important aspect of testing whether antipredator behavior by elk mediates cascading effects from wolves to plants in the Yellowstone ecosystem. [11]

**A FRESH LOOK AT AN OLD WED MAPPING TOOL.** Larry Lass and Timothy Prather, University of Idaho, Moscow.

The State of Idaho and other partners acquired a complete collection of natural color, digital ortho imagery for the summer growing season of 2004 from the National Agricultural Imagery Program (NAIP). Compressed county mosaics are currently available for all counties in Idaho and statewide coverage consisting of 3.75' quadrangles will be available later this year (<http://www.insideidaho.org>). All county data are in UTM projection, NAD83 datum and compressed in MrSID format. The 3.75' data will be in geotiff format. The imagery has either 1 m spatial resolution with rectified to a horizontal accuracy of +/- 3 m or 2 m spatial resolution with a horizontal accuracy of +/- 10m. Idaho's images are for the most part cloud free, but NAIP data may contain as much as 10% cloud cover. Data appears to have been collected in late June to early July based on canola flowering in northern Idaho and row closure of crops in southern Idaho. These data make wonderful background maps when using geographic information systems to locate weeds, place treatment crews, and monitor the progress of weed management. The data are exportable to hand held computers using global positioning systems (GPS) for field surveying weed locations. Image classification using principle component analysis (PCA) and spectral angle mapper algorithm (SAM) allow the user to identify potential weed infestations prior to field surveys. Results of image classification and other potential use of NAIP data for weed management will be presented. [12]

**AMINOPYRALID: A NEW HERBICIDE FOR BROADLEAF WEED CONTROL IN RANGELAND AND PASTURES IN CANADA AND UNITED STATES.** Donald D. Hare\*, Allan G.G. McFadden, William R. McGregor, Leonard T. Juras, Norbert M. Satchivi, and Gary C. Turnbull, Dow AgroSciences Canada Inc, Calgary, Alberta, Canada.

Aminopyralid is a new systemic active ingredient developed by Dow AgroSciences specifically for use on rangeland, pasture, industrial vegetation management areas, non-cropland, and natural areas in Canada and United States. It is formulated as a liquid, 240 g ae/litre triisopropylamine salt. This herbicide has postemergence activity on a variety of established broadleaf and woody weeds and provides residual seedling control of a number of key broadleaf weeds species. An international field trial program has shown aminopyralid to be effective at rates between 52.5 and 120 g ae/ha, which can be as little as 5% of the use rate of currently registered rangeland and pasture herbicides including, clopyralid, 2,4-D, dicamba, picloram, and triclopyr. Aminopyralid controls over 40 species of broadleaf weeds the year of and after treatment, which extends the value of aminopyralid in rangeland and pasture vegetation management programs. Weeds controlled by aminopyralid include *Acroptilon repens*,

*Amaranthus spinosus*, *Ambrosia artemisiifolia*, *Ambrosia psilostachya*, *Artemisia absinthium*, *Carduus acanthoides*, *Carduus nutans*, *Centaurea diffusa*, *Centaurea maculosa*, *Centaurea solstitialis*, *Chrysanthemum leucanthemum*, *Cirsium arvense*, *Cirsium vulgare*, *Lamium amplexicaule*, *Matricaria inodora*, *Ranunculus bulbosus*, *Rumex crispus*, *Solanum carolinense*, *Solanum viarum*, *Verbesina alternifolia*, *Vernonia baldwinii*, and *Xanthium strumarium*. Aminopyralid will be used alone or in combination with 2,4-D amine at rates ranging from 420 to 1440 g ae/ha to further complement the spectrum of broadleaf species controlled. The addition of 2,4-D amine to aminopyralid will control *Daucus carota*, *Symphoricarpos occidentalis*, and *Tanacetum vulgare* among others. Over 20 species of both warm- and cool-season rangeland and pasture grasses are tolerant to aminopyralid applied at proposed label rates. Research continues to determine the efficacy of aminopyralid on other weeds and on the role of aminopyralid in facilitating desirable plant establishment and rangeland and pasture renovation. [157]

## PROJECT 2: WEEDS OF HORTICULTURAL CROPS

**ROTATIONAL CROP RESPONSE TO TRIFLOXYSULFURON.** Santos Barron, Jill Schoreder, and Cheryl Fiore. New Mexico State Univ., Las Cruces, NM

Trifloxysulfuron is a new ALS inhibitor belonging to the sulfonyleurea family, marketed by Syngenta Corporation for post-emergence control of morningglory species and purple and yellow nutsedges in cotton, sugarcane, and transplanted tomatoes. Trifloxysulfuron could be a beneficial herbicide for New Mexico because of its low ecological impact and because it controls these important weed species. However, persistence of trifloxysulfuron in soil is a concern because of the variety of rotational crops grown under furrow irrigation in New Mexico. A bioassay was conducted during the winter of 2004 to estimate concentrations of trifloxysulfuron that persist at the end of the growing season and response of corn, turnip, chile and onion to increasing concentrations of trifloxysulfuron. The soil was a Belen clay loam with 43% sand, 19% silt, 38% clay, 1.3% organic matter, CEC 24 and a pH=7.7. Trifloxysulfuron was sprayed at 4.6, 9.4 and 1.4 g ai/ha in chile peppers on June 2004 and soil samples were taken at a depth of 15 cm in September 2004. Corn and turnip root length in soil treated with trifloxysulfuron at 0, 0.25 0.5, 0.75, 1.25, 2.5 ppb, were used to develop a standard curve, which was then used to estimate trifloxysulfuron concentrations in the field soil. Chile and onion were also planted in the same soil to determine if the residual herbicide caused any damage to these crops. Corn and turnip root length was reduced at a concentration greater than 0.5 ppb and onion at 0.25 ppb compared to the control. [13]

**WEED CONTROL IN GRAPE AS AFFECTED BY FALL AND SPRING HERBICIDE APPLICATIONS.** Sorkel Kadir\*, Kassim Al-Khatib, and Doug Shoup, Kansas State University, Manhattan.

Soil residual herbicides registered for use on grapes can be applied from fall to spring, before weed emergence. However, ample early-spring moisture and warm weather may enhance weed emergence before herbicide application in the spring and prevent timely application. Therefore, fall application of herbicides can be beneficial if herbicides would provide adequate weed control in the following spring. Warm and wet winter may enhance herbicide degradation and shorten herbicide residual activity which result in poor weed control the following spring. Fall and spring application of oryzalin or norflurazon applied alone or in combination with diuron, simazine, or oxyfluorfen were evaluated for weed control in grape at Oskaloosa and Eudora in northeast Kansas in 2003 and 2004. Weeds were not controlled adequately with oryzalin or norflurazon applied alone. At the end of the growing season, however, weed control was greater with spring than fall application. In addition, weed control with norflurazon was slightly greater than oryzalin. Norflurazon or oryzalin applied in combination with simazine, diuron, or oxyfluorfen controlled more weeds than norflurazon or oryzalin applied alone. The greatest control was with norflurazon or oryzalin applied with oxyfluorfen. In general, all herbicide combinations applied in the spring and fall provided similar weed control four months after spring application. However, at the end of the growing season, weed control was 10 to 20% greater when herbicides applied in the spring than fall. This study showed that acceptable weed control can be achieved when norflurazon or oryzalin applied with oxyfluorfen and diuron in the fall. [14]

**HAIRY NIGHTSHADE PRESENCE AFFECT THE DURBAILITY OF NAMATODE RESISTANCE IN POTATO.** Rick Boydston, Hasan Mojtahedi, Charles R. Brown, and Trevea Anderson. USDA-ARS, Prosser, WA

Columbia root-knot nematode (*Meloidogyne chitwoodi*, race 1) (MC1) is a major pest of potato grown in the Pacific Northwest and is primarily controlled by soil fumigation at a cost of \$400 per hectare. MC1 resistant potato lines



have been developed which resist infection in roots and/or tubers. Nematode resistance in laboratory, greenhouse, and most field trials was excellent, but in some field trials MC1 damage occurred on tubers of some resistant lines. Some MC1 resistant potato lines appear to resist nematode reproduction on roots, but lack tuber resistance to MC1 infection, whereas other resistant lines possess both root and tuber resistance. Escape and late season weeds that are hosts of MC1 may act as nematode reservoirs, allowing tuber infection to occur in resistant lines possessing only root resistance. Green house and field trials were conducted to test the hypothesis that weed hosts of MC1 grown with potato could act as nematode reservoirs, which could result in tuber infection of nematode resistant potato lines. Three potato lines: Russet Burbank, susceptible to MC1 in roots and tubers; PO95B4-67, roots resistant to MC1, but tubers susceptible; and PA99N82-4, which appears to have both root and tuber resistance to MC1, were grown in the presence or absence of hairy nightshade, a known good host of MC1. Russet Burbank tubers were damaged by MC1 regardless of hairy nightshade presence. PO95B4-67 grown in the absence of hairy nightshade had little or no MC1 damage on tubers, but grown in the presence of hairy nightshade, significant tuber damage occurred. PA99N82-4 tubers were free of MC1 damage regardless of hairy nightshade presence. In greenhouse studies, MC1 applied to potatoes that had already formed tubers, infected Russet Burbank and PO95B4-67, but failed to infect PA99N82-4. These results demonstrate how weed hosts of MC1 may negate the positive impact of growing MC1 resistant potatoes that possess only root resistance. [15]

**CROP GROUPINGS TO ENHANCE PESTICIDE REGISTRATIONS.** Dudley Smith\* and Juan Anciso, Texas A&M University System, College Station and Weslaco TX 77843-2474.

Major North American crops, such as wheat, provide ample market potential to support pesticide development. Although registrations for speciality crops, which include many agronomic and horticultural crops, lag due to regulatory costs and economic risks, these crops make up 44% of all crop cash receipts in 18 western states. The IR-4 program partners with US EPA, land grant universities, USDA/ARS, pesticide registrants, and grower organizations. The registration process is initiated with a Pesticide Clearance Request (PCR) and then the national IR-4 office manages preliminary reviews, plans field and lab GPL work, prepares petitions for EPA review, and assures linkages with the registrant. Over 800 crops are organized into 20 Crop Groups based on similar edible parts, which enhances the registration process. Representative crops in each group act as surrogates for the group. For example, tolerance data from carrot trials may be used to extend labels to other root and tuber crops such as table beets. Crop groupings result in a more efficient registration process. More than 60% of all residue tolerances granted by the EPA to date were based on petitions from IR-4. Plans are to expand the crop group scheme in cooperation with Canada for greater international harmonization. [16]

**REPLACEMENT SERIES OF SIX COWPEA (*VIGNA UNGUICULATA*) GENOTYPES AND SUNFLOWER (*HELIANTHUS ANNUUS*) OR PURSLANE (*PORTULACA OLERACEA*).** Guangyao Wang, Jeff D. Ehlers, Eddie J. Ogbuchiekwe, Milton E. McGiffen, Jr. Corresponding author. Department of Botany and Plant Sciences, University of California, Riverside, CA 92521-0124; milt@ucr.edu

Twelve replacement series was performed in the summers of 2003 and 2004 to investigate the relative competitiveness of six cowpea genotypes with common purslane and common sunflower. Six cowpea genotypes have similar vegetative vigor but different growth habits, in which two genotypes are erect, two are semi-erect, and the other two are prostrate. Sunflower and purslane are chosen in the experiment because the competitive ability of cowpea is of interest when competing with a tall or a short plant. Cowpea and weed dry weight were measured 36 days after planting. Relative yield total (RYT) and aggressivity indices were compared using ANOVA and isotonic regression test. All cowpea genotypes in different cowpea:sunflower or cowpea:purslane proportion had similar RYTs, indicating that cowpea used the same resources with sunflower or purslane. When grown with sunflower, erect varieties and semi-erect varieties appear to have higher aggressivity indices than prostrate varieties. When grown with purslane, erect and prostrate varieties appear have higher aggressivity indices than semi-erect varieties. The results are confirmed by isotonic regression test on the respective aggressivity indices order. The experiments indicate that cowpea genotypes differ in their ability to compete with purslane or sunflower. Erect genotypes were the most competitive, suggesting that an erect growth habit may be more effective in suppressing weeds than semi-erect or prostrate growth habits. Those results were confirmed by additive field experiment. [17]

**A NEW GRANULAR HERBICIDE FOR CONTAINER, LANDSCAPE AND FIELD-GROWN ORNAMENTALS.** Randy L. Smith\*, Darin W. Lickfeldt, Dan L. Loughner, Mike W. Melichar, James M. Breuninger, Dow AgroSciences LLC, Indianapolis, IN

In 2003 and 2004, a new herbicide containing three active ingredients was evaluated for efficacy on important weed species and the tolerance of popular ornamental plant species. Currently available ornamental herbicides differ greatly in the weeds they control and tolerance of ornamental plants grown in production nurseries. This new granular product, Showcase, also known by its experimental number GF-1162, contains 2% trifluralin, 0.25% isoxaben and 0.25% oxyfluorfen. With preemergent applications applied to pots artificially infested with weed seed, Showcase demonstrated exceptional control of many difficult to control species such as spurge, groundsel, bittercress, oxalis, and crabgrass. When applied preemergence at 150 lb/A, Showcase was as efficacious as current standards. At 200 lb/A weed control was exceptional, exceeding all products included in the trials. Ornamental tolerance to Showcase was comparable to that of Snapshot TG with the exception of whorled plants. On whorled plants such as Daylily and Hosta, where granular products can be retained on leaf surfaces, products containing oxyfluorfen must be applied with special precautions to immediately shake or wash granules from leaf surfaces. Even when whorled plants were injured by Showcase, they did eventually recover. Showcase received a federal registration in 2004 and state registrations may be complete as early as Spring 2005 at which time this new herbicide would be made available to ornamental nurseries and lawn care companies as an alternative to current herbicide options. [18]

**HERBICIDE TESTING IN APIACEAE SEED CROPS.** Robert K. Peterson, Timothy W. Miller and Carl R. Libbey, Agriculture Research Technologist, Extension Weed Scientist and Scientific Assistant. Washington State Univ., Northwestern Washington Research and Extension Center, Mount Vernon, WA

Early-flowering and long-standing cilantro, coriander, carrot, dill, parsnip, and parsley crops were field tested in 2003 and 2004 for reactions to fifteen POST herbicides. In both years, crops were seeded in early June and sprayed at the early (1- to 2- leaf) and late (3- to 4- leaf) stages of growth in early July. In both years, crop injury data was taken 9 DAT, and biomass in early August. In combined analysis, years were not significantly different ( $P < 0.05$ ) for crop injury but were for biomass. Product timing was significantly different for both crop injury and biomass. Products causing  $>20\%$  crop injury in both years and at both timings were sulfentrazone and fomesafen on early-flowering cilantro, and isoxaflutole on early-flowering cilantro, carrot, parsnip and parsley. Based on a combination of crop injury levels and biomass compared to the untreated control, prometryne, linuron, lactofen, napropamide, flumioxazin, and pendimethalin appear safe for use on these crops. Crop/herbicide combinations that resulted in slight to moderate reductions in biomass were: oxyfluorfen and bensulide on long-standing cilantro; metribuzin + flufenacet, and sulfentrazone on long-standing cilantro and coriander; s-metolachlor on long-standing cilantro; thiazopyr on long-standing cilantro and dill; dimethenamid-p on long-standing cilantro and carrot; fomesafen on early-flowering cilantro, long-standing cilantro, coriander, and dill; and isoxaflutole on long-standing cilantro, coriander, carrot, dill, and parsley. [19]

**EFFECTS OF MESOTRIONE ON PACIFIC NORTHWEST SWEET CORN VARIETIES.** Carl R. Libbey and Timothy W. Miller. Scientific Assistant and Extension Weed Scientist. Washington State University, Northwestern Washington Research and Extension Center, Mount Vernon, WA.

Nine Pacific Northwest sweet corn varieties were tested during 2003 and 2004 for sensitivity to preemergence and postemergence applications of mesotrione. Tested cultivars were 'Prelude', 'Coho', 'Kokanee', 'Sockeye', 'Lumina', 'Chase', and 'Jubilee', plus two advanced breeding lines. Early POST treatments were applied when corn plants averaged 3 to 4 leaves. Late POST when corn plants averaged 6 to 8 leaves. For measured sweet corn parameters, applications of mesotrione were safe on all tested varieties. Foliar injury was less than 2% for all treatments both years. A split-application of mesotrione applied early POST followed by a late POST application provided the best overall weed control. Single late POST emergence treatments also had excellent weed control. A single early POST (0.0625 lbs ai/A) had the poorest weed control for both years. In 2004, mesotrione PRE (0.21875 lbs ai/A) application was included which resulted in poor weed control. Corn heights were shorter after these two mesotrione treatments due primarily to increased weed competition. Likewise, the number of ears per plot and the number of ears per plant were reduced from these two treatments. Corn stand counts per plot were not affected by treatments when compared to the control plots. [20]

**EFFECT OF APPLICATION METHOD AND RATE OF METAM SODIUM ON GERMINATION OF YELLOW NUTSEDGE.** Brad Geary\*, Brigham Young University, Provo, UT; Mike Thornton, Deron Beck, and Dennis Atkinson, University of Idaho, Parma, ID.

Yellow nutsedge has become one of the most difficult to control weed pests in Western Idaho cropping systems. Onions are especially sensitive to yield reduction under heavy nutsedge pressure because they emerge and develop a full canopy at such a slow rate. The objective of this study was to determine which application method and rate of metam sodium provides the best level of nutsedge control. Nutsedge tuber populations were determined in soil cores prior to and after fumigation. Twelve inch soil cores were divided into three sections to determine the location of tubers within the soil profile. Tubers recovered were tested for viability. Metam sodium was incorporated by the standard method (shank injection at two depths) or with a plow. A third treatment consisted of applying half the fumigant with the plow, followed by the other half by shank injection. Metam sodium was evaluated at rates of 0, 50, 60 and 75 gallons/acre. Populations of viable nutsedge tubers were reduced by all fumigation treatments. The plow plus shank combination was the only incorporation treatment that significantly reduced nutsedge populations near the soil surface (0-4 inch depth). Even under the best treatments the reduction in nutsedge germination by fumigation was in the range of 40 to 50%. Due to this weeds ability to spread rapidly from a single tuber, this level of control is not adequate to allow fumigation to be used as a stand alone practice for control of yellow nutsedge. [63]

**PROJECT 3: WEEDS OF AGRONOMIC CROPS**

**EFFECT OF TEMPERATURE ON GERMINATION OF CLOVER BROOMRAPE (OROBANCHES MINOR).** Salam A. Althahabi, J.B. Colquhoun, C.A. Mallory-Smith, Oregon State University.

Small broomrape, a holoparasitic weed, was recently introduced to the Pacific Northwest and contaminated a limited number of red clover fields in Oregon. Studies were conducted to determine the relationship between temperature and small broomrape seed germination. Two experiments were conducted in controlled-environment growth chambers at four temperatures (5, 10, 15, and 20 C) for four weeks. Temperature was positively correlated with the seed germination. Small broomrape seed did not germinate at 0 C. Germination percentage was greatest at 15 C and 20 C in the first study and 20 C in the second study. Maximum germination was 61 % and 32 % at 20 C in the first and second studies, respectively. [21]

**INFLUENCE OF SEEDING DEPTH AND FLUFENACET TIMING IN WINTER WHEAT.** Richard P. Affeldt\*, Jed B. Colquhoun, Charles M. Cole, and Carol A. Mallory-Smith, Oregon State University, Corvallis.

According to the flufenacet label, wheat should be seeded at least 1 inch deep. It has been suggested that flufenacet injury on shallow seeded wheat can be avoided by delaying the timing of flufenacet application. A trial was conducted to evaluate crop injury from flufenacet applied at four growth stages on wheat seeded at two depths. 'Foote' winter wheat was seeded on October 13, 2003 to a depth of 0.5 inches for shallow seeding and 2 inches for deep seeding. When applied preemergence to shallow seeded wheat, injury was 30 and 34% from flufenacet and flufenacet plus metribuzin 20 days after treatment, respectively. Deep seeded wheat was much less injured from preemergence applications. When applied preemergence to deep seeded wheat, injury was 14 and 9% from flufenacet and flufenacet plus metribuzin 20 days after treatment, respectively. Flufenacet applied to shallow seeded wheat at emergence and 1 leaf timings caused less injury than flufenacet plus metribuzin. Injury from flufenacet applied at emergence, 1 leaf, and 2 leaf timings on shallow seeded wheat was not evident until mid-January. Wheat injury was still visible on March 4 when the wheat was mostly tillered; but, grain yield did not differ among treatments. Delaying application timing of flufenacet resulted in less injury on shallow seeded wheat. However, deep seeded wheat showed less injury after mid-January than shallow seeded wheat at any application timing. [22]

**CURRENT STATUS OF THE FIELD BINDWEED MITE PROJECT.** Amber D. Roberson\* and Thomas F. Peeper, Oklahoma State University, Stillwater.

Field bindweed is a serious problem throughout Oklahoma and there are currently no registered herbicides that provide complete control of it. The need for an alternative control method, led Oklahoma State University to develop a biological control project for the control of field bindweed (*Convolvulus arvensis*) in the spring of 2003.

The biological control agent is a mite (*Aceria malherbae*) which feeds along the midrib of the leaves. This feeding prevents the plants from elongating and can prevent flowering. The project is a cooperative effort with county Agricultural Extension Educators to establish field bindweed mite nurseries in ten southwestern counties in Oklahoma. The nurseries are to be used as a source for individuals to collect and re-distribute the mites. In the spring of 2003, efforts to establish the nurseries began. Infested field bindweed plants were collected from Goodwell, Oklahoma and transplanted into pots. The infested plants were then transported to the release sites where the pots were placed into a hole approximately 6 inches deep. The sides of the pot were cut down to expose the infested plant so that it could be tied to a healthy field bindweed plant within the field. By August of 2003, mites had established at 8 of the 10 nurseries and by May of 2004, 6 of the 8 sites that had established had over-wintered. This project is now into its third year and the sites will be evaluated in May of 2005 to determine whether the mites have over-wintered for a second year. [23]

**TECHNIQUES FOR STAND REMOVAL OF GLYPHOSATE RESISTANT CREEPING BENTGRASS SEED PRODUCTION FIELDS.** MD. Butler, Oregon State Univ. and Ron P. Crockett, Monsanto.

Herbicide plus tillage treatments were evaluated for removal of commercial plantings of glyphosate resistant creeping bentgrass (*Agrostis stolonifera*). Herbicide treatments were applied 7 May 2004 to plots 10 ft by 55 ft replicated four times in a randomized complete block design. The trial was conducted in a commercial field of glyphosate resistant creeping bentgrass grown on sandy loam soil near Madras, Oregon. Plots were evaluated for control of glyphosate resistant creeping bentgrass 24 June 2004. This was followed by a double disking across the plots, with a second evaluation conducted 3 September 2004. The trial was rotated after the second evaluation to dislodge random plants missed during disking, and will be evaluated during the spring of 2005 for new growth following winter precipitation. Treatments of clethodim at 0.53 lb ai/A and clethodim at 0.53 lb ai/A plus imazapyr at 0.0625 lb ai/A provided 73 and 71 percent control of glyphosate resistant creeping bentgrass. This was followed by fluazifop at 0.375 lb ai/A with 65 percent control, clethodim at 0.53 lb ai/A plus primisulfuron at 0.285 lb ai/A and quizalofop at 0.11 lb ai/A with 61 percent control, and imazapyr at 0.625 lb ai/A plus terbacil at 0.4 lb ai/A with 60 percent control. Primisulfuron at 0.285 lb ai/A and imazapyr at 0.0625 lb ai/A in combination with clethodim at 0.53 lb ai/A did not appear to increase efficacy. After disking there was 100 percent control of creeping bentgrass, including the untreated check that received no herbicide treatment. [24]

**ESTIMATION LANDSCAPE LEVEL GENE FLOW IN WHEAT AND JOINTED GOATGRASS.** T. Gaines, P. Byrne P. Westra, and S.J. Nissen, Colorado State Univ., Fort Collins, CO

Pollen-mediated gene flow among crop cultivars and from crops to compatible relatives is an important issue for crops with regulated markets and with traits that may impact non-target organisms. The objectives of this project are to evaluate landscape-level crop-to-crop and crop-to-weed gene flow in wheat using tolerance to the herbicide imazamox as a marker trait. We are monitoring pollen movement to imazamox-susceptible wheat and to jointed goatgrass in fields adjacent to 'Above,' an imazamox-resistant winter wheat cultivar. Wheat and jointed goatgrass samples were collected in eastern Colorado in 2003 and 2004. Additionally, a Nelder wheel plot was sampled in 2004 to estimate gene flow to jointed goatgrass. Wheat sub samples from commercial fields were screened for resistance by treating with 44 g/ha in field plots. Additional wheat sub samples and jointed goatgrass samples were screened in the greenhouse with 44 g/ha imazamox. In both the field and greenhouse, hybrids were identified by an injured (tillering) phenotype and were confirmed with additional testing. The average cross-pollination observed in wheat collected from one to three feet away from Above was 0.63%. As distance from Above increased, the level of cross-pollination observed in commercial samples declined rapidly. The average cross-pollination rate for jointed goatgrass collected within Above at the Nelder wheel was 0.18%. Field sampling will continue in 2005, to complete three years of data collection for this project. [25]

**HERBICIDE TIMING FOR CONTROL OF DANDELIONS (*TARAXACUM OFFICINALE*) IN DIRECT SEEDED SPRING WHEAT** Ken L. Sapsford<sup>1</sup>, Fredrick.A. Holm, University of Saskatchewan, Saskatoon, SK; and Eric N. Johnson, Agriculture and Agri-Food Canada, Scott, SK.

The trial was conducted near Saskatoon, Sk.(2001), Scott, Sk.(2002) and Colonsay, Sk.(2004). Treatments were applied in September or October. All fall treatments received an application of glyphosate at 450 gai/ha 3 days prior to planting. Treatments were 1) glyphosate at 900 gai/ha Sep. or Oct. or Pre-seed. 2) 2,4-D ester at 840 gai/ha Sep. or Oct. 3) 2,4-D ester at 1120 gai/ha Sep. or Oct. 4) Express<sup>®</sup> - tribenuron methyl at 7.5 gai/ha Sep. or Oct. 5)

Express Pack® - tribenuron methyl at 7.5 gai/ha + 2,4-D ester at 420 gai/ha Sep. or Oct. 6) Spectrum® - florasulam at 5 gai + clopyralid at 75 gai + MCPA at 420 gai/ha Sep. or Oct. 7) Amitrol 240® - Amitrol at 960 gai/ha Pre-seed. Observations: Sept. applications of tribenuron methyl at 7.5 gai/ha, tribenuron methyl at 7.5 gai/ha + 2,4-D ester at 420 gai/ha and florasulam at 5 gai + clopyralid at 75 gai + MCPA at 420 gai/ha controlled dandelions through all rating periods from May 11 to Aug. 11. Sept. applications of glyphosate at 900 gai/ha controlled dandelion through July 8. Oct application of glyphosate controlled dandelion through June 9 only. The spring application of glyphosate did not control dandelion. Spring applied Amitrol at 960 gai/ha suppressed dandelions through June. Sept. applications of glyphosate at 900 gai/ha, tribenuron methyl at 7.5 gai/ha + 2,4-D ester at 420 gai/ha and florasulam at 5 gai + clopyralid at 75 gai + MCPA at 420 gai/ha significantly reduced dandelion count from the untreated check as assessed on May 13, 2004. Sept. application of tribenuron methyl at 7.5 gai/ha, tribenuron methyl at 7.5 gai/ha + 2,4-D ester at 420 gai/ha, florasulam at 5 gai + clopyralid at 75 gai + MCPA at 420 gai/ha and Oct. application of florasulam at 5 gai + clopyralid at 75 gai + MCPA at 420 gai/ha and 2,4-D ester at 1120 gai/ha and spring applied Amitrol 240® significantly reduced dandelion count on Sept. 29, 2004. Highest wheat yields were achieved with Sept. applications of glyphosate at 900 gai/ha, tribenuron methyl at 7.5 gai/ha, tribenuron methyl at 7.5 gai/ha + 2,4-D ester at 420 gai/ha, florasulam at 5 gai + clopyralid at 75 gai + MCPA at 420 gai/ha and the Oct. application of florasulam at 5 gai + clopyralid at 75 gai + MCPA at 420 gai/ha. Mean yield of all Sept. and Oct applications was 247% and 177% of the untreated check, respectively. Overall, dandelion control declined over the growing season due to regrowth of existing plants or germination of new dandelions. Conclusions: Fall treatment for control of dandelion should be applied in September for best results. tribenuron methyl at 7.5 gai/ha, tribenuron methyl at 7.5 gai/ha + 2,4-D ester at 420 gai/ha and florasulam at 5 gai + clopyralid at 75 gai + MCPA at 420 gai/ha applied in September supplied the longest and most consistent control of dandelions. Long-term control of dandelion will not be achieved with a one-time treatment. [26]

**ESTIMATING THE TOTAL AREA OF JOHNSONGRASS ON THE WASHITA WILDLIFE AREA USING GPS TECHNOLOGY.** A. Aldrich and L. Boggs, Southwestern Oklahoma State Univ. Weatherford.

Johnsongrass is an invasive species of Mediterranean origin that is now considered a noxious weed. Once established, it is difficult to control because it has abundant seed production and an extensive rhizome system. Johnsongrass, which was introduced for foraging purposes, can be poisonous to livestock and wildlife while it is under stressful growing conditions. Johnsongrass out competes the indigenous plant species, especially the native grasses. The Washita Wildlife Refuge (WWR) located in Custer County, Oklahoma, encompasses over 8000 acres of native grasslands, farmlands, and wetlands. Large areas of the refuge have been invaded by Johnsongrass. It is hypothesized that the areas in the refuge that have been disturbed by refuge improvement projects would have the greatest Johnsongrass concentration. During the fall of 2004, some areas of extensive Johnsongrass invasion were selected and mapped using Global Position Satellite Technology. Out of those areas approximately 16,862 hectares (41,668 acres) of Johnsongrass were mapped. The undeterminable results obtained from the small sample do not reflect the true Johnsongrass dissemination to the rest of the refuge. Poor weather conditions and equipment availability has prevented more extensive mapping. We believe this ongoing research will eventually reveal a much larger extent of Johnsongrass encroachment. [27]

**IGNITE AND LIBERTYLINK COTTON FOR THE CALIFORNIA PRODUCTION SYSTEM.** Ron Vargas, Steve Wright, Tomé Martin-Duvall and Lalo Banuelos, University of California Cooperative Extension, Madera/Merced and Tulare, CA

Field studies were conducted from 2002 to 2004 to evaluate weed control efficacy and tolerance of both LibertyLink and non LibertyLink cotton to Ignite (glufosinate). Ignite was applied over-the-top of LibertyLink FM 966L cotton in the 4 to 5-leaf stage when pigweed (*amaranthus* spp) and black nightshade (*Solanum nigrum*) were in the 2 to 8-leaf stage. Control was excellent when weeds were 4 true leaves or less with control being poor when weeds were 5 true leaves or greater. When Ignite was tank mixed with either Staple (pyrithiobac sodium) or MSMA the 5 true leaf weeds were effectively controlled. There were no differences in control regardless of whether Ignite followed a PPI application of Treflan (triflurin) or not. No injury was observed on the cotton with Ignite alone, although some injury was noted when tank mixed with Staple, MSMA or Dual Magnum (metolachlor). Ignite applied post directed to non LibertyLink cotton exhibited mild injury to the lower stem and leaves contacted by the spray solution. Seed cotton yields of Ignite alone were significantly greater than the untreated control. When tank mixed with Staple, MSMA or Dual Magnum yields tended to be lower. Seed cotton yields of post directed Ignite on non LibertyLink cotton were lower, but not significantly lower, than the untreated control. [28]

#### **NITROGEN DEFICIENCY STRESS EFFECTS ON COTTON AND SPURRED ANODA PHYSIOLOGY.**

Greg T. Bettmann\* and Tracy M. Sterling, New Mexico State University, Las Cruces. H. Harish Ratnayaka, Xavier University, New Orleans, LA. William T. Molin, Southern Weed Science Research Unit, Stoneville, MS.

Physiological and antioxidant responses of two species of cotton (*Gossypium barbadense* L. cv. Pima S-7, and *Gossypium hirsutum* L., cv. Delta Pine 5415) and two accessions of spurred anoda [*Anoda cristata* L. Schlecht, New Mexico (NM) and Mississippi (MS)] were investigated under nitrogen (N) stress in the greenhouse. Nitrogen was withheld in one half of the plants in each plant type at six weeks old for four weeks. Biomass decreased in all plant types under N stress, with Pima exhibiting the least and MS accession the greatest. Plant height decreased in all plant types except for MS accession, which increased in height, under N stress. Height:node ratio increased at least 2% in spurred anoda accessions, but decreased ca 5% in cotton when deprived of N. N stress reduced photosynthesis ca 50% in cotton, and ca 30% in spurred anoda. Comparable decreases were found in stomatal conductance and transpiration, suggesting strong stomatal regulation of gas exchange under N stress. Leaf fluorescence (Fv/Fm) increased at least 4% under N stress in all plant types suggesting that fluorescence is an important component of quenching excitation energy at PSII. Although, concentrations of chlorophyll a and b, lutein, and beta-carotene declined under N stress in all plant types, antioxidant indices such as alpha-tocopherol and xanthophyll cycle conversion state increased. Alpha-carotene decreased for all species, except for the NM accession, in which the levels increased. Physiological and antioxidant responses to N stress of cotton and spurred anoda appear to be largely similar. [29]

#### **WEED CONTROL IN DRYLAND AND IRRIGATED CHICKPEA.** Drew J. Lyon\* and Robert G. Wilson, University of Nebraska, Scottsbluff.

Field studies were conducted in 2003 and 2004 near Scottsbluff and Sidney, Nebraska to identify efficacious chemical weed control options for both irrigated and dryland production of chickpea (*Cicer arietinum* L.), respectively. Only imazethapyr, when applied preemergence at 0.053 kg ai/ha, reduced plant height compared to the nontreated or hand-weeded checks. Other visual injury symptoms observed with this treatment included chlorosis and delayed maturity. At Scottsbluff, ethalfluralin applied preplant and mechanically incorporated caused significant crop injury in 2003, but the ethalfluralin treatment also maintained total weed densities 4 wk after crop emergence that were not significantly different than the hand-weeded check treatment at both sites in 2003 and 2004. Treatments containing sulfentrazone, whether applied alone or in combination with pendimethalin, dimethenamid-P, or imazethapyr, provided weed control similar to the ethalfluralin treatment, but without any evidence of crop injury. There was no significant treatment effect for seed weight at Scottsbluff in either 2003 or 2004. Seed yield at Scottsbluff ranged from 89 kg/ha for the nontreated check to 1700 kg/ha for the imazethapyr + sulfentrazone treatment. At Sidney, seed yield ranged from 135 to 413 kg/ha for the imazethapyr and dimethenamid-P + sulfentrazone treatments, respectively. The nontreated check treatment yielded 190 kg/ha. Herbicide treatments containing sulfentrazone appear to provide good broadleaf weed control in irrigated and dryland production systems in western Nebraska with little risk for crop injury. [30]

#### **EFFECT OF GLYPHOSATE RATE AND APPLICATION TIMING ON ANNUAL RYEGRASS COVER CROP REMOVAL.** Chuck Cole, Carol Mallory-Smith, Richard Affeldt, and Jed Colquhoun, Oregon State University, Corvallis.

Annual ryegrass has been undergoing testing in the Midwestern and Southern regions of the U.S.A. as a winter cover crop within conventional tillage corn-soybean rotations. Winter cover crops reduce soil erosion via runoff, consequently mediating nitrate and herbicide losses following snowmelt. Soil organic matter is also improved when the plant material is turned into the soil. However, concerns have been raised that annual ryegrass will become a troublesome weed if it is not controlled before spring planting. Trials were established during 2002 in Corvallis, OR, Simpson, IL, West Lafayette, IN, and Jackson, TN, and 2003 in Corvallis, OR, Simpson, IL, and Jackson, TN to test the efficacy of glyphosate in removing an annual ryegrass winter cover crop. A blend of several Oregon-grown annual ryegrass cultivars was sown at a rate of 30 lb/A at each location. Three glyphosate rates, 0.37, 0.74, and 1.48 lb ae/A, were applied at each of four annual ryegrass growth stages: late tillering, second node, boot, and early flowering. The experimental design for each trial was a randomized complete block with four replications. Annual ryegrass control at each location was directly related to glyphosate rate, regardless of growth stage at the time of application. In Oregon and Illinois, control was greatest where glyphosate was applied at 1.48 lb ae/A to late

tillering annual ryegrass. No treatment provided greater than 90% annual ryegrass control in Illinois. Glyphosate at 1.48 lb ae/A provided greater than 95% control when applied prior to early flowering in Indiana. Annual ryegrass was most effectively controlled in Tennessee with the high rate of glyphosate applied at the late tillering and early flowering stages of growth. Glyphosate applied at the high rate to early flowering annual ryegrass provided 100% control while returning the greatest relative quantity of biomass to the soil. The return of viable seed to the soil was observed frequently in both Illinois and Tennessee in 2002. No seed was recovered in Oregon or Indiana in 2002; however, viable seed was recovered from a majority of treatments in Oregon, Indiana, and Tennessee in 2003. No single rate of glyphosate at any timing provided 100% annual ryegrass control or prevented viable seed production across locations. [31]

**EFFECT OF MESOSULFURON APPLICATION TIMING ON ITALIAN RYEGRASS CONTROL IN WINTER WHEAT.** Jed Colquhoun\*, Charles Cole, Richard Affeldt, and Carol Mallory-Smith, Oregon State University, Corvallis.

Field observations suggest that mesosulfuron efficacy on Italian ryegrass is determined by a combination of weed growth stage and climatic conditions surrounding the time of application. Research was conducted in 2003 and 2004 in Corvallis, Oregon to determine the optimum mesosulfuron application timing for Italian ryegrass control in winter wheat. 'Foote' winter wheat and Italian ryegrass were planted on three dates (late-September, mid-October, and late-October). Six mesosulfuron application timings (at 0.0134 lb ai/A; every two weeks from early-November through mid-February) were evaluated individually at each planting date. The study was arranged in a split-plot design with four replications of plots measuring 8 by 28 feet. Among planting dates, weed control was greatest when the Italian ryegrass was in the 3-leaf to 2-tiller growth stage. In the late-October planting date, Italian ryegrass control was poor when mesosulfuron was applied in early- or mid-November, presumably because the majority of Italian ryegrass had not yet emerged. Conversely, in the late-September planting, weed control was poor when mesosulfuron was applied in mid-February to Italian ryegrass 16 inches in height. Wheat yield did not differ among mesosulfuron application timings within each planting date. [32]

**DEVILS CLAW CONTROL IN IMAZAMOX TOLERANT (CLEARFIELD) SUNFLOWER.** Brian L. S. Olson\* and Dallas E. Peterson, Kansas State University

Devils 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 devils claw as a troublesome weed in High Plains sunflower production. With the advent of imazamox tolerant sunflowers, imazamox, sold as Beyond, could be applied to sunflowers and potentially control devils 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. A two year study was initiated in the spring of 2003 in Northwest Kansas with two sites in each year. Fields were located that had a naturally occurring infestations of devils claw. A preemergence application of pendimethalin at 1,387 g ai/ha was applied to suppress grasses and some broadleaves. At planting, a Clearfield sunflower hybrid was seeded, 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 devils claw was at the 2, 8, and 12 to 14 true leaf stage. In addition to devil's claw, other weeds were rated if the naturally occurring population was consistent across the study site. These weeds were tumble pigweed and puncturevine in 2003. Weather conditions in both years were extremely dry which hindered weed growth and sunflower yield. Weed control ratings were consistent with application timing having the greatest affect regardless of the weed. Early treatments provided 90% control for devils claw and tumble pigweed and 83% control for puncturevine. A 30% 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 and COC was observed when ratings were taken on devils 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. In conclusion, the Clearfield sunflower system appears to have potential for controlling many troublesome weeds like devils claw that occur in High Plains sunflower production. [33]



**REVIEW OF RESEARCH ON WEED RESISTANCE TO GLYPHOSATE.** Kirk A. Howatt\*, Paula J. Petersen, Mary K. Corp, Tom H. Beckett, James D. Harbour, Steven S. Seefeldt, and Mike Enslinger, WSWS Herbicide Resistant Plants Committee, Newark, CA.

Glyphosate is one of the safest and most popular herbicides in the world. Originally released in 1974, glyphosate use increased with commercialization of glyphosate-resistant crops in the late 1990s and the expiration of the patent on glyphosate. The selection pressure of glyphosate in repeated applications over several years has led to the development of resistance in some species. Rapid and spontaneous expression of resistance in horseweed populations from distant geographic locations in the United States and the increasing problem of resistant annual ryegrass populations in Australia have led to concern over the longevity of glyphosate-resistant cropping systems as well as conventional systems that rely on glyphosate for weed control. While the presence of glyphosate-resistant weed biotypes has been documented, the mechanism and inheritance of resistance has not been irrefutably confirmed. Retention, uptake, and metabolism were similar in glyphosate-susceptible and glyphosate-resistant horseweed. However, susceptible horseweed translocated over 50% more glyphosate to the roots than resistant horseweed. Altered translocation also was implicated in biotypes of field bindweed that exhibited altered response to glyphosate. While resistant-horseweed EPSP synthase was susceptible to glyphosate, resistance in goosegrass was believed to be at least partially target-site based. Four resistant goosegrass populations from Malaysia have been extensively studied and several point mutations identified; however, the significance of the mutations has not been fully elucidated. Two of the resistant populations have mutations that cause a proline<sub>106</sub> to serine<sub>106</sub> substitution and one has a mutation that causes a proline<sub>106</sub> to threonine<sub>106</sub> substitution, but the fourth population doesn't have either of these mutations. For horseweed and goosegrass, glyphosate resistance was conferred by a single, incompletely-dominant, nuclear gene. [34]

**CONTROL OF WEEDS IN CERTIFIED ORGANIC FARMING SYSTEMS.** Benny Fouche, University of California Cooperative Extension, Stockton, California.

Two applications of OMRI approved weed control materials and methods were made on certified fava beans, *Vicia faba* L. Vetch. *Luguminosae*. Two types of propane powered flamers, an Eco Weeder radiant burner and a conventional flame burner were compared against Matran-2, Xpress and horticultural vinegar liquid sprays. A hand weeded plot and an untreated control were also included. Weeds present during the trials were annual bluegrass, *Poa annua* L. Bluegrass. *Gramineae* and burning nettle, *Urtica urens* L. Nettle. *Urticaeae*. The first application was made on Nov 25<sup>th</sup>, 200, when the first true leaves were present on burning nettle, *Urtica urens*. Liquid sprays at 50 GPA volume were applied using an 8003VS Flat Fan Nozzle @ 25 PSI. Materials were as follows: Matran-2 - 45.6% Clove Oil @ 5 GPA Product (10% Product), Matran-2 - 45.6% @ 5 GPA (10% Product) + NuFilm 17@ 16oz/ac, Express - 20.5% Clove & Thyme Oils @ 7.5 GPA (15% Product), Bradford Horticultural Vinegar - 20% Acetic Acid @ 15 GPA 7% final concentration. Control of weeds following the first application was most effective using the standard flame burner, Matran-2, and hand weeding. Control of weeds following the second application indicated that the standard flame burner, Matran-2 and the higher rate of the vinegar were effective in controlling weeds [35]

**DETERMINING PHYSIOLOGICAL MATURATION OF JOINTED GOATGRASS (*AEGILOPS CYLINDRICA*) CARYOPSES.** Michael P. Quinn\* and Don W. Morishita, University of Idaho, Twin Falls; William J. Price, University of Idaho, Moscow.

Jointed goatgrass is an invasive winter annual grass weed that infests winter wheat fields and is capable of reducing wheat yield and quality. Control is difficult due to the close genetic relationship between jointed goatgrass and wheat. Greenhouse experiments were initiated in fall 2002 and 2003 and completed the following springs. The objectives were to: 1) identify the point in the jointed goatgrass maturation process when the seed first becomes germinable; 2) model germination response to varying maturity; and 3) examine seed germination differences within the spike. Jointed goatgrass plants were grown from seed, vernalized for 8 weeks at 4 C and grown in a greenhouse. Treatments were the number of days after anthesis (DAA) a spike was allowed to remain on the plant before harvesting and ranged from 2 to 34 DAA in one (2002), or two (2003) day increments. All treatments were assigned randomly to individual spikes. Anthesis was defined as one third of the spike having anthers dehiscent. Individual spikes were divided at harvest into three sections: top, middle and bottom. Spikelets in these sections were disarticulated from the rachis and allowed to afterripen for 72 days at room temperature. Samples were placed into a germinator at 15 C for 20 days and germination recorded each day. Samples were considered germinated when 3 mm of the radicle emerged. Goatgrass spikelets harvested <7 DAA had less than 3% germination for all spike



sections and was extremely variable especially for the middle and bottom sections. Although limited, earliest germination observed was in samples harvested 2 DAA. Time to germination was similar for all sections of the spike. Jointed goatgrass germination by DAA was examined using a linear plateau model. This model describes a process in which germination initially increases linearly with maturity until the germination response achieves a constant value. The DAA or point in maturity at which there was no change in germination was 25, 21, and 23 d for the top, middle, and bottom spike sections. Maximum average germination of the top section was 72% compared to 86% for the bottom and middle sections. This suggests that factors other than developmental rate (ie dormancy) may impact germination in sections of the spike. A second year of the experiment was conducted to validate the model. Data from this experiment indicated that the germination models underestimated the response observed in the second year. Maximum germination in all three spike sections was >84%. Model validation for time to germination indicated that the models overestimated the response observed in the second year. Time to germination in all spike sections was greater in the second year. The variation in response may be attributed to minor environmental differences between years. Model validation indicates that variation in germination response between years may be too great for predictive model construction. However, this research demonstrates that control measures must be implemented earlier than previously prescribed to prevent goatgrass reproduction. [36]

#### **DIFFERENTIAL RESPONSE OF WILD OAT BIOTYPES TO ACCase INHIBITORS**

Ahmet Uludag, Kee-Woong Park, Joshua B. Cannon, Carol A. Mallory-Smith, Oregon State University, Corvallis.

Three fenoxaprop-resistant sterile wild oat (*Avena sterilis*) biotypes from Turkey and five suspected ACCase-resistant wild oat (*Avena fatua*) biotypes from the Pacific Northwest were tested to determine their response to ACCase inhibitors. Greenhouse pot experiments were conducted and dry weight data were used to compare populations. All *A. fatua* populations were resistant to fenoxaprop but at different levels. Two of the populations survived 64 times the recommended field rate of 90 g ai/ha fenoxaprop while two other populations survived two times the rate that killed the susceptible population. The fenoxaprop-resistant *A. fatua* response to tralkoxydim was similar to the fenoxaprop-susceptible population when dry weight was used for comparison. However, three populations, which were moderately resistant to fenoxaprop, had regrowth when treated with tralkoxydim. One *A. sterilis* population was resistant to tralkoxydim and regrew when treated with clethodim. None of *A. fatua* populations were resistant to clethodim. [37]

#### **STS/ROUNDUP READY STACKED-TRAIT SOYBEAN USES FOR MANAGING WILD BUCKWHEAT AND OTHER GLYPHOSATE TOLERANT WEEDS.** James D. Harbour\*, Mick F. Holm, J. Leslie Lloyd, and David W. Saunders, DuPont Ag & Nutrition, Johnston, IA.

STS®/Roundup Ready® (STS/RR) soybean varieties contain genetic traits conferring increased tolerance to certain ALS-inhibitor herbicides and tolerance to glyphosate. STS/RR soybeans allow farmers additional choices for weed control management without increased risk for crop response. The study objective was to determine the benefit of adding thifensulfuron and/or chlorimuron-ethyl herbicides to glyphosate for enhanced control of broadleaf weeds that may be difficult to control with glyphosate treatments alone. STS/RR soybean were treated with glyphosate applied at 15 oz ai/a alone, glyphosate (15 oz ai/a) tank mixed with thifensulfuron at 0.0625, 0.125, or 0.25 oz ai/a, glyphosate (15 oz ai/a) tank mixed with chlorimuron-ethyl at 0.125 or 0.25 oz ai/a, or glyphosate (15 oz ai/a) tank mixed with thifensulfuron at 0.25 oz ai/a and chlorimuron-ethyl at 0.25 oz ai/a. Ammonium sulfate, at 2% (v/v), was added to all treatments. Overall weed control and crop safety with mixtures of thifensulfuron and/or chlorimuron-ethyl plus glyphosate was as good or better than applications of glyphosate alone, particularly on wild buckwheat and horseweed. [38]

#### **COTTON INJURY SYMPTOMS AND YIELD AS AFFECTED BY SIMULATED DRIFT RATES OF SEVEN HORMONAL-TYPE HERBICIDES.** Kassim Al-Khatib\*, Douglas E. Shoup, Molly E. Marple, Dallas E. Peterson, and Mark M. Claassen, Kansas State University, Manhattan.

Cotton response was evaluated when 2,4-D amine, 2,4-D ester, dicamba, clopyralid, picloram, fluroxypyr, and triclopyr were applied at rates simulating spray drift during the 6 to 8 leaf stage at Manhattan and Hesston, Kansas in 2004. Herbicide rates applied represented 0, 1/100, 1/200, 1/300, and 1/400 of the use rates of 561, 561, 561, 280, 561, 210, and 561 g ha<sup>-1</sup> for 2,4-D amine, 2,4-D ester, dicamba, clopyralid, picloram, fluroxypyr, and triclopyr, respectively. Injury from 2,4-D amine and 2,4-D ester were similar and was greater than that of other herbicides. The order of phytotoxicity was 2,4-D>picloram>dicamba>fluroxypyr>triclopyr>clopyralid. All herbicides caused

characteristic symptoms of hormonal-type herbicide, except triclopyr and clopyralid which caused severe bleaching and chlorosis. By 56 days after treatment, no injury symptoms were observed on cotton plants except all rates of 2,4-D, the three highest rate of picloram, and the highest rate of dicamba. The greatest yield reduction was with 2,4-D amine and 2,4-D ester, whereas triclopyr, clopyralid, and dicamba had the least effect on yield among the seven herbicides. In general, fiber quality was not affected by herbicide treatment except for fiber elongation where 2,4-D reduced elongation compared to the control. This research clearly showed that cotton is extremely susceptible to simulated drift rates of 2,4-D. [39]

**MANAGEMENT OF RATTAIL FESCUE IN CHEMICAL FALLOW.** Daniel A. Ball\*, Sandra A. Frost, Larry H. Bennett, Oregon State University, Pendleton; Traci A. Rauch, Eric Jammett, Donn C. Thill, University of Idaho; Joe P. Yenish, Rodney J. Rood, Washington State University

Control of rattail fescue, (*Vulpia myuros*), a winter annual grass weed, has been difficult in chemical fallow or prior to establishment of direct seeded spring or winter cereals. Options for effective control without tillage in fallow and in cereal crops have not been adequately investigated, and need to be developed. Six studies were established in fall 2003 in summer fallow to investigate the response of rattail fescue to different rates and timings of glyphosate. Locations included Pendleton and Mission, OR; Pullman and Dayton, WA; Genesee and Moscow, ID. Mature rattail fescue was fall seeded onto study sites where needed. Results indicated that early postemergence (EPOST) timings across herbicide rates provided better rattail fescue control at Genesee, ID and Pullman, WA, while late postemergence (LPOST) timings provided better overall control at Pendleton, OR. Control at Mission, OR, Moscow, ID and Dayton, WA was more rate dependent than timing dependent. As expected, higher rates generally provided a higher level of control. Split applications of glyphosate provided the most consistent control across locations, and provided the greatest overall reduction in late-season rattail fescue panicle density and subsequent seed production. In general, glyphosate was more consistently effective at controlling rattail fescue than paraquat + diuron, but control with paraquat + diuron when used as a split application with glyphosate provided acceptable control. Environmental factors may have contributed to the differences in control between locations, more so than rattail fescue growth stage at time of application. [40]

**RIMSULFURON PLUS GLYPHOSATE FOR ONE PASS WEED CONTROL IN GLYPHOSATE RESISTANT CORN.** James D. Harbour\*, J. Leslie Lloyd, and David W. Saunders, DuPont Ag & Nutrition, Johnston, IA

Studies were conducted at 17 university locations in 2004 comparing herbicide systems in glyphosate tolerant corn. Glyphosate applied alone early and mid post emergence was compared to tank mixtures of glyphosate and rimsulfuron. Results were compared to 10-acre commercial demonstrations of glyphosate plus rimsulfuron at 72 total locations in both 2003 and 2004. In addition, data was averaged for this tank mix from in house DuPont Crop Protection trials conducted in the years 2000-2004. Key weeds included giant foxtail, yellow foxtail, fall panicum, common lambsquarters, and several amaranthus species. For season long weed control it was necessary to add rimsulfuron to the glyphosate for control of several grass and broadleaf weed species. Rimsulfuron provided good residual control of many grass and small seeded broadleaf species and improved the control of the glyphosate on some broadleaf species. [41]

**RATTAIL FESCUE CONTROL IN IMAZAMOX-TOLERANT WINTER WHEAT.** T. Rauch\*, E. Jemmett, D. Thill, University of Idaho, Moscow; D. Ball, L. Bennett, S. Frost, Oregon State University, Pendleton; C. Mallory-Smith, C. Cole, Oregon State University, Corvallis; J. Yenish, Rod Rood, Washington State Univ., Pullman

Rattail fescue is a winter annual grass that is found in direct seed cereal production systems in the Pacific Northwest. Rattail fescue is typically controlled by tillage; however, populations are expanding with the increase in low disturbance farming systems. Few herbicides are currently registered for rattail fescue control in winter wheat. Rattail fescue control and wheat response with diuron, flufenacet, imazamox, mesosulfuron, pendimethalin, and sulfosulfuron was determined in imazamox-tolerant winter wheat in six studies established in Idaho, Oregon, and Washington. The experimental design at all locations was a randomized complete block. Herbicides were applied preemergence in the fall and/or early postemergence in the spring. Rattail fescue control was evaluated visually and biomass was collected. Wheat seed was harvested at crop maturity. At three sites, mesosulfuron and imazamox injured wheat 8 to 9 and 10 to 20%, respectively. At Corvallis, OR, flufenacet applied preemergence injured wheat 11 to 18%. At five sites, rattail fescue control was best with flufenacet applied alone preemergence or combined

with all other herbicides (92 to 100%). At four sites, pendimethalin combinations controlled rattail fescue 92 to 100%. Rattail fescue biomass was greatly reduced by flufenacet and pendimethalin alone or in combination with other herbicides at four and three sites, respectively. Wheat yield varied across sites, primarily due to differences in growing season precipitation. [42]

**MEASURING JOINTED GOATGRASS VIABILITY LOSSES ACROSS ENVIRONMENTS AFTER ONE YEAR.** Dave Wilson, Gustavo Sbatella and Steve Miller, University of Wyoming, Laramie.

A study was initiated in August of 2003 to study the loss of viability of jointed goatgrass seeds in no-till conditions compared to conventional tillage systems. The methodology utilizes microchip tracking, GPS and IR camera systems for evaluating viability and predation losses. Study plots were installed on September 15-17, 2003. Baseline seed viability for the jointed goatgrass seed used (NE Colorado 2003 seed source) was 67% with an average of 1.8 seeds per joint. Initial predation for September and October 2003 at Nebraska sites ranged from 0 to 100% with a mean of 54% for both Nebraska sites combined. Wyoming seed predation has been extremely low with an average across replicates of only 2% predation, even though there was evidence of geese and songbirds on the site. North Platte has had the highest predation of seed. Observations at that location indicate most predation is occurring from rodents rather than birds. Trends indicate increasing predation on sites with higher organic surface cover. Collection of predation data for the late spring period was not satisfactory at Archer and Sidney due to the loss of seed from heavy rains. Predation methodology has been modified for 2005. Proposed changes include the use of seed cards and the installation of motion sensitive digital IR cameras in order to identify specific predation agents at the study sites. Field collection of no-till and tilled seed packets was conducted in the spring and fall of 2004, using GPS field location and microchip tracking methods. Viability tests for these first two sample dates were completed in May 2004 and January 2005 respectively. A general loss of viability was observed with increasing burial depth in the samples collected in spring of 2004 for both tilled and no till conditions. This is contrary to previously observed seed viability losses in undisturbed studies and may be attributed to summer drought conditions which depleted surface moisture and decreased germination. Jointed goatgrass seed was observed germinating from as deep as 15 cm below the surface where moisture was present. Viability losses exhibit a linear trend at the Nebraska sites, while a fluctuating pattern was observed in Wyoming. These preliminary results also suggest greater viability losses under tillage conditions, due to the burial of surface implanted seed. Field collection of seed packets will continue in the spring and fall of 2005. [43]

**JOINTED GOATGRASS BY WINTER WHEAT HYBRID DYNAMICS IN COLORADO WHEAT FIELDS.** Philip Westra, Brad D. Hanson, David S. Belles, and Todd Gaines, Colorado State University, Ft. Collins.

Although jointed goatgrass by winter wheat hybrids are not common in Colorado wheat fields, rigorous field scouting yields a few such plants. Jointed goatgrass by winter wheat hybrids were collected from winter wheat fields in eastern Colorado in 2002, 2003, and 2004. The spikes were photographed prior to counting and mapping the spikelets as they were planted in shallow furrows 1" apart in commercial Metromix 250 potting soil in 12 inch by 20 inch by 2 inch flats. The spikes of these plants readily disarticulate from the stem, but the spikelets stay strongly attached to the central rachis, unlike jointed goatgrass. Spike color varies considerably, as does the awn length. Plants began to emerge in 7 to 10 days, although a few emerged after 14 days. After 21 days, no additional emergence was observed. When the emerged plants were at the 3 to 4 leaf stage, they were transplanted into individual pots and then placed in a vernalization chamber at 33 F for 8 weeks. In 2002, of 1,929 spikelets planted, 0.83% produced plants. In 2003, of 5,773 spikelets planted, 0.69% produced plants. In 2004, of 6,326 spikelets planted, 1.66% produced plants. The number of hybrid spikelets per spike averaged 9.4, 10.8, and 10.8 respectively in 2002, 2003, and 2004. The vernalized 2003 plants produced numerous reproductive heads in the greenhouse. Some heads were bagged prior to flowering, and others were left unbagged. Preliminary greenhouse research suggests that when left to self pollinate or to cross pollinate, these plants exhibit no self fertility, likely due to sterile pollen. [44]

**MANAGING IMAZAMOX-RESISTANT WHEAT IN CROP ROTATIONS FOR JOINTED GOATGRASS CONTROL.** David Belles\*, Phil Westra, and Brad Hanson, Colorado State University, Ft. Collins

A study was initiated in 2000 at two locations in Colorado and conducted for four years to evaluate the best use of Clearfield winter wheat for jointed goatgrass management in wheat-based cropping systems in the Central Great

Plains. In 2000, Clearfield winter wheat, standard winter wheat, and fallow blocks were established. From 2000 to 2004, 16 different Clearfield winter wheat, standard winter wheat, and fallow rotations were applied. In 2004, the smallest subplot was 9 by 12 m. Each year prior to harvest, reproductive jointed goatgrass tillers were counted in four 1 m<sup>2</sup> quadrats in each sub-sample. Wheat yields were recorded at harvest. The appropriate fertility, tillage, planting dates, and crop management were used to optimize crop production. Jointed goatgrass populations in imazamox treated plots were 13 plants m<sup>-2</sup> in 2001 and declined to 0 plants m<sup>-2</sup> by 2003. These plots were fallow in 2004. In plots not treated with imazamox, jointed goatgrass populations declined from 42 plants m<sup>-2</sup> to 1 plant m<sup>-2</sup>. No jointed goatgrass was found in plots treated with imazamox in 2001 or 2003. Plots fallow in 2001 but planted in 2002 had jointed goatgrass in 2 of 4 untreated plots in 2002. No jointed goatgrass was found in these plots in 2004 after a year of fallow in 2003. Although drought in 2002 and 2003 resulted in poor jointed goatgrass germination and low population numbers, imazamox treatments significantly reduced populations further. Averaged over both sites imazamox treated wheat yielded 2223 kg ha<sup>-1</sup> and 2391 kg ha<sup>-1</sup> in 2001 and 2002, respectively while untreated wheat yielded 2147 and 2223 kg ha<sup>-1</sup> in 2001 and 2002, respectively. In 2003 and 2004 wheat yields were highest in wheat that was treated again. Wheat that was untreated in both years had the lowest yield and wheat treated one out of two years yielded in between the wheat treated or left untreated in both years. The fall of 2004 and spring of 2005 produced good moisture for jointed goatgrass germination. Benefits from imazamox should become more apparent in the final two years of this study. [45]

**LENTIL TOLERANCE TO SOIL-APPLIED HERBICIDES.** Brian M. Jenks\*, Gary P. Willoughby, Denise M. Markle, Kent R. McKay, North Dakota State University, Minot; and Neil R. Riveland, North Dakota State University, Williston

Four studies were conducted to evaluate conventional-till and no-till lentil tolerance to herbicides and efficacy of these herbicides. In study 1, we evaluated no-till lentil tolerance to preemergence (PRE) herbicides. In study 2, we evaluated no-till lentil tolerance to herbicides applied 1 year prior to planting, the fall prior to planting, and PRE. In study 3, we evaluated no-till lentil tolerance to PRE and postemergence (POST) herbicides. In study 4, we evaluated conventional-till lentil tolerance to herbicides applied preplant incorporated (PPI), PRE, and POST. In study 1, tribenuron (0.125 and 0.25 oz) and thifensulfuron (0.225 and 0.45 oz) applied PRE caused moderate to severe lentil injury. Thifensulfuron caused more visible crop injury as well as a greater reduction in crop density than tribenuron. Carfentrazone (0.008 lb) caused little or no crop injury. 2,4-D ester (0.25 lb) caused very severe crop injury and reduced crop density by one-half. In study 2, fall and spring applications of sulfentrazone alone (0.125-0.188 lb) or tank mixed with pendimethalin (0.95-1.25 lb) or ethalfluralin (0.75-1.125 lb) reduced lentil densities. The tank mixes reduced crop densities and increased visible crop injury more than when the herbicides were applied individually. Crop injury was consistently higher with spring applications compared to fall applications. Pendimethalin alone or tank mixed with imazethapyr (0.016-0.032 lb) provided better kochia control when applied in the spring, but also resulted in more crop injury. Sulfentrazone generally provided good to excellent kochia control. Sulfentrazone (0.25 lb) applied 1 yr prior to planting caused moderate crop injury and only provided fair kochia control. In study 3, all herbicide treatments caused visible crop injury. All sulfentrazone (0.047, 0.070, and 0.094 lb) treatments caused a slight reduction in lentil density, but yields were generally as high as other treatments. Pendimethalin (0.095 lb), imazethapyr (0.032 lb), and metribuzin (0.188 lb) applied alone or as a tank mix caused slight to moderate crop injury. Tribenuron (0.063-0.125 oz) and thifensulfuron (0.094-0.188 oz) applied PRE with glyphosate also caused slight to moderate crop injury. Sulfentrazone provided good to excellent weed control. Pendimethalin, metribuzin, and imazethapyr generally provided less Russian thistle control compared to sulfentrazone. In study 4, all herbicide treatments caused moderate to severe crop injury. Sulfentrazone (0.070, 0.094, 0.117, and 0.14 lb), tribenuron (0.25 oz), and thifensulfuron (0.45 oz) applied PRE reduced crop density. Sulfentrazone tank mixed with pendimethalin (0.095 lb) caused more crop injury than either herbicide applied alone. Metribuzin applied PRE (0.25 lb) or POST (0.125 lb) caused severe crop injury. Pendimethalin caused more injury applied PRE than PPI, but kochia and pigweed control was significantly less PPI than PRE. The injury observed in studies 1, 3, and 4 conducted in Minot, ND may be viewed as a worst case scenario given the weather conditions of 2004. The PRE treatments were applied on May 10. Within three days, 1.3 inches of precipitation fell in the form of rain and snow. Within three weeks after the PRE application, the area had 3.2 inches of precipitation and generally cold conditions. In study 2, at Williston, 0.36, 1.66, and 2.78 inches of cumulative precipitation fell 4, 14, and 28 days after the PRE application. [46]

**LONG-TERM CONTROL OF COMMON MILKWEED.** Brian M. Jenks\*, Gary P. Willoughby, Denise M. Markle, North Dakota State University, Minot

Two studies were initiated to investigate the effect of various herbicides, application timings, and milkweed size on milkweed (*Asclepias syriaca*) control in wheat. The first study was initiated near Wolf Creek, ND in 2002. The study focused on tribenuron which had shown activity on milkweed in previous studies. Tribenuron was applied with various tank mixes in a single or split application. Single application treatments were applied with or without a pre-harvest glyphosate application. The various treatments provided inconsistent control when evaluated 2 months after treatment (MAT). However, milkweed densities 12 MAT were lower where glyphosate had been applied pre-harvest. Treatments with preharvest glyphosate reduced milkweed density an average of 85% compared with 40% for in-crop treatments alone. The second study was initiated near Minot, ND in 2003 to observe the effect of milkweed size at time of application on milkweed control. Milkweed plants were marked for 5 different size groups; less than 1-inch, 1- to 3-inches, 3- to 6-inches, 6- to 10-inches, and greater than 10-inches tall. Herbicide treatments consisted of various tribenuron or carfentrazone tank mixes applied alone, or followed by a preharvest glyphosate application. The plants were marked and counted just prior to herbicide application, and evaluated and counted again about 1 and 2 MAT. Control was similar across all sizes of milkweed, regardless of treatment, though there was a trend for less control of larger milkweed (greater than 10-inches). However, 20-40% of the milkweed plants emerged after herbicide application. Additionally, treatments with a preharvest glyphosate again reduced milkweed densities more than in-crop treatments alone 12 MAT. Treatments with a preharvest glyphosate reduced milkweed density by 95% compared with 57% for in-crop treatments alone. [47]

**VOLUNTEER CANOLA CONTROL IN SIX CROPS.** Kent R. McKay\*, Brian M. Jenks, Denise M. Markle, Gary P. Willoughby, North Dakota State University, North Central Research Extension Center, Minot, ND

Canola can volunteer for several years following a canola crop. These volunteers can be very competitive and hard to control, especially in other broadleaf crops. Weed control options that provide excellent control of volunteer canola (VC) are often limited in broadleaf crops, especially soil-applied herbicides. In 2004, a VC control study was conducted at the North Central Research Extension Center, Minot, ND to evaluate several herbicides for control of VC in dry pea, flax, sunflower, soybean, and corn. The trial evaluated the effect of canola growth stage on herbicide efficacy. In general, VC control was better when postemergence herbicides were applied at the 3-leaf canola stage compared to 6-leaf or later. Only six postemergence herbicides provided excellent VC control at both application timings including tribenuron, nicosulfuron&rim sulfuron, nicosulfuron, foramsulfuron+isoxadifen safener, imazamox, and fomesafen+adjuvants. Several postemergence herbicides provided good to excellent VC control when applied at the 3-leaf canola stage, but provided significantly less control when applied at the 6-leaf stage. In peas, soil-applied metribuzin provided excellent VC control. Metribuzin applied postemergence provided good VC control at the 3-leaf stage, but only fair control at the 6-leaf stage. VC control with MCPA amine and bentazon was good to excellent at the 3-leaf stage, but very poor when applied at the 6-leaf stage. Imazamox provided good to excellent VC control at either stage. In flax, soil-applied sulfentrazone provided poor VC control, which was expected. Bromoxynil&MCPA ester provided excellent VC control when applied at the 3-leaf stage, but control dropped 10-15% when applied at the 6-leaf stage. Thifensulfuron provided only fair VC control early and poor control with the late application. In tribenuron-resistant sunflower, tribenuron and imazamethabenz provided good to excellent VC control at either application stage. Soil-applied sulfentrazone provided good VC control in sunflower and dry pea, which was better than expected. In soybeans, soil-applied flumioxazin and imazethapyr&glyphosate provided excellent VC control, while metribuzin and flumetsulam provided fair to good control. Imazamox and fomesafen applied postemergence provided excellent VC control at both timings. Thifensulfuron, bentazon, and lactofen provided much less control when applied at the 6-leaf stage. Acifluorfen provided poor VC control at either timing. In corn, soil-applied isoxaflutole provided excellent VC control. Postemergence herbicides nicosulfuron&rim sulfuron, nicosulfuron, and foramsulfuron provided excellent VC control at both application timings. VC control with mesotrione and dicamba&diflufenzopyr dropped 12-13% with the 6-leaf application, while control with 2,4-D amine dropped 43%. Atrazine and fluroxypyr provided very little control at either application stage. In 2002, a volunteer canola study was conducted in spring wheat. Thifensulfuron, 2,4-D ester, and carfentrazone provided excellent control of cotyledon stage canola. Carfentrazone + MCPe, bromoxynil&MCPe, and thifensulfuron + MCPe provided excellent control of 3-leaf and 5-leaf canola. Thifensulfuron + fluroxypyr, fluroxypyr + MCPe and tribenuron + MCPe provided excellent control of 3-leaf canola; however, control dropped approximately 10% when applied to five-leaf canola. [48]

**EFFICACY EVALUATION OF VARIOUS HERBICIDES IN SPRING WHEAT-2004.** B. W. Alford<sup>1</sup>, R. E. Mack<sup>2</sup>, J. R. Roberts<sup>3</sup> Helena Chemical Company Memphis, TN 38120

Bromoxynil and 2,4-D are two herbicide chemistries used for controlling various weed species in wheat. Double Up B+D is an in-can premix of these two chemistries; which contains 2 lbs of bromoxynil and 2 lbs of 2,4-D ethylhexyl ester. Field trials in Oregon, Colorado and North Dakota showed Double Up B+D displayed effective control of Russian thistle, kochia, wild buckwheat, blue mustard, common lambsquarter and prickly lettuce. Control of Russian thistle was averaged across two locations where Double Up B+D (1.5 lbs ai/A) and bromoxynil and 2,4-D (2 lbs ai/A) displayed 99% control. Double Up B+D (.75 lbs ai/A) and bromoxynil (1.0 lbs ai/A) provided 95 and 94% control while all other treatments provided < 75% control of Russian thistle. Control of kochia was also averaged across two locations where Double Up B+D (1.5 lbs ai/A), bromoxynil and 2,4-D (2 lbs ai/A) and bromoxynil (2 lbs ai/A) provided 92, 92 and 91% control. Across all locations for all weed species, Double Up B+D (1.5 lbs ai/A), bromoxynil (1.0 lbs ai/A), bromoxynil and 2,4-D (2 lbs ai/A) and Double Up B+D (.75 lbs ai/A) provided 97, 95, 92 and 89% control, while 2,4-D ester (.22 and .37 lbs ai/A) and bromoxynil (.50 lbs ai/A) provided < 75% control. [49]

**EVALUATION OF PENOXsulAM FOR WEED CONTROL IN WESTERN RICE.** Alan E. Haack\*, Rick K. Mann, Roger E. Gast and Debbie D. Shatley, Dow AgroSciences, Indianapolis, IN.

Penoxsulam (DE-638) is a triazolopyrimidine sulfonamide herbicide being developed globally for control of major rice weeds. Penoxsulam is a reduced risk status herbicide that will be launched in the U.S. in 2005 with the trade names Grasp® in southern U.S. and Granite® in California. When applied as a granule formulation applied directly into water at 40 g ai/ha in research trials of water-seeded rice in CA, penoxsulam provides excellent control of early watergrass (*E. oryzoides*), barnyardgrass (*E. crus-galli*), annual arrowhead (*Sagittaria* spp), water plantain (*Alisma plantago-aquatica*), duck salad (*H. limosa*) and ricefield bulrush (*Scirpus mucronatus*). Rice has demonstrated excellent tolerance to penoxsulam in research trials. Penoxsulam can be applied in sequential with cyhalofop, triclopyr, propanil, and thiobencarb to increase the weed control spectrum. In large commercial type trials penoxsulam as Granite® GR, a 0.24% ai granule, was aerial applied to water-seeded rice at six different locations in the Sacramento Valley, CA at a rate of 40 g ai/ha. Trial sites ranged from 1 to 5 acres in size and were managed under grower/cooperator direction, which provided a true assessment of product performance under commercial conditions. Control of susceptible weed species, including but not limited to watergrass (*E. oryzoides*), ricefield bulrush (*Scirpus mucronatus*), duck salad (*Heteranthera* spp) and annual arrowhead (*Sagittaria* spp) met or exceeded grower expectations. No adverse effects to the rice were observed.  
® Registered trademark of Dow AgroSciences LLC. [50]

**CHICKPEA PRE-HARVEST DESICCATION.** Brian M. Jenks, North Dakota State University, Minot; E. S. Davis, Montana State University, Bozeman; Gary P. Willoughby, Denise M. Markle, and Kristie L. Michels\*, North Dakota State University, Minot.

Chickpea acreage in North Dakota, as well as the United States as a whole, has been declining for several years. Total acres in the US decreased from 116,000 in 2000, to 44,000 in 2004. One of the challenges of raising chickpeas successfully is uneven ripening of the crop. Due to its indeterminate growth habit, a crop that looks mature might suddenly start to green up. One option to manage the ripening process is to apply a pre-harvest desiccant. This trial was conducted in two locations to compare six herbicides, paraquat (labeled for use), glyphosate, glufosinate, carfentrazone, flumioxazin, and lactofen for pre-harvest desiccation of chickpea. Percent dry down of the chickpea plants was evaluated at approximately 3, 7, and 14 DAT. Early evaluations indicated that paraquat was the fastest acting. However, glufosinate and eventually glyphosate gave similar or better desiccation by 14 DAT. Glyphosate, glufosinate, and paraquat consistently provided 90% or better control by the last evaluation in both locations. All treatments, with the exception of carfentrazone, provided at least 70% desiccation in both locations. Economically, glufosinate provided excellent desiccation, but was the most expensive treatment. Paraquat provided similar desiccation, but at less than half the price of glufosinate. Of the three most effective treatments, glyphosate was the least expensive; however, it required 14 days to reach the same level of effectiveness. [51]

**EVALUATION OF FALL APPLIED SULFENTRAZONE IN SPRING SEEDED CROPS.** Brian M. Jenks, Denise M. Markle, and Gary P. Willoughby\*, North Dakota State University, Minot

Kochia, wild buckwheat, and other persistent weeds can be a threat to yield in spring-seeded crops. Pulse crops and cereal grains do not compete well with kochia and wild buckwheat. In addition, harvesting crops infested with these weeds can be very difficult. In North Dakota trials at Minot and Carrington, sulfentrazone was applied both fall and spring to examine its effectiveness in controlling kochia, wild buckwheat, Russian thistle, redroot pigweed, foxtail, and common lambsquarters. At Minot, sulfentrazone was applied in the fall and spring (2002-03) to chickpea and spring wheat at 0.14, 0.188, and 0.25 lb ai/A. There was no visible crop injury with any treatment. Fall-applied sulfentrazone at 0.188 and 0.25 lb ai/A provided good to excellent control (>87%) of kochia, wild buckwheat, lambsquarters, and pigweed. Fall-applied sulfentrazone at 0.14 lb ai/A generally provided 5-10% less control. Spring-applied sulfentrazone at 0.14, 0.188, and 0.25 lb ai/A provided excellent control (>90%) of kochia, wild buckwheat, lambsquarters, and redroot pigweed. At Carrington, sulfentrazone was applied in the fall at 0.188 and 0.25 lb ai/A and in the spring at 0.188 lb ai/A in dry pea. None of the fall- or spring-applied treatments caused visible crop injury. Fall-applied sulfentrazone provided fair to good (68-89%) control of common lambsquarters and pigweed. Spring-applied sulfentrazone provided good to excellent (83-99%) control of common lambsquarters and pigweed. At Minot, sulfentrazone was applied in the fall and spring (2003-04) at 0.094, 0.14, 0.188, and 0.25 lb ai/A in dry pea at two locations (loam and sandy loam soils). There was no visible crop injury or difference in dry pea density with any treatment. Yields were similar for both spring and fall sulfentrazone applications, although there was a trend for higher yields with the spring treatments. All fall and spring treatments provided excellent control of kochia, wild buckwheat, Russian thistle, and lambsquarters at the July rating. At Minot, trials were also conducted in 2004 to determine the effect of seeding depth on dry pea tolerance to spring-applied sulfentrazone. Dry pea was seeded into loam and sandy loam soils at one- and two-inch depths. The sandy loam soil had pH 5.3 and 2.8% organic matter, while the loam soil had pH 6 and 3% organic matter. In both loam and sandy loam soils, no visible injury from sulfentrazone was observed at either the one- or two-inch depths. Dry pea yields in the loam soil were similar between treatments and depths. However, dry pea yields in the sandy loam soil were slightly higher with the 2-inch seeding depth compared to 1-inch. [52]

**PROJECT 4: TEACHING AND TECHNOLOGY TRANSFER**

**BIOLOGY AND BIOLOGICAL CONTROL OF INVASIVE PLANTS: A MANUAL SERIES.** Linda M. Wilson\*, University of Idaho, Moscow.

Technology transfer of biological control is the transfer of information to land managers concerning the use of biocontrol as a weed control method. Gaps in the transfer of technology to the user may hamper the implementation of biocontrol programs. A manual on biological control of yellow starthistle was published in 1995 by the US Forest Service to provide needed information to land managers wanting to implement weed biocontrol in their management areas. The success of this manual compelled the expansion of the manual into a four-volume series. Two additional volumes on biocontrol of knapweeds and purple loosestrife, as well as a second edition of the yellow starthistle manual, were published between 2000 and 2004. The fourth volume on biocontrol of toadflax is scheduled for publication in 2005. Each volume includes a detailed description and photographs of the weed(s), and information on the identification, distribution, biology, and ecology. Another section includes a detailed description, photographs, and information on the biology of each biocontrol agent. The largest section of each manual includes detailed instructions on how to plan, implement, evaluate and monitor a biocontrol program. Included are guidelines for establishing the agents, with specific recommendations on selecting release sites, and methodology to collect and release biocontrol agents. A separate section highlights methods to monitor the biocontrol agents and vegetation over time, which helps land managers determine the biocontrol agent's population size and subsequent impact to the target plant. A glossary, sample monitoring forms, troubleshooting guide, and selected references are included. [53]



## PROJECT 5: WEEDS OF WETLANDS AND WILDLANDS

**DETERMINING EFFECTIVE SEARCH SWATH WIDTHS FOR WILDLAND WEED SURVEYS.** Steven A. Dewey and Kimberly A. Andersen\*, Utah State University, 4820 Old Main Hill, Logan

Timely discovery of early-stage invaders requires that field surveys be conducted periodically at the highest level of detection confidence practicable. The objective of this study was to compare detection efficiencies in simulated field surveys searching for selected invasive weed species under conditions of varying swath widths, infestation sizes, and associated vegetation. In the first study (A) 15 single plastic replicas each of spotted knapweed, yellow starthistle, and leafy spurge plants were placed randomly within a 90-meter by 270-meter (2.5 hectares) plot area covered with a moderately dense stand of rabbitbrush. In the second study (B) 10 single plastic replicas each of leafy spurge and spotted knapweed plants were placed randomly within a second plot area of equal size which was covered by a mixed community of perennial grasses and forbs. Also placed in study B were 10 clusters each of leafy spurge and spotted knapweed, with each cluster consisting of 12 plastic plants grouped closely together to form a patch approximately 4 square meters in size. A total of 40 persons searched each plot, recording the number of individual plants or clusters found and the time required to search each plot. Plots were searched by walking parallel transects spaced 11.25, 22.5, 45, or 90 meters apart. In study A, half of the surveyors searched only for leafy spurge, while the other half searched for all three species simultaneously. In study B, half of the surveyors searched for single plants, while the other half searched only for clusters. The data represent averages of 5 replications. In both studies some target plants were never detected, even at the narrowest search swath width. The greatest swath width in which at least 90 percent of single leafy spurge plants were consistently detected in both studies was 11.25 meters. A higher percentage of single spurge plants were detected than either knapweed or starthistle, illustrating the significant differences in species visibility. In study A at the narrowest swath width searchers found 71 percent of single leafy spurge plants, compared to 55 and 48 percent of knapweed and starthistle plants, respectively. Searching for more than one species at a time reduced detection efficiency. In the narrowest search width 96 percent of leafy spurge plants were found when searched for alone compared to 71 percent when searched for simultaneously with knapweed and starthistle. As was expected, weed patches were visible from greater distances than were single plants, with 98.8, 84, and 70 percent of spurge patches being detected in the 22.5, 45, and 90-meter search swath widths, respectively. The average search time required ranged from 6 minutes per hectare for the 90-meter swath width to 30 minutes at the 11.25-meter width. Based on an hourly wage of \$12.00, the cost of searching for these weeds would have ranged from \$1.20 to \$6.00 per hectare. However, the total cost of conducting an actual wildland weed survey could be considerably greater than suggested by these figures because a significant amount of additional time may be spent traveling to and from the survey sites, entering data into field GPS units, downloading and analyzing data, and preparing report documents. [54]

**THE POTENTIAL FOR GERMINATION AND ESTABLISHMENT OF SELECT WEED SEED ON IRRIGATION CANALS IN SOUTHERN NEW MEXICO.** Cheryl Fiore and Jill Schroeder, New Mexico State University, Las Cruces

Elephant Butte Irrigation District (EBID) provides services to approximately 30,000 ha in southern New Mexico's Mesilla Valley. The system is primarily a gravity flow system with containment and delivery in the form of compacted earthen canals and laterals. Irrigation water is distributed through two canal and lateral types; intermittent facilities that hold water only when land is being irrigated from the canal or lateral and continuous facilities that hold water throughout the irrigation season. The irrigation season generally runs from February through October. Data collected at sites along the canal banks in 2002-04 demonstrates the variability of the canal bank environment. Bank angles range from 10 to 90 degree slopes; canal depths range from .75 to 3.2 meters; the water flow capacity for the canals and laterals range from 425 Ls<sup>-1</sup> to 14157 Ls<sup>-1</sup>. Soil characteristics are also highly variable. For example, electrical conductivity ranges from 0.89 to 50 dsm<sup>-1</sup> and sodium adsorption ratios range from 0.75 to 190. The objective of this poster is to establish a framework for understanding how the canal bank environment, the present weed populations, and EBID management practices are influencing the weed populations now and in the future. Common bermudagrass (*Cynodon dactylon* (L.) Pers.) and scouringrush (*Equisetum hyemale* L.) are creeping perennials that reproduce by underground vegetative structures. Both species are well adapted to the canal environment. Forty-two percent of the sites sampled were dominated by bermudagrass; and scouringrush was established at a third of all sample sites. Russian thistle (*Salsola iberica* Sennen) and kochia (*Kochia scoparia* (L.) Schrad.) are small seeded annuals that germinate from January through March in southern New Mexico when rainfall provides adequate soil moisture. Both species are common in the region, but were found at less than 1% of



the sites we sampled. Plant reproduction, seed dispersal methods, habitat requirements, phenology and physiology and vulnerability to EBID management strategies of scouringrush, Russian thistle, kochia and bermudagrass are compared with the canal type, bank and soil characteristics to assess potential for establishment. [55]

**THE DECLINE OF MUSK THISTLE IN FREMONT COUNTY, WYOMING SINCE 1980.** John L. Baker\*, Nancy A. P. Webber and Kim K. Johnson, Supervisor, Research Associate, and Research Associate, Fremont County Weed & Pest, Lander, WY.

Musk thistle was wide spread across southwestern Fremont County, Wyoming infesting 11,000 acres of crop and rangeland in 1980 as recorded on USGS Quads. Releases of 100 *Rhinocyllus conicus* adult weevils were made at several locations within the county in 1979 and 1980. In 1984, releases of 100 *Tricosirocalus horridus* adult weevils were made at some of the same locations. Both species established and quickly spread over 30 miles from the point of release. Visually dramatic declines could be seen at several sites by 1986, however most sites showed no change in Musk thistle population in spite of a high level of bioagent infestation. Musk thistle continued to spread. By 1990, fence line demarcations could be seen, and scattered, single plant infestations across the range had disappeared. By 1995, there was a general collapse of Musk thistle across the county. In 2004, 25 years after the initial release of *Rhinocyllus conicus*, every previously mapped Musk thistle site was visited and plants were inspected for level of attack and density. Using GPS and GIS technologies, 1,400 acres of Musk thistle were recorded, for an 87% reduction from the 1980 survey. Nearly every plant was heavily attacked. At the original release sites plant density declined by over 96%. [56]

#### **PROJECT 6: BASIC SCIENCES: ECOLOGY, BIOLOGY, PHYSIOLOGY, GENETICS**

**EVOLUTION OF MUSTARD BIOTYPES WITH RESISTANCE TO IMIDAZOLINONES, BUT NOT SULFONYLUREAS.** Joshua B. Cannon\*, Kee Woong Park, and Carol A. Mallory-Smith, Oregon State University, Corvallis.

Four populations of wild mustard suspected of being resistant (R) to ALS-inhibitors were identified in the Pacific Northwest. They were selected in legume crops that had been treated with imazethapyr every other year for several years. The purpose of this study was to characterize the mechanism and level of resistance, as well as the cross-resistance patterns of these populations. A susceptible (S) wild mustard population was identified in an area where no ALS-inhibitors had been used. Seed from the R- and S-populations were collected and grown in a greenhouse. Two weeks after emergence, ALS enzyme was extracted. In vitro enzyme assays showed reduced sensitivity of the enzyme from the R-populations to the imidazolinone herbicides imazamox and imazethapyr. Enzyme  $I_{50}$  values for the R-populations ranged from 600 to 750 times and from 250 to 1000 times that of the S-population for imazamox and imazethapyr, respectively. Other ALS-inhibitors screened included chlorsulfuron, thifensulfuron, propoxycarbazone, and flumetsulam. There was no reduced enzyme sensitivity to any of these herbicides. The reduced sensitivity of the enzyme to imidazolinones suggests that an altered target site is the mechanism of the resistance. [57]

**LONGSPINE SANDBUR INTERFERENCE AND CONTROL IN SUNFLOWER.** Leandro D. Perugini, Kansas State University, Manhattan; Phillip W. Stahlman\*, Kansas State University Agricultural Research Center-Hays; and J. Anita Dille, Kansas State University, Manhattan.

Field research was conducted at Hays, KS in 2003 and 2004, to investigate the critical period of absence for longspine sandbur [*Cenchrus longispinus* (Hack.) Fern.] in cultivated sunflower and to characterize effects of delayed weed emergence on longspine sandbur growth and development when competing with cultivated sunflower. Densities of 25 or fewer longspine sandbur plants  $m^{-2}$  emerging simultaneously with sunflower did not reduce sunflower yield either year, nor did densities as high as 60 plants  $m^{-2}$  in 2004 when sandbur plants of similar age to sunflower were transplanted within seven days after sunflower emergence. Longspine sandbur development was influenced by time of emergence relative to the crop and cumulative growing degree days. In 2003, longspine sandbur emerging simultaneously with sunflower developed 10.7 tillers and produced 325 burs per plant. In comparison, plants emerging two weeks later than sunflower developed 1.7 tillers and produced 42 burs per plant, and plants emerging three or more weeks later than sunflower developed no tillers and produced 13 or burs per plant. Weather conditions were more favorable in 2004 for rapid early sunflower growth and canopy closure, which hindered the growth and development of longspine sandbur plants more than in 2003. In 2004, bur production was

71 and 67% lower than in 2003 for longspine sandbur emerging simultaneously and two weeks later than the crop, respectively. [58]

**FACTORS INFLUENCING METHAM SODIUM EFFICACY ON YELLOW NUTSEDGE TUBERS.** Corey V. Ransom\*, Charles A. Rice, and Joey K. Ishida, Oregon State University, Ontario.

Yellow nutsedge infests a large number of acres in the Treasure Valley of Eastern Oregon and Western Idaho. Much of its continued expansion is related to onion production in the valley. Fall applications of metham sodium are often used to control yellow nutsedge prior to planting an onion crop with mixed results. Trials were conducted in the laboratory to determine the influence of metham sodium rate, duration of exposure, temperature during exposure, and tuber conditioning on yellow nutsedge control. Yellow nutsedge tubers were extracted from the soil in November and either stored at a constant 50 F in a small volume of soil or washed and subjected to 38 F for 4 weeks prior to the initiation of the experiment. The treatment of the tubers was meant to either preserve or overcome dormancy. Washing and chilling have been reported as effectively overcoming dormancy. Soil and 15 tubers were placed in jars, the soil was wetted to 14% moisture and the jars were placed in growth chambers at 41, 55, or 77 F for 24 hr to equilibrate. Metham sodium was then injected into the soil 0.5 inch below the tubers at equivalent rates of 85, 170, 256, and 341 lb ai/A based on soil volume. Jars were sealed and placed back in their respective temperatures for 1, 3, or 5 days. After each duration of exposure, the soil was removed from the jars and the tubers were washed from the soil. Extracted tubers were placed in petri-dishes between two pieces of filter paper and 5 ml of water was added to each dish. The Petri-dishes were sealed and placed in the dark at 77 F. Germinated tubers were recorded at the time of removal and weekly for 6 weeks. Treatments were replicated 4 times and the trial was repeated. Total percent tuber germination was analyzed by ANOVA. All main effects and interactions were highly significant ( $P < 0.00001$ ). In general, tuber germination was reduced by increasing metham sodium rate, increasing exposure temperature, and increasing duration of exposure. Conditioned tubers were also more susceptible than non-conditioned tubers. Non-linear regression was used to describe the dose response within each set of conditions. At 41 F, dormant tubers did not respond to metham sodium dosage when exposed for 1 day, while exposure of 3 and 5 days gave a dose response with increasing duration reducing the dosage required for control. Conditioned tubers had a weak linear response when exposed for 1 day at 41 F. As exposure temperature increased the duration of exposure became less critical. At 77 F there were no differences among the different exposure durations for conditioned tubers. However, for dormant tubers exposed for 1 day, higher metham sodium rates were required for effective control compared to 3 or 5 days of exposure. Variable response to metham sodium applications in the field may be related to low use rates, short duration of exposure, and low soil temperatures at the time of treatment. In addition to the environmental factors, this research demonstrated that the condition of yellow nutsedge tubers at the time of fumigation is also critical. [59]

**DO ENVIRONMENTAL STRESSES AFFECT CLEARFIELD WHEAT RESPONSE TO IMAZAMOX?** Bradley D. Hanson\*, Colorado State University, Fort Collins; Dale L. Shaner, USDA-ARS, Fort Collins; Phil Westra, Scott J. Nissen, and David S. Belles, Colorado State University, Fort Collins, CO

Clearfield (imidazolinone-resistant) winter wheat was released for commercial planting in the Great Plains states in the fall of 2002. Although they produce a resistant form of the ALS enzyme, Clearfield winter wheat cultivars occasionally exhibit injury following spring applications of imazamox. Injury generally consists of chlorosis and stunting, but rarely substantial yield loss can occur. Environmental conditions common in early spring such as wide day/night temperature fluctuations, cool and wet soil conditions, and low nitrogen fertility retard wheat growth and may interact with the imazamox treatment to injure the crop. Additionally, the number and genomic location of the resistance gene(s) may influence susceptibility to injury. Current research objectives are to determine which environmental stresses have the greatest impact on Clearfield wheat injury and to determine if genome location of the resistance gene alone or in combination with environmental stress affects potential crop injury. To date, three days of shade or saturated soils pre or post imazamox application have had little to no impact on the growth rate of imidazolinone-resistant wheat grown in the greenhouse. Nitrogen stress combined with imazamox reduced growth rate more than either stress alone. Future research will examine other stresses in more detail including the effects of resistance gene location and genetic background on susceptibility to injury and on the effects of environmental stress on enzyme activity and gene expression, and imazamox absorption and metabolism. [60]

**DOES PROMETRYN TOLERANCE IN COTTON CONFER TOLERANCE TO PARAQUAT?** Irene G. Calderon\*, Greg T. Bettman, and Tracy M. Sterling, New Mexico State University, Las Cruces

Previous studies have shown that prometryn tolerance in cotton is not due to differences in prometryn uptake, translocation, metabolism or sensitivity at the site of action, but rather may relate to an ability to handle oxidative stress. This research evaluated the responses of two cotton species (*Gossypium barbadense* L. cv Pima S-7 and *G. hirsutum* L. Delta Pine 5415) and two spurred anoda accessions (*Anoda cristata* (L.) Schlecht) from Mississippi (MS) and New Mexico (NM) to paraquat. Paraquat is a photosystem I inhibitor that induces oxidative stress and membrane destruction within hours of application. Plants have evolved the ability to scavenge free radicals induced by oxidative stress under multiple environmental stresses. Therefore, free radical scavenging properties of each species and induction of protective systems were measured using the DPPH (1,1-diphenyl-2-picrylhydrazyl) assay and HPLC separation of antioxidants. Necrosis and fluorescence increased with increasing rate for all species with MS spurred anoda the most sensitive. Scavenging ability was higher in cotton than spurred anoda species regardless of herbicide rate. Chlorophyll, beta-carotene, lutein and alpha-tocopherol contents were unaffected by herbicide rate, but depended more on the time of day. The species most tolerant to paraquat were Pima cotton and MS spurred anoda and they possessed the highest constitutive levels of alpha-tocopherol. The shift toward energy dissipation by the xanthophyll cycle pigments increased with increasing herbicide and was highest for MS spurred anoda. Implications for protection against free-radical producing herbicides will be discussed. [61]

**THE EFFECTS OF SOIL TEMPERATURE ON YELLOW NUTSEDGE, PURPLE NUTSEDGE, AND ROOT-KNOT NEMATODE DEVELOPMENT.** Sonia C. Nunez\*, Jill Schroeder, Stephen H. Thomas, and Leigh W. Murray, New Mexico State University, Las Cruces.

Yellow nutsedge (*Cyperus esculentus*) and purple nutsedge (*Cyperus rotundus*) are considered to be two of the world's worst weeds in irrigated regions. They produce large numbers of tubers, and inhibit the growth of desirable plants such as lettuce, chile, and cotton. Southern root-knot nematode (*Meloidogyne incognita* (RKN)) is the major plant-parasitic nematode infecting the same production field soil as yellow and purple nutsedge. Nutsedge tubers serve as an alternative host for nematodes, and the pests have a mutually beneficial relationship. Two studies were conducted at Leyendecker Plant Science Research Center in the spring 2004 to test methods for studying if heat unit accumulation can be used to predict nutsedge sprouting and RKN development more accurately than calendar date. The objective for study one was to determine emergence dates for each nutsedge species, and if the first generation of nutsedge tubers is initiated at the same time the first generation of RKN eggs begin to hatch. It was conducted in the field with six one-meter square quadrats randomly selected to monitor emergence of yellow and purple nutsedge. Twice a week, starting on April 1, plants next to the quadrats were carefully removed and rinsed. Data included shoot and subshoot counts and dry weights, root and rhizome dry weight, root-extracted RKN egg counts, tuber counts and dry weights, hourly soil temperature, and rainfall. The objective for study two was to compare RKN reproduction on yellow and purple nutsedge initiated from surface sterilized RKN tubers. This study was conducted in twelve RKN-free microplots (six per nutsedge species), and tubers originated from RKN infested microplots. Two yellow or purple nutsedge tubers were planted one inch deep in eight locations per microplot after surface sterilization on April 20. Plants were sampled three weeks after planting or when heat accumulation units reached 250 degree days based on a basal temperature of 18°C. Once sampling began, sampling occurred every three to four days with the same data obtained. In study one, purple nutsedge emerged on March 30 at 3,555 accumulated heat units, and yellow nutsedge emerged on April 6 at 4,738 accumulated heat units. RKN egg production began on the first of April, and had a heat accumulation of 3,987. Tuber production for yellow nutsedge began on April 16 at 6,003 heat units, and purple nutsedge followed on April 20 with 6,702 heat units. We could not differentiate whether RKN infection came from eggs present in the soil or from nutsedge tubers in study one. In study two, at 15,689 heat units after planting, root-knot nematode reproduction was higher in yellow nutsedge than purple nutsedge. Based on the results of study two, we could not determine whether spring temperature and heat units can be used to predict nutsedge and RKN growth and reproduction because planting didn't occur until later in the season. By planting tubers earlier in the season, temperature fluctuations can be monitored and heat units can be calculated to determine the relationship between early season temperatures, emergence of nutsedge and RKN reproduction. [62]

## GENERAL SESSION

**WELCOME TO VANCOUVER.** Mehesh Upadhyaya, Professor and Associate Dean, University of British Columbia, Vancouver.

**Presidential Address: Challenges and Opportunities in Changing Times.** Phil Stahlman, Kansas State University Agricultural Research Center, 1232 240<sup>th</sup> Avenue, Hays, KS 67601.

Like those before me on this morning's program, let me also welcome you to the 58<sup>th</sup> annual meeting of the Western Society of Weed Science, our first meeting held in Canada. I extend a special welcome to those of you who may be attending your first WSWS meeting and hope you will find reason to attend future meetings regularly. The WSWS is the oldest of the professional weed science societies; the first meeting as the Western Weed Control Conference was held in Denver, Colorado in 1938. I believe it is the most diverse of the regional weed science societies and is the friendliest and most inclusive of the professional organizations I am associated with.

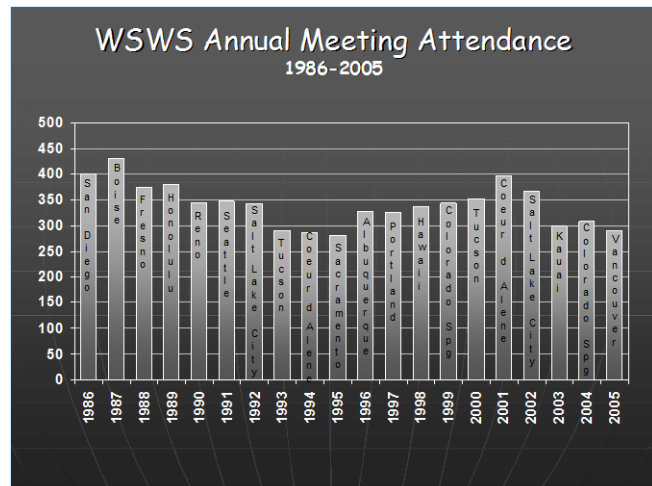
My purpose today is to report on the status of the Society, on activities and actions of the Board of Directors during the past year, and to share the results of the member survey that was conducted at the annual meeting last year in Colorado Springs. Vanelle Carrithers will then report on how the Board responded and used to the survey results to establish priorities and develop short- and long-range goals for the Society.

**Financial status.** The WSWS is financially sound but not flush, and is in comparatively better shape in terms of membership stability than several other professional societies. However, we too have been negatively impacted by the changes in the agricultural industry and the weak economy. A common theme among many agricultural professional organizations in recent years has been how to respond to membership decline.

Our financial investments continue to recover from post 9/11 declines in value and were up 10.85% for the year as of January 31, 2005. However, the number of Sustaining Members declined by two, income from sales of the *Weeds of the West* have dropped below 500 per month, and we realize little profit from sales of the Proceedings or Research Progress Reports. The Society's major product is the annual meeting and the major source of income is registration fees to attend the annual meeting. Thus, income is directly tied to annual meeting attendance.

Last year I reported that attendance at our annual meeting was down about 7 percent compared to average attendance over the previous 18 years and that the makeup of the membership was changing. The figure to the right shows annual meeting attendance since 1986. Attendance is down slightly again this year and is the lowest in the past 10 years. Because membership and registration fees for the annual meeting are the major sources of income for the Society, income is declining at the same time operating costs are increasing. Obviously, we can not allow this trend to continue indefinitely and must increase income to offset increased operating costs. I'll detail some of the increased costs later.

The most obvious ways to increase income is to increase attendance at the annual meeting, increase registration fees, increase the number of Sustaining Members, and come up with new revenue generating products or services. The preferred way to increase income is to increase attendance at the annual meeting. To do this, we must offer a diverse program of high quality and value that is attractive to all segments of the membership and to actively reach out to groups who might benefit from attending but are not. A comparison of annual meeting registration fees among several professional agricultural societies reveals that registration fees for the WSWS are among the lowest of the organizations polled, in most cases between one-third and one-half as much as most other Societies. Indeed, the WSWS is a bargain compared to other Society's.



**Board actions.** Your Board has been especially busy the past year and I want to update you on several issues that the Board has addressed. Last April the Board voted to subsidize publication of the book *Biological Control of Invasive Plants in the United States*, published by Oregon State University Press, in the amount of \$15,000. The book is dedicated to the memory of longtime WSWS member and Past-President Barbra Mullin and includes an acknowledgement that publication was made possible by a grant from the WSWS. The WSWS will receive all royalties from sales of the book. Though this book is unlikely to have the same widespread appeal as *Weeds of the West*, I'm pleased to report that initial sales have been brisk and we have received our first royalty check.

Shortly after last year's annual meeting, multiple website problems occurred when trying to obtain database information necessary to complete the proceedings of the annual meeting. Also, several pages of the website were inaccessible for several weeks. Because the hosting company was unresponsive to our requests to fix the problems, the decision was made to discontinue their services, redesign the site, and transfer everything to a Windows-based server with a different hosting company. This took more time and effort than anticipated when Tony White agreed to serve as the new Website Editor. He is to be commended for his dedication and persistence in resolving this and other website issues and in developing the new website with several new features.

Another unanticipated expense resulted when I discovered that we have been in breach of contract with hotels the past couple of years in that we have not had the required liability insurance specified in those contracts as a result of the 9/11 act of terrorism. Fortunately, the hotels did not require proof of coverage nor was there a liability claim. However, because this is now a standard non-negotiable provision in most major corporate hotel contracts, we can not knowingly operate in violation of the provision and must purchase liability coverage for future annual meetings.

Some have voiced concern in recent years about the value of service provided by HelmsBriscoe relative to fees received from the hotel for future meeting site selection and hotel negotiation. The WSWS incurs no direct costs for using HelmsBriscoe for site selection, but there is an indirect cost to the members who attend the annual meeting in the form of higher room rates, meal and beverage costs, and discretionary fees charged by the hotel to cover the commission paid to HelmsBriscoe. The Board voted to discontinue our relationship with HelmsBriscoe and to enter into a one-year contract for \$1,500 with Allen Marketing & Management for site-selection and hotel negotiation for the 2008 meeting. We will reassess the issue after one year.

In response to numerous requests and after studying various options, the Board voted yesterday to begin accepting credit card payment for meeting registration and product sales in the very near future.

For several years, each regional and the national weed science society and the American Society of Agronomy pooled resources to fund two Congressional Science Fellows to advocate for weed science and other agriculture and environmental sciences in Washington D.C. This led to the regional societies and the WSSA deciding in the mid 1990's to support one half-time and eventually one full-time person who would be employed by AESOP Enterprises (primarily a lobbying group for the National Association of State Land Grant Universities and Colleges). The person would have the title of Director of Science Policy. Rob Hedberg was hired for the position in 1999 and became an employee of the WSSA in 2003. Throughout, Rob's position has been supported by the regional and national weed science societies and the Aquatic Plant Management Society. A great deal has been accomplished in advancing the awareness of weeds and their impacts at the federal level and of the attributes of the weed science societies. Clearly, the Director of Science Policy has provided the supporting societies a national policy presence for weed science that was previously absent. Since 1999, the WSWS has contributed \$7,300 annually to support the Director of Science Policy. There is now need for all supporting societies to substantially increase their annual contribution. For additional information on the background, justification and details of the needed increase, I refer you to a WSSA proposal for funding the Director of Science Policy position through 2011 published in Board minutes elsewhere in these proceedings. In response to the WSSA proposal, the Board voted unanimously to increase support of the Director of Science Policy to \$15,000 annually for the years of 2006-2011.

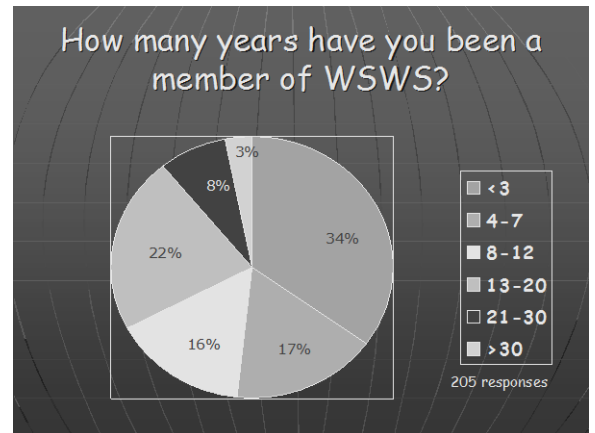
**Member survey results.** Considering the dramatic changes that have occurred in the crop protection industry and academia in recent years, it should no surprise that professional societies are experiencing declining membership causing them to examine their purpose, function, and future. Ecology teaches us that biological systems that fail to adapt, fail. Why then would we expect institutions and organizations to respond differently? *Though change does not assure progress, progress requires change; otherwise stagnation and eventual obsolescence will result.* In order to initiate change, we must first understand who and what we are.

As a first step, 20 current and former board members completed an extensive benchmarking survey that compared the WSWS with accepted standards for not-for-profit organizations. Those results confirmed that the society is doing several things well, including organizing a high quality annual meeting and handling the finances of the organization (financially sound). However, questions were raised about the long-term sustainability of the organization in light of ongoing external changes and whether the Society should provide more to its members than the annual meeting.

As a second step, at last years annual meeting in Colorado Springs members were asked to fill out a survey to gather information on what they valued about the WSWS, concerns, and suggestions to improve the value and future direction of the Society. Two-thirds (215) of those in attendance completed the survey. An Ad-Hoc committee tabulated the responses and at the summer board meeting considerable time was spent discussing the results and developing short-range and long-range plans based on results of the survey. Jill Schroeder and Vanelle Carrithers, with coaching from Institute of Conservation Leadership consultant Pam Mavrolas, did a great job of facilitating the discussion and keeping the group focused and on task. I will report the results of the survey and Vanelle Carrithers will report how the Board responded to the results.

**1. How many years have you been a member of the WSWS? 205 responses**

- The tenure mix is relatively good
- 51% have been members for  $\leq 7$  years
- Retaining about half of <3 year group
- Similar percentages for 4-7, 8-12, & 13-20 year groups (16 to 22%)
- 11% have been members >21 years, 3% >30 years



**2. Where are you currently in your career? 198 responses**

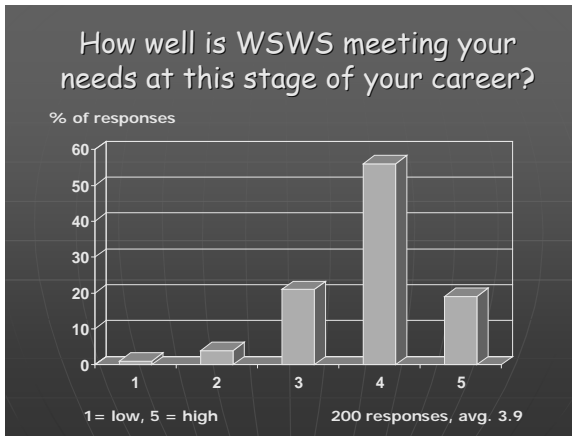
- Similar percentages of members in the early, mid, and late career stages
- Slightly higher percentage of members just beginning their career than those nearing retirement



**3. How well is WSWS meeting your needs at this stage of your career? 200 responses, mean score 3.9**

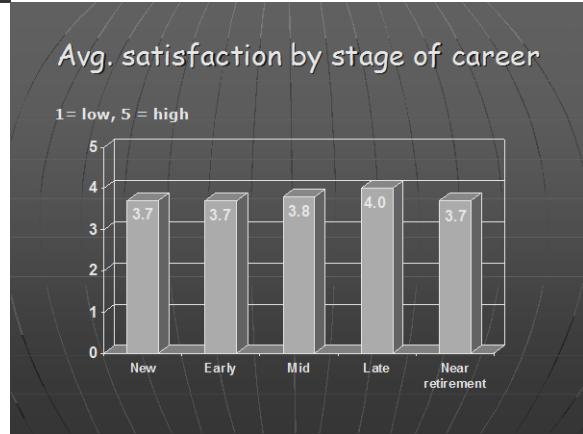
- 75% of respondents are highly satisfied, answering 4 or 5
- We must identify what changes are needed to retain the 21% who answered with a score of 3

- Results are probably favorably biased because few members not in attendance at the meeting completed and returned the survey



**4. Average satisfaction at this stage of your career.**

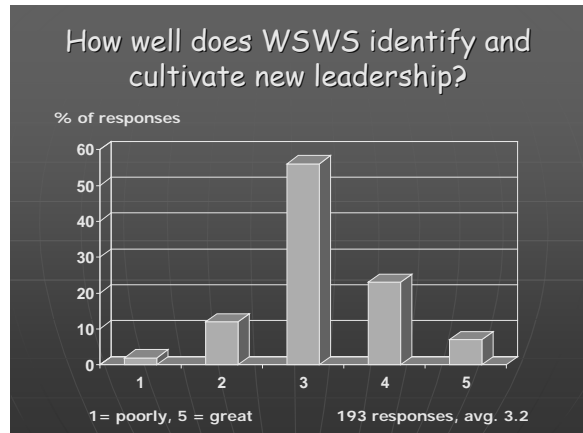
- Satisfaction score is remarkably similar across career stages
- Mean scores ranged from 3.7 to 4.0



**5. How well does WSWS identify and cultivate new leadership?**

*193 responses, mean score 3.2*

- The strong majority response was average, 3 on a 1 to 5 point scale
- Only 30% of respondents scored the question 4 or 5
- Results are consistent with results of the Benchmarking survey



For the following questions, individual responses were subjectively grouped into categories of like or similar responses. When more than one response was given, each was categorized. The values indicate the total number of times that response was given.

**6. What does WSWS offer that is most valuable or useful to you?**

• Networking and interaction with colleagues; identify collaborators	111	
• Latest research and information		52
• Annual meeting, workshops, symposia, discussion		24
• Diversity of the society, e.g. wildlands to wide variety of crops, etc.		17
• Personal exposure and feedback on individuals research		15
• Growth and breadth of professional perspective		11
• Opportunities for graduate students		
7		
• Publications		
5		
• Other miscellaneous uncategorized responses		
7		

**7. What else should WSWS offer that would be of high value or use to you?**

• Nothing; things are good as they are		30
• More workshops and symposia		26
• More ecology, IPM, involve other disciplines		19
• More web based education		11
• More on forests, rangelands, and invasive species	9	
• Focus on students and early career individuals		7
• Publications: reviews, compendiums, wildland weed biology	7	
• More technical information on herbicides	6	
• Numerous single uncategorized responses		

In response to what are the big challenges and opportunities in the next 5 to 10 years, there were 21 categories of challenges and 6 categories of opportunities. The top 11 challenge categories in decreasing order of (response frequency) are:

1. Invasive species and noxious weeds; weed control in rangeland, pasture, public lands and weed management areas; habitat and ecosystem restoration (20%)
2. Funding of agricultural research, especially long-term studies (14%)
3. Weed shifts, herbicide resistance, gene flow, weed genetics (10%)
4. Improved cropping and IWM systems; biocontrol and non-traditional methods; development and integration of new technology (9%)
5. Consolidation and downsizing; retirements, unfilled positions, increased demands, low morale (9%)
6. Few new herbicides; few modes-of-action; generics and retaining off-patent active ingredients (7%)
7. How to grow and diversity the WSWS membership, attract federal agency personnel; how to control meeting costs (5%)
8. Public acceptance of biotechnology, genomics (4%)
9. Few employment opportunities (4%)
10. How to influence policy, regulation, legislation; public education (4%)
11. Agency and institution cooperation; alliances and partnerships (3%)

The opportunities in decreasing order of (response frequency) are:

1. Chance to exercise leadership in invasive plant management, ecosystem restoration, range, forest, and wildland weed management (36%)
2. Take advantage of current public receptiveness to educate about the threat and impact of noxious weeds, invasive species, and the importance of weed management; take advantage of the wildlife and endangered species angles to advance the cause (18%)
3. Growth in specialty crops, turf and ornamentals (14%)
4. Integration of management tools; alternative control methods; increase studies on the biology and ecology of individual species and plant communities (14%)
5. Build partnerships and promote interdisciplinary cooperation (14%)
6. Advance biotech traits in agricultural crops, e.g. drought resistance (5%)



**8. Which, if any, of the challenges and opportunities is critical for WSWs to be engaged in or working on?**

1. Stay engaged in invasive species and noxious weed management, weed control in rangeland, pasture, public lands and weed management areas, and habitat/ecosystem restoration (22% of responses)
2. Be proactive in identifying and securing funding sources (12%)
3. Be proactive in influencing policy, regulation and legislation, and engage in more public education (12%)
4. Promote improved cropping and integrated weed management systems, environmentally-friendly methods such as biocontrol and non-traditional control methods, and be proactive in developing and integrating new technology (9%)
5. Promote government agency and institution cooperation, be proactive in building alliances and partnerships, and hold joint meetings when they make sense (8%)
6. Weed shifts, weed resistance, gene flow, and weed genetics (7%)
7. Diversify membership; seek a mix of scientific disciplines; appeal to federal agency personnel; consider meeting location and costs (4%)
8. Student placement and job listings (2%)
9. Promote acceptance of herbicide resistant, transgenic crops and public acceptance of biotechnology; genomics (2%)
10. Help overcome resistance and adapt to change in science (2%)
11. Continue to emphasize graduate and undergraduate programs; encourage students to engage in invasive species research; be more proactive in telling junior high and high school students about weed science (2%)
12. Keep up the good work (2%)
13. Continue traditional weed science aspects, e.g. environmental safety, efficacy, drift, carryover, label expansion, etc. (2%)
14. Schedule more workshops and discussion sessions at annual meeting to generate more interest (2%)

This survey confirmed that the WSWs is a sound and relevant organization valued by its members and is doing several things well. It also identified challenges, opportunities, and areas you feel are critical for WSWs involvement. As we consider how to respond to the challenges before us, let us not forget where we've been and who we are, but let us let approach the future with openness and optimism, and capitalize on the opportunities before us. It is important that we continue to embrace scientific discovery, new technology, and the application of integrated weed management principles.

In closing, I want to thank you for the opportunity to serve as your President. It's been an honor and a gratifying experience and I encourage you to say yes when asked to serve the Society. Thanks for your attention, and have a good meeting. [64]

**WSWS PRIORITIES AND ACTIVITIES FOR THE FUTURE.** V. F. Carrithers, Dow AgroSciences, Mulino, Oregon.

- 20 Current and former Board members completed survey in late 2003
  - Used to benchmark WSWs
  - Helped to develop full membership survey
- Membership survey at 2004 March annual meeting
  - 320 attended the meeting
  - 215 completed the survey (67%)
  - THANK YOU!!
- Ad-hoc Member Survey Committee consisted of Phil Stahlman, Phil Banks, Jill Schroeder, and Vanelle Carrithers
  - Sorted and grouped responses for each question
  - Organized a Future Planning Session at the summer Board meeting
  - Objective was to use/compare results from both surveys to decide on areas of work that will build and strengthen WSWs
- Jill and Vanelle facilitated the 1.5 day meeting
  - Used small group breakouts to review responses from groups of similar questions (2-4)

- Compared similarities and differences between the 2 surveys (benchmarking and member surveys)
- Used information to develop new opportunities
- Grouped and prioritized them
- Priorities from that meeting are reported in this presentation
- Annual meeting seen as strong with desire to see this continue
- Identified need to improve communication
  - Long lapses between meetings
  - Continue to improve web site
- Need to recruit and retain new members
- Need to have leadership recruitment and development
- Financial issues
  - Member view is on individual costs (registration and travel)
  - Board view is on organization finances
- Alliances
  - Member view is on individual member desires
  - Board view is on synergies in cooperation
- Leadership
  - Member view is an unknown to many
  - Board view is that leadership is strong
- **Annual Meeting**
  - **Goal** - Maintain the core annual weed science meeting and expand the content to provide value to a diverse audience from the western US and western Canada
- **Mentoring/Leadership Development**
  - **Goal** - WSWS has a known mentorship program and broad representation in the organization, on committees and on the board of directors.
- **Broaden Membership (recruitment) and alliances with other organizations**
  - **Goal** - Broaden membership to include nontraditional individuals and form alliances with compatible organizations.
- **Goal** - Maintain the core annual weed science meeting and expand the content to provide value to a diverse audience from the western US and western Canada
- Activities
  - 1. Solicit papers/symposia/workshops around emerging issues
  - 2. Inform membership how to propose topics—website, newsletter, personal
  - 3. Maintain strong discussion sections
  - 4. Market the program – work to provide content driven titles, etc.
  - 5. Balance economic reality/venue selection
- Who should be involved?
  - program committee, project chairs, board, site selection committee, publications, public relations, operating guide chair, MEMBERS!
- Tools & Resources
  - website improvement, budget for conference calls, budget for symposia/workshops
- Timeline
  - 2005 annual meeting for some, 2006 annual meeting for others
- **Goal** - WSWS has a known mentorship program and broad representation in the organization, on committees and on the board of directors.
- Activities:
  - 1. Graduate student breakfast introduction to WSWS
  - 2. New member orientation & recognition
  - 3. Increase number of board members-at-large to represent private & public to serve 2-year terms.
  - 4. Board recruits new participants for committees and project chairs
  - 5. Continue “Student Night Out”
  - 6. Evaluate committees
    - number of members; assess need for inactive standing committees
  - 8. Board to develop vision statement for WSWS
  - 7. Develop mentorship program
- Who should be involved?

- Past president, constitution & by-laws, board members, all past presidents & fellows, MEMBERS
- Tools & Resources
  - Program chair, newsletter, local arrangements, website, public relations, other members
- Timeline
  - 6 months to 2 years
- **Goal** - Broaden membership to include nontraditional individuals and form alliances with compatible organizations
- Activities
  - 1. Appoint ad-hoc committee (Membership Development)
  - 2. Enlist the assistance of the Director of Science Policy to communicate with federal/state agencies
  - 3. Promote sponsoring workshops with other organizations
  - 4. Promote WSWs annual meeting with noxious weed short course attendees
  - 5. Explore joint meeting with compatible organizations
- Who should be involved?
  - MEMBERS, president, president-elect, Director of Science Policy
- Tools & Resources
  - Personal contact, conference call budget
- Timeline
  - March 2006 annual meeting (2-3 years)
- What organizations do you work with that would be compatible with WSWs for alliances/co-meetings, etc?
- What would a WSWs mentoring program look like?
- Are there barriers to your increased participation in the society?
- Would you be willing to work on any of these areas? Contact Phil Banks.
- Vote on change to the constitution for member-at-large
  - Change from 1 member to 2 members
    - one private sector and one public sector
  - Change from 1 to 2 years, alternating terms
  - Thursday business meeting vote
- Outstanding program
  - 2 Symposia
    - Crop Protection Chemistry vs Genetically Modified Crops
    - Estimation of Dose Response Functions
- Vision statement in development
- Board members attending Graduate Student breakfasts
- Notice that most of the resources outlined were not for budgets
- Most of the resources listed were for members time
- We all get out what we are willing to put in to the organization
- **Remember you are the WSWs**
- **Three priorities developed**
  - Continue and Improve Annual Meeting
  - Develop Mentoring/Leadership Programs
  - Broaden Membership and alliances with other organizations
- Contact any board member with your continued ideas or use note cards on registration desk and at Thursday business meeting
  - Hand back cards at registration desk or at business meeting [65]

**CONGRESSIONAL UPDATE: RECENT SUCCESSES AND FUTURE OPPORTUNITIES FOR WEED SCIENCE.** Robert Hedberg, Director of Science Policy, Washington, D.C. (Abstract not submitted) [66]

It is rather presumptuous to talk about "solutions", therefore, I will attempt only to present ideas that may stimulate some thinking related to weed management. Because we really don't know very much about agroecosystem interactions, it is necessary to start from a position of humility rather than hubris. Two quotes provide insight. First, Ed Wilson of Harvard is purported to have said that: "We probably know less than a fraction of a fraction of one percent of all species on earth in any kind of detail." David Suzuki of British Columbia, Canada, responded to that thought by suggesting that if we know so little about what constitutes the living world, "how can anyone have the temerity to say that we can manage it?" After all, in our discipline of Weed Science, there is little indication that weeds are waving the "white flag". And, if some weeds could be "defeated", what would be the ecosystem consequences from such a defeat and the measures required to obtain it?

Herbicide advertisements imply that, given the right herbicide, the task of weed control is "dead simple". However, there are effective weed management techniques that can augment herbicide performance and reduce the need for herbicide applications in the first place. One of the major keys for herbicide performance and for lower herbicide requirements in general is crop health. Crop health implies that crop roots and shoots are robust and will compete with weed species to the full extent of their genetic potential. Digital photographs of crop canopies enable us to determine how quickly crops are able to pre-empt light and other resources from weeds. In general, those agronomic practices that favour rapid canopy closure, also favour lower herbicide requirements and better performance when herbicides are used.

Combining optimal agronomic practices can dramatically reduce weed infestations. In an ongoing study at Lacombe we are investigating cultivar, seeding rate, herbicide rate and crop rotation effects on barley health, productivity and weed management. Individually, these factors had considerable effects on wild oat (*Avena fatua* L.), but when combined, the effects were dramatic (unpublished observations). For example, at ¼ of the recommended herbicide rate, the higher seeding rate decreased wild oat biomass and seed numbers approximately 4-fold while the tall barley cultivar decreased wild oat biomass and seed numbers approximately 10-fold compared to the short cultivar. Combining higher seeding rates with the taller barley cultivar decreased wild oat biomass and seed numbers approximately 40-fold. Growing barley in rotation with canola and pea rather than continuously, and combining the rotation effect with higher seeding rates and the taller barley cultivar decreased wild oat biomass and seed numbers approximately 100-fold. In a silage study at Lacombe, we are currently attempting to combine species and barley variety rotation with high crop densities and early silage cutting to successfully reduce wild oat populations without herbicide assistance.

Gordon Thomas (AAFC, Saskatoon, SK) has compiled the data from western Canada post management weed surveys conducted over the last 30 years. In general these surveys indicate that the most dominant weeds such as green foxtail (*Setaria viridis* (L.) Beauv.), wild oat, wild buckwheat (*Polygonum convolvulus* L.) and Canada thistle (*Cirsium arvense* (L.) Scop.), have changed very little in terms of relative abundance. Weeds such as volunteer wheat (*Triticum aestivum* L.), false cleavers (*Galium spurium* L.), kochia (*Kochia scoparia* (L.) Schrad.) and dandelion (*Taraxacum officinale* G.H. Weber ex Wiggers) have been increasing over the last thirty years. However, just as interesting is the fact that over a 30 year interval, overall weed community structure has changed substantially. In an average survey field, species richness has decreased from 6.7 to 4.8, weed-free quadrats (20 per surveyed field) have increased from 15.8% to 36.5%, and weed density has decreased from 100.4 to 30.8 plants/m<sup>2</sup>. These changes confirm that weed management techniques have been very successful. One might well ask how successful do we need to be, or how successful should we be?

The advent and widespread adoption of herbicide-resistant crops have increased weed control to levels that are unprecedented. Perhaps these unprecedented levels of weed control have led or will lead to unintended consequences. For example, Taylor and Maxwell (Paper #71, WSWS, 2001) showed that conventional weed management in Montana could have negative consequences for pheasant chicks by reducing weeds and the chick-food arthropods which depend on them. It is conceivable that if fewer birds are attracted to fields to consume beneficial insects, that insect pest species moving in to a crop would have fewer natural enemies and may more easily flourish. Therefore very "successful" herbicide applications could precipitate greater insecticide usage. Clearly, herbicide-resistant crops generally result in even higher levels of weed control than are common after conventional weed management.

Unprecedented levels of weed control in herbicide-resistant crops may also lead to weed shifts and weed resistance. In a western Canada study at six locations (Harker et al. 2005. Weed Sci. "in press"), higher frequencies of RR crops were associated with weeds such as henbit (*Lamium amplexicaule* L.) and round-leaved mallow (*Malva neglecta* Wallr.). However, just as important, rotations without in-crop glyphosate were associated with much more

common, widespread species such as green foxtail, wild buckwheat, wild oat and sowthistle (*Sonchus spp.*). Although it is clear that any repeated agricultural practice will favour some weed species over others and cause weed shifts, repeated herbicide use also leads to weed resistance to herbicides. Currently, no product dominates the global herbicide market like glyphosate. Since 2002, glyphosate has been used exclusively on the majority of United States soybean crops. "In the U.S. we are putting on 100 million pounds of glyphosate on 60 million acres of cropland every year. What do you think is going to happen?" (John Wilcut, NC State). Indeed, in soybean growing regions, glyphosate resistance has already been confirmed in horseweed (*Conyza canadensis* (L.) Cronq.) and common ragweed (*Ambrosia artemesifolia* L.); certainly there will be others.

Other weed management paradigms can be successful without being wholly "organic". In Britain, when it was realized that unprecedented levels of weed control in GM beets would not favour wildlife, changes that ultimately led to a much lower level of weed control were implemented. Following is a press report from The Daily Telegraph (*GM Beet Helps Birds to Survive the Winter*, Jan. 19, 2005): "A British study recently announced that genetically modified beets, designed to tolerate herbicides, can maximize benefits to both crops and wildlife... To obtain the benefits for the wildlife, researchers at Broom's Barn changed the timing of the herbicide application, and left weeds between crop rows for wildlife. With these adjustments in the management system, seeds production for wildlife increased 16 fold, and birds were able to eat both seeds and insects associated with the weeds. The new GM management system benefits crops and wildlife, and it also reduces pesticide costs by omitting a second spraying." From the same study, another quote (IPM Net News #135, March 2005) is also instructive: "revised weed management of GM sugar beet (in a geographic zone where moisture is not a constraint) not only incurs no yield loss, but enhances weed seed banks, and provides (weed) seed for wild birds and invertebrates." Few North American Weed Scientists would claim to have successfully enhanced weed seed banks.

In the future, near weed-free fields may not be considered acceptable. Research prospects for the impact of varying weed management systems on the innumerable agroecosystem organisms contiguous with crops and weeds are unlimited. Funding support that could be garnered for such studies might also have few limits. If we desire more agricultural support from constituencies with dominant political influence (votes), we might do well to alter our view of what is desirable: from an "ultra-clean" crop with no weeds visible to a more species-rich field with sub-threshold weed communities. [67]

## ORAL PRESENTATIONS

### WEEDS OF AGRONOMIC CROPS

**COMMON LAMBSQUARTERS RESPONSE TO GLYPHOSATE APPLIED AT THREE DIFFERENT GROWTH STAGES.** Christopher L. Schuster, Douglas E. Shoup\*, and Kassim Al-Khatib, Graduate Research Assistant, Graduate Research Assistant, and Professor. Department of Agronomy, Kansas State University, Manhattan, KS 66506.

The objectives of this research were to determine the efficacy of glyphosate on common lambsquarters from five regions around the United States at the 2.5, 7.5, and 15-cm growth stage, and determine glyphosate absorption and translocation at the same three growth stages. Common lambsquarters populations from Kansas, Nebraska, North Dakota, Ohio, and Washington were treated with 0, 0.125, 0.25, 0.5, 1, 2, 4, and 8 times the use rate of glyphosate (1060 g ha<sup>-1</sup>) at three growth stages. Plant dry weights were determined at 14 days after treatment (DAT). Data were analyzed using nonlinear regression analysis. Herbicide rate required to inhibit plant dry weight by 40% (GR<sub>40</sub>) were calculated for each growth stage of the five common lambsquarters populations. GR<sub>40</sub> values ranged between 0.18 to 0.27, 0.49 to 0.96, and 0.71 to 3.97 times the use rate for the 2.5, 7.5, and 15-cm growth stage, respectively. In a separate study, the second fully expanded leaf from the top of common lambsquarters at the three growth stages were treated with <sup>14</sup>C-glyphosate. Plants were harvested 1, 3, and 7 DAT and radioactivity in the treated leaf, foliage above treated leaf, foliage below treated leaf, and roots were determined. Data were analyzed using analysis of variance. There were no differences in absorption or translocation between growth stages. At 7 DAT, common lambsquarters absorbed 60, 68, and 61% and retained 89, 83, and 76% of radioactivity in the treated leaf at the 2.5, 7.5, and 15-cm growth stage, respectively. [68]

**DRY EDIBLE BEAN TOLERANCE TO SULFENTRAZONE.** Eric Delahoyde\* and Richard Zollinger, North Dakota State University, Fargo.

Sulfentrazone has been an effective preemergence herbicide for controlling small-seeded broadleaf weeds in many crops, including dry edible bean. Field trials were conducted at Buffalo, Thompson, and Minot, North Dakota, in 2004 to evaluate the tolerance of black, Great Northern, navy, pink, pinto, and small red bean to sulfentrazone in a high-pH soil. Sulfentrazone at 0.09, 0.14, 0.19, 0.25, and 0.38 lb ai/A was applied preemergence, with one control treatment. Crop injury and yield data were collected. At Thompson and Buffalo, crop injury at 42 d after treatment (DAT) by sulfentrazone at 0.09 lb/A ranged from 0 to 2%, at 0.14 lb/A was 0 to 4%, and at 0.19 lb/A was 2 to 8%, with no significant yield reductions. However, sulfentrazone at 0.25 lb/A caused crop injury ranging from 4 to 12%, and at 0.38 lb/A caused crop injury of 5 to 29%. Furthermore, sulfentrazone at 0.25 lb/A reduced yields of pink and small red bean, and at 0.38 lb/A reduced yields of black, navy, pink, and small red bean. Crop injury 35 DAT at Minot from sulfentrazone at 0.09 lb/A ranged from 0 to 24%, at 0.14 lb/A was 2 to 34%, at 0.19 lb/A was 5 to 47%, at 0.25 lb/A was 4 to 55%, and at 0.38 lb/A was 5 to 73%. Yields at Minot were reduced for small red bean by sulfentrazone at 0.25 and 0.38 lb/A and for black, navy, pink, and pinto bean by sulfentrazone at 0.38 lb/A. [70]

**SITE-SPECIFIC VELVETLEAF CONTROL OVER THREE YEARS.** Douglas J. Munier\*, University of California Cooperative Extension, Orland; Wayne T. Lanini, University of California Cooperative Extension, Davis; and Jerry L. Schmierer, University of California Cooperative Extension, Colusa.

Velvetleaf seed bank longevity and its patchy distribution were studied to determine the opportunities for site specific weed control. All velvetleaf plant locations were mapped in a 75 acre field during three years, 2002 to 2004. Several times each year, plants in the field were mapped with sub-meter GPS equipment, and were removed with their seed. In the first year, 680 plants were mapped. There were 702 and 771 plants mapped and removed in 2003 and 2004, respectively. These plants were from dormant seed in the seed bank, produced in 2001 and prior years. The number of velvetleaf plants has not decreased during 2003 or 2004, even though no velvetleaf seed has been produced since 2001. In 2003 and 2004 most of the plants were located close to the locations of the 2002 plants. On average over the two years, 48, 82, and 89 percent of the plants were within 10, 50, or 100 feet, respectively, of a 2002 plant location. Ninety-eight percent were within 150 feet of a 2002 plant location. Tillage, which is typical for row crops in California, may have been responsible for movement of some dormant seed, although other studies have indicated limited movement of seed with tillage. Over the three years, there were an average of 718 velvetleaf plants per year in the 75 acre field. If each velvetleaf plant occupied 10 ft<sup>2</sup>, then a very small part of the field, 0.2 percent, was occupied by velvetleaf. Under typical Sacramento Valley field crops farming practices, velvetleaf has persisted at a steady population for several years and has primarily remained in the same patches. [71]

**EFFECTS OF RATE AND ADDITIVES ON COMMON LAMBSQUARTERS CONTROL WITH GLYPHOSATE.** Andrew R. Kniss, Stephen D. Miller, University of Wyoming, Laramie; and Robert G. Wilson, University of Nebraska Panhandle Research and Extension Center, Scottsbluff

Field studies were conducted at three sites near Scottsbluff, NE and Torrington, WY in 2004 to compare glyphosate formulation, rate, and various spray additives with respect to common lambsquarters control and glyphosate-resistant corn response. Herbicide treatments were applied when common lambsquarters was 15 cm tall at Scottsbluff and Torrington West sites, and 30 cm tall at Torrington East site. No differences between treatments were observed in crop injury or stand at any location. Common lambsquarters densities of 8.4, 540, and 540 plants m<sup>-2</sup> reduced corn yields 53, 77, and 99% compared to the average of all treated plots at Scottsbluff, Torrington East, and Torrington West sites, respectively. Significant treatment by location interactions were present with respect to common lambsquarters control and corn yield, so data were analyzed separately by site. A potassium salt formulation of glyphosate at 0.84 kg ae/ha plus AMS (2.0%) plus non-ionic surfactant (0.25%) provided greater common lambsquarters control than a separate potassium salt formulation at the same rate plus AMS (2.0%) at Scottsbluff, but this difference was not observed at either Torrington site. Adding 2% AMS to a potassium salt formulation of glyphosate applied at 0.84 kg ae/ha did not increase common lambsquarters control at Scottsbluff, but did at both Torrington sites. When applied at 0.84 kg ae/ha plus AMS, all glyphosate formulations provided similar common lambsquarters control at Scottsbluff, while inconsistent differences were observed at the two Torrington sites. At Scottsbluff, mesotrione (0.056 kg ai/ha) plus atrazine (0.56 kg ai/ha) provided greater common lambsquarters control than all glyphosate treatments except a potassium salt formulation at 0.84 kg ae/ha plus non-

ionic surfactant (0.25%) plus AMS (2.0%), and a separate potassium salt formulation at 1.25 kg ae/ha plus AMS (2.0%). At both Torrington sites, mesotrione (0.056 kg ai/ha) plus atrazine (0.56 kg ai/ha), glyphosate formulated as a potassium salt at 0.84 kg ae/ha plus thifensulfuron at 0.0025 kg ai/ha, and the same formulation of glyphosate at 1.25 kg ae/ha plus AMS (2.0%) all provided greater than 94% control of common lambsquarters. Differences in corn yield due to herbicide treatments were only observed at the Scottsbluff site, and yields were highly correlated with common lambsquarters control ( $r = 0.8$ ). [72]

**DIMETHENAMID-P FOR WEED CONTROL IN SUGARBEETS.** Abdel O. Mesbah\*, University of Wyoming Research and Extension Center, Powell; and Stephen D. Miller, University of Wyoming, Laramie.

Field experiments were conducted in 2003 and 2004 at the Powell Research and Extension Center, Wyoming to evaluate weed control and sugarbeet response to several postemergence applications of dimethenamid-P. Dimethenamid-P was applied alone as layby application at 8 to 10 sugarbeet leaf stage or in combination with sugarbeet herbicides using full and micro rate systems at 2, 4, or 6 sugarbeet leaf stage. Tank-mixing dimethenamid-P with sugarbeet herbicides increased redroot pigweed and green foxtail control by 5 to 7%, but no effect was shown on redstem filaree control. With these treatments, sugarbeet injury ranged from 3 to 10%, depending on the application timing. The highest sugarbeet injury (10%) was observed when Dimethenamid-P (0.7 lb/A) was applied at two leaf sugarbeet stage. Dimethenamid-P applied as layby at 8 to 10 sugarbeet leaf stage did not cause any sugarbeet injury and increased redroot pigweed and green foxtail control by 11 to 12%. Sugarbeet root yields were 2.2 T/A higher in layby treated plots compared to the standard plots (no dimethenamid-P). Sugar content among all treated plots including the weedy check ranged from 17.7 to 18.4%. [73]

**INTROGRESSION OF THE PCH1 GENE INTO JOINTED GOATGRASS.** Alejandro Perez-Jones, Carol A. Mallory-Smith, Oscar Riera-Lizarazu, and Christy J. W. Watson, Oregon State University, Corvallis; Maqsood Rehman and Robert S. Zemetra, University of Idaho, Moscow.

Strawbreaker foot rot (SFR) caused by *Pseudocercospora herpotrichoides* is a disease of winter wheat (*Triticum aestivum* L.) in the Pacific Northwest. Resistance to SFR is conferred by a single dominant gene (*Pch1*) derived from *Aegilops ventricosa* that was transferred onto chromosome 7D of wheat. Madsen wheat carries *Pch1* and is highly resistant to SFR. Jointed goatgrass (*Ae. cylindrica* Host.), a winter annual grass weed, currently infests over 3 million ha of wheat in the USA. Wheat and jointed goatgrass share a common genome (D) and have been found to hybridize in the field. Hybrids between jointed goatgrass and wheat backcross under field conditions and set seed. Since SFR resistance in wheat is controlled by *Pch1* on the D genome, it is theoretically possible for resistance to be transferred to jointed goatgrass via backcrossing. The SFR resistant jointed goatgrass population would potentially have an ecological advantage in the presence of the disease. To evaluate the likelihood of gene introgression, two wheat cultivars (Madsen and Stephens), three jointed goatgrass accessions, and 15 backcross progenies (BC<sub>2</sub>S<sub>1</sub> and BC<sub>2</sub>S<sub>2</sub>), were inoculated with *P. herpotrichoides*. The percentage of infection in Stephens, the jointed goatgrass accessions, and the backcross progenies was 85% or higher, except for one BC<sub>2</sub>S<sub>2</sub> progeny that had only 20% infection. None of the plants of Madsen were infected. Presence of *Pch1* was confirmed using a biochemical and a molecular marker linked to the resistance gene. These results provide evidence for introgression of a SFR resistance gene from wheat to jointed goatgrass. [75]

**IMAZAMOX INTERACTION WITH FOLIAR INSECTICIDES AND WEED CONTROL IN IMAZAMOX TOLERANT SUNFLOWER.** John C. Frihauf, Phillip W. Stahlman, Patrick W. Geier, and Anthony D. White. Kansas State University, Agricultural Research Center-Hays.

Field experiments were conducted near Hays, KS in 2003 and 2004 to evaluate imazamox tolerant sunflower response to imazamox plus insecticide tank-mixes. Pendimethalin and sulfentrazone were applied to the entire experiment area to establish weed free plots in 2003 and 2004. Leaf chlorosis in both studies was minimal. Imazamox tank-mixed with esfenvalerate caused the most leaf chlorosis 6 days after treatment (DAT) in 2003 (5%). Sunflowers completely recovered 11 DAT. Leaf chlorosis from all other treatments was not observed in 2003. All treatments caused minor leaf chlorosis 6 DAT ranging from 1 to 10% in 2004. Leaf chlorosis declined to 5 to 6% in all treatments except imazamox plus the dry formulation of carbaryl 14 DAT. The sunflowers regained normal color 22 DAT. Treatments did not reduce sunflower yield when compared to the untreated control in both years. A field experiment was also conducted near Hays, KS in 2004 to assess weed control in imazamox tolerant sunflower. Injury was not observed in this experiment. Preemergence (PRE) applications of pendimethalin and sulfentrazone

followed by postemergence (POST) treatments of imazamox provided the best control of Palmer amaranth, puncturevine, and green foxtail ranging from 96 to 100% 16 days after POST application. Postemergence treatments of imazamox with nonionic surfactant (NIS) without prior PRE applications controlled green foxtail better than imazamox with concentrated crop oil (COC); however, puncturevine control was greater in imazamox treatments with COC. Palmer amaranth control was similar regardless of adjuvant in imazamox applications applied without prior PRE treatments. Herbicide treatments increased sunflower yield 41 to 52% compared to the untreated control. Sunflower yields of imazamox with NIS applied POST and PRE treatments followed by imazamox plus NIS were similar ranging from 1930 to 2300 lbs/A. Pendimethalin followed by imazamox mixed with COC and sulfentrazone followed by imazamox plus COC yielded 19 and 20% better than imazamox with COC applied POST without prior PRE treatment, respectively. [76]

**PRELIMINARY OBSERVATIONS OF THE SPECIES AREA CURVE IN ORGANIC AND CONVENTIONAL SPRING WHEAT SYSTEMS.** Fredric W Pollnac\*, Bruce D. Maxwell and Fabian Menalled, Montana State University, Bozeman

The species-area curve is a widely used method in ecology, and has been successfully applied to natural ecosystems. However, it is seldom applied to agroecosystems. Our objective was to compare weed species richness and diversity between conventional and organic systems using species-area relationships. Data were collected in 2004 at Moore, Montana. Three organic plots (445.3m<sup>2</sup>) and 3 conventional plots (222.65m<sup>2</sup>) were sampled three times during the summer. Weed species richness data were collected at the whole plot scale and from two randomly located nested plots (0.1m<sup>2</sup>, 1m<sup>2</sup>, 10m<sup>2</sup>) within each plot. Plots were in the spring wheat phase of rotation (organic: spring wheat, lentil, barley, and fall Austrian winter pea; conventional: spring wheat, winter wheat, barley, chemical fallow). Crop was added to species richness for all plots to account for system species richness. System species richness increased consistently with area for conventional and organic plots. Organic and conventional curves differed significantly for the early-summer ( $p = 1e-4$ ) and late-summer ( $p = 8.32e-6$ ) sampling periods, with the organic curves' slopes (beta-diversity) and intercepts (alpha-diversity) being higher than those of the conventional curves. Mean system species richness was also significantly higher for the early-summer ( $p = 0.03$ ) and late-summer ( $p = 0.002$ ) sampling periods. There were no significant differences in the curves or mean richness values for the mid-summer sampling period. Further research has been initiated to more clearly understand if there is any functional management significance to greater weed community diversity in organic systems. [77]

**COMPARING GLYPHOSATE FORMULATIONS WITH ADJUVANTS.** Richard K. Zollinger\* and Jerry L. Ries, North Dakota State University, Fargo.

Isopropyl amine (ipa) and potassium (K) salts of glyphosate with no, partial, or full adjuvant concentrations in the formulation are commercially available. Replicated field research was conducted near Alice, ND on a field containing a pure monoculture of common lambsquarters. The field had been planted to Roundup Ready soybean for at least eight consecutive years and glyphosate was applied for weed control once or twice each year. As a result, a glyphosate insensitive common lambsquarter population was selected. In field research, glyphosate was applied at 0.28 lb ae/A to 8 to 14 inch common lambsquarters in distilled water or water containing 500 ppm hardness of calcium and magnesium to evaluate adjuvant enhancement and adjuvants overcoming hard water antagonism. The hard water completely inactivated glyphosate (0% common lambsquarters control) whether applied at 0.28 or 0.42 lb ae/A. All adjuvants were applied at label recommendations. Ammonium sulfate (AMS) at 1 lb/A was able to overcome hard water antagonism. Weed control from glyphosate was greatest when applied with AMS plus surfactant regardless of glyphosate formulation (85-93%). However, surfactants providing greater enhancement of glyphosate were R-11 (80%) and Wet-Sol (78%). Less effective surfactants were Liberate, TopSurf, and Activator 90 (30-53%). Glyphosate-ipa formulations (Roundup UltraMax and Roundup Custom) gave greater weed control than glyphosate-K formulations (Roundup UltraMax II and Touchdown HiTech) regardless of adjuvant used. Current mechanisms of adjuvants to overcome hard water antagonism are use of AMS, chelators, and acidifiers. AMS overcomes hard water antagonism by forming glyphosate-NH<sub>4</sub><sup>+</sup> + Ca<sup>2+</sup>SO<sub>4</sub><sup>2-</sup> in the droplet as the water evaporates. Citric acid can act as a chelator to make salt non-reactive. Acidifiers, such as sulfuric and phosphoric acid can reduce spray solution pH to the pKa of glyphosate (pH 2), thereby, making glyphosate non-reactive with salts. Several adjuvants classified as AMS replacement products were tested against AMS and AMS plus R-11 surfactant. AMS replacement adjuvants claim to "condition" the spray solution preventing hard water antagonism of glyphosate. No AMS replacement adjuvant performed better than AMS plus surfactant (R-11 + AMS) (93%). Some AMS replacement adjuvants enhanced glyphosate (N-Tank, Full Load HWP, and Reddy It) (90-96%). N-Tank,



contains sulfuric acid and effectively overcame hard water antagonism (96%), while Citron (contains citric acid) partially overcame hard water antagonism (65%). Arrow Four, Choice, Quest, Spray Savy, Citron, and Herbolyte AMS replacement adjuvants gave less control (65-70%) than AMS without surfactant (80%). Adjuvants containing petroleum oil have been found to reduce weed control from glyphosate because glyphosate is a water soluble herbicide. However, oil adjuvants with sufficient emulsion surfactants can enhance glyphosate. Reddy It is classified as methylated seed oil (MSO) complex surfactant blend and enhanced glyphosate activity (93%). [78]

**REPRODUCTIVE STRATEGIES - A STUDY OF RATTAIL FESCUE SEED BIOLOGY AND PLANT VERNALIZATION REQUIREMENTS.** Catherine Tarasoff\*, Lynn Fandrich, Carol Mallory-Smith, Oregon State University, Corvallis

Daniel A. Ball, Sandra Frost, Oregon State University, Pendleton In a series of studies, reproductive attributes including seed production, dormancy, optimal germination temperatures, and vernalization requirements were studied for the *Vulpia myuros* (rattail fescue). This species has an enormous seed production potential producing over 300,000 seeds/m<sup>2</sup> under fallow conditions. As well, rattail fescue has a very limited afterripening requirement, reaching 93% germination when germinated in a 2.5% solution of potassium nitrate and a germination temperature of 20 C after only 30 days of afterripening. While this species has optimal and rapid germination rates at fluctuating temperatures of 25/20 C reaching 92% germination after 3 days; it will reach an average of 90% germination after 12 days at continuous and/or fluctuating temperature combinations ranging from 10 to 25 C. Field studies near Pendleton, OR indicate a vernalization requirement is needed. Seeds planted on February 24 and March 18, 2004 did not produce panicles by the July 12, 2004 harvest date indicating a vernalization requirement for the species. Of the planting dates which did produce panicles, October produced the highest seed yield with an average yield of 50,000 seeds/50 cm<sup>2</sup>. As well, the largest difference in subsequent seed germination from the field study was the October versus January dates where in on average seeds were 3.8 times more likely to germinate if they were harvested from October planted parent plants than those planted in January. In conclusion, once vernalization requirements are met, rattail fescue has the ability to produce a high number of viable seeds which, following 1 month after ripening, can germinate across variety of temperatures. [79]

**WEED CONTROL SYSTEMS IN ROUNDUP READY FLEX COTTON.** Erin L. Taylor\* and Patrick A. Clay, University of Arizona Cooperative Extension, Phoenix.

Weed control, potential antagonism from tank mix applications, and cotton yield were evaluated in Roundup Ready Flex cotton at the University of Arizona Maricopa Agricultural Center during the 2004 growing season. Postemergence weed control systems included broadcast applications of glyphosate (Roundup WeatherMax) when weeds reached 2-3 inches (0.75 lb ae/A), 4-6 inches (1.125 lb ae/A) and 7-9 inches (1.5 lb ae/A). Palmer amaranth (*Amaranthus palmeri*) and annual morningglory (*Ipomoea* sp), control was evaluated on a 0-100 scale, with 0 indicating no control and 100 indicating complete control. Weed control in systems that utilized an application of pendimethalin (Prowl) at 0.825 lb ai/A pre-plant incorporated (PPI) was 85-95% for Palmer amaranth and 55 to 64% for annual morningglory 24 days after treatment. For the first in-season application of glyphosate (cotton at 1 true leaf), plots that received an application of pendimethalin PPI had weeds at the 2-3 inch stage while treatments that received no PPI application had weeds at the 4-6 inch stage. Glyphosate rates were adjusted to accommodate the increased weed size, but control of larger annual morningglory was still reduced 16 to 21%. On July 16 (layby), weed control was similar for all weed control systems regardless of application timing. Broadcast applications of acephate (Orthene) at 0.45 lb ai/A plus glyphosate at 0.75 lb ae/A, mepiquat pentaborate (Pentia) at 0.077 lb ai/A plus glyphosate at 0.75 lb ae/A, pendimethalin (Prowl H<sub>2</sub>O) at 0.95 lb ai/A plus glyphosate (1.125 lb ae/A), and a layby application of flumioxazin (Chateau) at 0.064 lb ai/A plus glyphosate at 0.75 lb ae/A did not result in a reduction in control. Flumioxazin applied at layby, provided excellent control until harvest. Seed cotton yield per acre was not different for any of the treatments evaluated. [80]

**WEED CONTROL IN CHICKPEAS USING CHEMICAL AND BIOCONTROL METHODS.** Ryan Rapp, Stephen D. Miller and David W. Wilson, Graduate Assistant, Professor and Lecturer, Department of Plant Sciences, University of Wyoming, Laramie, WY 82071.

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 SAREC located at Lingle and Torrington Research and Extension Centers in 2004 to evaluate weed control and chickpea response with herbicides or grazing sheep. Herbicide plots were 3 by 9m using 4 replications while grazed plots at Torrington were 25 by 49m and at SAREC the plots were 30 by 52m. 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 ethafluralin, pendimethalin, dimethenamid-P and sulfentrazone (mean < 15% injury) at Torrington. At SAREC, chickpea exhibited good tolerance to ethafluralin, pendimethalin, dimethenamid and sulfentrazone (< 5% injury) however, treatments using imazethapyr had a higher injury response (> 15%) with little plant improvement late in the season. 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. In both grazing locations little weed control was obtained. Treatments containing a combination dimethenamid-P, or ethafluralin plus sulfentrazone provided the highest level of weed control while treatments containing imazethapyr, imazamox, or pyridate provided the lowest level of control. [81]

**KIH-485 EFFICACY AND CARRYOVER.** Jerry Ries and Richard Zollinger, North Dakota State University, Fargo.

KIH-485 is an experimental herbicide from Kumiai America. Research was conducted near Prosper, ND, to evaluate KIH-485 carryover to crops. KIH-485 was applied at 3.57 and 7.14 oz/A to flax, sugarbeet, canola, and sunflower. KIH-485 has soil residue that extends to the following year and injures some crops. KIH-485 caused 10 to 20%, 50 to 77%, 20 to 70%, and 10 to 55% injury to flax, sugarbeet, canola, and sunflower, respectively, at 21 and 28 days after planting (DAP). However, at 42 DAP; sugarbeet was the only crop to exhibit phytotoxicity at the 3.57 oz/A rate (70%). KIH-485 at 7.14 oz/A gave 0%, 77%, 25%, and 20% injury to flax, sugarbeet, canola, and sunflower, respectively. Other objectives were to evaluate KIH-485 for two years in course (Valley City, ND), medium (Carrington, ND), and fine textured (Casselton, ND) soils and to compare weed control with s-metolachlor, acetochlor, dimethenamid-P, and flufenacet at a respective rate range based on soil type. KIH-485 was used at 1.2, 1.8, 2.4, 3.0, 3.5, and 4.3 oz/A. Ratings were taken mid-season. KIH-485 gave 85 to 99% control of green and yellow foxtail, wild buckwheat, and wild mustard at all rates. Competitive products gave 60 to 99% green and yellow foxtail, 0 to 50% wild buckwheat, and 20 to 75% wild mustard control. KIH-485 above 2.4 oz/A gave 99% control of prostrate pigweed and redroot pigweed, although 1.8 oz/A at two locations gave 60 to 83% control. Competitor products gave 47 to 99% control. Eastern black nightshade, common ragweed, and marshelder control was greater than 93% at 1.8 oz/A and greater. Other products gave 87 to 99% eastern black nightshade, and 0 to 83% common ragweed and marshelder control. Kochia control of 99% was obtained at 3.0 oz/A. Other products ranged greatly from 0 to 68% control. Generally, KIH-485 at 3.0 oz/A gave greater than 92% control of common lambsquarters, but lower rates tended to be more erratic (63 to 99%). Other products ranged from 37 to 99% control. Common cocklebur at rates of 1.8 to 4.3 oz/A did not give greater than 13% control. [82]

**EVALUATING SOIL RESIDUAL HERBICIDES FOR WEED CONTROL IN CHEMICAL FALLOW.** Dennis J. Tonks, Washington State University Extension, Davenport; Joseph P. Yenish, Washington State University, Pullman.

Chemical fallow as practiced in the Pacific Northwest depends heavily on repeated applications of glyphosate. Russian thistle and other broadleaf weeds often establish despite repeated postemergence herbicide application. Studies were conducted at Pullman, Davenport, Wilbur, and Lind, WA, representing four distinct rainfall and production areas of eastern Washington, to evaluate the efficacy of soil applied herbicides in chemical fallow. Treatments included glyphosate at three timings and glyphosate tank mixed or in sequence with residual herbicides. Sulfentrazone, flumioxazin, isoxaflutole were applied alone or in combination followed by an application of glyphosate to control emerged weeds. Dicamba and metribuzin plus glyphosate or paraquat plus diuron were applied to provide both foliar and residual weed control. At Pullman, mayweed chamomile was the predominate species and Russian thistle was the predominate species at the other three locations. One, two or three applications of glyphosate did not effectively control Russian thistle. Combinations of isoxaflutole plus sulfentrazone and flumioxazin plus sulfentrazone controlled weeds most effectively and consistently across locations. Sulfentrazone, isoxaflutole, and flumioxazin tended to provide better weed control than dicamba or metribuzin at all locations. Paraquat plus diuron required sequential applications for effective weed control. Costs for the most effective control treatments were roughly equivalent to multiple applications of glyphosate. [83]

**PROJECT OKANOLA – INTRODUCTION OF WINTER CANOLA AS A ROTATIONAL CROP FOR OKLAHOMA WHEAT GROWERS.** Mark C. Boyles\* and Thomas F. Peeper, Oklahoma State University, Stillwater.

The interest in canola production has increased significantly in the United States in the last 5 to 10 years. Most of the increased production has occurred in northern states where spring varieties of canola are planted. Today, there is an increasing demand for this oil by diet-conscious consumers. With the development of new winter tolerant varieties (conventional and RR) canola offers promise as an excellent rotational crop to winter wheat. Winter canola has high quality oil and can be used as an excellent source of forage, hay and meal. A rotation with canola provides an opportunity to control difficult grass weed species found in traditional wheat. These include cheat, Italian ryegrass, jointed goatgrass, rescuegrass, wild oats, and feral rye. The objective of the OKANOLA project is to provide research, education and demonstration to stimulate the development of winter canola as a major profitable rotational crop for Oklahoma wheat growers. This project is a coordinated effort to rapidly introduce winter canola as a major crop in Oklahoma with the objective of improving wheat quality. In the fall of 2003, 100 acres of RR canola (DKW 13-86, DKW 13-62) were established (10 – 10 acre blocks) in north western Oklahoma to evaluate the agronomic fit in traditional wheat growing areas. Also approximately 700 acres of conventional canola (Wichita) were also established. The current OKANOLA project initiated in the fall of 2004 has 15,000 to 16,000 acres in Oklahoma and 3000 to 4000 acres in southern Kansas. The fields in Oklahoma were selected by the OSU county extension educator in each of 15 key counties. After county educators received training, each educator identified 4 to 8 growers who were willing to establish field demonstrations with RR canola with 80 to 160 acres per site. Each participating producer identified was required to attend a winter canola production workshop before planting his acreage. County extension educators are responsible for providing hands on information transfer to all growers currently evaluating RR canola within their counties. Thus, the County educators are responsible for site selection, soil testing, planter calibration, fall and spring stand counts, bi-weekly crop progress reports, assessing pesticide application needs, providing general production information and collecting yield data. Sites are established in Alfalfa, Blaine, Canadian, Custer, Dewey, Garfield, Grady, Grant, Harper, Kay, Kingfisher, Logan, Major, Woods, and Woodward counties. A tour will be conducted in the spring of 2005 in each county. Interest in winter canola production is increasing rapidly. The success of the project to date can be attributed to the willing cooperation of all involved including OSU Stillwater, OSU Area and County Educators, Monsanto / Dekalb, SW Seed, Oklahoma wheat growers, and Oklahoma grain buyers. [132]

**RELATIVE SUCCESS OF NO-TILL IN CONTINUOUS WINTER WHEAT DEPENDS ON PRODUCTION OBJECTIVE.** Deena L. Morley\* and Thomas F. Peeper, Oklahoma State University, Stillwater.

Hard red winter wheat (*Triticum aestivum* L.) is the primary crop produced in Oklahoma, with more than half of the wheat being utilized as a dual-purpose crop (forage plus grain). An experiment was established to agronomically compare no-till and conventional till production systems in continuous wheat with five production objectives. These five objectives are: (1) Maximize fall wheat forage and harvest wheat for hay in the spring; (2) Maximize fall wheat forage, harvest wheat hay in the spring, and produce doublecrop foxtail millet hay (*Setaria italica* hay (L.) Beauv); (3) Maximize fall wheat forage and harvest wheat for grain; (4) Traditional balance of fall wheat forage and grain production; (5) Maximize grain production only. Experiments were initiated on three on-site farms in north central Oklahoma by harvesting wheat hay in May or harvesting wheat grain in June 2002. After harvesting the hay, foxtail millet was seeded in appropriate plots and harvested in August. OK101 hard red winter wheat was seeded on appropriate dates corresponding with production objectives, beginning in early September and ending in mid-October. The first year tillage affected millet forage yield at only one location, where the no-till increased the yield by 1998 pounds of dry matter per acre. The second year conventional tillage increased millet production by over 800 pounds per acre at two of the three locations. Wheat forage for both years was consistently affected by planting date, tillage and insertion of the summer crop. The first year no-till grain yields were 3 to 18 bushels per acre less than conventional till. The second year grain yields with no-till were 10 to 12 bushels per acre less than conventional till at two of the three sites. The treatments are being continued for a third year to determine whether yield losses due to no-till will decrease over time. [133]

**SPRING WHEAT SEED SIZE AND CULTIVAR EFFECTS ON YIELD AND WILD OAT INTERFERENCE.** Qingwu Xue\* and Robert N. Stougaard, Montana State University, Northwestern Agricultural Research Center, Kalispell; James A. Mickelson, Pioneer Hi-Bred International, Johnston, IA; Qasim Khan, Montana State University, Southern Agricultural Research Center, Huntley; and Fernando Guillen-Portal, Montana State University, Northwestern Agricultural Research Center, Kalispell.

We previously reported that, within a single cultivar, spring wheat plants grown from large seeds had significant benefits in reducing yield loss and suppressing wild oat as compared to similar plants derived from small seeds. The question remains as to whether or not the effect of seed size on wheat competitive ability is consistently expressed among genetically divergent wheat cultivars. The objective of this study was to investigate the interactive effects of spring wheat seed size and cultivar on competitive ability against wild oat. Field experiments were conducted during 2002 and 2003 at Kalispell and Huntley, MT. The treatments consisted of three spring wheat cultivars (McNeal, Penewawa and Explorer), three seed size classes (large, medium and small), and two wild oat densities (0 and 160 plants per square meter). Spring wheat yield loss due to wild oat competition ranged from 24% to 77%, depending on environment, seed size and cultivar. While genotype by environmental interactions were evident, the response to spring wheat seed size was very consistent. When grown in the presence of wild oat, spring wheat yield increased in a linear fashion, regardless, of the location, year or cultivar. Relative to the small seeded treatments, plants established from large seed improved yields by 11% under wild oat free conditions and by 29% when grown in competition with wild oat. Interactions were not detected among spring wheat cultivars for any of the wild oat yield components. However, these wild oat parameters were significantly reduced as spring wheat seed size increased. Averaged across environments and cultivars, plants derived from large seeds reduced wild oat panicles by 18%, biomass by 26% and seeds per square meter by 20% as compared to plants established from small seeds. The results of this study corroborate our previous findings, demonstrating that plants established from large seeds are more competitive than those derived from small seeds. Further, these results indicate that the effect of seed size appears to be very durable, being consistently expressed over a range of genotypes and environments. [134]

**MECHANISMS ASSOCIATED WITH THE EFFECT OF SEED SIZE ON SPRING WHEAT – WILD OAT INTERACTIONS.** Robert Stougaard, Fernando Guillen-Portal\*, and Qingwu Xue, Montana State University, Northwestern Agricultural Research Center, Kalispell.

Crop seed size affects the competitive interaction between spring wheat and wild oat. However, the plant growth resources affected, and mechanisms associated with the process are not known. The effect of seed size on spring wheat - wild oat competition was assessed using a mechanistic system involving yield and its determinants in these species. Large and small seed size classes of 'McNeal' spring wheat were evaluated under different seeding rates and wild oat densities during 1999-2001 near Kalispell, MT. Interactive linear structural models based on ontogenic diagrams were constructed for each seed size system. Spring wheat grain yield was primarily determined by spikes  $m^{-2}$  and kernels spike $^{-1}$  when wheat was established from large seeds, but only by spikes  $m^{-2}$  when derived from small seeds. Concurrently, wild oat seed production was determined by panicles  $m^{-2}$  when grown in competition with wheat established from large seed, but by both panicles  $m^{-2}$  and seeds panicle $^{-1}$  under the alternative scenario. Plants derived from large seed had a noticeable effect on wild oat via a reduction in seeds panicle $^{-1}$ . Wild oat competition reduced wheat spikes  $m^{-2}$  under both seed size systems. However, plants established from large seed compensated for this effect via a compensatory mechanism involving kernels spike $^{-1}$ . Non-genetic variations in crop seed size affected the competition between these species by altering their mechanisms of yield compensation in which seed number was principally involved. [135]

**AN ECONOMIC ASSESSMENT OF WHEAT SEED SIZE AND SEEDING RATE EFFECTS ON WILD OAT INTERFERENCE.** Robert Stougaard\* and Qingwu Xue, Montana State University, Northwestern Agricultural Research Center, Kalispell.

A three-year field experiment was conducted at Kalispell, MT to investigate the effects of spring wheat seed size and seeding rate on wheat yield loss and economic returns as a function of wild oat density. Treatments consisted of four wild oat densities (0, 8, 16 and 32 plants  $ft^{-2}$ ), three spring wheat seed size classes (large, small and bulk), and two spring wheat seeding rates (16 and 26 plants  $ft^{-2}$ ) arranged in a complete factorial design. Weed-free yield potential varied yearly. As yield potential declined, wild oat competitive effects were less evident, and economic thresholds increased. Nonetheless, crop competitive ability increased as wheat seeding rate and seed size increased, with the greatest differences among treatment factors being observed at low weed densities. Both treatment factors

decreased spring wheat yield loss, increasing economic returns during all three years of the study despite the higher associated seed costs. Averaged over all other factors, adjusted gross returns were 193 and 217 \$ A<sup>-1</sup> for the low and high seeding rates, while values of 183, 211 and 221 \$ A<sup>-1</sup> were obtained for the small, bulk and large seed size classes, respectively. Both treatment factors increased economic thresholds in two of three years. These results demonstrate that the use of higher seeding rates and larger seed size classes both improve wheat competitive ability toward wild oat. However, the extent to which economic threshold values are raised will vary depending on the weed-free yield potential. [136]

**EFFICACY AND UTILITY OF A FLUROXYPYR PLUS CLOPYRALID PRE MIX FOR DICOT WEED CONTROL IN NORTHERN PLAINS CEREAL CROPS.** Brett M. Oemichen\*, Randy L. Smith, Mark A. Peterson, Roger E. Gast Dow AgroSciences, Indianapolis, IN 46268

Kochia (*Kochia scoparia*), wild buckwheat (*Polygonum convolvulus*), and Canada thistle (*Cirsium arvense*) are three of the most troublesome weed problems for growers of spring-seeded cereal crops in the northern plains of the United States. Other dicot weeds such as field bindweed (*Convolvulus arvensis*), prickly lettuce (*Lactuca serriola*), and volunteer flax (*Linum usitatissimum*) are also important yield reducing weeds in spring cereals. Two years of replicated field trials have characterized the efficacy and crop safety of GF-1203 (a 1:1 ratio pre mix formulation of fluroxypyr plus clopyralid) for control of these important weeds. Results indicated that fluroxypyr at 105 gm ae/ha plus clopyralid at 105 gm ae/ha applied at the 4 to 5 leaf, early tillering crop stage provided excellent control of kochia, wild buckwheat, Canada thistle, volunteer flax and prickly lettuce. Control of these key weeds, including ALS resistant kochia, with GF-1203, was frequently superior to that of the commercial standards. GF-1203 also provided suppression of field bindweed, common lambsquarters (*Chenopodium album*), redroot pigweed (*Amaranthus retroflexus*), Russian thistle (*Salsola iberica*), and several Brassica species. The addition of 2,4-D, MCPA or ALS inhibiting herbicides to GF-1203 improved control of common lambsquarters, redroot pigweed, Russian thistle, and Brassica species providing a wide spectrum of broadleaf activity. Crop safety across trials was excellent. In compatibility trials with ACC-ase and ALS inhibiting grass herbicides, GF-1203 did not antagonize green foxtail (*Setaria viridis*) or wild oat (*Avena fatua*) efficacy. Registration for GF-1203 under the tradename of WideMatch was received in 2004, providing an important new weed control tool for spring cereal growers. [137]

**PINOXADEN – A NEW SELECTIVE POSTEMERGENCE GRAMINICAIDE FOR WEHAT AND BARLEY.** SM Schrärer, DJ Porter, Syngenta Crop Protection, Inc, Greensboro, NC; Urs Hofer, Syngenta Crop Protection AG, Basel, Switzerland; and Myron Kopec, Syngenta Cop Protection Canada, Inc, Guelph.

Skip row corn may increase the success of rainfed corn especially in those areas where the yield potential is less than 100 to 140 bushels/acre. An example is the trial conducted at Akron, Colorado in 2004. Yields in plant 2, skip 2 corn were 50 to 47 bushels per acre for plant populations of 12,000 and 16,000 respectively, while conventionally planted corn yielded 16 and 21 bushels/acre for 12,000 and 16,000 population respectively. Conversely at North Platte, Nebraska in 2004, with above average rainfall yields were similar for skip row and conventional planted corn in the 100 to 120 bushel/acre range. Weed management in skip row corn begins with establishing a good winter wheat crop. Control weeds in the winter wheat and at harvest spread the crop residue evenly. With the residue from a 60 bushel wheat crop spread evenly, the weed density was 20% of the weed density where crop residue was not present. Control weeds after winter wheat harvest and prevent them from producing seed. In the spring apply a preplant or preemergence herbicide. If weed pressure is light a 2/3 rate may be considered. Plant Roundup Ready Corn II and follow up with glyphosate treatments as needed. With Roundup Ready Corn II a glyphosate application may be made as late as 48" high corn when applied with drop nozzles. Control weeds when they are small as the corn crop needs all the soil water. [139]

**AMINOPYRALID, A NEW HERBICIDE FOR DICOT WEED CONTROL IN WHEAT.** Randy L. Smith\*, Brett M. Oemichen, Mark A. Peterson, Dow AgroSciences LLC, Indianapolis, IN

Wild buckwheat (*Polygonum convolvulus*) and kochia (*Kochia scoparia*) pose a serious problem for growers of cereal crops throughout major production areas of the United States. Infestations of these and other dicot weeds such as common lambsquarters (*Chenopodium album*), redroot pigweed (*Amaranthus retroflexus*), wild mustard (*Sinapis arvensis*) and Russian thistle (*Salsola iberica*) can dramatically reduce crop yields. Several years of replicated field trials have characterized the usefulness of aminopyralid (DE-750) for control of these important weeds. Results indicated that aminopyralid at 10 gm ae/ha plus fluroxypyr at 140 gm ae/ha applied at the 4 leaf crop

stage provided excellent control of wild buckwheat and kochia with a very good margin of crop safety. Control of these two key weeds, including ALS resistant kochia, with aminopyralid plus fluroxypyr, was often superior to that of the commercial standards. Crop yield data from weed free tolerance studies confirmed a 2X margin of crop safety. The addition of 2,4-D, MCPA or ALS inhibiting herbicides to aminopyralid plus fluroxypyr improved control of common lambsquarters, redroot pigweed, wild mustard and Russian thistle, providing a complete spectrum of broadleaf activity. Plant back studies indicated acceptable rotational crop tolerance for corn, sorghum, barley and flax planted one year after application. Pulse crops such as chickpeas, field peas and lentils were adversely affected when planted back into treated areas one year after application. Sunflower, soybean and safflower were moderately affected at one year after treatment. Aminopyralid plus fluroxypyr will provide an important new weed control tool for wheat growers. [140]

**ADVANTAGES OF WET BOOMS OVER DRY BOOMS ON SPRAYERS AND HOW TO CONVERT.** R. Klein, University of Nebraska, North Platte.

Field sprayer booms are an important part of the pesticide delivery system and can influence application accuracy and efficiency. Booms come in all shapes and sizes, depending on their use, and deliver the spray solution to the nozzles and tips at the desired pressure for the target. A small hand boom may be only a single nozzle while a large field sprayer could have a 120-foot or wider boom. There are two types of boom: wet and dry. A boom is considered a wet boom if the pipe span is not only used as a support mechanism for the spray nozzles but delivers spray solution to them as well, hence the name "wet boom." A boom that is used merely as a span along which to space the nozzles, but which does not deliver the spray solution, is considered a dry boom. The solution is delivered to the nozzles via a separate hose line which runs along the boom span using it as a support mechanism to mount each nozzle. The advantages of a wet boom are: less plugging of nozzle tips and the spray boom on a wet boom needs only to be fed with the spray solution on the end. The angle of the boom can be changed and in most situations it is easier to change the height of a wet boom than a dry boom. The main disadvantage of a wet boom is the initial cost. [146]

**CANOLA PHYTOTOXICITY FROM REPEAT APPLICATIONS OF RESIDUAL ALS INHIBITORS IN A FIELD PEA-WHEAT-CANOLA CROPPING SEQUENCE.** E. N. Johnson\*, Agriculture and Agri-Food Canada, Scott, SK; J. R. Moyer, Agriculture and Agri-Food Canada, Lethbridge, AB; A. G. Thomas and J. Y. Leeson, Agriculture and Agri-Food Canada, Saskatoon, SK; F. A. Holm, K. L. Sapsford, J. J. Schoneau and A. M. Smigielska, Univ. Saskatchewan, L. M. Hall, Univ. Alberta, M. E. Kuchuran, BASF Canada, L.S. Blashko, BASF Canada, R. G. Hornford, BASF Canada, and R. S. Pidskalny BASF Canada.

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 additive or synergistic phytotoxicity 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 registered rates in 2002. In 2003, the wheat phase received a post-emergence application of a non-Group 2 check (clodinafop-propargyl and bromoxynil-MCPA), imazamethabenz, flucarbazone-sodium, sulfosulfuron, or florasulam-MCPA at registered field application rates. In the wheat phase of the sequence, imazamox:imazethapyr followed by flucarbazone-sodium, sulfosulfuron, or florasulam-MCPA resulted in higher levels of wheat injury and lower wheat yields than the check treatments at one site-year only. In the canola phase of the rotation (2004), imazamox:imazethapyr followed by imazamethabenz or sulfosulfuron resulted in higher levels of canola injury and lower canola yields than the check treatments at two site-years. The sites where the canola injury occurred were low organic matter soils which received below normal precipitation in both 2002 and 2003. The results suggest that under certain soil and climatic conditions, repeated application of residual Group 2 herbicides can result in synergistic phytotoxicity to rotational crops. [147]

**APPLICATION TECHNIQUES TO IMPROVE SOYBEAN CANOPY PENETRATION.** Robert E. Wolf\*, Kansas State University, Manhattan.

Three application systems were tested to determine abilities to get spray droplet penetration into the lower portions of a dense soybean plant canopy for late season control of soybean aphid. The systems tested were conventional, electrostatic, and aerial. For each system, typical spray operation parameters were used as treatments while comparing application volumes and/or deposition aid products. For all trials, kromekote paper was positioned near the top, middle, and bottom of the canopy to collect the spray droplets and DropletScan™ was used to measure and compare the coverage differences. A conventional ground application system was used to compare turbo (TT) and venturi/air-induction (AI) flat-fan nozzle types and application volumes (5, 7.5, 10, and 12.5 GPA) for ability to maximize spray droplet penetration into a dense soybean canopy. Results show the greatest differences in the top of the canopy with a trend toward increased coverage as the application volume increased. Differences in nozzle types were not significant. These trends were very evident when all collection locations were totaled for each nozzle type and application volume. A Spra-Coupe equipped with the electrostatic spray process (ESP) was field tested to determine if the electrostatic charge would improve canopy penetration. Treatments with extended range (XR) and turbo (TT) flat-fan nozzle types and charged spray vs. no-charged spray were compared. Significant differences were only found in the top of the canopy with the charged spray resulting in more coverage for the XR nozzle and the non-charged spray resulting in much more coverage for the TT nozzle. When total coverage was determined, the charged spray was slightly better for the XR, while for the TT, the non-charged spray was significantly better. Overall, the non-charged spray coverage with the TT nozzle was better than the charged spray coverage with the XR nozzle. A field study was conducted to determine the influence of application volume and tank mix deposition aids on soybean canopy deposition for a fixed wing aerial application. A turbine powered aircraft was used to apply four products designed to improve deposition in one and three GPA tank mix solutions. Water only was used as a check. Differences in coverage were found between products in all three collector positions in the canopy (top, middle, and bottom) with the top position being significant. All four deposition aid products resulted in more coverage than water alone. Significant differences were found in the application volume and product comparisons for percent area coverage at all levels in the canopy. Typically the higher application volume treatments resulted in higher coverage's for all products tested. The presence of the soybean canopy reduced the amount of coverage in the top of the canopy nearly three times. It is concluded that when using the application systems evaluated in these studies applicators will have limited success in placing droplets into the lower parts of full canopied soybean plants. With the conventional spray system nozzle type had little effect. For the conventional and aerial trials the coverage improved with increased application volumes. The addition of deposition aids tends to improve the total amount of coverage. Adding a charge to the spray does not provide significant improvement. [148]

**ROUNDUP READY® ALFALFA: WEED CONTROL AND CROP SAFETY DURING ESTABLISHMENT YEAR.** Sheldon E Blank Monsanto Company, Kennewick, WA, 99337

Field studies were initiated in 2002 and 2004 near Walla Walla, WA to compare the efficacy and crop safety of glyphosate against imazethapyr and imazamox for selective weed control in a spring seeding of glyphosate resistant alfalfa. The following herbicide treatments were applied when seedling alfalfa was in the 3 to 4 trifoliate growth stage: glyphosate 0.75 lb ae/A; imazethapyr 0.096 lb ai/A; imazamox 0.039 lb ai/A. No additional herbicide treatments were made during the establishment year of the alfalfa. In 2002, glyphosate provided 30 to 35% superior control of barnyardgrass, redroot pigweed, tumble pigweed and common lambsquarters compared to imazethapyr and 15 to 20% superior control compared to imazamox. In 2004, glyphosate provided 100% control of redroot pigweed, green foxtail, yellow foxtail, barnyardgrass, shepherdspurse, henbit, Russian thistle, hairy nightshade, kochia and prickly lettuce. Imazethapyr and imazamox were ineffective in controlling kochia, Russian thistle and prickly lettuce. When crop safety was averaged over the two years, applications of glyphosate, imazethapyr and imazamox resulted in 0%, 28%, and 41% growth reduction of alfalfa, respectively, at 14 days after treatment. In 2002, glyphosate provided 109% (1.24 T/A) and 98% (1.18 T/A) greater alfalfa cumulative dry weight yield than imazethapyr or imazamox over 3 cuttings. In 2004, glyphosate, imazethapyr, imazamox and untreated check provided the following cumulative dry weight alfalfa yields over 4 cuttings: 7.08 T/A; 6.47 T/A; 5.92 T/A; 5.64 T/A. **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 pesticide label directions. Roundup Ready® crops contain a Roundup Ready® gene, which confers tolerance to glyphosate, the active ingredient in Roundup® agricultural herbicides. Roundup® agricultural herbicides will kill plants that do not



contain a Roundup Ready® gene. Roundup Ready® and Roundup® are registered trademarks of Monsanto Technology LLC. [149]

**WEED MANAGEMENT AND RAINFED SKIP ROW CORN.** Robert Klein\*, University of Nebraska, North Platte

Skip row corn may increase the success of rainfed corn especially in those areas where the yield potential is less than 100 to 140 bushels/acre. An example is the trial conducted at Akron, Colorado in 2004. Yields in plant 2, skip 2 corn were 50 to 47 bushels per acre for plant populations of 12,000 and 16,000 respectively, while conventionally planted corn yielded 16 and 21 bushels/acre for 12,000 and 16,000 population respectively. Conversely at North Platte, Nebraska in 2004, with above average rainfall yields were similar for skip row and conventional planted corn in the 100 to 120 bushel/acre range. Weed management in skip row corn begins with establishing a good winter wheat crop. Control weeds in the winter wheat and at harvest spread the crop residue evenly. With the residue from a 60 bushel wheat crop spread evenly, the weed density was 20% of the weed density where crop residue was not present. Control weeds after winter wheat harvest and prevent them from producing seed. In the spring apply a preplant or preemergence herbicide. If weed pressure is light a 2/3 rate may be considered. Plant Roundup Ready Corn II and follow up with glyphosate treatments as needed. With Roundup Ready Corn II a glyphosate application may be made as late as 48" high corn when applied with drop nozzles. Control weeds when they are small as the corn crop needs all the soil water. [150]

**CONTROLLING COMMON MALLOW IN ESTABLISHED ALFALFA.** Jerry L. Schmieder\*, University of California Cooperative Extension, Colusa, CA

Common mallow is a troublesome weed to the production of alfalfa. It is not controlled with common weed control practices and will lower quality and price of alfalfa hay infested with this weed. Over a 2 year period, herbicides registered for use on alfalfa were tested in tank mix combinations to ascertain the potential effectiveness of the mixture to control common mallow. Herbicides were applied either in the fall (October or November) or in January. Field observation revealed that common mallow germinated from September to February with germination following rain or irrigation. Common mallow that germinated in the fall was the most difficult to control with a January application. Several of the herbicide combinations were effective in controlling seedling and young mallow, but lacked effectiveness on more mature plants. While controlling the small mallow, fall herbicide applications did not provide long enough control for many of the other winter annual weeds that are common to alfalfa. Small mallow plants were controlled with the January applications of hexazinone, imazamox, and metribuzin. More mature mallow plants were controlled with the tank mixtures of paraquat plus hexazinone or paraquat plus metribuzin. The tank mixtures of paraquat plus either of the photosynthesis inhibitor herbicides hexazinone or metribuzin also provided adequate control of all the other winter annual weeds present. An application of imazamox in the fall provided control of the fall germinating mallow and a sequential application of one of the other herbicides provided good control of the other winter annual weeds. [151]

**MANAGEMENT OF KEY COLORADO WEEDS USING IMAZAMOX IN IMAZAMOX-TOLERANT SHORT-STATURE SUNFLOWER.** Alan L. Helm\*, Colorado State University Cooperative Extension, Holyoke; W. Brien Henry, USDA-ARS, Akron; and Philip Westra, Colorado State University, Ft. Collins, CO

Sunflowers have become an integral part of dryland rotations in Colorado. Rotating from a grass crop (wheat) to a broadleaf crop such as sunflower increases the number of herbicide options available to producers for weed management. Currently the most common weed management system in sunflowers is sulfentrazone plus a dinitroaniline (DNA) applied prior to planting. Other herbicide options include s-metolachlor applied prior planting for grass and broadleaf weed control, followed by clethodim or sethoxydim for in-season grass control. Recently herbicide-tolerant sunflowers that have the same technology as the imazamox-tolerant wheat system have been introduced. Imazamox-tolerant sunflower allows a producer to apply imazamox up to the V-8 growth stage. Imazamox applied during the growing season increases the spectrum of weed control to include many troublesome broadleaf and grass weeds. Another problem in sunflower production is lodging of plants prior to harvest due to insects and wind. Short-stature varieties of sunflower tend to withstand this pressure better than taller, conventional varieties due to shorter stature and thicker stalk diameter. This study was conducted at the USDA ARS Central Great Plains Research Station at Akron, CO in 2004. This randomized complete block experiment consisted of 11 treatments, three replications, and a plot size of 3m by 10m. Pre-plant applications of sulfentrazone and



pendimethalin (EC and H<sub>2</sub>O) were made on May 21, (47 days before planting). Pendimethalin EC was mechanically incorporated immediately following application. Short-stature Clearfield sunflower (Triumph s675) was planted on June 3. Glyphosate was applied as a burndown at a rate of 1.12 kg ai/ha 14 days prior to the preplant applications. Imazamox was applied on July 7 at the V-6 growth stage. Weed control evaluations were made on July 7, July 30, August 16 and September 14. On July 7, all treatments that included pre-plant applications that included pendimethalin H<sub>2</sub>O and sulfentrazone provided at least 96% control of redroot pigweed, puncturevine, and kochia. Imazamox applied July 7 increased weed control in the imazamox + NIS + UAN from 0% control of all species to 82, 53, 98, and 90% for redroot pigweed, puncturevine, kochia and Russian thistle respectively. Imazamox + COC + UAN controlled redroot pigweed, puncturevine, kochia and Russian thistle 82, 47, 80, 93% respectively. This was statistically significant for kochia control. Treatments 5, 6, and 7 included 3 different rates of sulfentrazone (0.158, 0.105, and 0.053 kg ai/ha respectively). No significant differences were detected among these three treatments, all provided adequate control (>90%) of all weed species during the growing season when used in conjunction with pendimethalin H<sub>2</sub>O [152]

**FLAX RESPONSE TO THIFENSULFURON APPLICATION TIMING AND RATE.** Kirk A. Howatt\* and Ronald F. Roach, North Dakota State University, Fargo.

Postemergence control of redroot pigweed in flax is difficult because of long pigweed germination periods and lack of consistent pigweed control with bromoxynil and MCPA. Thifensulfuron has been investigated for utility in flax weed control programs. The practice showed promise, but rates of thifensulfuron used in cereals produced variable crop response. Field experiments were established near Fargo and Prosper, ND, to determine the most appropriate rate and application timing of thifensulfuron in flax to control redroot pigweed. Thifensulfuron at 0, 0.03, 0.06, 0.11, or 0.22 oz ai/A with bromoxynil and MCPA at 6 oz ai/A was applied to 3- or 6-inch flax. Thifensulfuron did not visibly affect flax health at Fargo, but thifensulfuron caused greater chlorosis than bromoxynil and MCPA when applied to 6-inch flax at Prosper. Thifensulfuron at 0.06 oz/A did not reduce flax height compared to bromoxynil and MCPA, but thifensulfuron at 0.11 or 0.22 oz/A caused short-term stunting, especially when applied to 6-inch flax. Thifensulfuron at 0.06 oz/A provided greater than 90% control of redroot pigweed compared with 65 to 80% control with bromoxynil and MCPA when applied to 6- or 3-inch flax, respectively. Flax population, height at maturity, and number of seed bolls per plant were not affected by thifensulfuron, but thifensulfuron treatments resulted in flax yields that were 20 to 40% greater than flax treated with bromoxynil and MCPA alone. In a second experiment, thifensulfuron at 0.06 or 0.22 oz/A with bromoxynil and MCPA at 6 oz/A was applied to flax that was 2, 4, 6, 8, or 10 inches tall. Chlorosis and stunting appeared more severe with earlier application because of the relative size of the flax plant. Flax population and height at maturity decreased as herbicide application was delayed. Thifensulfuron did not reduce the number of seed bolls per plant, but flax yield was generally 20% greater when treatments were applied to flax that was 4 inches tall or shorter compared with 6 inches tall or taller. [153]

**CROP TERMINATION AND WEED CONTROL IN GLYPHOSATE-TOLERANT ALFALFA.** Kwame O. Adu-Tutu\* and William B. McCloskey, University of Arizona, Tucson.

The efficacy of 2,4-D and dicamba alone or in combination for the termination of alfalfa was studied in plots that were tilled or untilled after herbicide application at the University of Arizona Maricopa Agricultural Center, Maricopa, AZ and the University of California Desert Agricultural Research and Extension Center, El Centro, CA. Tank mixes of 2,4-D and dicamba at 0.56, 0.84, 1.12, 1.4 or 1.68 kg total ae ha<sup>-1</sup> reduced the number of emergent alfalfa crowns 85 to 100% in disked plots, and controlled regrowth of alfalfa crowns 81 to 99%. Glufosinate, glyphosate and paraquat were less effective than 2,4-D and dicamba tank mixes. Emergent alfalfa groundcover in disked herbicide-treated plots was less than 2%, compared to 4% groundcover in the unsprayed plots. The effect of tillage on alfalfa control, averaged across herbicide rates, was significant: disked the plots controlled regrowth 95 to 100%, compared with 58 to 87 % control without tillage. Tillage effects were especially pronounced in plots treated with contact herbicides; most of the 2,4-D and dicamba tank mix treatments were as effective in untilled as in tilled plots. The efficacy of herbicides for weed control in alfalfa was also studied at the Maricopa Agricultural Center. Glyphosate (0.84 or 1.68 kg ae ha<sup>-1</sup>), imazethapyr (0.105 kg ai ha<sup>-1</sup>) and imazamox (0.053 kg ai ha<sup>-1</sup>) were applied to alfalfa at the 3.5 or 9 trifoliate leaf stage. The imazethapyr and imazamox treatments were applied alone or tank mixed with 2,4-DB (0.56 kg ae ha<sup>-1</sup>). The predominant weeds were prostrate knotweed, African mustard, shepherd's-purse, annual bluegrass, annual sowthistle and littleseed canarygrass. Weed control was better when herbicide treatments were applied at the 3.5 trifoliate leaf stage than at the 9 trifoliate leaf stage. Glyphosate applications provided better weed control than imazethapyr or imazamox. The imazamox and 2,4-DB tank mix

application provided broadleaf weed control comparable to that provided by glyphosate at 1.68 kg ae ha<sup>-1</sup>, but it resulted in 69% stunting one month after the 3.5 trifoliolate leaf application, and caused yield reductions at the first two harvests. Imazamox applied alone (i.e. not tank mixed with 2,4-DB) at the 3.5 trifoliolate leaf stage or tank mixed with 2,4-DB at the 9 trifoliolate leaf stage caused much less stunting and did not affect yield at the first and second harvests. A glyphosate and 2,4-DB tank mix also did not cause yield reductions, indicating that significant stunting and yield loss were specific to the imazamox and 2,4-DB tank mix applied at a young growth stage when there was significant bare soil. [154]

**EFFECT OF SIMULATED RAINFALL AND SEEDING DEPTH ON DRY PEA TOLERANCE TO SULFENTRAZONE.** Brian Jenks\*, Gary Willoughby, and Denise Markle, North Dakota State University, Minot

A study was conducted to determine the influence of rainfall amount and timing of rainfall on dry pea tolerance to sulfentrazone. Sulfentrazone was applied at 0.14 lb ai/A immediately after direct seeding dry peas into a sandy loam soil. Water was sprayed over 1-square meter plots with a tractor sprayer to simulate 0.25, 0.5, and 1.0 inch rainfall. The desired precipitation amount was achieved by repeated passes with a boom equipped with XR8015 nozzles. The simulated rain was applied on three separate dates: 1 day after seeding, early emergence (cracking), and postemergence (1- to 2-inch peas). Each treatment was evaluated visually for crop tolerance in July. Yield was determined by hand-harvesting the entire square meter plot. Soil characteristics varied widely from plot to plot, especially soil pH. Dry pea injury appeared to be distinctly correlated to soil pH and somewhat less correlated to soil organic matter (OM). There was little correlation with rainfall amount or timing. If rainfall had an effect on injury, it was likely masked by the effects of soil pH and OM. Correlation analysis showed an r factor of 0.89 when comparing soil pH and sulfentrazone injury symptoms. As soil pH increased, crop injury also increased. OM was negatively correlated with sulfentrazone injury symptoms ( $r=-0.57$ ). Stand reduction was slightly correlated with soil pH ( $r=0.34$ ) and OM ( $r=-0.21$ ). Yield was negatively correlated with soil pH and positively correlated with OM. In a separate study, dry pea was seeded into loam and sandy loam soils at one- and two-inch depths to determine the effect of seeding depth on dry pea tolerance to spring-applied sulfentrazone. No visible injury from sulfentrazone was observed at either the one- or two-inch depths at either location. Soil pH at these locations was 6.0 or less. [155]

**THE TIMING OF GLYPHOSATE APPLICATION ON SEASONAL CHANGES IN STORED SOIL MOISTURE.** Randall S. Currie and Norman L. Klocke, Kansas State University, Garden City.

Wheat is a major weed in wheat-fallow-wheat rotations. Although much research has been done on rates and timings to kill wheat with glyphosate, little is known about the impact of these treatments on soil water storage, which is the main objective of the fallow period. In the winter of 2000-2001, 0.21, 0.42, 0.62, or 0.83 kg/ha applications of glyphosate were made on uniform stands of wheat in November, March, April, or May. A bare-soil control received 1.1 kg/ha applications of glyphosate as needed for a weed-free control during the winter and spring. Soil water was measured monthly in 0.3 m increments to a depth of 2.4 m for a year after initial treatment. After volunteer wheat senescence, the entire plot was maintained weed free with 1.1 kg/ha applications of glyphosate as needed. The experiment was repeated at different locations in 2001, 2002, 2003, and 2004. More season long total soil water was lost if glyphosate applications of 0.83 kg/ha were delayed until May. Details on the effects of these higher application rates are presented in greater detail elsewhere. (Proc. of NCWSS. 59:169.) If glyphosate was applied at 0.62 kg/ha in March or April soil water in the top 1.8 m in May was not significantly lower than the bare soil controls in 4 out of 5 locations. However, 0.83 kg/ha applications of glyphosate delayed until May had significantly less soil water in May than in the bare soil controls in the top 1.8 m at 4 out of 5 locations. Soil water in September did not significantly interact with glyphosate rate and/or spray date in 2 of 5 locations. At these locations glyphosate applied in May and November had from 28.7 to 50.8 mm less soil water in the top 1.8 m than the bare soil controls. There were 3 locations at which glyphosate application rate and spray date did interact. At 2 of these locations, the May glyphosate application of 0.83 kg/ha had from 53.4 to 68.6 mm less soil water than the bare soil controls. We conclude glyphosate application rate is much less critical in March and April than during other periods and that glyphosate should be applied before May. [156]

## WEEDS OF RANGE AND FOREST

**PLANT DIVERSITY, DYNAMICS AND INVASION IN SAGEBRUSH GRASSLANDS.** Tim Seipel\*, Bruce Maxwell, Matt Lavin, Montana State University, Bozeman

Sagebrush grasslands are often recipients of exotic plant species. Understanding the dynamics of invasion into native plant communities is important for land management and conservation practices. We initiated a study of plant diversity of sagebrush grass vegetation during 2004 on the three hectare Burke Park in Bozeman, MT. Initial findings revealed 213 vascular plant species inhabiting sagebrush-grass dominated vegetation, 68 of the plant species are non-native. Burke Park is heavily influenced by the public, understanding how and where exotic plants establish is an important consideration for a weed management plan. Cover of each species was recorded in 15 quadrats imbedded within 15, 10 by 50 m plots. Generating dominance-diversity distributions we considered all species and their ranks. This novel approach will allow us to identify the many invasive nonnative plant species that rely on disturbance before populations can spread, as opposed to those invasive species that are capable of spreading into native sagebrush-grass habitats regardless of disturbance. Of 68 nonnative species 38 appeared within intact native vegetation. The remaining 30 were confined to areas near trails where disturbance was more intense. [84]

**RANGE EXPANSION OF DOWNY BROME TO HIGH ELEVATION: LOCAL ADAPTATION OR ALL-PURPOSE GENOTYPES?** Cynthia S. Brown, Colorado State University, Fort Collins, Colorado.

Downy brome is an early-season, annual invasive grass that has negative impacts on plant communities and ecosystems through altered fire regimes, competition with native plants and interactions with microbial communities. Downy brome has spread to high elevations in the western U.S. over the last 10 to 15 years, raising concerns about the effects it will have on newly invaded habitats. Although there have been climate and N deposition changes that may facilitate the success of downy brome at high elevations, genetic factors may also be at work. To investigate the role of local adaptation and phenotypic plasticity in the range expansion of downy brome, seeds and plants from populations along an elevation gradient were tested for differences in dormancy and flowering patterns, respectively. If local adaptation has occurred, I expected seeds from low elevations to have greater dormancy and requirements for cold stratification and light to stimulate germination than those from high elevations due to less reliable summer rainfall in the plains compared to the mountains. Seeds from low elevations tended to have greater dormancy than those from high elevations ( $P = 0.0006$ ,  $R^2 = 0.10$ ), but location, independent of elevation, best explained the variation in the data ( $P < 0.0001$ ,  $R^2 = 0.61$ ). The germination of seeds from four of the twelve populations differed over time in response to pre-chilling and light, but there was no clear pattern associated with elevation. Because of short growing seasons at high elevations, I expected flowering in the greenhouse to increase with elevation. Plants grown from seeds from the twelve populations differed in the likelihood that they would flower after vernalization. Contrary to my expectation, I found that elevation and flowering were negatively related ( $P = 0.009$ ). However, the model explained very little of the variation in the data ( $R^2 = 0.01$ ). When considered independently of elevation, locations of populations were significantly associated with flowering ( $P < 0.0001$ ) and explained a greater proportion of the variation in the data ( $R^2 = 0.14$ ) than did elevation. Overall, these results suggest the differences among these downy brome populations are due to a combination of factors. There is evidence of selection for greater dormancy and increased flowering under experimental conditions in populations from low elevations and release from this selection at high elevations. However, there are very strong differences among populations that are not related to elevation and may be better explained by population founder effects than local adaptation. [85]

**EFFECT OF SEED MATURITY ON THE RESISTANCE OF WEED SEEDS TO SIMULATED FIRE: IMPLICATIONS FOR TIMING PRESCRIBED BURNS.** Sara B. Sweet\* and Joseph M. DiTomaso, University of California, Davis.

Prescribed burning is a common tool used to control invasive exotic annual grasses. One such grass, medusahead, has shown conflicting responses to prescribed burns, suggesting that seeds may increase their resistance to fire as they mature. The potential influence of seed maturity on resistance to fire has, however, not yet been investigated. Such data would be useful in timing prescribed burns to achieve maximum control. This research simulated the conditions of a grassland fire to determine the effect of seed maturity on resistance to fire. We simulated conditions at the soil surface and in the flame with a muffle furnace and a Bunsen burner, respectively. Simulations were carried out multiple times during seed maturation, using seeds from medusahead, barb goatgrass,

and ripgut brome. Final statistical analysis is in progress, but data show that medusahead and barb goatgrass seeds increase in resistance to fire as maturation progresses, while seeds of ripgut brome decrease. These trends match those of a pilot study completed the year before. We tentatively conclude that medusahead and barb goatgrass should be burned before seeds mature, but that ripgut brome should be burned at seed maturity. [86]

**THE CONTROL OF LEAFY SPURGE (*EUPHORBIA ESULA* L.) USING STRATEGIC SHEEP GRAZING AND IMAZAPIC.** S. M. Van Vleet\* and Steven S. Seefeldt, USDA-ARS, Dubois, ID

Leafy spurge is a prolific seed producer and can spread rapidly by seed. The objective of this study was to determine the effect of sheep grazing, with or without autumn applied imazapic, on leafy spurge productivity and soil seed banks. The study was conducted on a U.S. Sheep Station cooperative research site (Spencer, ID) from 2002 to 2004. The experimental design was a randomized complete block with 2 x 2 factorial of grazing and autumn applied imazapic. The four treatments were replicated four times for a total of sixteen pastures. Sheep grazing began each year when leafy spurge flowered, but before mature seed had developed. Grazing continued until reproductive structures were eliminated. Pastures containing sheep as a treatment were grazed for two seasons (2002 and 2003). Imazapic was applied the autumn of 2003. Leafy spurge stem counts were evaluated along with percent cover of grass, leafy spurge and forbs. Soil samples were collected from all pastures in late autumn 2002 and 2003. Soil samples within a pasture were combined and seeds in a 1-kg sample were germinated in a growth chamber for determining soil seed bank. Germinated seedlings of leafy spurge, grass and forbs were counted and removed from growth chamber weekly until emergence ceased (6 weeks). No interactions among treatments were found. Imazapic applications decreased ( $p < 0.05$ ) leafy spurge stem counts (44 to 1 per 0.18 m<sup>2</sup>) and ground cover (62 to 4%) compared to the control. Grass cover (21 to 53%) was higher ( $p < 0.05$ ) in the imazapic treatment, while forb cover was higher (14 to 68%) in the sheep grazed, autumn-applied imazapic treatment. Grass seed banks increased ( $p < 0.05$ ) in the ungrazed treatment (35 to 58) and remained constant in the grazed treatment (23 to 30), however, forb seed banks increased similarly in the grazed and ungrazed treatments (18 to 31 and 14 to 27). Leafy spurge seed banks increased ( $p < 0.05$ ) in the ungrazed treatments (7 to 24) while remaining constant in the grazed treatment (7 to 6). Sheep were effective in preventing an increase in leafy spurge soil seed bank. [87]

**EFFECTS OF DISTURBANCE AND ENVIRONMENT ON THE INVASION POTENTIAL OF YELLOW TOADFLAX.** Erik A. Lehnhoff\*, Lisa J. Rew and Bruce D. Maxwell, Montana State University, Bozeman.

Yellow toadflax, a non-indigenous species from Eurasia, has invaded plant communities in the Rocky Mountains. Anthropogenic disturbances such as clearcuts or roads are often cited as factors enhancing the potential establishment of yellow toadflax. However, little quantitative information is available regarding the effect of environment or different types of disturbance on the invasiveness of existing populations. This project examined the effects of four different types of disturbance – soil digging, vegetation clipping, burning, and herbicide application (Picloram, 1 lb ai/A) – on yellow toadflax patch density and expansion. Monitoring plots were established in existing yellow toadflax patches at four different sites – open meadow, clearcut, wildfire burned forest and riparian. Treatments and controls were randomly assigned to plots and implemented in July 2004. Stem density of yellow toadflax was recorded in each plot prior and subsequent to treatment. First order effects were observed for both treatment and site. Density increased with clipping ( $45.3 \pm 49.2$  stems/m<sup>2</sup>), burning ( $81 \pm 80.2$  stems/m<sup>2</sup>), and digging ( $78.4 \pm 140.7$  stems m<sup>-2</sup>) and decreased with herbicide treatment ( $-83.2 \pm 106.6$  stems/m<sup>2</sup>). Densities in control plots decreased overall in the meadow ( $-13.3 \pm 62.2$  stems/m<sup>2</sup>), wildfire ( $-12.3 \pm 32.6$  stems/m<sup>2</sup>) and riparian sites ( $-17.0 \pm 72.2$  stems/m<sup>2</sup>), and increased in the clearcut ( $12 \pm 23.6$  stems/m<sup>2</sup>). An invasiveness index was calculated for each treatment and site based on various statistics of the measured population dynamics. Burning, digging, and clipping resulted in invasiveness in all plots, herbicide resulted in local extinction, and invasiveness of the control plots was mixed. [88]

**EFFECT OF HERBICIDE TREATMENTS ON ESTABLISHMENT OF DALMATIAN TOADFLAX WITHIN BURNED FORESTED SITES.** Melissa L. Brown, Celestine A. Duncan\*, Weed Management Services, Helena, MT; Lois J. Olsen, Elizabeth A. Burke, Helena National Forest, Helena, MT; Rita E. Beard, United States Forest Service, Ft. Collins, CO; and Mary B. Halstvedt, Dow AgroSciences, LLC, Billings, MT.

Wildland fire is a natural disturbance of ecosystems that affects community structure and function. However, the presence of competitive non-native plants such as Dalmatian toadflax may drastically alter post-fire succession. Research trials were established in 2001 to measure the effect of herbicide treatments on Dalmatian toadflax

establishment and desired plant community composition following wildfire. Herbicides were applied using a hand-held boom sprayer delivering 13 gpa. Experimental design was a randomized complete block with three replications per treatment and individual plot size was 10 by 70 feet. Treatments included picloram at 0.5 lbs ae/A, picloram plus imazapic at 0.25 lbs ae/A plus 0.094 lbs ae/A, and an untreated control plot. Plant community data collected 10 months after treatment (MAT) and 3 yr after treatment (YAT) included vegetative and ground cover, and Dalmatian toadflax density. Dalmatian toadflax soil seed bank was measured pretreatment and 3 YAT.

There was no significant difference between picloram alone and picloram combined with imazapic for all attributes sampled. Herbicide treatments reduced Dalmatian toadflax density in the low and moderate burn severity sites by 94% and 88% respectively at 3 YAT. In the high burn severity, Dalmatian toadflax density did not significantly increase during the 3-yr period in either herbicide treated or non-treated plots. Dalmatian toadflax soil seed bank was similar between burn intensities and averaged 46.8 viable seeds/10.7 ft<sup>2</sup> prior to treatment. Herbicide treatments significantly decreased forb cover 10 MAT and 3 YAT at all burn severities compared to non-treated controls. Three years after treatment, grass cover increased 25% in untreated plots within all burn severities. Increase in grass cover in treated plots was similar to untreated plots at the moderate and high burn severity sites. At the low burn site, grass cover in treated plots increased 46% during the 3-yr period and was significantly greater than in untreated plots. The effects of herbicide treatments on shrub canopy cover varied between burn severities. Shrub cover was significantly reduced by herbicide treatments in moderate and high burn severity sites; however, there was no difference between treated or untreated plots at the low severity burn site. Bare-ground declined from pretreatment levels during the 3-yr period at all burn severities. At the high burn severity site, bare-ground was significantly higher in herbicide treated plots compared to untreated plots 10 MAT and 3 YAT. Results of this study suggest that post-fire herbicide treatments are effective in reducing Dalmatian toadflax establishment on low and moderate burn severities that are highly susceptible to invasion. However, there can be significant negative impacts to the forb component of the plant community for at least 3 YAT. Herbicide treatments on high severity burn sites have negative impacts on shrub and forb components of the plant community, and increase bare ground without reducing Dalmatian toadflax establishment. [89]

#### **EFFECTS OF MOISTURE ON DISPERSAL OF THREE TUMBLEWEEDS: IMPLICATIONS FOR DROUGHT?** Dirk V. Baker\* and K. George Beck, Colorado State University, Fort Collins

Plants from a number of different families have evolved the tumbleweed mechanism of dispersal. Several of these are important weeds, particularly in the more arid regions of western North America. Based on field observations, we hypothesized that, in drier areas or during drier years, the tumbling mode of dispersal would be maximized. Logically, dry soils provide a stronger fulcrum for wind to act against and break plant stems. Individuals of *Centaurea diffusa*, *Salsola iberica* and *Kochia scoparia* were reared in pots outdoors during the summer of 2004. When plants began to senesce, they were moved into the greenhouse and allowed to complete senescence. Plants were then randomly assigned to one of two treatments; receiving water or not. After 8 weeks, the horizontal force required to break plant stems was measured along with stem diameter, canopy diameter and plant height. *S. iberica* plants showed no difference between watered and non-watered. *C. diffusa* plants that received water post-senescence required approximately 40% less force to break than those receiving no water. *K. scoparia* plants that were watered required more force to break than non-watered plants and 80% of watered plants did not break at all. Stem diameter was a significant covariate for both *C. diffusa* and *K. scoparia*. Only the results for *K. scoparia* provide support for our hypothesis. Clearly, there are a variety of factors not measured in this study that may affect the force necessary to break plant stems. These may include soil type, organic matter, and time since senescence. [90]

#### **INTEGRATION OF HERBICIDES, BIOLOGICAL CONTROL AGENTS, AND NATIVE GRASSES FOR LEAFY SPURGE (*EUPHORBIA ESULA*) CONTROL.** Chelsea J. Juricek\*, Laurie A. Richardson, and Rodney G. Lym, North Dakota State University, Fargo.

Herbicides combined with biological control agents or competitive native grasses have been more effective for leafy spurge control than any single method. The purpose of this research was to evaluate imazapic, *Aphthona czwalinae/lacertosa* biological control agents, and native grass species alone or combined for leafy spurge control. The 5-yr experiment was established in 2001 as a randomized split-block design with four replicates within the Shyenne National Grassland (SNG) and in 2002 near Walcott, ND. Whole plots consisted of imazapic and two native grass mixtures alone or combined. The interseeded native grass species included one mixture of warm-season grasses and one mixture of cool- and warm-season grasses. Sub-plots were segregated by insect and non-insect

treatments. Leafy spurge stem density at the SNG site was unchanged by *Aphthona* 36 mo after release or by interseeded native grasses 15 mo after seeding when used alone. Imazapic at 105 g ai/ha by 9 mo after application reduced leafy spurge from an average of 92 to 8 stems/m<sup>2</sup>. Leafy spurge stem density at Walcott was unchanged by *Aphthona* 24 mo after release or by interseeded native grasses 3 mo after seeding when used alone. Treatments at Walcott produced control similar to the same treatments at SNG. The combined treatment of imazapic plus *Aphthona* plus interseeded native grasses reduced leafy spurge stem density more effectively than any single treatment at both locations. Treatments that include competitive grasses should extend the duration of leafy spurge control because the weed is replaced, not just removed. [91]

**RANGELAND BRUSH SPECIES TOLERANT TO IMAZAPIC.** J. Vollmer, BASF, Larmie, WY (No abstract) [92]

**POPULATION DYNAMICS OF TANSY RAGWORT (SENECIO JACOBAEA) WITH AND WITHOUT BIOLOGICAL CONTROL.** Brad Bauer\*, Bruce Maxwell, Lisa Rew, Theodore Weaver, Cathy Zabinski, Montana State University, Bozeman; and George Markin, Rocky Mountain Research Station, Bozeman, MT

Tansy ragwort is a non-indigenous species first appearing in Northwest Montana in the 1990s. Our study aimed to quantify the relative invasiveness of tansy ragwort at different environments and in response to a biological control agent (cinnabar moth, *Tyria jacobaeae*). In 2001 populations of tansy ragwort were permanently located along transects in four environmental types. Additionally, cinnabar moths were excluded from half of the plots along transects with established biological control agents. By monitoring the number of plants in each life stage twice each field season the proportion of plants per plot transitioning from one stage to the next was calculated. These proportions were used to construct a tansy ragwort population model to project population dynamics for different environments. The model allowed a multigenerational assessment of the biological control effect on relative invasiveness of the populations and subsequent management prioritization. After four field seasons the populations in burned and salvaged logged environments had a probability of being invasive of  $P(\text{invasive}) = 0.384$ , burned not-logged  $P(\text{invasive}) = 0.25$ , unburned forest  $P(\text{invasive}) = 0.441$ , and unburned meadow  $P(\text{invasive}) = 0.051$ . Where the cinnabar moths had established the burned and logged environment  $P(\text{invasive}) = 0.000$ , burned not-logged environment  $P(\text{invasive}) = 0.261$ , and unburned forest  $P(\text{invasive}) = 0.116$ . The study indicates that managers should prioritize weed control efforts on burned and salvage logged and burned not-logged areas. Additionally, preliminary results indicate that the cinnabar moth biological control agent may most effectively reduce the population invasiveness in the burned and logged and non-burned forest environments. [93]

**WILDFIRE MANAGEMENT ACTIVITIES AND THE POTENTIAL FOR ESTABLISHMENT AND SPREAD OF NON-INDIGENOUS SPECIES.** Rew LJ\*, Johnson M, Maxwell BD, Montana State University, Bozeman.

Wildfire and the anthropogenic disturbances employed to control it have numerous indirect effects on the native ecosystem, including changing environmental conditions to enhance the potential of plant species invasion. A web-based questionnaire was sent to resource managers and weed supervisors in federal, state and private enterprises in the Western States, during December 2003 – April 2004. 136 responses were received. The survey aimed to obtain a better understanding of which wildfire management activities are correlated with establishment and spread of non-indigenous species (NIS). And, to establish how much of this information was based on quantitative data. 79% of managers stated that NIS populations increased or new populations established 0–3 years following a wildfire, compared with 50% as time since fire increased (>3 years). Initially after wildfire fewer populations stayed the same (6%) or decreased (6%) compared with >3 years since wildfire (15% and 13% respectively). Access roads (19%), fire dozer lines (18%), staging areas (11%), gravel sources (10%) and camp fires (10%) were the most frequently associated fire-fighting activities; erosion control (23%), intentional non-native seeding (21%) and contaminated native seeding (19%) the most frequent rehabilitation activities; and, roads (20%), domestic grazing (13%) and recreation (e.g. camping, 13%) the most frequently stated management activities. Xeric shrublands and xeric grasslands were considered the most susceptible vegetation types and mesic forests, xeric forests and deserts the least. Integration of such knowledge with results of clearly defined experiments, at a fine landscape scale, should be used to reduce NIS invasion potential after wildfire. [94]

**THE INFLUENCE OF WATER STRESS AND TIMING OF HERBICIDE APPLICATION ON AFRICAN RUE CONTROL.** Kevin S. Branum\*, Laurie B. Abbott, Tracy M. Sterling,  
New Mexico State University, Las Cruces.

African rue was introduced into the U.S. in New Mexico in the early 1920's. Since then African rue has been documented in seven western states. It is an aggressive perennial weed with a deep tap root and extensive network of lateral roots. Effective control methods are limited due to its perennial nature and harsh environments in which it thrives. The interaction of soil water availability on efficacy of hexazinone, imazapyr and metsulfuron was evaluated at two locations, during two growing seasons, for three application timings (early, mid, and late) per season. Differences in soil water availability were established to compare plants receiving natural rainfall to those with supplemental water either from roadsides or supplemental irrigation. Physiological status was evaluated at herbicide application with gas exchange and water potential measurements. Natural rainfall treatments averaged 0.8 MPa lower water potential and gas exchange was decreased. For 2003 treatments, there were no water, timing, or location interactions, but necrosis when evaluated in spring 2004 was highest in African rue plants treated with imazapyr (78%) compared to metsulfuron (69%) or hexazinone (69%). In fall 2004 ratings after 2003 treatments, water decreased necrosis of control plants yet had no effect on herbicide response. This same trend was observed in 2004 treatments evaluated in fall 2004 with the exception of higher necrosis for all herbicide treatments applied in mid season. Therefore, the water-deficit stress imposed in natural rainfall conditions did not impact herbicide efficacy or its interactions with application timing and location. [95]

**METSULFURON METHYL AND CHLORSULFURON: COMBINATIONS THAT PROVIDE POSTEMERGENCE WEED CONTROL IN IMPROVED PASTURES AND RANGELAND.** M.T. Edwards, R. N. Rupp, E.P. Castner J.D. Harbour, C.W. Kral, L. S Tapia, DuPont Crop Protection, Wilmington, DE

Metsulfuron methyl and Chlorsulfuron are combined in different products to provide residual postemergence weed control in pasture and rangeland. Combinations of metsulfuron methyl, 2,4-D amine and dicamba (Cimarron Max), and combinations of metsulfuron methyl and chlorsulfuron (Cimarron X-tra) are new product offerings from DuPont Crop Protection that in replicated field trials have measured grass response and weed control in improved pastures and rangeland. Control was achieved greater than 85% on annual and perennial broadleaf weeds including musk thistle, Canada thistle, fringed sagebrush, sand sagebrush, silver sagebrush, buckbrush (Western Snowberry), Kochia and Russian thistle. Multi-year studies result in biomass reduction of prickly pear, brittle cactus and yucca. Clipping studies in native wheatgrass rangeland resulted in a 2 to 3-fold increase in grass forage, 40-60% increase in carrying capacity, and a 60-80% reduction in supplemental protein when metsulfuron methyl and chlorsulfuron combinations are used. [96]

**REDUCING HERBICIDE USE NEAR SALMON HABITAT WITH VEGETATIVE WATERWAYS.** Ryan D. Lins\*, Jed B. Colquhoun, and Charles M. Cole, Oregon State University, Corvallis.

The production of high-quality, certified grass seed in Oregon's Willamette Valley allows for minimal tolerance of crop contamination by weed seeds. Weed growth in production fields and surrounding waterways is typically suppressed with herbicides. However, repeated herbicide applications to waterways, in addition to an annual rainfall of over 102 cm, has led to surface water pollution of nearby streams. Vegetative waterways can suppress weeds, minimize erosion, and filter runoff from agricultural fields and may be an effective alternative to repeated herbicide use in sensitive areas. Therefore, in 2003 and 2004 studies were conducted in the Willamette Valley to evaluate red clover, white clover, alfalfa, birdsfoot trefoil, and creeping red fescue in vegetative waterways. In both years, fall planted creeping red fescue provided greater than 58% ground cover in April of the establishment year. Creeping red fescue suppressed weed ground cover to 3 and 25% in April 2003 and 2004, respectively, while weed ground cover was 57% in 2003 and 87% in 2004 for the conventional herbicide treatment (diuron and glyphosate). Large-scale vegetative waterway studies were also conducted in 2003 and 2004 with fall planted creeping red fescue only. In both years, creeping red fescue ground cover was greater than 80% in all sampling dates. Weed ground cover and biomass were greater in the conventional herbicide treatment than in the creeping red fescue treatment for all sampling dates in both years. [97]



**AMINOPYRALID: A NEW HERBICIDE FOR BROADLEAF WEED CONTROL IN RANGELAND AND PASTURES IN CANADA AND UNITED STATES.** Donald D. Hare\*, Allan G.G. McFadden, William R. McGregor, Leonard T. Juras, Norbert M. Satchivi, and Gary C. Turnbull, Dow AgroSciences Canada Inc, Calgary, Alberta, Canada.

Aminopyralid is a new systemic active ingredient developed by Dow AgroSciences specifically for use on rangeland, pasture, industrial vegetation management areas, non-cropland, and natural areas in Canada and United States. It is formulated as a liquid, 240 g ae/litre triisopropylamine salt. This herbicide has postemergence activity on a variety of established broadleaf and woody weeds and provides residual seedling control of a number of key broadleaf weeds species. An international field trial program has shown aminopyralid to be effective at rates between 52.5 and 120 g ae/ha, which can be as little as 5% of the use rate of currently registered rangeland and pasture herbicides including, clopyralid, 2,4-D, dicamba, picloram, and triclopyr. Aminopyralid controls over 40 species of broadleaf weeds the year of and after treatment, which extends the value of aminopyralid in rangeland and pasture vegetation management programs. Weeds controlled by aminopyralid include *Acroptilon repens*, *Amaranthus spinosus*, *Ambrosia artemisiifolia*, *Ambrosia psilostachya*, *Artemisia absinthium*, *Carduus acanthoides*, *Carduus nutans*, *Centaurea diffusa*, *Centaurea maculosa*, *Centaurea solstitialis*, *Chrysanthemum leucanthemum*, *Cirsium arvense*, *Cirsium vulgare*, *Lamium amplexicaule*, *Matricaria inodora*, *Ranunculus bulbosus*, *Rumex crispus*, *Solanum carolinense*, *Solanum viarum*, *Verbesina alternanfolia*, *Vernonia baldwinii*, and *Xanthium strumarium*. Aminopyralid will be used alone or in combination with 2,4-D amine at rates ranging from 420 to 1440 g ae/ha to further complement the spectrum of broadleaf species controlled. The addition of 2,4-D amine to aminopyralid will control *Daucus carota*, *Symphoricarpos occidentalis*, and *Tanacetum vulgare* among others. Over 20 species of both warm- and cool-season rangeland and pasture grasses are tolerant to aminopyralid applied at proposed label rates. Research continues to determine the efficacy of aminopyralid on other weeds and on the role of aminopyralid in facilitating desirable plant establishment and rangeland and pasture renovation. [98]

**PRAIRIE CONEFLOWER (*RATIBIDA COLUMNIFERA*) SEED PRODUCTION FOR REVEGETATION OF DISTURBED AREAS.** Myrna D. Ulmer\*, Thomas D. Whitson, Alan M. Gray, and W. Bart Stevens, University of Wyoming Research and Extension Center, Powell, WY; and Joseph D. Scianna, USDA-NRCS Plant Materials Center, Bridger, MT.

Disturbed land reclamation projects at the Francis E. Warren Air Force Base at Cheyenne, Wyoming have utilized introduced species and herbicides as a restoration strategy. Public land management policy now embraces ecosystem restoration with source identified endemic plant species. Seed supplies of endemic species are limited or nonexistent. Field experiments were conducted in 2003 and 2004 at two locations (Powell, WY and Bridger, MT) to evaluate the effect of three plant spacings (15, 30, and 60 cm) on seed yield of cultivated native prairie coneflower [*Ratibida columnifera* (Nutt.) Woot. & Standl]. Plots were established under sprinkler irrigation with 60 cm row spacing. Seed yield, biomass production, inflorescence count, and percent seed germination were recorded. There was a significant positive relationship between seed yield, biomass production, and inflorescence count at both locations. At Bridger, seed yield, biomass production, and inflorescence count with 15 cm plant spacing were significantly higher than with 30 and 60 cm plant spacings. In 2004, Bridger seed yields were 1,738 kg ha<sup>-1</sup> for the 15 cm spacing and 950 kg ha<sup>-1</sup> for the 60 cm spacing. However, no significant differences were observed at Powell with an average seed yield of 1,245 kg ha<sup>-1</sup>. Seed produced from the 60 cm spacing at Bridger germinated more rapidly than the other spacing treatments, but total germination after three weeks did not differ significantly among the three plant spacings. Preliminary findings indicated a plant spacing of 15 cm provided the highest seed yield response as an irrigated row crop. [99]

**AMINOPYRALID: A NEW REDUCED RISK ACTIVE INGREDIENT FOR CONTROL OF BROADLEAF INVASIVE AND NOXIOUS WEEDS.** V. F. Carrithers\*, P. L. Burch, W. N. Kline, R. A. Masters, J. A. Nelson, M. B. Halstvedt, J. L. Troth, and J. M. Breuninger; Dow AgroSciences LLC, Indianapolis, IN

Aminopyralid is a new systemic herbicide developed by Dow AgroSciences specifically for use on rangeland, pasture, rights-of-way, such as roadsides for vegetation management, Conservation Reserve Program acres, non-cropland, and natural areas in the United States and Canada. The herbicide is formulated as a liquid containing, 240 g ae/liter of aminopyralid as a salt. The herbicide has postemergence activity on established broadleaf plants and provides residual control of germinating seeds of susceptible plants. Field research has shown aminopyralid to be effective at rates between 52.5 and 120 g ae/ha, which is about 1/4 to 1/20 less than use rates of currently registered



rangeland and pasture herbicides with the same mode of action including, clopyralid, 2,4-D, dicamba, picloram, and triclopyr. Aminopyralid controls over 40 species of annual, biennial, and perennial broadleaf weeds including Russian knapweed (*Acroptilon repens*), absinth wormwood (*Artemisia absinthium*), plumeless thistle (*Carduus acanthoides*), musk thistle (*Carduus nutans*), diffuse knapweed (*Centaurea diffusa*), spotted knapweed (*Centaurea maculosa*), yellow starthistle (*Centaurea solstitialis*), oxeye daisy (*Chrysanthemum leucanthemum*), Canada thistle (*Cirsium arvense*), bull thistle (*Cirsium vulgare*), henbit (*Lamium amplexicaule*), *Matricaria inodora*, bulbous buttercup (*Ranunculus bulbosus*), curly dock (*Rumex crispus*), horsenettle (*Solanum carolinense*), *Solanum viarum*, and common cocklebur (*Xanthium strumarium*). Most warm- and cool-season rangeland and pasture grasses are tolerant of aminopyralid applications at proposed rates. Research continues to determine the efficacy of aminopyralid on other key invasive weeds and on the role of aminopyralid in facilitating plant community improvement in land management programs. [124]

**CONTROL OF INVASIVE WEEDS WITH AMINOPYRALID IN NORTH DAKOTA.** Rodney G. Lym, North Dakota State University, Fargo, ND, 58105.

*Abstract.* Aminopyralid is a member of the pyridinecarboxylic acid (picolinic acid) family of herbicides but is active at much lower use rates than other picolinic acid herbicides. Aminopyralid is known to control several noxious weed species but the entire weed control spectrum and optimal use rate and timing is not yet known. The purpose of this research was to evaluate aminopyralid for control of absinth wormwood (*Artemisia absinthium* L.), Canada thistle (*Cirsium arvense* L.), leafy spurge (*Euphorbia esula* L.), and perennial sowthistle (*Sonchus arvensis* L.). Aminopyralid was spring- or fall-applied in a rate range from 0.75 ai oz/A to the maximum potential use rate determined by the manufacturer of 1.75 oz/A in all experiments. Results were compared to a standard herbicide applied at the general use rate for each weed species. Herbicides were applied using a hand-held boom sprayer delivering 17 gpa at 35 psi. Treatment plots were 10 by 30 feet and were replicated three or four times in a randomized complete block design at two locations for all species evaluated except leafy spurge which was evaluated at one location. Aminopyralid provided an average of 98% absinth wormwood control regardless of application rate, date, or location 12 MAT (months after treatment). Canada thistle density and cover was much higher at experiments established in Jamestown than in Fargo and control varied by location. For instance, Canada thistle control was 98% 12 MAT averaged over aminopyralid application rate when applied in the fall at Fargo. However, the same treatments provided from 52 to 83% control 12 MAT when aminopyralid was applied from 0.75 to 1.75 oz/A, respectively, at Jamestown. In comparison, the standard treatments of picloram or clopyralid applied at 6 oz/A in the fall provided 98% Canada thistle control 12 MAT at Fargo but only averaged 83 and 19%, respectively, at Jamestown. Similar to the fall-applied treatments, long-term Canada thistle control with spring treatments was much higher at Fargo than Jamestown. Aminopyralid spring-applied provided an average of 93% Canada thistle control 15 MAT at Fargo which was similar to the standard of picloram or clopyralid at 6 oz/A. However, Canada thistle control 15 MAT at Jamestown averaged 27% across all rates of aminopyralid similar to 41 and 17% control with picloram or clopyralid at 6 oz/A, respectively. Aminopyralid provided 90% or better perennial sowthistle control 12 MAT regardless of application rate, date, or location. Spring- or fall-applied aminopyralid did not control leafy spurge at proposed use rates. In summary, aminopyralid controlled absinth wormwood, perennial sowthistle, and Canada thistle at application rates much lower than currently used herbicides but long-term Canada thistle control varied by location. [125]

**AMINOPYRALID A NEW REDUCED RISK HERBICIDE FOR INVASIVE SPECIES CONTROL: TOXICOLOGY, ECOTOXICOLOGY AND ENVIRONMENTAL FATE PROFILE.** John J. Jachetta\*, Patrick L. Havens, Joseph A. Dybowski, James A. Kranzfelder, Carmen Tiu, Dow AgroSciences LLC.

Aminopyralid is a new systemic low rate post-emergence herbicide in the pyridine carboxylic acid class for the selective control of noxious/invasive and agronomic broadleaf weeds in range and pasture, industrial vegetation management and wheat. As its formulated product (GF-871), aminopyralid exhibits low acute toxicity (Category III/IV). Overall, aminopyralid has a very favorable toxicity profile, with no evidence of teratogenicity, mutagenicity, carcinogenicity, endocrine or adverse reproductive effects. Because of aminopyralid's low toxicity, risks to workers handling aminopyralid soluble liquid formulations are extremely low. Aminopyralid produces no significant soil or water metabolites except CO<sub>2</sub> and exhibits very low acute and chronic toxicity (practically nontoxic) to mammals, birds, fish, and aquatic invertebrates. Aminopyralid is slightly toxic to algae and aquatic vascular plants and is substantially below all of EPA's levels of concern for adverse effects to these organisms. The route of degradation in soils is aerobic biodegradation with a median field

soil half-life at North American locations of 32 days and an average  $K_{oc}$  of 10.8 L/kg. Field experiments showed limited movement in the soil profile and aminopyralid demonstrates a low potential for groundwater concentration in EPA groundwater contamination models. In aquatic systems, the main route of aminopyralid degradation is photolysis with a half-life of 0.6-d. Aminopyralid does not have the physical/chemical properties similar to bioaccumulative compounds ( $K_{ow} < 3$ ). Aminopyralid was granted the Reduced Risk classification by the US EPA in October, 2004 based on favorable toxicological, ecotoxicological and environmental fate effects in combination with unique and improved features for invasive weed control. [126]

**CONTROL OF RUSSIAN KNAPWEED WITH AMINOPYRALID.** Steven Dewey, Utah State University, Logan, UT; Vanelle F. Carrithers, Dow AgroSciences, Mulino, OR; Joseph M. DiTomaso, University of California, Davis, CA; and Tom Whitson, University of Wyoming, Laramie, WY

Russian knapweed (*Acroptilon repens*) is a pernicious perennial weed infesting an estimated 486,000 hectares in much of the western U.S. Active ingredients currently registered for Russian knapweed control on pasture and rangeland sites include chloresulfuron, clopyralid, dicamba, glyphosate, imazapic, metsulfuron, and picloram. Aminopyralid is a new herbicide developed by Dow AgroSciences for use on rangeland to control Russian knapweed and other broadleaf noxious and invasive weeds. Field tests were conducted between 2001 and 2004 to assess the efficacy of herbicides applied at bud stage, seed set and/or fall timings at 7 locations in California, Oregon, Utah, Washington, and Wyoming. Herbicides were applied using a backpack sprayer with hand-held boom sprayer delivering 140 to 280 L/ha. Treatments were replicated three or four times in a randomized complete block design. Visual control ratings were collected during season of application and 1 year after treatment. Aminopyralid at 60 to 70 g ae/ha applied in the summer when Russian knapweed was at bud to seed set stage of development provided excellent and consistent control (98%) 1 year after application that was equal to control provided by picloram applied at 420 to 560 g ae/ha. Fall applications of aminopyralid at 70 g ae/ha provided excellent control at 1 year after treatment. Control with fall-applied aminopyralid was equal to picloram at 560 g ae/ha and much better than imazapic at 175 g ae/ha or 210 g ae/ha (19 or 21%, respectively). In each trial, Russian knapweed control with aminopyralid was equal or superior to control with all other herbicides tested. Aminopyralid rates needed to provide effective Russian knapweed control were substantially lower than rates of other herbicides needed to achieve comparable control. Excellent control was achieved whether aminopyralid applications were made at the bud to seed set stages of development or to senesced plants in the fall. [127]

**CONTROL OF YELLOW STARHISTLE (CENTAUREA SOLSTITIALIS) WITH AMINOPYRALID.** Joseph M. DiTomaso<sup>1</sup>, Vanelle F. Carrithers<sup>2</sup>, Eric A. Flora<sup>2</sup>, and Wayne S. Belles<sup>3</sup>, <sup>1</sup>University of California, Davis, CA, <sup>2</sup>Dow AgroSciences, Mulino, OR and Indianapolis, IN, respectively, and <sup>3</sup>Belles Agronomic Services, Moscow, ID.

The effect of aminopyralid (GF-871) was evaluated on yellow starthistle (*Centaurea solstitialis* L.) populations at six sites in four western states (Washington, Oregon, Idaho and California). For the dose response study, all treatments were made in spring (April-May) when plants were in the rosette stage. Treatment rates of aminopyralid included 35, 44, 53, 61, 70, 90 and 120 gm ae/ha. For comparison, each site also received treatments with clopyralid at 105 and 210 gm ae/ha and picloram at 280 and 420 gm ae/ha (3-4 replicates per treatment). All plots were visually evaluated for percent control relative to untreated control plots in the summer following treatment and in some cases one and two years following treatment. Results indicate no significant difference in the response among sites. When the data for all six sites were pooled, good to excellent control of yellow starthistle was achieved with all three herbicides at all rates. Rates of aminopyralid at 61 gm ae/ha and above gave complete control. Clopyralid at 105 gm ae/ha gave an average of 91% control, whereas complete control was obtained at 210 gm ae/ha. Picloram gave between 94 and 95% control at the two rates tested. Aminopyralid also gave excellent control of *Amsinckia menziesii* (fiddleneck) and *Vicia* spp.(vetch) at all rates tested, as well as *Trifolium* spp. (clover) at rates above 35 gm ae/ha, but did not injure *Erodium* spp. (filaree) or a native Asteraceae, slender tarweed (*Madia gracilis*). When re-evaluated one year after treatment, all rates of aminopyralid and picloram, and the highest rate of clopyralid gave better than 95% control of yellow starthistle. This is probably due to the stimulation of competing vegetation rather than soil residual activity of clopyralid or aminopyralid. In support of this, results of another study conducted in Davis, CA, showed that in a test site without substantial competition, aminopyralid did not provide season long control of yellow starthistle when applied in November. However, treatments made between December and February gave nearly complete control at all rates from 35 to 120 gm ae/ha. These studies demonstrate that aminopyralid is approximately three to four times more active than clopyralid and nearly ten times more active than

picloram on the control of yellow starthistle. In addition, the longer residual activity of aminopyralid compared to clopyralid provides a wide treatment window in winter. [128]

**CANADA THISTLE CONTROL WITH AMINOPYRALID.** Robert G. Wilson\*, University of Nebraska, Scottsbluff, NE; Pat Burch, Dow AgroScience, Christianburg, VA; Vanelle Carrithers, Dow AgroScience, Mulino, OR; Celestine Duncan, Weed Management Services, Helena, MT; Robert A. Masters, Dow AgroScience, Lincoln, NE; and Tom Whitson, University of Wyoming, Powell, WY.

Field studies were initiated at seven locations in the USA to examine the efficacy of aminopyralid for Canada thistle control. Four experiments were initiated in the summer of 2001 when Canada thistle was in the prebud growth stage. Comparisons were made between aminopyralid at 30, 60, 90, and 120 g ae/ha and picloram, clopyralid, and dicamba. Canada thistle control increased from 69 to 91% as aminopyralid rate increased from 30 to 120 g ae/ha 366 to 411 days after treatment. Aminopyralid applied at 30 g/ha or more provided Canada thistle control equivalent to picloram or clopyralid at 280 g/ha and usually superior to dicamba at 1120 g/ha. Three additional experiments were initiated in 2003 to examine aminopyralid applications at prebud and fall rosette growth stages. Prebud applications of aminopyralid at 88 g/ha provided 87% control of Canada thistle 364 to 457 days following treatment and control was equivalent to picloram applied at 420 g/ha. Fall applications of aminopyralid provided on average 30% greater Canada thistle control than treatments made in the spring. Aminopyralid at 70 g/ha, applied in the fall, reduced Canada thistle shoot density 97%, 265 days following treatment while picloram at 420 g/ha, clopyralid at 420 g/ha, dicamba at 1120 g/ha, and chlorsulfuron at 78 g/ha reduced Canada thistle shoot density 73, 73, 43, and 62%, respectively. Aminopyralid did not injure range grasses, sedges, and brush species at the study sites. Results from experiments conducted across the USA showed that aminopyralid was very effective in controlling Canada thistle. [129]

**MANAGING NOXIOUS WEEDS ON WESTERN RANGELANDS WITH AMINOPYRALID.** Celestine A. Duncan\*, Weed Management Services, Helena, MT; Vanelle F. Carrithers, Mary B. Halstvedt, Dow AgroSciences, LLC, Mulino, OR and Billings, MT; Wayne S. Belles, Belles Agronomic Services, Moscow, ID; and Jay A. Gehrett, SprayTech, Walla Walla, WA.

Aminopyralid is a new grass selective, broadleaf weed management herbicide being developed by Dow AgroSciences for use in range, pasture, wildlands, and rights-of-way. Aminopyralid is not yet registered with the Environmental Protection Agency, but a Section 3 registration of aminopyralid with the Environmental Protection Agency is anticipated in 2005. Aminopyralid is a 2.0 lb ae/gallon amine formulation with label use rates from 0.75 to 1.75 oz ae/A (3 to 7 fl oz product/A) for control of numerous herbaceous noxious weeds. Research trials were established in 1999 and 2001 through and 2003 in Montana, Washington, and Idaho to assess the response of spotted knapweed, diffuse knapweed, and orange and yellow hawkweed to aminopyralid. Results with aminopyralid were compared to standard herbicide treatments applied at general use rates for each weed species. Herbicides were applied using a hand-held boom sprayer delivering 13 to 20 gpa. Treatment plots were replicated three or four times in a randomized complete block design at a minimum of two locations for each species. Visual evaluations were collected during season of application and 1 to 2 YAT (yr after treatment). Aminopyralid at 1.25 oz ae/A applied to spotted knapweed at the bolting growth stage gave excellent control (>90%) of both established plants and seedlings up to 1 YAT compared an average of 85% control with the standard picloram at 4 oz ae/A. At 4 sites in Montana control of spotted knapweed at 2 YAT was 87 to 99% with aminopyralid at 1.25 to 1.75 oz ae/A respectively, and was similar (83-96%) to the standard picloram at 4 oz ae/A. Aminopyralid at 1.25 to 1.75 oz ae/A applied at rosette to pre-bud growth stages provided excellent control (>95%) of diffuse knapweed for at least 1 YAT. Control of hawkweed with aminopyralid at 1.25 oz ae/A averaged greater than 90% control between 2 locations 1 YAT. Aminopyralid effectively controlled these invasive plants at reduced rates compared to rates of 2,4-D, picloram, clopyralid, and dicamba, required to achieve the same level of control. Aminopyralid will have an excellent fit for managing invasive plants on range, wildlands, and pasture in the western U.S. [130]

**CONTROL OF MUSK THISTLE AND OTHER BIENNIAL THISTLES WITH AMINOPYRALID.** Robert A. Masters\*, Patrick L. Burch, Vanelle F. Carrithers, and Mary B. Halstvedt. Dow AgroSciences, LLC, Lincoln, NE 56506, Christiansburg, VA 24073, Mulino, OR 97042, and Billings, MT 59106, respectively.

Experiments at multiple rangeland and pasture sites across the USA were conducted to determine the response of musk thistle and other biennial thistles to aminopyralid, a new herbicide active ingredient being introduced by Dow

AgroSciences for use on rangeland, pastures, and non-cropland. Aminopyralid was applied to musk thistle plants at varying growth stages from fall rosette to spring rosette, bolting, and late bolt to early bloom. Efficacy of aminopyralid at 53, 70, 88, and 105g ae/ha applied alone or with 2,4-D was evaluated. Results were compared to herbicides commonly recommended for musk thistle control including picloram, dicamba, 2, 4-D, and metsulfuron. Aminopyralid applied to musk thistle rosettes in the fall or spring at 53 g/ha or higher provided excellent control of musk thistle rosettes and was similar to the results with picloram at 140 g/ha and dicamba at 1120 g/ha. In addition, aminopyralid and picloram control of musk thistle seedling emergence in the spring and summer, at least 90 day after treatment, was superior to that observed with dicamba. Aminopyralid at 53 g/ha provide excellent control applied of musk thistle that was bolted at time of application. The level of bolted musk thistle control with aminopyralid was similar to the control with picloram at 140 g/ha + 2,4-D at 560 g/ha and better than control obtained with dicamba at 280 g/ha + 2,4-D at 804 g/ha or 2,4-D at 1120 g/ha alone. Aminopyralid at 70 g ha or aminopyralid at 53 g/ha + 2,4-D at 560 g/ha controlled musk thistle treated at the late bolt to early bloom stages of growth as well as picloram at 140 g/ha + 2,4-D at 1120 g/ha or metsulfuron at 11 g ai/ha + 2,4-D at 1120 g/ha. As with musk thistle, treatment of other biennial thistles (plumeless thistle and bull thistle) at the rosette growth stage in the spring with aminopyralid at 53 g/ha provided excellent control. In these experiments, introduced cool-season forage grasses (smooth brome grass, timothy, orchardgrass, tall fescue, and Kentucky bluegrass) and native perennial grasses (prairie junegrass, big bluestem, little bluestem, and sideoats grama) were not injured by aminopyralid, regardless of rate applied. Aminopyralid at 53 g/ha provided excellent control of musk thistle, plumeless thistle, and bull thistle rosettes emerged at time of application and controlled emergence of thistle seedlings after application. [131]

## WEEDS OF HORTICULTURAL CROPS

**DIRECT-SEEDED LETTUCE TOLERANCE TO CARFENTRAZONE, FLUMIOXAZIN AND OXYFLUORFEN APPLIED 30 TO 90 DAYS BEFORE PLANTING.** Steven A. Fennimore, John S. Rachuy and Jose A. Valdez. (Weed Science Program, University of California-Davis, Salinas, CA 93905)

A field study was established in 2003 and repeated in 2004 to evaluate herbicides for weed control on stale seedbeds prior to lettuce planting. Pre-plant herbicides, flumioxazin 51WG at 0.063, 0.094, and 0.188 lb ai/A, oxyfluorfen 4F at 0.25 and 0.5 lb ai/A, oxyfluorfen 2E at 0.25 and 0.5 lb ai/A, and carfentrazone 2E at 0.032 lb ai/A were applied to fallow raised beds at 90, 60, and 30 days prior to lettuce planting. Lettuce 'Sharpshooter' was seeded, and pronamide at 1.2 lb ai/A was applied post plant preemergence to the entire trial. Lettuce stand counts were measured after planting but before lettuce thinning. Weed densities were measured at the end of the fallow period, just prior to lettuce seeding. Crop injury (0 = no injury, 10 = dead) was evaluated periodically. At crop maturity, marketable heads were harvested, sorted by size and weighed. Flumioxazin at 0.188 lb ai/A applied 90, 60, and 30 days before planting caused lettuce injury and yield loss. At 0.094 lbs ai/A, flumioxazin applied 60 and 30 days before planting caused lettuce injury and yield loss. The 0.063 flumioxazin treatment was safe when applied at least 90 days before planting, but caused marginal injury and yield loss at the 30 and 60 day timings. Carfentrazone and both oxyfluorfen formulations were safe on lettuce when applied 60 and 90 days before planting. Primary weeds at the field sites were burning nettle in 2003 and shepherd's-purse in 2004. Because of their soil activity, flumioxazin and oxyfluorfen treatments were most effective on weeds when applied at 60 or 90 days prior to planting. Due to the limited soil activity of carfentrazone, and its postemergence activity, weed control with carfentrazone was best at the 30 day timing. We conclude that carfentrazone, and oxyfluorfen treatments have potential for use as stale seedbed herbicides for lettuce. However, flumioxazin should be used with caution in fields used for lettuce production. [100]

**INVESTIGATIONS INTO THE UTILITY OF MESOTRIONE IN MINOR CROPS.** Peter C. Forster, Thomas H. Beckett and Michael D. Johnson, Research and Development Scientists and Technical Brand Manager, Syngenta Crop Protection, Greensboro, NC 27419.

Field studies were conducted in 2004 evaluating mesotrione for potential use in selected minor crops. The purpose of these trials was to evaluate the level of crop tolerance to mesotrione under field conditions. The rates generally evaluated were 70, 105 and 210 gai/ha, applied preemergence and postemergence. Most seeded annual vegetables evaluated were found to be intolerant to mesotrione applications. Sweet potato and horseradish transplants were severely injured. Perennial crops appear to show the most tolerance to mesotrione applications. Cranberries have exhibited excellent tolerance and Section 18's have been approved. A related species, blueberry, has also been

found to be very tolerant to mesotrione. Moderate tolerance has been observed on peppermint and flax. Preliminary data suggests that asparagus and okra may have good tolerance, but additional field studies are required. Further evaluation has also been recommended for crops in the berry family, such as *Rubus* (blackberry, raspberry and loganberry), *Ribes* (current and gooseberry), *Sambucus* (elderberry) and *Vaccinium* (lingonberry). [101]

**USING MESOTRIONE FOR WEED CONTROL IN TURF.** Sowmya Mitra\* and Russell V. Plumb, California State Polytechnic University, Pomona

Mesotrione can be used selectively to control broadleaf weeds in cool-season turfgrasses. Mesotrione acts systemically within the plant and controls weeds by inhibiting the enzyme HPPD (4-hydroxyphenylpyruvate dioxygenase) in the carotenoid biosynthesis pathway. Field experiments were conducted at the California State Polytechnic University, Pomona to evaluate the effect of timing of application on the efficacy of mesotrione. Mesotrione was applied at three different rates (0.125, 0.187 and 0.25 lb a.i./A) as an early-postemergence (early POST) and late-postemergence (late-POST). The late-POST applications were applied 4 weeks after the early-POST treatment. All the treatments were laid out in randomized block design with four replicates and were compared to a three way ester application. Sequential applications were also included for all the three rates of mesotrione. Injury on common bermudagrass was also recorded. The mid and the highest rate of mesotrione (0.187 and 0.25 lb a.i./A) resulted in significantly higher level of control of swinecress and sowthistle compared to the ester application 14 days after treatment (DAT). The highest rate of mesotrione injured 13% of the bermudagrass 14 DAT. Bleaching of the leaves was observed but the injury reduced to 5% at 28 DAT and was not noticeable at 42 or 60 DAT. All the sequential treatments resulted in higher level of control of weeds compared to a single application at 28 DAT. There was no significant difference between the treatments in reference to control of swinecress and sowthistle at the 42 DAT except the single application of the lowest rate of mesotrione. [102]

**BENEFITS OF EARLY SEASON WEED MANAGEMENT IN CHILE PEPPERS.** Justin H. Norsworthy\*, and Mark Renz, New Mexico State Cooperative Extension, Las Cruces; Jill Schroeder, New Mexico State University, Las Cruces

Few herbicides are registered that are effective in managing broadleaf weeds in direct seeded chile peppers. Due to restricted application timings, weed spectrum and drift concern, no effective herbicide options are available for early season broadleaf weed management. Growers must rely on frequent mechanical methods such as hand-hoe crews, or cultivation until peppers are 5 to 7 inches in height. Studies conducted in Las Cruces, New Mexico have tested pyriithiobac in peppers with preemergent (PRE), postemergent (POST), and post-directed (POSTdirect) treatments for six years. Pyriithiobac at 0.0625 lbs. ai/A applied PRE, POST and PRE + POST showed no significant injury in <31 days after the last application. In addition, no yield reduction from herbicide injury was observed with any treatment. Results found early season control of palmer amaranth and Wright groundcherry greater than 88 % one month after PRE or POST treatments. This level of control was consistent across three separate studies over three years. Spurred anoda and morningglory species are two particularly troublesome weeds in pepper production in New Mexico. These species were suppressed for several weeks, but long-term control was not observed. Experiments also investigated the benefits of herbicide treatments in season long management. Pyriithiobac applied in split treatments (PRE + POST), along with a preemergent application of clomazone (0.75 lbs ai/A) reduced the time spent in the field manually removing weeds by upwards of 60 % throughout the season compared to untreated controls. Data indicate that pyriithiobac can safely be applied PRE and POST emergent to chile peppers and provide needed early season broadleaf weed management. [103]

**HERBICIDE APPLICATIONS TO FRESH-MARKET ONIONS PRIOR TO SECOND TRUE LEAF EMERGENCE.** Grant Poole, University of California Cooperative Extension, Lancaster; and Jesse Richardson PhD., Dow AgroSciences, Hesperia, CA.

High weed populations in fresh market onion fields can substantially reduce yields and increase hand-weeding costs. Because onions are such poor competitors with weeds, control is critical in the early stages of growth. Traditional herbicide treatments applied prior to the second true onion leaf either cause excessive crop injury with poor weed control in sandy soils common to Southern California high desert areas, or are expensive for growers to use. Recent formulations of oxyfluorfen and pendimethalin may allow for earlier treatment of onions to provide more effective weed control without causing significant crop injury in sandy soils. Oxyfluorfen, pendimethalin, dimethenamid, and flumioxazin were applied at different onion growth stages prior to the second true leaf emergence to evaluate their

effects on filaree (*Erodium cicutarium* L.), Russian thistle (*Salsola iberica* L.), and puncturevine (*Tribulus terrestris* L.) and onion crop injury. Dimethenamid and flumioxazin treatments applied at 0.56 and 0.004 lbs a.i. per acre, respectively, resulted in unacceptable onion injury in the sandy loam soils tested. Oxyfluorfen applied at the first true leaf provided adequate control of filaree and puncturevine at 0.12 to 0.18 lbs a.i. per acre. Pendimethalin provided the best control of filaree with minimal onion injury when it was applied during the onion (loop) flag leaf stage at 0.81 lbs a.i. per acre. [104]

**PREEMERGENCE AND EARLY POSTEMERGENCE DIMETHENAMID-P AND SULFENTRAZONE: A COMPARISON OF GROUND AND CHEMIGATION APPLICATIONS FOR EFFICACY AND POTATO CROP SAFETY.** Pamela J.S. Hutchinson and Daniel M. Hancock, University of Idaho.

Preemergence (PRE) and early postemergence (EPOST) ground applications (followed by sprinkler incorporation) or chemigation applications of dimethenamid-p at 0.64 lb/A or sulfentrazone at 0.094 lb/A were made in a 2004 Idaho field trial. CHEAL control 10 wk after treatment (WAT) by PRE-applied dimethenamid-p or sulfentrazone was similar regardless of application method and ranged from 87 to 99%. However, on the same rating date which was 4 wk after POST applications, POST ground-applied or chemigated dimethenamid-p only controlled CHEAL 57 to 60% while POST-applied sulfentrazone provided greater common lambsquarters control at 96 to 99%, regardless of application method. By the end of the growing season, CHEAL control with PRE ground-applied dimethenamid-p was reduced to 63% compared to 82, or 100 or 98% control with PRE-chemigated dimethenamid-p, or PRE-ground-applied or PRE-chemigated sulfentrazone, respectively. Similar to PRE treatments, POST-applied sulfentrazone provided greater CHEAL control at 85 to 88% than POST-applied dimethenamid-p at <45%. At approximately 3 wk after the PRE and 1 wk after the POST applications, potato crop injury from all PRE treatments and POST-chemigated dimethenamid-p was ≤5%. POST dimethenamid-p or sulfentrazone applied by ground and POST-chemigated sulfentrazone caused 25, 60, or 40% injury 1 WAT. Injury consisted mainly of stunting and leaf malformation from both POST-applied herbicides and in addition, POST-applied sulfentrazone initially caused interveinal blackening on the leaves. At 4 WAT, POST-ground-applied sulfentrazone was still causing 50% potato crop injury while POST-chemigated sulfentrazone injury was now 15%. POST-applied dimethenamid-p was causing 5% injury at that time regardless of application method. Tuber yields were not reduced as a result of any herbicide treatment compared to the untreated, weed-free control even though some of those treatments resulted in relatively severe crop injury earlier in the season. [105]

**PURPLE NUTSEDGE CONTROL IN TURFGRASS WITH ALS-INHIBITING HERBICIDES.** Kai Umeda and Gabriel Towers, University of Arizona Cooperative Extension, Phoenix.

The efficacy and comparison of six acetolactate synthase (ALS) enzyme inhibiting herbicides was demonstrated in several field trials during the summer of 2004 in the Phoenix area. Two or three applications of trifloxysulfuron at 0.026 lb ai/A controlled nutsedge better than 94% at the end of the season in late September to early October. Three monthly applications (July, August, and September) of halosulfuron at 0.062 lb ai/A gave 88 to 90% control. Imazaquin at 0.5 lb ai/A combined with MSMA at 3 lb ai/A was applied monthly three times to give 91% control. After the first timing of multiple applications or only single applications of ALS herbicides, nutsedge control lasted approximately one month. The most rapid nutsedge control was observed at 15 days at 91% after a single application of flazasulfuron at 0.047 lb ai/A. The most efficacious nutsedge control of 96% was observed at 28 days after one application of sulfosulfuron at 0.094 lb ai/A. Purple nutsedge control using ALS herbicides was most effective with two or three timely applications at four to six week intervals. A single application was effective in controlling nutsedge for only approximately one month. The addition of MSMA improved nutsedge control when it was combined with imazaquin while trifloxysulfuron and halosulfuron activity or the length of control was not enhanced. Bermudagrass turf did not exhibit any injury symptoms or discoloration following any ALS herbicide application. [106]

**REFINING PRONAMIDE CHEMIGATION PARAMETERS IN LETTUCE.** Jesse M. Richardson, Dow AgroSciences, Hesperia, CA, Barry R. Tickes, University of Arizona, Yuma, Kurt J. Hembree, University of California, Fresno and Roger E. Gast, Dow AgroSciences, Indianapolis, IN.

Applying Kerb® 50-W herbicide (pronamide) through overhead sprinklers has become commonplace during the past two seasons in the low desert lettuce production region of Arizona and southern California, as a result of a section 24(c) registration. To fine-tune application parameters, field studies were established in Yuma, AZ and Five Points, CA in 2004. In Yuma, two large-plot replicated studies were conducted to determine the optimal chemical injection duration and post-application incorporation water volume necessary to obtain the highest level of weed control. The treatments in both studies were applied four days after sprinkler irrigations were initiated. In the first study, 0.65 lb a.i./A of pronamide was injected into the sprinkler irrigation stream for three different durations; 30-, 60- or 90-min. These durations correspond to 0.05-, 0.1- and 0.15-in water. Following injection, all three treatments received 0.4-in water for incorporation. In the second study, 0.65 lb a.i./A of pronamide was chemigated for 60-min, followed by incorporation water volumes of 0-, 0.4-, 0.8- or 1.2-in. Prior to establishing the two studies, plots were overseeded with giant Indian mustard seeds as an indicator weed. Both experiments included an untreated check. Forty-one days after Kerb application, weed control was determined by removing all weeds in a 10-ft length along the bed top between two lettuce seed lines, and measuring fresh weights. In the injection duration study, the highest level of weed control was achieved with the 90-min injection. The 30-min treatment was no different than the untreated check, while the 60-min duration provided measurable control. In the post-application incorporation study, there were no differences detected in weed control among the various water volumes. However, there was a distinct trend suggesting that weed control decreased with increasing volumes of incorporation water. The best performance came from the 0- and 0.4-in treatments, while the poorest came from the 1.2-in treatment. At Five Points, Kerb applied by chemigation at 0.75 lb a.i./A was compared to Kerb applied in 5-in bands by ground at 1.5 lb a.i./A in the treated zone. Because the chemigation treatments were broadcast applications of the chemical, those treatments resulted in substantially fewer weeds within the plots than the band treatments. However, comparing 4-in wide zones along the lettuce seed lines, both treatments provided excellent control of common purslane and grass weeds. With pigweeds and shepherdspurse, numerical trends favored the chemigation treatments, but significant differences were not detected. Hand hoeing costs in the chemigation treatments were \$155/A less than in the ground treatments. © Trademark of Dow AgroSciences LLC Kerb 50-W is a Federally Restricted Use Pesticide. [107]

**AUTOMATIC SPOT SPRAY TECHNOLOGY AND WEED MANAGEMENT IN ARIZONA TREE CROPS.** Ryan J. Rector\*, William B. McCloskey, Glenn C. Wright, Trent Teegerstrom, University of Arizona, Tucson; and John B. Wilkerson, University of Tennessee, Knoxville.

Automatic spot spray technology (Weedseeker; NTech Industries, Inc) was compared with conventional continuous spray technology in pecan and lemon orchards in Arizona. WeedSeeker spray units optically detect and spray when green plants are below the nozzles thus reducing the amount of bare soil sprayed. The total area sprayed was reduced 59 and 51% by the Weedseeker system in Bowie (sprinkler irrigated pecans) and in Sahuarita (flood irrigated pecans), respectively, when postemergence herbicide was applied in 18 ft strips centered on the tree rows compared to a conventional sprayer. The area sprayed was further reduced by 37% in Bowie and by 21% in Sahuarita when a preemergence herbicide was applied prior to making postemergence herbicide applications with the WeedSeeker sprayer compared to treatments without a preemergence herbicide. The WeedSeeker sprayer reduced the total area sprayed 66% in Dateland (micro-sprinkler irrigated lemons) compared to a conventional sprayer. When a preemergence herbicide was applied in winter in 14 ft strips centered on the tree rows and followed by postemergence herbicide applied with the WeedSeeker system, the area sprayed annually was further reduced by 30% compared to treatments without a preemergence herbicide. Although both spray systems provided commercially acceptable weed control, weed control was better with the conventional spray system because the WeedSeeker sprayer sometimes didn't detect small weeds. Thus, Weedseeker treatments required one more postemergence herbicide application at all locations annually. Crop budgets were developed to allow growers to determine the value of adopting the technology. [108]



## TEACHING AND TECHNOLOGY TRANSFER

**ARIZONA WEED CONTEST AND TRAINING SYMPOSIUM.** Patrick A. Clay\*, Erin L. Taylor, Kai Umeda, University of Arizona, Phoenix; and William B. McCloskey, University of Arizona, Tucson.

Since 2002 the Arizona Weed Contest and Training Symposium has been held annually at the University of Arizona Maricopa Agricultural Center to give clientele a hands-on opportunity to enhance their knowledge of weed management in Arizona's diverse cropping systems. Proper early identification of weeds, appropriate herbicide selection, and accurate calibration of application equipment are essential components for a successful weed management program. Weeds cause economic losses for many Arizona producers because they compete with crops for light, space, water, and nutrients. Weeds may also serve as host for insect pests and plant pathogens, hamper harvest efficiency, and can reduce the quality of the harvested crop. The Arizona Weed Contest was developed to educate a target audience of producers, pest control advisors, and other professionals from the agricultural industry. The event was divided into four components that focused on important aspects of integrated weed management - weed identification, herbicide identification, equipment calibration, and production problem solving. After completing the hands-on activities, presentations were delivered to summarize the events and provide reinforcement of key concepts. Exit surveys indicate that this was a valuable educational experience (97%) for those in attendance and should be repeated in the future (100%). Also, based on survey results, clientele prioritized herbicide symptom and weed identification as subjects where additional publications would be of benefit. [118]

## WEEDS OF WETLANDS AND WILDLANDS

**RE-EXAMINING THE ROLE OF (-)CATECHIN IN CENTAUREA MACULOSA INVASIONS.** Blair, A.C., Nissen, S.J.\*, Brunk, G.R., Hanson, B.D., Hufbauer, R.A., and Westra, P. Colorado State University, Ft. Collins

The role of allelopathy in the success of invasive plants has recently garnered significant attention. Much of the research on this topic has focused on the putative allelochemical (-)-catechin, which is secreted by the roots of *Centaurea maculosa* (spotted knapweed). Efforts to substantiate the production and biological activity of (-)-catechin have led us to question the significance of (-)-catechin in *C. maculosa* invasions. We were unable to extract catechin from liquid media using methods described in numerous publications. In these studies, *C. maculosa* was grown in sterile liquid media and high levels of (-)-catechin were reportedly extracted from the liquid media using hexane. We found that it was not possible to extract (-)-catechin from liquid media with hexane and developed a sample preparation method that provided quantitative recovery. Using this method we examined (-)-catechin production by *C. maculosa* collected from five western states. These plants produced an average of  $0.29 \pm 0.06$   $\mu\text{g/ml}$  (range of 0-2.44  $\mu\text{g/ml}$ ), based on data from 50 individuals. A quarter of the plants tested produced no detectable (-)-catechin, with a detection limit of 0.05  $\mu\text{g/ml}$ . The level of (-)-catechin production that we documented was 20 to 280 times less than what was previously reported. Published reports also suggest that (-)-catechin is found at very high concentrations in soil collected from *C. maculosa* monocultures. Extracting spiked soil samples with methanol, which was the published method, our recovery ranged from 0-17%. We explored a variety of soil extraction techniques and found that extracting soil with acetone:water:phosphoric acid (75:25:0.1) provided better and more consistent results. We then used this method to determine (-)-catechin levels in soil collected from two *C. maculosa* infestations in Montana. We found no measurable (-)-catechin in field soils from the two Montana sites at a detection limit of 0.5  $\mu\text{g/g}$ . Additional experiments indicated that pH has a significant influence on (-)-catechin stability, with pH levels below 5.5 significantly increasing stability. We hypothesize that the inability to find (-)-catechin in field soils from *C. maculosa* sites is a function of rapid chemical degradation, time dependent binding, or some combination of the two. In addition, bioassays with Idaho fescue, a reportedly sensitive native, indicated no germination or growth inhibition at concentrations up to 1000  $\mu\text{g/ml}$ . While allelopathy may have some impact on structuring plant communities, the issues we have identified with (-)-catechin provide strong evidence against the root exudation of (-)-catechin as the primary mechanism driving *C. maculosa* invasions. [142]



## BASIC SCIENCES: ECOLOGY, BIOLOGY, PHYSIOLOGY, GENETICS

**DICAMBA-RESPONSIVE GENES IN KOCHIA.** Anthony J. Kern, Northland College, Ashland, WI; Marta E. Chaverra, Harwood J. Cranston, and William E. Dyer\*, Montana State University, Bozeman

The Herbicide Resistance to dicamba (HRd) biotype of kochia is resistant to several auxinic herbicides, and is impaired in shoot gravitropism and other auxin-mediated responses. To better characterize the biotype and investigate its mechanism of resistance, we used mRNA differential display to compare patterns of dicamba-induced gene expression in HRd and susceptible (S1) plants. More than 60,000 cDNA fragments were generated and examined, 106 of which were isolated and used as probes on northern blots to confirm gene expression levels. Steady-state levels of > 90% of mRNAs did not change after dicamba application. However, several mRNAs were detected whose levels were decreased, increased, or differentially regulated between the biotypes within minutes of dicamba treatment. The abundance of three mRNAs decreased after treatment, two of which had significant sequence similarity to choline monoxygenase and 5,10-methylenetetrahydrofolate reductase, respectively. Conversely, increased expression levels were observed for a putative chloride channel protein, 1-aminocyclopropane-1-carboxylate synthase, and an unknown gene. Genes differentially expressed between HRd and S1 plants included those similar to a putative translation initiation factor, xyloglucan endotransglycosylase, and a hypothetical protein cloned from several organisms. The results demonstrate that mRNA differential display is a useful technique for discovering genes that are rapidly regulated as part of a physiological response, and that this approach may provide insight into the mechanism of auxinic herbicide resistance in kochia. [119]

**SCALE EFFECTS IN THE EVALUATION OF THE SPATIAL DISTRIBUTION OF NON-NATIVE SPECIES IN WILDLAND ECOSYSTEMS.** Frank L. Dougher\*, Lisa J. Rew and Bruce Maxwell, Montana State University, Bozeman

When evaluating the observed occurrences of non-native species in wildland ecosystems, the measured correlations and distributions are greatly effected by the scales at which they are studied. Presence/absence of 30 non-native species were recorded in the Northern Range of Yellowstone National Park along continuous transects over the course of three growing seasons. Five of the most prevalent species were chosen for this analysis: Canada thistle, downy brome, dalmatian toadflax, smooth brome and timothy. These continuous sample data were segmented into discrete presence/absence points at various scales between 1m and 40m increments. Fractal analyses and spatial autocorrelations were performed to determine the range of scales at which the distributions of these species could be studied and modeled without losing critical spatial information. The relationships of the presence/absence data at these scales to various spatial environmental datasets, such as elevation or land cover, for logistic regression and species occurrence modeling are discussed. [120]

**LOCAL ADAPTATION OF CANADA THISTLE TO RESOURCE AVAILABILITY.** David Belles\*, Todd Gaines, Cynthia Brown, Philip Westra, Scott Nissen, Colorado State University, Ft. Collins

Canada thistle is an aggressive, invasive plant of both crop and non-crop habitats. It is dioecious, which promotes out-crossing and development of high genetic variation, and it has rapid vegetative reproduction, which promotes the spread of well-adapted genotypes without disruption of successful gene complexes through out-crossing. The objective of this study was to determine if the success of Canada thistle in a wide range of habitats can be attributed to adaptation to management regimes or adaptation to environmental factors such as resource availability. Management regimes were defined as crop (annually cultivated) or non-crop (undisturbed), while resource availability was defined on the basis of soil moisture availability. Specimens from wetland (non-crop, seasonally wet), riparian (non-crop, perennially wet), upland dry (crop and non-crop, non-irrigated), and upland irrigated (crop, irrigated) habitats of Colorado were used. Four treatments, high or low water (field capacity and 40% field capacity, respectively) and high (112 kg/ha  $\text{NH}_4\text{NO}_3$  plus Hoaglands solution initially followed by 28 kg/ha each week) or low (initial Hoaglands without  $\text{NH}_4\text{NO}_3$ ) nitrogen, were applied to each sample in a split plot factorial design with water level as the main plot. Shoot and root biomass were measured at the end of eight weeks. The ratio of root to shoot biomass differed among resource level treatments ( $p=0.0002$ ), as did total biomass ( $p<0.0001$ ). Water level was the most important factor. Root to shoot ratios of individuals from resource-defined habitats also differed ( $p=0.0059$ ). Using Tukey's HSD ( $\alpha=0.05$ ) of 0.19, upland dry sites had a significantly higher root to shoot ratio (0.75) than riparian sites (0.53), while upland irrigated (0.62) and wetland (0.72) sites were not significantly

different. No significant difference was found among habitats for total biomass. Management regime (crop or non-crop) was not found to be significant for any response variable. Our results indicate that local adaptation to resource availability but not to management regime may play a role in the success of Canada thistle in a wide range of habitats. They also suggest that soil moisture availability is a potentially strong selective pressure for local adaptation of Canada thistle. [121]

**INFLUENCE OF TILLAGE SYSTEM ON HAIRY NIGHTSHADE RECRUITMENT AND SEED GERMINATION, MORTALITY, AND DORMANCY.** R. Ed Peachey and Carol Mallory-Smith, Oregon State University, Corvallis.

Seedling recruitment of hairy nightshade is significantly reduced if crops are no-till planted rather than conventionally planted. The cause is unknown, but may be due to increased seed mortality or greater seed dormancy when seeds are buried near the soil surface. Experiments of this study measured: 1) seedling recruitment in two tillage systems; and 2) the effect of winter burial depth, winter rainfall and 1 cm soil temperature on seed germination potential, mortality, and seed dormancy. Seeds were placed in soil tubes at 1 cm below the soil line, and then the soil tubes were buried so that seeds rested at 1, 6, 13, and 25 cm below the field soil surface. Tubes were relocated to the soil surface in the spring or removed from the field and placed in a controlled environment with a linear temperature gradient from 22.7 to 36 C. Seeds also were extracted from soil in the soil tubes to determine germination potential, mortality, and seed dormancy. Hairy nightshade seedling recruitment at 30.7 C was more than 15 times greater for seeds buried at 6, 13 and 25 cm than when buried at 1 cm in simulated no-till. Recruitment potential was low in March and April but increased to a maximum in May and June. Germination rates for seeds buried at 1 cm were lower and mortality and dormancy greater than for seeds buried from 6 to 25 cm during the winter. Protecting the seeds buried at 1 cm from rainfall during the winter increased seedling recruitment from 0 to 2 of 10 buried seeds, but had a negligible effect on seed mortality and dormancy. Soil density was negatively correlated with recruitment. Treatment of seeds buried at 25 cm with soil temperatures found at 1 cm reduced recruitment from 4.8 to 2.3 of 10 seeds at 33.3 C, but did not significantly increase seed mortality or dormancy. Seed dormancy and mortality probably reduced recruitment for seeds buried at 1 cm in NT, but a larger factor was regulating recruitment. Inconsistencies between the recruitment and germination data indicated that recovery of seeds from the soil concealed recruitment trends attributable to dormancy. [122]

**SOIL ORGANIC MATTER DOES MATTER, ESPECIALLY HOW YOU DETERMINE IT.** William T. Cobb\*, Cobb Consulting Services, Kennewick, WA and Robert Sickles, Northwest Agricultural Consultants, Kennewick, WA.

The labels of soil active herbicides often contain soil organic matter content restrictions or warnings. However, these same labels almost never specify a sample collection depth or a laboratory method for determining soil organic matter in order to be in compliance with the label soil organic matter restrictions or admonitions. Further complications arise from within the published laboratory methods themselves when determining soil organic matter; similar terms such as "air dried soil" have different meanings dependent upon the method being employed. Soil texture may even influence laboratory determined soil organic matter values. During the 2003 and 2004 growing season in the PNW, soil samples were routinely collected from various sites across several states at different depths and two or three different laboratory methods were used to analyze the samples for soil organic matter content. Sample collection depth was the single largest variable across all sites. Laboratory method influenced soil organic matter values at a particular site, but the results from different laboratory methods relative to one another, were usually consistent across sites. The need for the standardization of soil organic matter label statements, methods and depths is emphasized. [123]

**CROP PROTECTION CHEMISTRY VS. GENETICALLY MODIFIED CROPS SYMPOSIUM**

**PESTICIDES VS GENETICALLY ENHANCED CROPS: MEETING THE CHALLENGE OF SUSTAINABLE PEST CONTROL.** T.F.Peeper, Oklahoma State University, Stillwater.

While considerable progress has been made in the development of genetically enhanced crops to resist virus and insect pests, the use of biotechnology to protect crops from weeds has focused more on the development of herbicide resistant crops. This difference is perhaps not a result of chance but rather a result of different spatial relationships

between the crop and pest. For an insect or disease organism to attack a crop, physical contact is required, which often occurs early in the crop's life cycle. During seedling crop growth, an attacking weed, other than a parasite, may be spatially separate from the crop at too great a distance for the crop to interact either physically or through chemical diffusion, thus limiting the opportunity for the crop to biochemically suppress the weed. Limiting the negative effect of weeds would then depend on increasing the competitive ability of the crop by such means as accelerated growth rate, increased root efficiency, or other improved resource capturing ability. Given the numeric superiority of the weeds, and lack of physical contact required to cause crop damage, a successful bioengineered weed suppressive crop plant might also have to release a bioherbicide into the environment to reduce weed interference. Since many natural products are highly toxic, such a chemical introduction presents all the concerns of releasing any other herbicide. Registration of such a product could be complicated by environmental safety concerns. However, other approaches may deserve consideration. For example, a cover crop capable of producing an effective germination inhibitor might be grown preceding a cash crop. Alternately, the cover crop might simply possess enhanced physical characteristics, such as a large quantity of ultra-slowly degradable biomass that could serve as persistent mulch to suppress weeds and enhance carbon sequestration. Incorporation of natural fungicides into the cover crops genome might enhance this effect. Because of the cost of developing a new genetically engineered crop, and assuring its public acceptance, it is unlikely that public research organizations will undertake such activities on their own. Rather, we should expect to see collaboration increase between universities and corporate sponsors with the resources required for commercialization. In such collaboration, the university scientist may identify the gene product needed, identify the gene responsible for the product, and determine where it needs to be inserted. Collaboration will likely increase at the transformation and expression levels, and commercialization agreements will be negotiated well beforehand. Traditional funding agencies, such as commodity commissions and grower organizations, will expect to share in the rewards from research they have helped sponsor. Universities will need to maintain transparency in collaborative projects to insure continued public support. As industry reduces research into discovery of new pesticides, genetic modification of crops to permit new crop rotations and new uses of known herbicides needs to move forward at an accelerated pace. University outreach functions should accept the challenge of helping the public understand the science and the benefits derivable from biotechnology. [113]

**HERBICIDE DISCOVERY – YESTERDAY, TODAY AND TOMORROW.** James R. Bone, Manager Field Development, DuPont Crop Protection Chemicals USA, Valdosta, GA.

Lack of diversity in sources of input for new weed management practices promises to result in increased control issues for farmers leading to reduced profitability from crop ventures due to weed competition, interference with essential cultural practices and costs.

Yesterday's candidate selection process for new crop protection chemicals (CPC) based on targeted and random mass synthesis was not the overall success anticipated, but did illustrate the need and value of a more focused approach. As the impact of genetically modified organisms (GMO) in cropping systems becomes better understood obvious weed species can and will be identified as screening targets. Tomorrow's CPC discovery will focus on selection of both herbicides and delivery systems complimentary to GMO, but with a target to manage weed issues attendant to current and projected cultural practices. It will be paramount that the CPC discovery process, especially herbicides, be streamlined to eliminate all duplicate costs. This standard must apply particularly to crops not benefiting from GMO technology that previously enjoyed the umbrella of broad acre crop screening programs for new herbicide discovery. [114]

**INTEGRATING CHEMICALS AND GENETICS TO ACHIEVE PEST MANAGEMENT SOLUTIONS.** Stott W. Howard, Syngenta Crop Protection, Des Moines, IA.

Syngenta continues to invest and believe in both conventional technology and biotechnology for crop protection with the goal of providing unprecedented effective and flexible options for reducing losses to pests and maximizing crop value. Though the integration of various pest management techniques is not a new concept, the variety and dimension of options afforded by biotechnology increases our opportunities to: sustain the efficacy and longevity of pest management techniques, reduce the incidence of pest resistance, enable tailored site-specific recommendations, provide new opportunities for control of troublesome pests, and decrease yield barriers through the control of secondary pests. [115]

**BAYER CROPSCIENCE: TARGETING INTEGRATED WEED MANAGEMENT.** Allen C. Scoggan,\* Bayer CropScience, Kansas City MO; and Hermann Stübler, Bayer CropScience GmbH, Frankfurt am Main, Germany.

Consolidation in the number of basic manufacturers plus increasingly stringent regulation has resulted in a decline in the number of patents registered for new herbicides, a trend which has continued for several years. This trend, when combined with increased difficulty in discovering a cost effective and efficacious material which will pass the difficult registration hurdles has led to reliance on the same modes of action for nearly three decades. In order to maintain weed control in the face of an increasing resistance threat, use of broad spectrum, short to non-residual herbicides in crops specifically adapted for herbicide tolerance has increased. With that increase, the possibility of resistance to those modes of action also increases. Bayer CropScience recognizes the need to respond to this opportunity on multiple fronts by participating in: (1) herbicide tolerant crop development; (2) developing or supporting rotation schemes both between crops and within the same crop utilizing different modes of action; and (3) expanding our discovery effort in search of modes of action. Conscientious application of the first two steps will provide enough time to find and develop a new mode of action before control failures become widespread, keeping in mind that a minimum of another decade will be required to bring a new mode of action, once discovered, to the marketplace. [116]

**MONSANTO'S BIOTECH PIPELINE AND WHO WILL DELIVER IT?** Douglas W. Rushing\*, Monsanto Company, St. Louis, MO

Monsanto Company is the world leader in agricultural biotechnology. Biotech traits in corn, soybeans, cotton, and canola have been adopted at unprecedented rates over the past 10 years. And yet, new technologies moving through the development pipeline will have very different applications from the insect protected and herbicide tolerant crops that have replaced millions of pounds of insecticides and herbicides in seventeen countries around the globe. Two of our research targets are in the areas of environmental stress tolerance and healthier oils for consumer uses. Crops that can withstand drought or emerge faster from cold wet soils will be available to growers in the near future. Corn plants will be able to utilize nitrogen more efficiently. Consumer and processor focused projects provide better value in food and feed nutrition. Examples of these projects include protein enhancements such as improved amino acid balance, lipid enhancements, including improved fatty acid balance, and carbohydrate enhancements. These new technologies will require unique competencies from future researchers at Monsanto and other biotech companies. Expertise in plant physiology, water utilization, food science and nutrition, and field experimental design will be requirements in addition to basic agronomic knowledge. The key question is where do we find these multi-talented scientists of the future? [117]

## DOSE RESPONSE FUNCTIONS SYMPOSIUM

**HISTORICAL DEVELOPMENT OF DOSE-RESPONSE RELATIONSHIPS.** Steven S. Seefeldt\*, USDA-ARS, Dubois, ID.

Understanding and modelling the response of a living organism to a dose of a chemical or biological compound is an important aspect of biologic science. Many absorbed or ingested organic and inorganic components that are beneficial or at least harmless at low doses can be toxic at higher doses. When trying to recommend doses of a substance for killing a weed without harming a crop, the responses of the two plant species must be predicted. Early studies have determined that the response was often an asymmetric sigmoidal-shaped curve and that there was inherent variability in susceptibility among individuals in a population. From 1930 until almost 1960 there were heated discussions concerning whether probit or logit functions were best for modelling dose-response relationships. At that time all analyses had to be done by hand. Several attempts were made to simplify the calculations through the use of specially designed graph paper, but adoption of these methods was limited. Rather than spending large amounts of time with these models, most researchers resorted to conducting simpler average response analyses such as ANOVA at specific doses, or attempting to transform data into a linear format followed by linear regression. None of these simplified methods were useful for describing data at extreme values of doses nor were they biologically relevant. With the advent of computers and statistical software, more complex and biologically relevant

models could now be utilized to analyze dose-response relationships. The estimation procedures for these models are discussed and demonstrated in the upcoming presentations in this series. [143]

**ESTIMATION METHODS FOR DOSE-RESPONSE FUNCTIONS.** Bahman Shafii\*, University of Idaho, Moscow.

Dose-response design is often used in agricultural research when it is necessary to measure a biological response at various levels of an experimental factor. As might be expected, this type of research is common in the biomedical and chemical fields, as well as in other disciplines such as plant, animal, soil, and environmental sciences. While the analysis of dose-response data usually involves fitting a regression curve, the primary objective often centers on the estimation of dose-related percentiles such as the LD<sub>50</sub>. These measures are useful for comparing the relative efficacy of various treatments, however, the estimation of the specified percentiles is not always straightforward. Traditional methodology has relied on inverted solutions or asymptotic theory for statistical inference. More recently, computer intensive methods have been used to quantify dose-response data which may be more appropriate in certain situations. This presentation examines both the traditional and modern approaches to estimating dose-response functions. Empirical demonstration of these techniques will be covered as part of the next presentation in this series. [144]

**PRACTICAL APPLICATION OF DOSE-RESPONSE FUNCTIONS IN WEED SCIENCE.** William J. Price\*, University of Idaho, Moscow.

In this presentation, estimation of dose-response curves, as covered in the previous talk, will be demonstrated using the SAS software system. The topics addressed will include appropriate dose-response models, fixed and random model components, discrete versus continuous responses, and statistical inferences based on parameter estimates. Inferences for functions of parameter estimates as well as contrasts of parameter estimates will also be discussed. The examples shown will be taken from a variety of weed science experiments. The demonstration illustrates the similarities and differences between the SAS procedures NLIN and NLMIXED, and considers some commonly encountered estimation problems. [145]

## EDUCATION AND REGULATORY

**PESTICIDE REGISTRATION CHANGES, US INDUSTRY PERSPECTIVE.** John J. Jachetta\*, Dow AgroSciences LLC

Several new laws or interpretations of previous laws have significantly altered the regulatory landscape and US Environmental Protection Agency's (EPA) processes for herbicide regulation and registration. The Food Quality Protection Act (FQPA) of 1996 amended both the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) as well as the Federal Food, Drug and Cosmetic Act (FFDCA). Under this law, EPA must follow additional criteria for the registration of pesticides, including new considerations of exposure for infants and children and consideration of all risks posed by pesticides with similar modes-of-action. This rule did not provide any implementation time and has significantly altered the way all pesticides, including herbicides, have been evaluated. As with any new law, interpretation and implementation has evolved significantly over time. More recently, legislation was passed that dramatically changed EPA's internal processes and timelines for registration approval. In January of 2004, the US Congress passed the Pesticide Registration Improvement Act of 2004 which established a new section in FIFRA implementing a fee-for-service system. This new law requires industry to pay fees for many services that were previously free, but gives increased predictability for industry and its users. The Endangered Species Act (ESA) was established in 1973 to protect and promote the recovery of animals and plants that are in danger of becoming extinct due to the activities of people. Under the Act, EPA must ensure that use of pesticides it registers will not result in harm to the species listed as endangered and threatened, or to habitat critical to those species' survival. On August 26, 2004, a new agreement was reached between the EPA, the USDA Fish and Wildlife Service, the US National Oceanic and Atmospheric Administration, and the National Marine Fisheries Service that establish an alternate consultation agreement so that the EPA may fulfill its obligations under the ESA. Processes to implement this agreement are quickly evolving at EPA and will likely significantly affect the complexity of the environmental portion of any product's review. [109]

**PESTICIDE REGISTRATION CHANGES, CANADIAN INDUSTRY PERSPECTIVE.** Chris Warfield, Bayer CropScience Canada, Ottawa, Ontario.

The pesticide Registration System is a system in transition. New Legislation has been passed that will likely be implemented within the next year. Further legislation has been introduced into parliament which will change the way that Maximum Residue Levels (MRLs) are established in Canada. These legislative changes shift the focus of pesticide regulation in Canada by changing from a:

- "Safety, Merit, and Benefit" test for registration to risk based,
- pragmatic approach to trade in food commodities based on a general 0.1 ppm general regulation under the Food and Drug Regulations to a zero tolerance system similar to that in the US.
- Country specific approach to pesticide registration to a more NAFTA/Global based approach
- legislated protection of company submitted data to legislated transparency of the registration system
- company based approach to registration to participation in the registration process by all stakeholders
- paper, text based submission process to an on-line data based submission process
- chemical specific evaluation process to comparative risk assessments and the substitution principle.

Companies operating in Canada will need to ensure that they fully understand the emerging Canadian pesticide registration environment and watch for emerging opportunities and constraints. [110]

**NORTH AMERICAN FREE TRADE AGREEMENT (NAFTA) - IR-4 (MINOR USE) AND GLOBAL HARMONIZATION.** Sandra K. McDonald, Colorado State University

The North American Free Trade Agreement (NAFTA) calls for Canada, Mexico and the United States to harmonize pesticide regulations. These governments have formed the Technical Working Group (TWG) on Pesticides to serve as a focal point for addressing pesticide issues arising in the context of liberalized trade. A major objective of the NAFTA TWG is to provide equal access to markets and pest control tools. The TWG partners include the Canadian Pest Management Regulatory Agency (PMRA), a consortium of Mexican agencies responsible for pesticide regulation, and the United States Environmental Protection Agency (EPA) Office of Pesticide Programs.

The United States Department of Agriculture's (USDA) Interregional Research Project Number 4 (IR-4) and Agriculture and Agri-Food Canada (AAFC) are cooperating jointly in generating data on specialty crops and are TWG members. The main goal of this cooperation is to provide reduced risk pest control products to specialty crop growers and to reduce trade barriers in order for commodities to be shared by consumers across the borders. Members of the AAFC Pest Management Center have been active participants in annual IR-4 Food Use Workshops and National Research Planning Meetings. Since 2004, the AAFC and IR-4 have been working to submit petitions to PMRA and EPA for four pilot projects: fenhexamid on pome fruit (postharvest) and ginseng; acetamiprid on greenhouse tomatoes; and S-metolachlor on squash.

The Globally Harmonized System of Classification and Labeling of Chemicals (GHS) is an initiative adopted in 2003 by the United Nations Economic and Social Council to promote common, consistent criteria for classifying chemicals. The GHS sets out hazard classification criteria and key label elements, including symbols, signal words ("danger" or "warning," depending on the severity of the hazard), and hazard statements (such as "causes skin irritation"). The United States is voluntarily adopting parts of the GHS leading to changes in pesticide labels. Given the size and scale of the pesticide market in the United States and the importance of label review in the U.S. system of pesticide regulation, EPA recognizes that significant effort and time will be required to implement GHS label changes and conduct effective outreach and education activities. The EPA foresees this process occurring in multiple stages over several years. [111]

**CANADIAN MINOR USE PROGRAM UPDATE.** Greg Neil, Agriculture Canada, Ottawa, Ontario. (No abstract submitted) [112]

**PROJECT 1: WEEDS OF RANGE AND FOREST**  
**Chairperson: Janet Clark, Center for Invasive Plant Management, Montana State University**

*Topic: Long-Term Weed Management Planning*

Dr. Mandy Tu of The Nature Conservancy kicked off the Weeds of Range and Forage discussion session with an interesting talk about her agency's protocol for planning long-term weed management plans. Dr. Tu's emphasized the importance of designing weed management goals in a manner that enables managers to measure whether or not the goals are achieved. Useful questions that guide The Nature Conservancy's weed management planning include:

- What are the targets (desired future conditions)?
- What threatens those targets? Specific weeds, suites of weeds?
- Is there a general sense (or specific knowledge) of what invasive plants are present, where they are located, and what species might invade in the future? Which areas are the highest priorities?
- What resources are available (staff, volunteer, time, money, equipment, etc.) and what are the limitations?
- Is the desired future condition quantifiable? What constitutes success?

Following Dr. Tu's presentation 44 conference attendees engaged in a lively discourse on the economics associated with wildland weed prevention. Throughout the discussion, consensus built around the notion that weed science has done little to quantify the value of weed prevention efforts. Many in attendance felt that this is regrettable; because once exotic weeds invade managers become immersed in an endless cycle of controlling and then re-controlling each time the weeds reestablish. Several participants lamented that land management agencies receive such high praise for killing weeds, but so little credit for the more important task of preventing weeds from invading pristine ecosystems in the first place. Participants in our session's discussion think it is critical that we begin to quantify the value of weed propagule sanitation, early detection and eradication efforts.

Toward this end Dr. Cynthia Brown (Colorado State University) proposed that WWSWS offer a symposium on the emerging field of ecological economics at the 2006 annual meeting in Reno, Nevada. This field focuses on quantifying the risks and benefits of various resource management alternatives. Dr. Matthew Rinella (Agricultural Research Service) and Dr. Brown agreed to outline the symposium and propose it to WWSWS officials. Dr. Rinella and Dr. Brown also agreed to serve as chair and vice-chair, respectively, for the 2006 meetings.

**PROJECT 2: WEEDS OF HORTICULTURE CROPS SESSION**

*Topic: Developing Strategies for Weed Control in Specialty Crops: Maximizing Limited Resources*

The discussion for the Weeds of Horticulture Crops section was held prior to the paper presentations on Tuesday afternoon, March 8. Eleven weed scientists were present to contribute their thoughts on the topic "Developing Strategies for Weed Control in Specialty Crops: Maximizing Limited Resources". There were no formal presentations in the session. The discussion started by defining the limited resources facing specialty crop weed scientists which included (a) the small number of weed scientists working in this area; (b) the limited number of herbicides available or under development for conventional weed control; and (c) the limited, and decreasing, funds available at the states and federal levels to support research in specialty crop weed control.

Since there a small number of weed scientists conducting research on specialty crops communication is important. A Vegetable Weed list server has been set up for communication for the western specialty crops weed scientists but has been underutilized. It could easily be expanded for use on a national basis. Fred Salzman pointed out it may be useful for specialty crop weed scientists to group themselves on a national level by crops as well as by geography. In order to expand the use of the Vegetable Weed list server, it could be advertised in the WSSA and WWSWS newsletters and on the IR-4 website. Kai Umeda said that to subscribe send the message "subscribe vegweeders" to majordomo@cals.arizona.edu, keeping the subject line blank and removing any signatures within the message.

Since public weed scientists cannot control the number of herbicides available or under development for conventional weed control, Steve Fennimore emphasized that work must be done in the area of novel weed control mechanisms, particularly in finding ways to expand the use of the tools currently available. Working in this area will require innovative thinking and cooperation with researchers in other areas including those that might not readily come to mind. Steve's examples of innovative thinking included working with crop breeders to develop

specialty crops resistant to herbicides using conventional breeding methods, or developing a virus vector to insert genes into weeds that control growth, bud dormancy, or seed production. A logical source of funding for this work would be from the federal government, but the most recent budget proposal from the President called for reducing and eventually eliminating funding for USDA programs that would be logical sources.

Funding is an important issue, particularly for specialty crop weed scientists. Not only are they a minority within weed science, but weed scientists in general are in the minority when compared to entomologists or plant pathologists. This makes competition for federal funds to study crop pests and potential solutions, and making visible the crisis in specialty crop weed control, extremely difficult. In addition weeds in cropping systems are viewed as general, chronic problems rather than specific weed species an acute problem requiring a concentrated effort in study and control. It was asked if we could use the expertise of Rob Hedberg, Director of Science Policy, working with him to raise the awareness of the crisis in weed control in specialty crops and increasing the chances for success in accessing federal funding sources. Jill Schroeder pointed out that Rob's success in other weed science areas at the federal level is because he is a reliable source of information on those issues. For Rob to be of effective assistance, specialty crop weed scientists will need to provide him with accurate and reliable information when asked.

The lack of participation in the WWS by weed scientists involved in turf and ornamental crop research was identified as a deficiency. The question was raised as to how to encourage them to become involved but no immediate solution was proposed. The discussion ended with the identification of two action items for specialty crop weed scientists to pursue. The first is to revive the Vegetable Crops list server and expand it to the national level. The second action is to develop strategies to work with the WWS, WSSA, and Rob Hedberg to in provide weed control solutions for specialty crop growers.

Two people, Jesse Richardson and Rich Affeldt were interested in the position of chair-elect for the meeting in 2006. Rich Affeldt was elected.

Chair – 2006

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### **PROJECT 3: WEEDS IN AGRONOMIC CROPS REPORT**

**Chairperson: T. Vint Hicks, Monsanto Company**

*Topic: Utilizing Remote Sensing as a Tool for Weed Control in Agronomic Crops.*

On Wednesday afternoon, March 9, the Weeds of Agronomic Crops Project 3 met and conducted its discussion session. The session was moderated by the 2004 section chairperson T. Vint Hicks, Monsanto Company, Fountain Hills, AZ. The session lasted one hour and was attended by 50-55 persons.

The discussion topic was introduced by guest speaker John Wilcut of North Carolina State University. His presentation was titled: Integration of Site Specific Weed Management and Weed Biology. Dr. Wilcut gave an overview of some of his research utilizing weed or patch seeking sprayers that are real-time sprayers. These units are equipped with photo sensors that perceive the reflectance from the ground surface and differentiate between plant material and soil based on the quality of reflected light. The sprayers can be calibrated based on the soil type of a given site. The sprayer has limitations such as the inability to distinguish between the seeded crops and weed species or volunteer crop. Selectivity is controlled to some degree by shields or hoods which protect the row crop from directed spray nozzles. Each hood contains several sensors and coordinated nozzles. Another limitation of this sprayer technology is speed and cost. A four row sprayer travels at 3-4 miles per hour and cost \$16,000.00. Some advantages of this sprayer technology included; reduced herbicide use, data acquisition on weed densities and distribution within fields for mapping and incorporating biology based decision making tools.

Dr. Wilcut presented research results comparing combinations of pre and post applied herbicides in cotton production utilizing both conventional and site specific sprayer technology. Weed control was similar for both



methods with 98% of the weed populations controlled and no differences in cotton lint quality and yield as long as a pre-emergence herbicide was included. However, post emergence herbicide use was reduced by 85-95% when site specific sprayer technology was used. Weed maps generated by utilizing a data-logger and GPS sensor were geo-referenced and proved to be accurate. Dr Wilcut also presented discussed the shift from pre-emergence herbicide use to almost exclusively post-emergence herbicide use in cotton production following the introduction of transgenic cotton. His research results showed the importance of early post-emergence spraying to optimize cotton yield and lint quality. Maximum yield potential was realized when the first post emergence application occurred at 2 weeks following planting. Cotton yield was reduced by 20-25% when post-emergence applications were made at 4 weeks after planting and at 6-8 weeks following planting there was not an economic return.

A discussion session was held following Dr. Wilcut's presentation. Questions and discussion pertained to current limitations in technology of the real-time sprayers and future opportunities as technology improves. Of interest was the ability to differentiate between plant species for the purpose of weed control as well as accurate mapping by species spatial and temporal distribution. Current commercial utilization of optical recognition sprayer technology was discussed. Ideas were shared about data use and management with real-time and remote sensing technology.

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## PROJECT 4: TEACHING AND TECHNOLOGY TRANSFER

*Topic 1: WeedSOFT-A Weed Management Decision Support Tool.*

*Topic 2: CLIMEX and DYMEX-Predicting Weed Invasion Using Climatic Factors*

Project 4 of the Western Society of Weed Science convened at 9:30 AM in the Regency F room of the Hyatt Regency Hotel in Vancouver, British Columbia. Cheryl Wilen, Chair and Moderator for the 2005 session introduced the speakers and conducted the session. Project 4 contained one submitted paper and three discussion topics.

A submitted paper titled Arizona Weed Contest and Training Symposium was presented by Patrick A. Clay from the University of Arizona, Tucson. This presentation outlined the Arizona Weed Contest and suggested some ways that the Western Society of Weed Science might be able to use this format to develop a Western Regional Weed Contest. There was significant discussion after the presentation about the cost of developing and maintaining this program and the ability of WWS to be able to do a similar type program. Support from industry is crucial as is the time of year that the program is offered. In Arizona, programs offered in the summer were more successful (based on attendance) than programs offered in November. 18 people attended this portion of Project 4.

### Discussion Section

Topic 1: WeedSOFT-A Weed Management Decision Support Tool. Presentation and discussion lead by Drew Lyon, University of Nebraska. A history of WeedSOFT was presented and a demonstration of the program performed. The program is a decision support system that is also educational. If there are many options for weed control (herbicides etc.) in an area or state, the program is quite useful and helps sort out the best options for weed control treatments. If the crop or location has very few weed control options the program is not as powerful. Weed SOFT is fairly state specific and consequently some local effort is necessary to customize the program for each area or state. There was good discussion on this very interesting demonstration. 20 people attended this portion of Project 4.

Topic 2: CLIMEX and DYMEX-Predicting Weed Invasion Using Climatic Factors. Presentation and discussion lead by Scott Steinmaus, Cal Poly University, San Luis Obispo. This presentation demonstrated the ability to use CLIMEX to match the climatic requirements of a species with the climate in a given area. Using this predictive information it makes it possible to focus prevention efforts for weed management in areas where the invasive species in question is likely to survive. There is no point in making huge efforts to control a plant that will not survive in a given climatic zone anyway. A demonstration using this model to predict the distribution of gorse was presented. A handout was provided to all participants. CLIMEX assumes that scientists are modeling the most sensitive stage of plant growth. DYMEX, however, models all stages of growth for a species. This was a lively presentation with some very active discussion. 24 people attended this portion of Project 4.

Topic 3: Setting the Price-An Excel Spreadsheet to Assist in Cost Recovery for Extension Meetings. Presentation and discussion lead by Cheryl Wilen, University of California Cooperative Extension. In a political climate where it is more important than ever before to justify the cost of Extension Meetings and then to recover some of that cost this presentation demonstrated a spreadsheet approach to estimating the cost of meetings. The spreadsheet asks for input related to time and effort for meeting preparation and delivery and then estimates wages/hour to provide a cost/hour. One of the very interesting features of this program is that it estimates personnel costs and benefits, room costs, costs for food etc., travel costs, and other issues often overlooked such as printing costs. In short, this spreadsheet allows Extension Professionals to estimate all the costs of a meeting, including salary and incidental costs, and then calculate the necessary registration fee to cover all the costs. In addition to estimating the cost of meeting this spreadsheet approach can be used to estimate the cost basis for a grant proposal or to estimate the appropriate billing rate for consulting or guest speaker opportunities. This topic was introduced at the 2004 WWS meeting in Colorado Springs, Colorado and this topic was a follow-up to that meeting.

There was good discussion and group participation during the presentation. 15 people attended this portion of Project 4.

Suggested discussion topic for 2006. Ralph Whitesides, Utah State University, Logan, Utah, made a brief presentation suggesting that Project 4 dedicate the discussion in 2006 to issues related to Agricultural Ethics. The January 2005 CAST paper on Agricultural Ethics will serve as the backbone for the discussion topics.

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805-756-5142  
805-756-1419 Fax  
[ssteinma@calpoly.edu](mailto:ssteinma@calpoly.edu)

Project 4 concluded at 11:30 AM.

**PROJECT 5: WEEDS OF WETLANDS AND WILDLANDS**  
**Chair: Jodie S. Holt, University of California, Riverside, [Jodie.holt@ucr.edu](mailto:Jodie.holt@ucr.edu)**

*Topic 1: What is the Legal and Working Definition of Riparian?*

*Topic 2: Label Recommendations for Herbicide Use in Riparian Areas: Confusion or Opportunity?*

Discussion Leaders: Mark Renz, New Mexico State University  
Stephen Enloe, University of Wyoming

Participants: 113 chairs; approximately 75 participants for oral presentation (Nissen); 57 people signed attendance sheet; attendance at discussion ranged from approximately 60 to 26 at the end (as this was the last session of the meeting, several people left to catch planes)

A brief discussion was held about the low number of submitted papers for this section. It was suggested that there is considerable overlap among the papers in the different projects and that the distinctions between them should be clarified in future instructions for submission.

A proposal was made to hold a symposium or workshop each year at the annual meeting that deals with invasive species. The topics could be a specific invasive weed or weeds on public lands and the event could be advertised to local land managers for a one-day, walk-in fee. This event could also include training. It was suggested that Project 5, Wetlands and Wildlands, could co-sponsor this event with Project 1, Range and Forest. The recent Knapweed Symposium was mentioned as a model for the event.

The discussion began with a presentation by Stephen Enloe giving an overview of riparian areas, their importance, and the negative impacts of invasive weeds. He then showed photos of a variety of sites in the west and asked the audience to delineate the riparian vegetation in each picture. The responses were extremely variable and considerable discussion ensued, after which some thoughts on the definition of riparian with respect to the source of water began to emerge. From this exercise it was concluded that riparian areas may be classified by vegetation, the presence of water, the presence of species associated with sub-surface water, slope, and the high water mark.

Mark Renz then presented information showing that among government agencies there is no universally accepted or legal definition of riparian. In the west some riparian areas may not even be associated with water. Definitions used by agencies such as the NRCS, USDI-BLM, and USFS range from very simple to very complex. He then presented data to show that weed control within riparian areas has variable success depending on distance from water and other factors. The herbicides that are used by different agencies in riparian areas also vary, and not all of them can use the same herbicides. One particular concern is that the label, as determined by EPA, regulates herbicide use, but state departments of agriculture regulate use in each state and they do not use a consistent definition of each habitat type. It was noted that the EPA list of official site descriptions does not use the word riparian. All of these factors result in confusion and concern regarding what sites should be considered riparian, what herbicides may and may not be used in riparian areas, and who is liable if a use is found not to be in compliance with appropriate regulations. It was noted that vagueness on herbicide labels can be useful in some instances in allowing flexibility. It was suggested that participants should be careful in asking for more specific labels because they could become more restrictive. Several herbicide labels for products registered in riparian areas were shown and the specific wording was discussed in terms of whether it was helpful or confusing. A valuable discussion resulted in which industry participants explained the rationale for certain wording. It was noted that label verbiage may vary depending on who wrote it and for what purpose.

The discussion was very lively and the participants were enthusiastic about the topic, suggesting that it be continued next year with related topics and possibly even a training session.

**Chair-elect:** Stephen Enloe, University of Wyoming, [sfenloe@uwyo.edu](mailto:sfenloe@uwyo.edu)  
**Chair-elect for 2006:** Michael Edwards, DuPont, [Michael.T.Edwards@usa.dupont.com](mailto:Michael.T.Edwards@usa.dupont.com)

## **PROJECT 6: BASIC SCIENCES: ECOLOGY, BIOLOGY, PHYSIOLOGY, GENETICS**

**Chairperson: Tracy M. Sterling**

*Topic: Underground Strategies of Invasives*

1. *Do Invasive Weeds Alter Soil Attributes? (led by Mark Renz)*
2. *Quantifying the Impact of Management Underground.  
Root Study Technologies (led by Stephen Enloe)  
Debunking Myths of Herbicide Translocation to Roots (led by Rod Lym)*

The Basic Sciences Project 6 met Wednesday afternoon March 9. Approximately 35 people attended.

### **Do Invasive Weeds Alter Soil Attributes?**

As weeds invade a new area, what changes might be occurring to the soil in which they grow? The concept that plants alter soil attributes was introduced with examples of soil attributes that can be altered. It was emphasized that soil attributes naturally can be altered over-time (succession), so it is important to be very specific in how you compare how soil attributes change. Studies evaluating soil attribute change are difficult. There are many sampling issues involving time and cost. It is also difficult to evaluate mixed communities and microbial composition determination is very time consuming. Soil studies can be from pot to field scales and temporally diverse. Samples could be bulked or specific areas sampled more intensely. Research with pepperweed growing in sodic soils found changes in mineral content due to invasion, changes in soil enzyme activities, and soil structure. Resin capsules can be used to help estimate nutrient availability. Discussion centered on using this information to better manage invasives and preventing invasions.

### **Quantifying the Impact of Management Underground**

#### **Root Study Technologies or Getting to the Root of the Problem: Methods to Study Plant Roots**

Root biomass often accounts for much more than 50% of the total biomass of many invasive plants. Current management focuses on top growth, but what is the impact below ground? It is important to understand the biology and ecology of root systems to better quantify management impacts on the entire plant. When weed management fails, it is typically attributed to above-ground factors such as timing, genetic variability, environmental stress, or application error while below-ground factors are rarely blamed. There are several approaches to studying roots

include root trenching, root coring, pin-board sampling and rhizotrons and mini-rhizotrons. With the exception of the rhizotron methods, most of these methods require destructive sampling and recovery of the fine root fraction is very difficult. Rhizotrons and mini-rhizotrons provide a technique to nondestructively quantify root dynamics in response to many ecological variables including management strategies such as herbicides or biocontrol. Rhizotron placement in the ground helps stabilize soil temperatures. Methods to record root growth on transparent surfaces include acetate sheets for tracing and digital scanners. Digital photography of rhizotrons was also discussed. Coupled with computer assisted root image analysis software, many root parameters can be quantified, including root length, root number, and root turnover. Some difficulties with even small, moveable rhizotrons include separating roots of mixed species, and excluding light and temperature effects. Soil color can affect the ability to view roots and clay soils are typically more difficult to work with. Digital image collections add up quickly after multiple scans per rhizotron or minirhizotron tube. Image analysis is probably still the most time consuming component. Fine root definitions frequently vary in the literature. Root proliferation along the transparent surface may sometimes result in overestimation of root production in bulk soil. However, relative values among different treatments would still be of great benefit. Adventitious root buds have been difficult to observe with the minirhizotron camera system. Tracers were discussed and concerns over detecting them through the rhizotron window. Discussion also included alternative methods and how to deal with mixed stands.

#### **Debunking Myths of Herbicide Translocation to Roots**

Although it is taught in textbooks that fall herbicide applications on perennials are optimal because carbohydrates are moving to the sinks underground during that time of year, data does not bear that out. Research on specific weeds such as leafy spurge found no correlation with herbicide and carbohydrate translocation. Throughout a growing season, radiolabelled picloram moved primarily to the top growth early in the season and movement to roots was maximal in mid-June; movement to roots dropped off in August with a slight increase in the fall compared to a large increase in carbohydrate translocation. Overall, there was no correlation between radiolabel accumulation in roots and soluble or insoluble carbohydrate transport to roots. So why is it recommended to manage perennial weeds in the fall? Part of this recommendation might be due to relying on source-sink relationships which explain sucrose movement in plants. Or, perhaps other species or herbicides respond differently. For instance, glyphosate transport may be more tightly linked to carbohydrate movement to roots because this herbicide is highly phloem mobile. Although a plant might be better managed in the fall, it should not always be assumed that the reason is due to better herbicide transport to the roots in conjunction with storage carbohydrates.

There was discussion about the name of Project 6: 'Basic Sciences' and if it should be changed to be more descriptive and therefore more inclusive. A possible name change could be 'Biology, Ecology and Physiology'. Prior to 1991, this project was 'Project 7: Chemical and Physiological Studies'. In 1991, Project 7 became Project 6 and its name became 'Basic Sciences: Ecology, Biology, Physiology, Genetics & Chemistry'. Since 1992, Project 6 has been called 'Basic Sciences'.

Project 6 Officers for 2006:

Chair person:  
Bill Dyer  
Department of Plant Sciences  
Montana State University  
Bozeman, MT 59717

Chairperson-elect:  
Cheryl Wilen  
University of California Cooperative Extension  
UC Statewide IPM Program  
Los Angeles, Orange, and San Diego Counties  
5555 Overland Ave., Suite 4101  
San Diego, CA 92123

Western Society of Weed Science  
Summer Board Meeting  
30-31 July, 2004  
Hyatt Hotel  
Vancouver, BC

**Present:** Phil Banks, Vanelle Carrithers, Gil Cook, Wanda Graves, Charlie Hicks, Nelroy Jackson, Rod Lym, Drew Lyon, Tim Miller, Jill Schroeder, Phil Stahlman, Vince Ulstad

The annual summer board meeting of the WSWs was called to order at 7:45 AM on 30 July, 2004 by President Phil Stahlman.

Motion was made and seconded to accept the minutes of the 8 March, 2004 board meeting. Motion passed.

Motion was made and seconded to accept the minutes of the 11 March, 2004 post conference meeting.

Wanda Graves gave the financial report, including year-end report for 4-1-03 to 3-31-04 and the report to date (4-1-04 to 7-28-04) for the current year. Reprinting of the Weeds of the West book has begun and the first payment has been made (\$51,500). The next payment is due the end of December. The \$15,000 WSWs agreed to pay for the Biocontrol book has not yet been paid, nor the printing of the Proceedings for the last meeting (\$2,160). Proceedings are at the printer and will be printed soon. Printer hopes to have a delivery date of 9 August.

Nelroy Jackson moved & Vanelle Carrithers seconded the motion to accept financial report as presented. Motion passed on a voice vote. Jill expressed appreciation to Wanda for her excellent management of the society.

**Past president's report.** Submitted and given by Gil Cook. Gil has requested names of retirees so they can be recognized appropriately. Gil is writing letters to past committee chairs thanking them for their service. Motion made, seconded & passed to accept report.

**Program Committee report.** Submitted and given by Phil Banks. Phil reviewed the program schedule, to date, for the upcoming annual meeting, including the general session and speakers. WSWs needs to get as many Canadian attendees as possible. Neil Harker will be keynote speaker at general session.

The Japanese knotweed symposium was being actively planned but due to travel restrictions on many federal & state employees, who would be key attendees, the decision was made to postpone the symposium until the 2006 or 2007 meeting. Nelroy Jackson suggested a potential topic for the Reno meeting in 2006 would be perennial pepperweed. Portland in 2007 would be a good meeting location for the knotweed symposium.

Phil Banks will insure that the notice of the knotweed symposium being postponed will get into the next newsletter.

Phil Banks indicated he had received suggestions for 2 mini-symposia, including “Estimation of Dose-Response Functions” (Steve Seefeldt) and “Crop Protection Chemistry vs. Genetic Engineering of Crops to Resist Weeds, Diseases, and Insects—Where is the Future Headed?” (Jeff Tichota).

Phil Banks indicated the interest for a local tour put together by the local arrangements committee. Tim Miller indicated there is a very active greenhouse industry here and could be a potential tour.

The call for papers will go out in September newsletter. Procedure for submission of abstracts will be worked out with Drew Lyon & Charlie Hicks.

Phil indicated Neil Harker has requested possible travel support to the meeting. Minutes of a previous meeting indicated that the board has voted to provide up to \$1,000 of travel assistance for general session speakers that are non-members.

Nelroy Jackson moved to approve up to \$1,000 in additional travel support for the program at the 2005 meeting, with no restrictions on membership status. Vanille Carrithers seconded. After discussion on Neil’s membership status, Nelroy withdrew his motion.

Motion was made by Gil Cook and seconded by Vanille to approve Program report. Motion passed.

Drew Lyon presented the **Research Section Chair report**. Drew has updated the chair & chair-elect contact information. Drew & Charlie Hicks submitted procedural recommendations for submission of presentations (see italics in report). Discussion was held on how early to have the papers submitted prior to the meeting and the need to clearly communicate to presenters that presentations must be submitted prior to the meeting. Vanille moved to accept Drew’s report, Phil Banks seconded. Motion passed.

**Education & Regulatory Section Report.** Presented by Charlie Hicks.

Proposed topic for E & R section is the “Current Status of the US/Canada Pesticide Registration Process and Its Impact on Minor Crop Registrations”. Charlie is looking for a US pesticide registration expert. Charlie will also work in Steve Seefeldt’s suggested topic of a Dose-Response Function presentation.

Gil Cook moved to accept, Nelroy seconded, the report. Motion passed on voice vote.

**Local Arrangements Committee.** Presented by Tim Miller.

The importance of letting people know the expectations of traveling to Canada is critical, i.e. customs, passports/birth certificates, monetary exchange, shuttles. Details of shipping supplies, etc. need to be posted. Easels for poster sessions are in Tim’s hands, as well as foam boards.

Nelroy moved, Vanille seconded to accept Tim’s report. Passed on voice vote.

**Constitution & Operating Procedures Report.** Presented by Jill Schroeder.

Roland Shirman is working on updates and has/will request section & committee chairs to review the constitution and operating procedures relative to their respective



responsibilities for potential changes/updates. [Gil moved, Drew seconded to accept Jill's report. Motion passed on voice vote.](#)

**WSSA Representative Report.** Presented by Nelroy Jackson.

WSSA board met last week.

Discussion was held on whether to post presentations from the 2004 Saltcedar Symposium on a website and, if so, which website. Phil Westra has approval from 6 of the 8 presenters from the symposium. WSWS 'owns' the presentations and needs to maintain recognition of such if posted on other websites (i.e. WSSA, invasivespecies.gov, etc.) Key is to maintain visibility/recognition of WSWS as the source of this presentation. [Nelroy moved to put the PowerPoint presentations from Saltcedar symposium at invasivespecies.gov with links to WSWS and WSSA websites, with the proviso that it is clearly identified as a WSWS source. Motion seconded and passed on a voice vote.](#)

Nelroy reviewed the WSSA summer board meeting points.

Nelroy reviewed Rob Hedberg's Director of Science Policy Report, which was presented to the WSSA Board of Directors meeting last week.

[Motion made, seconded, & passed on voice vote to accept Nelroy's report.](#)

**CAST Report.** Presented by Rod Lym.

Phil Stahlman appointed Rod Lym to update & renew the WSWS logo renewal process, which must occur every 10 years.

[Motion made, seconded, and passed on voice vote to accept Rod's report.](#)

**Nominations Report.** No candidates for president-elect, to date. Bill McCloskey is contacting potential candidates. He has two candidates for Education & Regulatory Section Chair-elect and one candidate for Research Section Chair-elect. No action was taken on the Nominations Report as an incomplete slate of candidates was presented. Once the slate is complete, the board can communicate and vote via email.

**Site Selection Report:** Given by Phil Stahlman. Seven different sites for the 2008 meeting have been considered. Two hotels in Denver and two hotels in Anaheim are under consideration. Many venues declined to place bids based on WSWS's room to meeting space ratio.

Nelroy expressed concern over the value of the contract we currently have with Helms Briscoe. For the fee Helms Briscoe is receiving, is WSWS getting more than that value back over what could be done with some other planning organization or conducting the effort internally? Phil Stahlman expressed similar concern, noting though, that it is a significant effort and time-consuming process for anyone to conduct. Jill indicated that Jesse Richardson did a superb job when chair as the site selection committee. His efforts and protocol should have been documented for future reference.

Vanelle asked whether it is time to reconsider our relationship with Helms Briscoe. Rod indicated that the relationship between Helms Briscoe and WSWS began when he was president. They are to have a list of WSWS specifications for annual meetings. Rod feels Helms Briscoe has not done the job they indicated they would do for WSWS.

WSWS, ideally, should have a member(s) who would oversee the site selection process indefinitely. Rod suggested that Phil Stahlman write a letter to Helms Briscoe to convey our disappointment at their services. Nelroy suggested we contact Rhonda, with Allen Marketing, to inquire about her interest, availability, and services. Rod moved that the WSWS board ask Nelroy to work with Allen Marketing and our site selection committee to work on a site in California for 2008. Motion was seconded. Nelroy is willing to work with this direction given. Jill suggested that this concept be looked at relative to web site management and other society functions, from an efficiency and cost management perspective. Motion passed on a voice vote.

Phil Stahlman brought up the liability insurance issue and indemnification clause. WSWS needs liability insurance for the Portland meeting. Wanda is checking into insurance contracts to cover that. Our workers compensation insurance agency suggests waiting until closer to that meeting. These policies are site and meeting specific. Phil Banks indicated that we can ask sites for proof of liability if something occurs which is fault of the site. Nelroy moved that we get liability insurance for the Vancouver, BC meeting in March 2005 and all future annual meetings. Phil Banks seconded the motion, and amended the motion that the business manager insure this becomes part of the standard protocol for meeting process. Motion passed on a voice vote.

Vanelle moved and Phil Banks seconded to accept the site selection committee report. Motion passed on a voice vote.

**Awards Committee.** Phil was not able to make contact with Marvin Butler, but there are not any hold-over candidates for awards.

**Fellows and Honorary Members.** Submitted by Jeff Tichota.

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*Committee Members: Jeff Tichota (Chair), Frank Young and Carol Mallory-Smith*

*The committee received three public sector nominations in 2003, Don Morishita, Joan Campbell and Roland Schirman. Don Morishita was elected fellow. Three private sector nominations were also reviewed; Phil Banks, Bill Cobb and Vince Ulstad. Phil Banks was elected fellow. One nomination for Honorary Member was received and Doug Schmale was elected honorary member.*

*Nominations for Fellow and Honorary Member for the next WSWS selection are due December 1, 2004. We have two pending nominations in both the private and public sector and no nominations for Honorary Member.*

*Posting of selection criteria and reminder to sponsor nominations have been posted in the WSWS newsletter and will continue in future newsletters. Following the December deadline for nominations, I will copy and send the selection criteria and nomination letters to Frank Young and Carol Mallory-Smith. We will vote on the candidates and select one Fellow for the Public and Private sector and Honorary Member.*

*Please urge those attending the WSWS Summer meeting to contact other WSWS members and nominate additional candidates for these positions.*

*Jeff Tichota  
Fellows and Honorary Member Chair*

Motion made and seconded to accept the report. Motion passed on a voice vote.

**Finance Committee Report.** Submitted by Rick Boydston.

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*Report of the Finance Committee (Rick Boydston, Jesse Richardson, and Phil Munger)  
to the Executive Board's Annual Summer Meeting on July 31, 2004*

*The Finance Committee met at the annual WSWS conference in March and via telephone in July to review investment reports and to discuss the society's finances. 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 the Investment Advisor are operating according to the WSWS Investment Policy Guidelines and Objectives.*

*As of June 30, 2004 the RBC Dain Rauscher mutual funds and fixed asset account balances were \$227,868 posting a net gain of \$3,798, or 1.69%, since Dec. 31, 2003. Current asset allocation is 64% Stocks and 36% bonds, which is closely in line with the society's target allocation of 65% stocks and 35% bonds. The Finance Committee agrees with the financial advisor's recommendation that no re-distribution of investments should be made at this time.*

*As of June 30, 2004, the money market savings account (Newark) had a balance of \$41,302.55 and the checking account (Newark) \$1,442.99.*

*On July 6<sup>th</sup>, \$40,000 was transferred out of the RBC Dain Rauscher account to Wanda (Newark account) to go toward the 50% deposit required on the printing of another 10,000 copies of the Weeds of the West book. (Please note that the \$40,000 transfer from the RBC Dain Rauscher account occurred after the end of the 2<sup>nd</sup> quarter. Hence, the withdraw is not reflected in the current financial statement or in the balance of the RBC account or the money market savings account listed above.)*

*Several upcoming expenses include \$15,000 that WSWS committed to help reprint the Bio Weed Control Handbook and costs to cover the WSWS website relocation expenses. In addition, approximately \$1,300 may be needed for hiring a consultant to summarize and consider the results of the member Benchmarking survey, develop action plans, and develop a vision for the future of the WSWS. The fees for printing the WSWS Proceedings are also expected soon and will be approximately \$2,000.*

*Worker's Compensation Insurance is now required for Wanda Graves since she is an employee of the WSWS. The first year's premium was \$433.*

*Respectfully Submitted,*

*Rick Boydston,  
Finance Committee, Chair*

Phil Stahlman gave high review on the services and quality of service offered by Pam Mavrolos in consulting with WSWS on the member survey and review process. Gil moved to accept the report, Vanelle seconded. Motion passed on a voice vote.

**Sustaining member Report.** Submitted by Dennis Tonks.

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Motion made to accept the report. Seconded. Motion passed on a voice vote.

**Legislative Report.** Submitted by Dawn Rafferty. Presented by Nelroy Jackson. Vanelle moved to accept report, Gil seconded. Motion passed on a voice vote.

**Public Relations Report.** Submitted by Kai Umeda. Presented by Charlie Hicks.

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*WSWS Public relations committee report - Summer 2004*

*Kai Umeda, chair, Mark Ferrell, Brad Hanson, Milt McGiffen, Bill Cobb, Brian Olson*

*(Brian Olson was added in 2004)*

*1) Continuing education hours were requested and granted by 9 states and sign-in/sign-out sheets were submitted to individual state regulatory agencies.*

*Arizona, California, Colorado, Idaho, Montana, New Mexico, Oregon, Washington, and Wyoming had unique individual requirements for sign-in/sign-out by licensed attendees. Certified Crop Advisor (CCA) and Society for Range Management (SRM) CEU's were applied for and submitted.*

*2) Phil Banks and I were official photographers for the 2004 meeting. Photographs with a press release described the annual meeting highlights for inclusion in the WSWS newsletter, WSSA newsletter, the WSWS Proceedings. (Sent to David Shaw and Joan Campbell)*

*Pictures included Fellows and Honorary Members, Outstanding Weed Scientists and Presidential Award, WSWS officers and executive committee, student poster winners, and student paper winners.*

*3) Press release may be issued following September newsletter to announce the 2005 meeting in Vancouver, B.C. Canada*

*4) Press release generally is sent by email to publishers of various magazines after the program is released.*

*Associated Press, capitalpress.com, farmjournal.com, FarmProgress.com, metrofarm.com, agriculture.com, turfmagazine.com, advanstar.com, primediabusiness.com, freshcut.com, WSSA, yumasun.com, ASHS, ASA, vancepublishing.com*

*Inputs are requested for expansion of the distribution list for the press release.*

*Respectfully submitted,  
Kai Umeda*

Phil Banks moved to accept, Gil seconded, the report. Phil Banks expressed high appreciation for the work Kai has done on public relations. Motion passed on a voice vote. It was noted by Phil Stahlman that the composition of the public relations committee should be changed, requiring a by-laws change.

**Placement Committee Report.** Submitted by Pam Hutchinson. Presented by Drew Lyon.

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Due to technology changes, few people utilize the traditional placement service function. The committee should be encouraged to recommend changes in the function and/or form of the placement committee. Nelroy moved, Gil seconded to accept the report. Motion passed on a voice vote.

**Education Committee Report.** Submitted by Scott Nissen. Presented by Charlie Hicks.

Due to conflicting information on the MOA modules on the website between WSWS and Univ. of NE, the board recommends that Scott contact Tony White to clarify the situation. WSWS needs to cohost or mirror the Univ. of NE site for the herbicide MOA modules. The contact path, distance education specialist at Lincoln

Rod reported that a very successful short course was held in Chico Springs. A waiting list of attendees exists for the short course. Weed ID, sprayer calibration, problem handling, specific weed issues, riparian areas, mapping, herbicide MOA, safety, are topics covered in the course.

**Necrology Report.** No report submitted.

**Herbicide Resistant Plant Report.** No report submitted.

**Member Survey Report.**

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The board moved into discussion on the Member Survey & WSWS Future Direction project. Past & selected board members have taken a benchmarking survey. A member survey was conducted at the meeting in Colorado Springs. Vanelle, Phil S. & Phil B. have summarized that information and sent out summaries & assignments to the current board.

Vanelle lead the group discussion, with the following objectives:

- informed—member needs & perceptions
- decide on new areas of work
- develop course of action—within 18 months.
- have fun leading the course of WSWS direction

The agenda for this board meeting is:

- review & history
- Member Survey
  - o Data Analysis—small groups
  - o Small Group reports
  - o Board Discussion
- Benchmarking Memo
  - o Review
  - o Future Direction—small groups
- Deciding New Priorities
  - o Group Reports—future
  - o Board Discussion
- Next Steps/Evaluation—back to members

Board Member Survey Small Groups:

- Group 1: Jill, Gil, Wanda—Who are we? Questions 1, 2, 3a, 7  
Group 2: Vanelle, Tim, Charlie—Value of WSWS. Questions 3b, 3c  
Group 3: Phil B, Vince, Rod—Leadership & Representation. Questions 4a, 4b, 5  
Group 4: Phil S., Nelroy, Drew—Challenges to Our Organization & Profession.  
Questions 6a, 6b.
- 

**Group 1 Report:**

1. Lots of new members  
Early career dominates
2. Most are satisfied.  
Early career / new members expressed some dissatisfaction  
Keep meetings relevant & affordable.
3. Communication needs improving (advertising, web site, moving from small, intimate organization to larger, diverse organization—how to keep people engaged.
4. Are we losing the mature group? ( $\geq 20$  year membership)

**Group 2 Report:**

What's Going Well?

- annual meeting
  - o networking
  - o information exchange
  - o informal discussions

What's Not Going Well?

- including agency personnel (and topics) as well as other disciplines (ecology, etc.)
- more workshops/symposia
- on-line registration
- career management for young scientists

Coming 12-18 Months

- interdisciplinary exchange
- continue what's right
- website
- marketing to diversify membership (title review for projects)

Coming 2-5 Years

- Know/communicate the processes involved for symposia/workshops
- How to get involved as session chairs, active recruitment

**Group 3 Report:**

Question 4a. Leadership recruitment is generally adequate to better than adequate. Some new and early career feel it can be improved.

Question 4b. How to Improve?

- actively seek leadership from federal & state employees (Forest Service, Fish & Wildlife, etc.)
- cost of travel (especially to summer board meeting) inhibits some from accepting board leadership
- change board membership to add one more Member-at-Large. Thus we might have a *Member at Large, Private* and a *Member at Large, Public*.

- At graduate student breakfast, the immediate pas president visit with students and outline history and function of the society, how to get involved, etc. and put PowerPoint presentation on website.

**Group 4 Report: Questions 6a & 6b. Challenges & Opportunities.**

- A. What we are doing successfully
- a. Emphasis on range and forest, wildlands, invasive species
  - b. Discussion topics—a regional strength
  - c. Annual meeting is of value to the membership

Challenges

- concern over maintaining membership
  - lack of employment opportunities---lost positions, consolidations
  - reduced funding
  - perceived resistance to change—herbicide dominated, need more ecology, holistic approaches
  - capturing federal employees—capitalize on present and increase awareness of invasive species issues.
  - Continue invasive trend, form new alliances, & partnerships.
- B. strong interest in invasive weeds. (20% of responses)  
Demographics do not look good for continued growth without change, refocusing (~ 15% of responses)  
Retains core agronomic sections.

New Ideas & Directions:

- Thrust of invasive species, openness to change
- Don't lose agronomic base
- New & younger members into leadership roles
- Key members into influential positions, legislation & regulatory.

Member Survey Themes / Discussion:

1. Non-traditional members
  - a. Survey others (agency personnel, retired, "lost" members)
2. Program changes / maintain core agronomic focus
  - a. More ecology
  - b. Biotech crops
  - c. Emerging issues in weed science (e.g. invasive species)
3. Enable / engage new members to join / continue / increase involvement.
4. Retain established members  
Continue good annual meetings
5. More symposia / workshops
6. Continue discussion sessions
7. Website / Marketing / Membership
  - a. Frequently asked questions (FAQ)
8. Value of membership outside of employment career
9. Mentorship program—informal or other

The above list may be summarized as:



- Membership Issues
- Programming
- Communication
- Leadership Development
- Advocacy

Turning to the Benchmarking Survey conducted late last fall, 22 participants were asked to complete the survey. Of those, 20 completed & returned the survey. Jill & Vanelle asked the board to individually review the Benchmarking survey along the following guidelines:

- What were the themes/patterns from the member survey?
- Review the benchmarking memo with these in mind.
- What are the important ideas, similarities/differences, new conclusions?

#### *Board Discussion on the Benchmarking Memo*

Similarities between Benchmarking Survey & Member Survey:

- strong annual meeting
- communication improvement
- membership recruitment & retention
- leadership recruitment & development

Difference between Benchmarking Survey & Member Survey:

- alliances with other organizations
- financial issues: Board view is on finances. Member view is cost of travel & meeting registration.
- Board views leadership as strong and works well together, but lack of continuity, which is an outcome of annual leadership change.

Where do we go from here? (Reports of the board breaking down into 2 subgroups.)

Priority: Mentoring / Leadership Development (regardless of age)

- WSWS has a known mentorship program & broaden representation in the organization.

Activities:

- Graduate student breakfast introduction to WSWS
- New member orientation
- Increase board members at large to represent private & public, possible appointed by president-elect, to serve 2 year terms.

Who involved? Past president, constitution & by-laws, other board members

Tools:

Priority: Membership Retention & Value

- Have an annual meeting that informs a diverse audience.

Activities:

- Symposia & workshops
  - o How to propose
  - o Recruit ideas
- Balance economic reality/venue selection
- Meet with other organizations

Who involved?

Tools:

Priority: Broadening the program while maintaining the core focus. (to invasive species, ecology, biotechnology)

Outcome Goal: Maintaining the core program while broadening the offerings to include IS, ecology, & biotech.

Activities Toward Goal Achievement

- Review project titles with an eye towards IS/E/B
- Actively solicit papers/posters and encourage members to do the same
- Plan more symposia/workshops—develop a process
- Emphasize discussion sessions

Who?

Priority: Membership Broadening (retention & recruitment) and alliances with other organizations

Outcome Goal: Broaden membership to include nontraditional individuals and form alliances with compatible organizations.

Activities Toward Goal Achievement.

- appoint ad-hoc committee
- task\_\_\_\_\_ to communicate with federal agencies
- promote sponsoring workshops with other organizations
- promote WSWS annual meeting with short course attendees.

### **7-31-04:**

Combining some similar priorities from the groups yielded 3 basic priorities:

**Priority:** Annual Meeting (Phil Banks, as program chair / president-elect, to champion)

- Maintain the core annual weed science meeting and expand the content to provide value to a diverse audience from the western US and Canada.

- Activities
  1. Solicit papers/symposia/workshops around emerging issues
  2. Inform how to propose topics—website, newsletter, personnel
  3. Balance economic and venue issues

- 4. Strong discussion sections
- 5. Market-content driven titles, etc.
- Who: program committee, project chairs, board, site selection committee, publications, public relations
- Tools & Resources: website, budget conference calls, budget symposia/workshops

Timeline: 2005 annual meeting

**Priority:** Mentoring / Leadership Development (regardless of age) ( Gil Cook, as past president, to champion)

- WSWS has a known mentorship program & broaden representation in the organization.

Activities:

- Graduate student breakfast introduction to WSWS
- New member orientation & recognition
- Increase board members at large to represent private & public, possibly appointed by president-elect, to serve 2 year terms.
- Board recruits new participants.
- Continue "Student Night Out"
- Evaluate committee numbers / members
- Develop mentorship program
- Board to develop vision statement for WSWS

Who involved? Past president, constitution & by-laws, other board members, all past presidents & fellows,

Tools & Resources: Program chair, newsletter, local arrangements, website, public relations, personal invitations

Timeline: 6 months to 2 years

**Priority:** Membership Broadening (recruitment) and alliances with other organizations (Phil Stahlman, as president, to champion)

Outcome Goal: Broaden membership to include nontraditional individuals and form alliances with compatible organizations.

Activities Toward Goal Achievement.

- appoint ad-hoc committee (Membership Development)
- task\_\_\_\_\_ to communicate with federal / state agencies
- promote sponsoring workshops with other organizations
- promote WSWS annual meeting with short course attendees.
- explore meeting with compatible organizations

Who involved? WSWS membership, president, president-elect, science advisor,

Tools & Resources: Personal contact, conference call budget

Timeline: March 2006 annual meeting (2-3 years)

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Discussion was held on whether or not to develop a specific vision / mission statement for the WSWS. Gil Cook volunteered to begin the process of developing a vision statement.

(Gil's email address: [cookge@comcast.net](mailto:cookge@comcast.net))

Once these priorities are fine-tuned and board approved, the priorities need to be communicated / sent out to the membership. A list serve is currently being developed. Target date will be for an email message to go out 1 October, inclusion in the November newsletter, and a presentation at the general session of the next annual meeting. Phil Stahlman will write a cover letter to accompany the email and a presentation for the annual meeting.

One more session has been scheduled with Pam Mavrolis, ICL, to review the progress to date and debrief the entire process. Phil Stahlman requested an additional two hours of consultant time, if needed. Vanelle indicated a total of 4 hours may be needed. [Phil Stahlman moved, Phil Banks seconded, to approve up to an additional 4 hours \(\\$200\) of funding to complete this process, if needed. The board originally approved 14 hours. Motion passed on a voice vote.](#)

Communication and funding issues remain long term goals / needs for the board and society to address.

Thanks were expressed to Jill Schroeder and Vanelle Carrithers for moderating the process and the standard by which the process occurred, which will serve as an example to the other regional and national society.

[Gil Cook moved for the society to cover the expenses of the board dinner last night. Nelroy seconded the motion.](#) Discussion was held on historical precedence for this. It has not been standard practice for the organization to cover any travel expenses. No guidelines occur in the operating guidelines relative to this. Phil Banks did not feel it is appropriate for the board to take this up after the fact, but the issue could be addressed for future reference. Rod Lym gave a historical perspective on the society's view on financial issues. Phil Banks indicated it may be an issue which should be up to the membership to decide. Rod suggested that a budget for the board meetings be developed. [Motion was defeated on a voice vote.](#)

Phil Stahlman will appoint a committee to study the issue of expenses for board meetings and report back to the board. Gil Cook, as immediate past president, Phil Banks, as president-elect, Drew Lyon, & Rick Boydston, finance committee, were appointed to develop a recommendation for the board. This will be done in consultation with Wanda Graves, business manager.

**Publications Committee Report.** Presented by Phil Banks.

*Publications Committee  
Website Report  
Tony White*

*The WSWS website committee met during the 2004 annual meeting in Colorado Springs to discuss issues regarding the website. Specific information regarding the discussion that took place during this meeting is provided in the Website Ad Hoc Committee Report.*

*After Joan Campbell indicated she wanted to step aside as WSWS website editor, Tony White was named as the new website editor. During this transition, multiple problems occurred when trying to obtain database information necessary to complete the proceedings for the annual meeting. In addition, server and programming problems rendered many pages on the website inaccessible between early April and late June. Therefore, no information on the website could be changed or deleted through the module set up for editing. After several unsuccessful attempts to contact Intelsys or the programmer in Russia to fix the problems, the decision was made to discontinue their services, redesign the site, and transfer everything to a Windows-based server.*

*Tony White created a new website design that went online July 6, 2004. The Website Committee members were contacted to view the new site and provide input towards design and content. The site was designed to provide easy navigation and up to date Society information. The new design contains information from the old site and some new components. The online lessons are no longer operating on a mirrored site. With the permission of the University of Nebraska, lessons related to Weed Science are directly linked on the WSWS website. Written permission to do this is not necessary as long as UNL remains acknowledged as the host of the lessons.*

*The WSWS website will soon contain search capabilities, secure member profile information, online meeting registration, and online title/abstract submission pages. All of these components are currently in development and require thorough testing before available to all members. Plans are to have these components fully functional by the start of registration and online abstract submission in late Fall 2004. List serve email capabilities are also in the works for sending out email to all members, correspondence among board members, and newsletter subscriptions. Please submit additional web ideas to Tony White at [twhite@ksu.edu](mailto:twhite@ksu.edu).*

*Weeds of the West:* Reprint process needed to begin before this board meeting commenced. 5000 copies were in storage and average sales were 500 per month. It is recommended to the board that a careful analysis be done prior to the next anticipated reprinting of the book. Phil Stahlman indicated that the board had intended to examine this issue at this board meeting, but the issue was pressed by miscommunication during the process and the desire to save additional printing costs due to rise in paper costs.

*Biocontrol Publication:* An extensive email discussion was conducted among the board over the past 4 months and the board had voted to approve appropriation of \$15,000 to support publication of the Weed Biocontrol book by Oregon State University Press.

*WSWS Proceedings:* 225 copies of the 2004 Proceedings was printed by Omnipress and will be delivered to Wanda. The Proceedings has 196 pages and cost \$2,160 for \$9.60 per book. The Proceedings contains a subject index,

2005 call for research progress reports is being updated and will be included in the September newsletter. Income from the 2004 Research Progress Report was \$5,000. Comments were made as to moving the Proceedings and Research Project Report from printed to CD format. Phil Stahlman indicated it may be possible to automatically give everyone who registers access via the website to these reports.

*Newsletter Editor.* Pat Clay is the new editor. His first newsletter will be the September issue and will include the call for papers and an update on the upcoming meeting in Vancouver, BC in March 2005. Submissions for the newsletter should be made by middle of August.

*Website Editor.* Tony White is the editor. The new website design went on-line 6 January. Progress is being made and it has been a time-consuming task, as programming is involved. Discussion was held on budgeting and remuneration for this position. [Gil moved to provide travel expenses to the annual meeting for the website editor, congruent with that approved by the board for the Proceedings and Research Progress editors \(airfare, room for the 3 nights, copy of the Research Proceedings, complimentary registration\).](#) [Motion was seconded by Phil Banks.](#) Discussion was held on whether to put a cap on the amount. Phil S. offered a friendly amendment that the airfare be limited to a non-refundable ticket. [Motion passed on a voice vote.](#)

Discussion was held on further compensation for the website costs. Phil Stahlman will review the situation with Tony. Gil suggested that Tony submit an estimate of time spent on the website and the board consider reimbursing Tony for that time. Given the critical nature of the website to the WSWS, the board needs to stay on top of this issue. Consideration should be giving to tying in with the WSSA as this issue is similar for the national as well as regional societies. Phil Stahlman will talk to Tony and report back to the board.

Nelroy moved, Vanelle seconded, to accept the report of the Publications Committee.

**Student Paper and Poster Contest.** Report submitted by Kirk Howatt.

#### ***Student Paper Judging Committee***

*Members:* Steve Enloe  
Vanelle Carrithers  
Kirk Howatt (chair)

*July 19, 2004*

#### *Report:*

*The Student Paper Judging Committee acting on request from the Executive Board and by information presented in a formal letter of concern has considered the practice of presenting similar papers in more than one professional society contest. The committee also discussed students from outside the WSWS who may want to enter our contest, multiple entries from a student, student status, and sanctions.*

*The committee's suggestions for dealing with these points may be found in item five of the revised operating guide and paragraph two of the contest guidelines (see attachments). We feel these clarifications should be made known to individuals who advise students and request the Executive Board's comment on whether this announcement should come from the Judging Committee or the Executive Board.*

*Stipulations of student status were not further defined because it was decided that wording would be too restrictive. Students may be pursuing their degrees under a number of circumstances depending on personal, financial, and employment obligations. We felt the potential for professional persons entering the student contest was not a significant risk compared to eliminating appropriate contestants.*

*Sanctions were not included in the changes at this time. These revisions will more precisely explain what is expected as a valid entry in the Student Paper Contest. Violations are not expected, but infractions that may occur will likely vary in severity and require individual assessment. One point that may need to be inserted in the operating guide is who would deal with infractions. I would suggest dealing with infractions be handled by the executive board since it is the governing body of the Western Society of Weed Science.*

*Action Items:*

- 1) Approval of contest guidelines for the 2005 annual meeting.*
- 2) Approval of revisions to the operating guide.*
- 3) Advise whether the Student Paper Judging Committee or the Executive Board should make the formal announcement of contest entry clarifications.*
- 4) Addition to the operating guide pertaining to sanctions.*

*Respectfully Submitted,  
Kirk Howatt*

Kirk has asked that a protocol he submitted regarding the paper judging process be added to the Operating Guide. Discussion was held on students submitting multiple papers or posters, or a poster and a paper, and how to allow them to compete for recognition as compared to including more students in that competition for recognition. Board discussion was also held on striking the reference to not allowing students from states outside of the WSWWS geography to compete and win awards in paper and poster contests. Discussion was also held on policing the parameters of participation in national and other regional society contests. It is felt that it is the responsibility of the committee, not the executive board, to police and enforce the guidelines and rules. Gil moved to accept the report with modifications. Vanelle seconded. Motion passed on a voice vote.

**Student Poster Committee.** Report submitted by Tony White. Presented by Phil Banks.

*Poster Committee Report  
Tony White, Chair*

*The poster committee met informally during the 2004 annual meeting in Colorado Springs. Tony White agreed to serve as Chairman for 2005. The poster session during the 2004 annual meeting was smooth, even though some posters required moving to*



*make room for the banquet. Easels borrowed from the WSSA were returned by Phil Stahlman. WSWS easels were transported to Idaho for storage until the 2005 meeting. Arrangements for easel transport to Vancouver will be made at a later date.*

Easels have been transferred into Tim Miller's hands, for transport up to Vancouver. Phil B, Gil C moved to accept report. Passed.

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**Old business:**

The proposal for a summer weeds contest was brought up. Pam Hutchinson submitted a report on the 2004 NCWSS Weed Contest and a proposal to initiate a summer weed contest in the WSWS. Phil Banks indicated that it would be very important to survey major professors and students as to their desire and intent to participate in such a contest. There needs to be a core group of universities to take the lead in developing and maintaining such an effort. Jill indicated that for WSWS to participate as a sponsor, a significant number of the state members of WSWS would need to participate. It would not be fully representative to the WSWS membership for the society to sponsor such a contest for only a few participating universities.

General board comments were to encourage development of the contest, but with no commitment towards board funding of the expenses. Phil Stahlman will contact the ad hoc committee to relay the board's comments, concerns, and encouragement.

Gil moved, Drew seconded to accept the report as presented. Motion passed on a voice vote.

A formal vote had not been taken on whether to provide financial support for Pam Hutchinson to attend the NCWSS weed contest as an observer. Costs are not yet available for specific consideration. Phil Stahlman indicated we need to address the specific request made on expense support. He questions whether the issue is relative to the expense issue to board meetings and other society functions. General board consideration was not to reimburse any expenses for the trip.

The presence of a student representative on the board of directors was reviewed. No guidelines are presented in the Operating Guide for selection of a student representative. Ad hoc procedures have been utilized for selection in the immediate past. The bigger issue is to evaluate committee size, purpose, and composition relative to the overall Operating Guide procedures.

**New Business:**

Jeff Tichota's letter on expanding the interest of WSWS to include biotechnology issues was introduced for discussion. Phil Banks moved to accept the report, Gil Cook seconded. Motion passed on a voice vote.

A motion was made to adjourn, seconded, motion passed. Meeting was adjourned at 11:20 AM.

Respectfully submitted,

Vince Ulstad  
Secretary

Western Society of Weed Science Board Meeting  
7 March, 2005

***Hyatt Regency / Vancouver, BC***

Members Present: Phil Banks, Vanelle Carrithers, Janet Clark, Wanda Graves, Charlie Hicks, Nelroy Jackson, Kassim al Khatib, Rod Lym, Drew Lyon, Tim Miller, Corey Ransom, Jill Schroeder, Doug Shoup, Phil Stahlman, Vince Ulstad

The meeting was called to order at 8:01 AM by President Phil Stahlman.

Nelroy Jackson moved to approve the agenda for the meeting. The motion was seconded and passed on a voice vote.

Nelroy Jackson moved to accept reports as presented, as a block, rather than voting individually on each report. The motion was seconded and passed on a voice vote.

Introductions of members present was held.

Minutes of the summer board meeting were accepted with revisions, substituting the long range planning session notes with the revised survey report assembled by Jill Schroeder and Vanelle Carrithers.

**Business Manager's Report, Wanda Graves:**

Wanda reported that the year-end tax report will be filed the end of March. Our tax year runs April 1 to March 30. A large expense for reprinting of Weeds of the West was incurred, and income from that investment will come in as sales revenues are received.

Phil Stahlman indicated that Wanda has announced her intention to retire after the conclusion of the Reno meeting in March 2006. We are very appreciative of her service & strongly regret her decision, yet wish her the very best in her retirement. She has been the backbone of every board with which she has served.

**Program committee report, Phil Banks:**

The deadline for title submission was Dec. 1. Phil had a list of all titles within 5 days of that deadline. The total number of papers are down slightly, as are poster numbers, from previous years. Two symposia will be held. Other proposed symposia, including the knotweed symposium, were tentatively scheduled for future meetings. Typically, two symposia are all that can be effectively worked into an annual meeting. Seven hundred programs were printed. Wanda indicated that number is fairly firm in representing needs from year to year. All members get mailed a copy, extras are brought to the meeting for distribution, and some are distributed to WSSA attendees. Printing costs with the firm in Las Cruces, NM, who printed the programs this year, was very reasonable.

## **Research Section Report, Drew Lyon:**

### **Education & Regulatory Section report, C. Hicks:**

The session this year will address revisions in the pesticide registration process, with two speakers from industry and 2 from public positions.

Phil Banks indicated that some projects have had few papers over the past few years, including Wetlands & Wildlands, and Teaching & Technology. Discussion was held on balancing the paper numbers in these and all projects, and that certain meeting locations tend to encourage more presentations in certain project sections. Upcoming meeting locations should see more presentations in these sections, especially in Wetlands & Wildlands.

Twenty extra easels for the poster contest were obtained from WSSA. WSWS currently has 50 of our own. Consideration has been given to purchasing more easels for our own use. It may be more efficient and less expensive to rent them from WSSA. Phil Stahlman looked into purchasing more last year. Phil Banks will explore options for our easel needs. Nelroy Jackson suggested that the regional societies and WSSA explore having a common pool of easels and ship out of that pool for each meeting, i.e. shared costs. A central location for storage & shipping could save money and effort annually.

Jill Schroeder has been approached to expand the focus on Turf & Ornamentals and this may be an expansion area for projects and membership. Nelroy Jackson suggested they would currently fit in Horticulture. Kassim al Khatib & Phil Banks will explore this as a possible new outreach.

### **Past President's Report, Gil Cook:**

Gil has sent out and received comments back on the proposed mission statement. Gil presented a list of retirees who have been identified. These retirees will be recognized during the meeting.

The adhoc committee organized to research expense reimbursement for summer board meeting attendance of non-board members has met. Rick Boydston will present the discussions to the Finance Committee for recommendations. The Finance Committee will put forward a specific proposal.

A review of the proposed mission statement was held. Gil Cook presented the draft as it exists today and asked for comments. Nelroy Jackson suggested editing references of 'Canada' to 'western Canada'. Other suggestions were made and Gil will revise and work up a revised draft to circulate. The mission statement should reflect our efforts to reach out to all personnel involved in weed plant science. Gil will incorporate all comments he receives and email them back out for review.

### **WSSA Report, Nelroy Jackson:**

Attendance in at the annual meeting recently held in Honolulu was very high and demonstrated the value of carefully selecting a location. The 2006 meeting will be in

New York. WSWS will produce a poster reviewing the history of our society. Coordination of regional and national meetings has been addressed to avoid as many conflicts as possible.

WSSA is looking into digitizing back issues of Weed Science and Weed Technology.

The President's breakfast included regional society representatives, and reviewed the possibility of sharing executive leadership, annual meeting times & content, and overall membership declines. A committee was appointed of the regional society representatives and the WSSA vice-president to discuss membership issues. Another committee was appointed to discuss website issues. The three main focus areas for interaction are website issues, member services, and operating efficiency.

Jill Schroeder is the new vice-president of WSSA.

**CAST Report, Rod Lym:**

Rod reviewed the written CAST report.

**Constitution & Operating Guide Report, Jill Schroeder:**

Jill sent out suggested revisions to the operating guide last month. Jill moved to accept the operating guide in its updated & current form. Gil Cook seconded the motion. Discussion was held on how critical it is to update this document annually, as it forms the backbone of our operations. Phil Stahlman expressed thanks to Jill Schroeder and Roland Shirman for their efforts on updating the guide. Jill has resigned as Constitution and Operating guide representative, and Kai Umeda has replaced her. The motion passed on a voice vote.

Jill Schroeder moved and Vanelle Carrithers seconded a motion to accept Kai Umeda as the new Constitution & Operating guide representative. The motion passed on a voice vote.

**Member-at-Large Report, Vanelle Carrithers:**

Vanelle will present a review of the member survey conducted during last year's annual meeting to the general session and will visit the graduate students during their breakfast. Phil Banks suggested that general session speakers present a short, written version of their presentations to include in the proceedings.

Vanelle has been approached by some members of adding emphasis to the area of Turf & Ornamentals.

**Local Arrangements Committee Report, Tim Miller:**

Tim presented a verbal report on the status of the meeting and sessions.

Progress Reports and easels for the poster session are on the way to the hotel and will be set up this afternoon.

**Finance Committee Report, Rick Boydston (presented by Vince Ulstad):**

The submitted written report by the Finance Committee was read and discussed.

**Nominations Committee Report, Bill McCloskey (presented by Phil Stahlman)**

The submitted written report by the Nominations Committee was read and discussed.

**Fellows & Honorary Members Report, Jeff Tichota (presented by Gil Cook):**

A suggested change for the operating guide is that nominators of unsuccessful packages be notified of the results.

Rod Lym noted that the operating guide does not specify a Public and a Private breakdown in annual Fellow selection, yet this committee report implies that may have been the guidelines which were followed this year. This led to a discussion on how to insure that new committee members know where and how to review their respective duties & responsibilities as specified in the operating guide.

**Awards Committee Report, Marvin Butler (presented by Phil Stahlman):**

Phil Stahlman indicated the operating guide needed to be updated relative to the approval of new award categories approved a few years ago. Guidelines will be updated for the procedure, including forms for award nominations, and selection. Phil indicated there had also been approval in 2002 for an Outstanding Extension Worker award, for which there have been no nominations and the award seems to have been forgotten.

**Poster Contest Report, Tony White (presented by Phil Banks):**

The submitted written report by the Poster Contest committee was read.

**Student Paper & Poster Contest, Kirk Howatt (presented by Phil Banks):**

The submitted written report by the Student Paper Contest committee was read.

**Publications Report, Phil Banks:**

Phil reviewed the finances associated with the *Weeds of the West* publication. Average cost of printing the books has been \$10.50. The current selling price is \$13 to the University of WY. About 5,000 copies per year are being sold. Phil will recommend an analysis be conducted on how to best manage reprinting, as the expense hits on a one-time basis, yet income and expense recoupment from the process is spread out over the sales period of the book. The analysis should include ownership of the photos, historical sales analysis & pricing elasticity relative to demand, distributorship options, and firming up, contractually, expectations and responsibilities.

**Newsletter Report, Pat Clay (presented by Phil Banks):**

About 20% of the membership does not have their email address on the web. Discussion was held on whether or not to continue producing and distributing hard

copies of the newsletter, in addition to the electronic copy. Rod Lym spoke in favor of having the hard copy. Each edition costs about \$150 to 200 to send out. Maintaining communications with membership is always a critical issue for an organization. General consensus of the board was to continue to produce and mail hard copies. Email notices will still go out to membership indicating the newsletters are posted on the website.

#### **Website Report, Tony White (presented by Phil Banks):**

Phil noted how much effort and success Tony White has put into making the website a functional and successful process. Title and abstract submission was more efficient, with very few glitches in the process. Due to the high number of hours spent on getting the website functional to the current level, remuneration is suggested by the committee report, as well as suggestions for operating efficiencies related to meeting registration and use of credit card transactions over the web.

Gil Cook moved that WSWS set up on-line credit card processing for financial transactions. The motion was seconded by Kassim al Khatib. The motion passed on a voice vote. Phil Banks will work with Tony White to determine the best arrangements for the society to accomplish meeting registration. For now, several options for members to register need to be maintained.

Discussion was held on remuneration for the website coordinator. Tony has suggested that the level be comparable to what was previously associated with the website maintenance. Discussion was held on whether this should be extended to other editorial responsibilities and the fact that the board voted at the summer meeting to reimburse travel expenses for the website editor. It was pointed out that, if we are to compensate the website editor, we would need to compare other professional services that we could get for the money and balance that with the fact that outside services would not bring the personal knowledge of the society and its needs to the position. It was suggested that the Website/Publications and Finance committees, along with Phil Banks, oversee the development of this issue. A motion was made by Vanelle Carrithers and seconded by Gil Cook to table this issue until it can be discussed with Tony present. The motion passed on a voice vote.

#### **Sustaining Membership Report, Dennis Tonks (presented by Gil Cook):**

Discussion was held on sustaining member fees. Phil Banks indicated fees might be raised somewhat, but care needs to be taken not to drive sustaining members away, since they are also often paying for meal functions, breaks, and other society functions. Gil Cook suggested attempting to draw new members in, such as distributors and smaller companies. The current fee structure has been in place since initiating the sustaining membership category. Tony White indicated there are links on the website to sustaining member websites.

Nelroy Jackson suggested leaving membership fees as they are and institute the third tier of membership (\$100), for states, which was apparently approved at an earlier board meeting.

#### **Necrology Report, Carol Mallory-Smith:**

Three members were identified as having passed away and will be recognized at the business meeting and be sent to the newsletter committee.

**Placement Report, Pam Hutchinson (presented by Drew Lyon):**

The committee believes the current utility of the Placement Committee has declined significantly as technology over time relative to matching employers and employees has changed. The committee put forth several recommendations in its report. Many of the functions previously performed by placement committees have been replaced by the web.

Vanelle Carrithers moved to dissolve the Placement Committee. Gil Cook seconded the motion. This will require a constitutional change. The motion passed on a voice vote.

Discussion was held on having the Student Educational Enhancement Committee or an ad hoc committee write up a job series for weed science.

**Public Relations Report, Kai Umeda (presented by Charlie Hicks):**

The committee report was read. Kai Umeda has requested to be relieved from his duties as chair of the committee. Currently, the chair is set up as a non-rotating assignment for continuity reasons.

**Education Report, Scott Nissen (presented by Charlie Hicks):**

The committee report was read. Tony White indicated he has been in contact with Tracy Sterling about utilizing the web for the teaching modules. Phil Stahlman indicated that one of the items listed on the member survey was increased interest in web-based learning. Vanelle Carrithers encouraged the committee to work with the Center for Invasive Weed Management, which is also working to develop self-study modules.

The noxious weed short course will be held again, with a waiting list of potential attendees.

**Legislative Report, Dawn Rafferty (presented by Nelroy Jackson):**

Nelroy reviewed the priority issues for 2005 for the Weed Science Director of Science Policy. Rob Hedberg indicated he is still taking input on 2,4-D comments to be drafted. Rob also reviewed the chlorsulfuron risk quotient for endangered species and how it is determined which molecules with which to become involved in risk assessment.

**Herbicide Resistant Plants, Kirk Howatt:**

HRAC-NA has requested that a university representative from WSWS at their meetings, which are held during the WSSA annual meeting.

**Student Educational Enhancement Report, Bill Kral:**

No report was available.

**Site Selection Report, Traci Rauch:**

Drew Lyon moved to accept the Hyatt Regency, Orange County, March 8-14, seconded by Phil Banks, for the 2008 annual meeting. Motion passed on a voice vote.

**Director of Science Policy Report, Rob Hedberg:**

A written report will be available later.

Regarding the financial position of the Director of Science Policy, it is set through the end of 2005. No change in the costs for the position have changed for the past seven years. WSWS has contributed about one-half of that contributed by NCWSS and SWSS and about one-tenth of what WSSA has contributed. The finances are being reviewed by the societies to set the next five year period.

**Priorities:**

- federal weed series
- research funding
- invasive species
- regulatory objectives
  - o balanced endangered species perspective
  - o influence process:outcome perspective
  - o enhance stature as reliable provider of information
  - o responsive on ad hoc basis when issues arise

**Accomplishments:**

- job series for weed science and progress towards
- research funding
  - o stressed importance of applied aspects of weed science
  - o participation in PART analysis for CSRES
  - o participation with various coalitions on visiting congressional offices
  - o involvement with USGS for research funding
- invasive species
  - o Invasive Plants of Rangelands & Wildlands book publication: helping define the cost impact of invasive weeds. \$20/copy
  - o S144 act passed.
  - o Symposium on invasive and endangered species. Promoting the role of science & management in protecting endangered species by managing invasive species.
  - o Field tour for agencies to see herbicide application techniques.
  - o NIWAW: 160 people registered, from 35 states.

Nelroy Jackson will take over some of the NIWAW organizational responsibilities, to help free up some of Rob's time.

Weed science societies are now well recognized as being sources of expertise on endangered species.

- regulatory objectives: comments on atrazine review; counterpart registrations for impact on endangered species;

Issues for the coming year will include:

1. agricultural research funding levels



2. invasive species coalition building, especially between conservation groups and environmental groups

Board discussion on WSSA report regarding support of the Director of Science Policy proposal:

Nelroy Jackson requested board discussion. WSWS is the first board meeting since the proposal was put forward. Phil Stahlman lead a discussion on the proposal. Does WSWS want to continue supporting the DSP position? If so, what level of increased support, if any, does the board suggest?

Phil Banks moved to continue support, Rod Lym seconded the motion, of the DCP position. The motion carried on a voice vote.

Rod Lym moved that WSWS accept the support position, suggested by the proposal, to a level of \$15,000 per year through 2011. Phil Banks seconded the motion. The motion passed on a voice vote.

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Tom Whitson provided an update on *Weeds of the West*.

#### OLD BUSINESS:

Update on WSWS logo, report by Rod Lym:

The logo was officially registered on 3 February, 1998 with the US Patent & Trademark Office, for a 10 year period.

Additional member-at-large position on board:

Gil Cook moved to amend the constitution to provide for a second member at large, per the circulated proposal (see language in proposal). Rod Lym seconded the motion. The president-elect chooses the member-at-large, who serves through the presidential term of the president-elect. The motion passed on a voice vote.

#### NEW BUSINESS:

Travel support for summer board meeting:

The Finance committee will review the expenditures required to accomplish this and report back to the board.

Consideration of a Vice-President position on the board, in addition to the President-elect:

The rationale is that the lead time to learn the responsibilities of the office of president may be longer than that which is accomplished by the president-elect. Discussion was held on the issue. Further thought is needed and will be brought up at a future meeting.

Nelroy Jackson moved to adjourn. Phil Banks seconded the motion. The motion passed on a voice vote.

The meeting was adjourned at 5:18 PM.

Respectfully submitted,

Vince Ulstad  
Secretary

WSWS Business Breakfast  
**Secretary's Minutes**  
**10 March, 2005**  
**Hyatt Regency Hotel / Vancouver, BC**

The buffet breakfast, sponsored by BASF, was available at 6:45 AM.

President Phil Stahlman called the meeting to order at 6:55 AM. Announcement of the publishing of last year's business breakfast minutes in the Proceedings. Bob Parker moved and Tony White seconded a motion to accept those minutes as published. Motion passed on a voice vote.

**Business Manager's Report:**

Wanda Graves thanked the board for their support as she conducts her duties & responsibilities. Attendance was 290 registered for this meeting. It was one of the lowest attended meetings in the recent history of the Society. The registrations included 29 graduate students and 10 spouses.

Phil Stahlman announced to the membership of Wanda Graves' intention to retire at the conclusion of next years meeting.

**Program Committee Report, Phil Banks:**

Sixty-two posters and 75 papers were presented during the meeting. Both numbers were very close to historical averages. Topics were of great interest and sections were well attended. Incoming project chairs will be soliciting ideas for topics for next year. Some symposia ideas were not able to fit into this year's program, but may fit for future meetings. Members are encouraged to provide ideas for topics to the program committee.

**Local Arrangements Committee, Tim Miller:**

Tim thanked his committee for their efforts.

**Immediate Past President's Report, Gil Cook:**

Not available.

**Member-at-Large Report, Vanelle Carrithers:**

Membership survey review was provided at the general session. Graduate students expressed great interest in participating in the society. All members are asked to submit comments.

**WSSA, Nelroy Jackson:**

The next annual meeting (2006) will be in New York City. The 2007 annual meeting will be in San Antonio, TX

WSSA accepted a proposal to digitize all back issues of *Weed Science & Weed Technology* and are available on-line.

The Director of Science Policy position was reviewed by the WSSA board. A proposal was written to fund the position through 2011. WSWS board reviewed the proposal at its meeting on Monday and voted to support the proposal, which includes increased WSWS support for this position.

**CAST Report, Rod Lym:**

This is a pivotal year for CAST. Executive vice-president, Theresa Gruber, resigned. The CAST office in Washington, DC was closed due to expenses and uncertainty exists as to where the best location for the executive vice-president should be. CAST CD's from 1994 to 2001 are available, based on topic.

**Constitution and Operating Procedures Report, Jill Schroeder:**

Roland Shirman sent out operating guide procedures & update requests to each of the committee chairs last year. New updates to the operating guide will be published after this meeting and available for all committee chairs. The operating guide is a dynamic document and members are encouraged to submit suggestions for revisions. Kai Umeda will be the new constitution and operating procedures member.

**Poster Section Report, Tony White:**

Tony thanked the local arrangements committee and Tim Miller for transporting easels to Vancouver. Equipment will be transported to a site in Washington for storage until next year's meeting.

**Finance Committee, Rick Boydston:**

The society's investments returned about 10.8% this past year, and continue to be managed by Stan Cooper, RBC. Committee members include Phil Munger and Jesse Richardson. The board has asked the committee to review the society's current financial status, and new financial commitments, including the Director of Science Policy position and also review the Weeds of the West publication.

**Nominations Report, Bill McCluskey:**

Members include Gil Cook and Neal Hageman. Nominees for the various positions were sought and obtained. About a 25% ballot return was received for this year's elections. Members are encouraged to participate in the society's elections. Chair will be Jeff Koscelny. Bob Parker will join the committee this year.

Phil Stahlman encouraged all members to vote and consider running for office.

### **Fellows and Honorary Members Report, Jeff Tichota:**

The committee received three nomination packages for Fellow-Public Sector and three nomination packages for Fellow-Private Sector. No nominations for Honorary Member were received.

The Fellow Award winners are:

- Roland Shirman
- Nelroy Jackson
- 

### **Awards Committee Report, Marvin Butler:**

Seven nominations were received for the four awards given out this year. No nominations for Outstanding Weed Scientist, Early Career, were received. Members are encouraged to consider colleagues and members deserving of award recognition.

### **Publications Committee Report, Phil Banks:**

All society editors are members of the committee. Joan Campbell, publisher of Proceedings, indicates that session minutes, project reports, photographs, are due April 4, for publication in this year's Proceedings.

Key word indexing continues to expand in the Research Progress Report. The 2005 report is 205 pages. Total cost of the 2005 report was \$1947.

Pat Clay, newsletter editor, thanked Don Morishita and Wanda Graves for assisting with the transition. Members are encouraged to submit items and topics for the newsletters. Newsletters will continue to be mailed out and sent electronically to those members with email addresses.

Website editor Tony White reported on the new website and its design. A secure login site was set up to allow members to register for meetings, submit titles and abstracts, as well as search for other society members. On-line registration for this year's meeting went well. About 80% of this year's meeting registration was done on-line. The goal for next year's meeting is 100%. Titles & abstracts will continue to be submitted on-line, and the process will be streamlined slightly. On-line lessons will become available and some symposia slides may be posted as well. Credit card payment options will be available in the future on-line.

Janet Clark has taken over management of the Invasive Weeds book.

Tom Whitson was recognized for his efforts on *Weeds of the West*, which has sold about 128,000 copies. Sales are maturing, but the book has contributed significantly to the financial health of the society.

**Site Selection Report, Traci Rauch:**

Members Steve Dewey, Mike Edwards.

Board voted to approve Anaheim, CA for the 2008 meeting, at the Hyatt Regency hotel. Board voted to terminate the relationship with Helms Briscoe for site selection consultation. A contract with Allen Marketing was instituted and they have been very good to work with on the site selection process.

**Education Report, Tracy Sterling:**

On-line lessons for the website are being created, including herbicide mode-of-action. Several have been published in the *Journal of Life Science*. A distance course for Herbicide MOA is needed, due to reductions in number of institutions teaching this topic. Several members have expressed interest in helping develop this course mechanism. Members are encouraged to visit the site for information.

**Weed Short Course, Celestine Duncan:**

2005 course set for Chico-Hot Springs, MT. The course is full and a waiting list exists. The agenda will be finalized and instructors are set. Course fee is \$450 for this year.

**Placement Committee Report, Pam Hutchinson:**

Bill Kral, Tracy Sterling, Pam Hutchinson, members.

Three positions available were posted for this year's placement service. Results of the member survey indicated that the placement service functions have changed greatly over the years and the committee recommendations were for a web-based hosting of job postings. The board discussed this recommendation and a constitutional change would be required to dissolve this committee, if so determined.

**Public Relations Report, Kai Umeda:**

Press release announcing the annual meeting was sent and posted to a number of sites and publications. CEU credits were submitted to for a number of western states. Pat Clay will take pictures of all award winners, including student winners.

**Legislative Report, Nelroy Jackson:**

The committee established several priorities for the Director of Science Policy, including a federal job series, increased federal funding for weed science research, and a successful NIWAW VI.

**Student Educational Enhancement Report, Bil Kral:**

No report available.

**Sustaining Members Report, Dennis Tonks:**

***Lynn Fandrich, Steve Eskelson, Dennis Tonks, Neil Harker***

12 sustaining members are part of WSWS, down 2 from 2004. \$4200 was collected in sustaining member dues.

**Necrology Report, Carol Mallory-Smith:**

The committee was notified of the deaths of 3 society members in 2004-2005.

- Elvin Kulp
- Gail Wicks
- Rodney Kepner

Tribute to each of these members was given and a moment of silence was taken in honor and memory of these members.

**Herbicide Resistant Plants Report, Kirk Howatt:**

Committee has discussed various resistance issues and development of fact sheets to communicate key terminology and management factors. Several of these will be posted on the website. Members are encouraged to submit requests for topics for the committee to address.

Student award winners were announced. Judges of the paper and poster contest were recognized and thanked.

Fifteen papers and eight posters were presented.

Undergraduate Poster Contest had 4 posters entered.

First Place Award: 'Does Prometryn Tolerance in Cotton Confer Tolerance to Paraquat'.  
Irene Calderon, New Mexico State University.

Graduate Poster contest had 4 posters entered.

First Place Award: 'Estimating Landscape Level Gene Flow in Wheat and Jointed Goatgrass'.  
Todd Gaines, Colorado State University.

Weeds of Agricultural and Horticultural Crops had 6 papers entered.

Second Place award: 'Preliminary Observations of the Species Area Curve in Organic and Conventional Spring Wheat Systems'. Frederic Pollnac, Montana State Univ.

First Place award: 'Automatic Spot Spray Technology and Weed Management in Arizona Tree Crops'. Ryan Ractor, Arizona State University.

Weeds of Range and Forest section had 9 papers entered.

Third Place award: 'Effects of Disturbance on the Invasion Potential of Yellow Toadflax'.  
Erik Lehnoff, Montana State University

Second Place award: 'Effect of Seed Maturity on the Resistance of Weed Seeds to Simulated  
Fire: Implications for Timing Prescribed Burns'. Sara Sweet, University  
of California, Davis.

First Place award: 'The Influence of Water Stress and Timing of Herbicide Application on  
African Rue Control'. Kevin Branum, New Mexico State University.

Phil Westra indicated that the national meeting will recognize the 50<sup>th</sup> anniversary of the society  
WSWS has volunteered to make a DVD reviewing past history of the society and weed science.  
Send pictures, etc. electronically to Phil and a script will be put together.

### **OLD BUSINESS:**

A proposed constitutional change to allow for an additional member-at-large was discussed. This  
will increase representation and diversity, as well as provide for an odd number on the board for  
voting purposes. Members were notified in newsletters earlier this year in order to comply with  
the minimum 30 day notification for constitutional changes. A motion was placed on floor by  
Phil Stahlman and seconded by Nelroy Jackson to add an additional member-at-large position to  
the board. Discussion was held on whether the members-at-large would be appointed or elected.  
The president-elect will appoint a member-at-large to serve with them through their term, thus  
alternating between industry and public

Motion passed on a hand vote.

President Phil Stahlman announced the recipient of the Presidential Award of Merit as being  
Tony White, for his dedication and service to the society in working with the website  
development.

### **NEW BUSINESS:**

A proposed resolution, drafted and presented by Don Morishita, regarding the federal FY2006  
budget request for funding of agricultural research, was discussed. It would convey to western  
state congressional members the desire of WSWS to have them continue support of the Hatch  
Act, McIntire Stennis, Act, and Animal Health and Disease Programs.

Don requests that WSWS contact congressional members to ask for their support and for  
individual members to contact their representatives to ask for support.

Don moved that WSWS accept this resolution. The motion was seconded by George Beck.

Discussion was held as to whether Rob Hedberg, Director of Science Policy, is working on this  
bill. Impact statements from various land grant institutions have been developed regarding this  
bill and are available on-line.

The motion passed on a hand vote, with no dissenting votes registered.

Tony White encouraged members to maintain current information on themselves on the website.

Tony will send out login information to all members prior to next meeting for abstracts, title submission, and registration.

List serves can be set up through the website, but only to members with listed emails.

Phil Westra inquired as to whether any fee increases in registrations will occur. Phil Banks indicated the Finance Committee has taken up this issue and will report to the membership.

Phil Stahlman passed the presidential gavel, the commemorative hoe, to Phil Banks, reminding him to keep the weeds out of the WSWS.

Phil Banks presented a plaque to Phil Stahlman in honor & recognition of his service.

The meeting was adjourned at 8:33 AM.

Respectfully submitted,

Vince Ulstad  
Secretary

Western Society of Weed Science  
Post Conference Board Meeting  
10 March, 2005  
Hyatt Regency Hotel / Vancouver, BC

**Members Present:** Dirk Baker, Phil Banks, Vanelle Carrithers, Janet Clark, Joe Ditomaso, Wanda Graves, Kirk Howatt, Kassim al-Khatib, Rod Lym, Tim Miller, Corey Ransom, Jill Schroeder, Phil Stahlman, Vince Ulstad, Joe Yenish,

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.

The Finance Committee will review registration fees.

An adhoc committee was formed, consisting of Phil Stahlman, Vanelle Carrithers, Jeff Koscelny, Lars Baker, Brenda Waters, Jim Olivarez, Dirk Baker, as student representative, and Ralph Whiteside for the purpose of determining what individuals and groups are we missing with our meetings and are any groups being marginalized. Phil is collecting names for potential members/disciplinary representation.

A *Weeds of the West* review committee to include the Finance Committee and the Publications Committee and chaired by Janet Clark, member-at-large, will be appointed.



Phil Banks & Phil Stahlman met w/ Tony White to discuss his request for compensation for website editor. The board discussed differences between that editorial position and other editors in the society. Tony will check on outside bids for programming costs and report back. This will provide the basis to determine fair compensation and options.

Phil Banks met w/ Bill Kral to discuss future of the Student Educational Enhancement Program. Bill thinks the committee can try to rejuvenate the committee and will discuss options with the committee and report back to the board.

Discussion was held on conducting WSWS board business via email. Phil Banks will try to send out a protocol to conduct WSWS business via email. For example: Board topics that require motions—someone initiates the motion, someone seconds the motion, then the motion is open for discussion for a set time, after which a set amount of time to vote on the motion will be specified. Email systems of board members need to be set not to block incoming messages. Will ask for confirmation of receipt.

The board was encouraged to begin thinking of a site for the 2009 meeting. We need to give general areas for the site selection committee to work with. Nelroy Jackson will help select a local arrangements chair for the 2008 meeting.

Dates for summer board meeting were tentatively set for Aug. 5-7 in Reno, starting at noon on Friday through Saturday afternoon. Attendees will need to make their own room reservations from a room block. Agenda items will include business manager replacement. Jill Schroeder and Vanelle Carrithers are willing to put together an analysis of various options to consider so that a specific direction and job description can be assembled. The goal would be to come out of the summer board meeting knowing what we want and then seek to fill the position by the 2006 meeting. Discussion was held on how this fits with combining resources with other organizations.

Review of the annual meeting was held.

Tim Miller met with hotel management this morning. Meeting rooms and food were just over \$15,000. AV equipment was about \$3800. We were short on fill rate, at 88.5% full (11 rooms short), for a cost of about \$1600. Total cost for the meeting will be about \$21,000. The cost of meeting to the society will be more than was taken in by registration fees. The hotel has been very good to work with.

Having the WSSA meeting so close and in Hawaii certainly hurt our attendance. Travel restrictions on federal employees also hurt attendance. Phil Banks will write a letter of appreciation to the hotel, thanking them for their hospitality.

Some comments on costs for industry members was received, generally concerning food costs, etc.

Positive comments were received on the program. No one was aware of any negative comments. Jeff Tichota's session was very well attended. Jeff had passed out an evaluation form and will tally results and report back. It may provide opportunity to evaluate another project for the society.

Jill Schroeder will send out updates on the operating guide and to Tony White to have put on the website. An addition to the operating guide to accommodate the WSWS student representative needs to be made.

The resolution which was passed at the business breakfast needs to be distributed quickly, as the congressional vote is tomorrow.

Kirk Howatt gave an update on the student contest. Positive comments were received. Judges appreciated having a non-student paper in between student papers, so that they could catch up with their notes & evaluations.

Kirk inquired about making a change in the operating guide for a member of the herbicide resistance committee to attend the national weed resistance meeting. Kirk will write up the operating guide language for the change.

The meeting was adjourned at 1:14 PM.

Respectfully submitted,

Vince Ulstad  
Secretary

WESTERN SOCIETY OF WEED SCIENCE  
 YEAR-END FINANCIAL STATEMENT  
 APRIL 1, 2004 THROUGH MARCH 31, 2005

CAPITAL

2003-2004 Balance Forward	\$277,848.45	
Current Income (Loss)	(33,325.11)	
		\$244,523.34

DISTRIBUTION OF CAPITAL

RBC Dain Rauscher Funds	\$165,515.61	
Money Market Savings (Newark)	70,939.59	
Checking Account (Newark)	8,068.14	
		\$244,523.34

INCOME

Registration & Membership Dues	\$27,733.30	
Proceedings	4,166.98	
Research Progress Report	3,214.55	
2005 Sustaining Membership Dues	4,200.00	
WSWS Promotional Hats	168.00	
Noxious Weed Short Course	19,450.00	
Weeds of the West Book	92,324.50	
Bio Book	1,204.17	
Bank Account Interest-Newark Accounts	244.57	
RBC Dain Raucher Investment Interest	12,647.24	
WSWS Promotional Hats	24.00	
Annual Meeting Refreshment Break Contribution	3,500.00	
<b>Total Income YTD</b>		<b>\$168,877.31</b>

**WSWS Year-End Financial Report**  
**April 1, 2004 through March 31, 2005**

**EXPENSES**

Office Supplies & Equipment	\$ 388.20
Postage, Box Rent, Bulk Mailing Permits	2,109.53
Telephone, Internet	1,278.52
Business Record Storage	342.00
WSSA Board Representative	798.60
WSSA Director of Science Policy	7,300.00
Bio Control of Invasive Plants Book	15,000.00
Institute for Conservation Leadership Consultation	1,238.44
CAST Representative Travel	229.58
2005 CAST Membership Dues	588.00
WSWS Logo Trademark Registration Renewal	670.00
Tax Accountant – Tax Preparation	400.00
Franchise Tax Board	10.00
Secretary of State – Bi-Annual Filing Fee	20.00
CA State Worker's Compensation Insurance	433.00
California Employment Development Taxes	597.86
IRS Employee taxes	3,202.40
Website	432.95
Newsletters-Printing	1,064.71
2004 Proceedings-Printing	2,160.00
2005 Research Progress Reports	1,947.00
Envelopes, Letterhead, Forms	562.51
2005 Programs	513.60
Noxious Weed Short Course	16,757.22
Weeds of the West Book	104,442.00
Award Plaques	781.41
Business Manager Salary (net)	12,782.98
Annual Meeting Student Room Subsidy	150.00
Annual Meeting Student Paper/Poster Contest	600.00
AV Rental	3,938.00
Annual Meeting Awards Luncheon	11,959.00
Annual Meeting Refreshment Breaks	3,500.00
Annual Meeting Meeting Room Rental	1,559.00
California Continuing Education Application Fee	135.00
Executive Board & Committee Meetings	3,073.75
Research & Proceedings Editor Expense	587.16
Refunds of Registration Fees	650.00
<b><u>Total Expenses YTD</u></b>	<b><u>\$202,202.42</u></b>



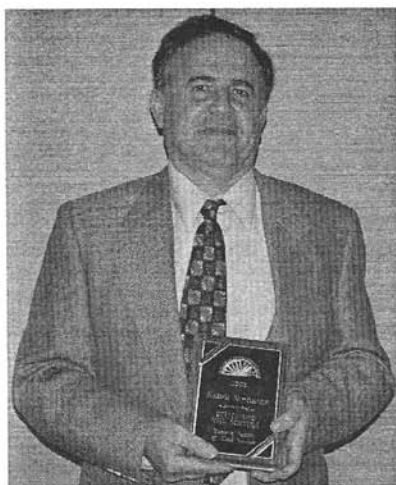
Nelroy Jackson, 2005 Fellow



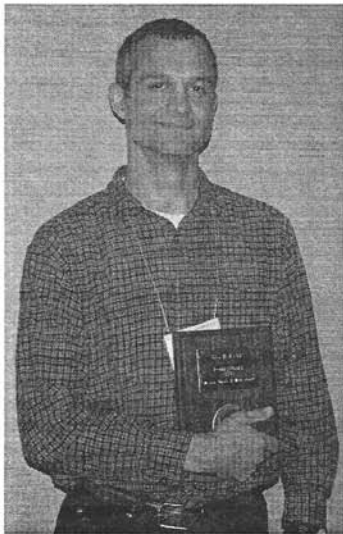
Roland Shirman, 2005 Fellow



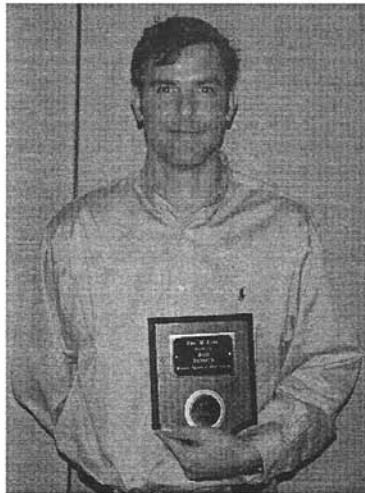
Kelly Luff, 2005 Outstanding Weed Scientist , Private Sector



Kassim Al-Khtib, 2005 Outstanding Weed Scientist , Public Sector



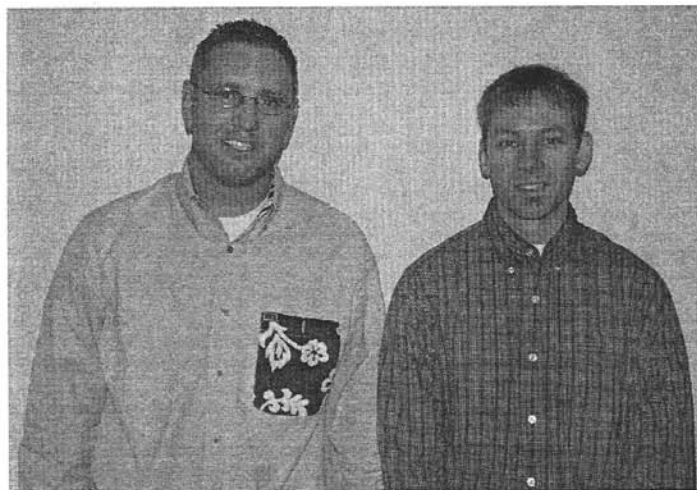
Guy Kyser, 2005 Outstanding Achievement Award



Eric Lane, 2005 Weed Manager Award



Student Contest Poster Award: Irene G. Calderon – New Mexico State University, Undergraduate award  
Todd Gaines – Colorado State University, Graduate award

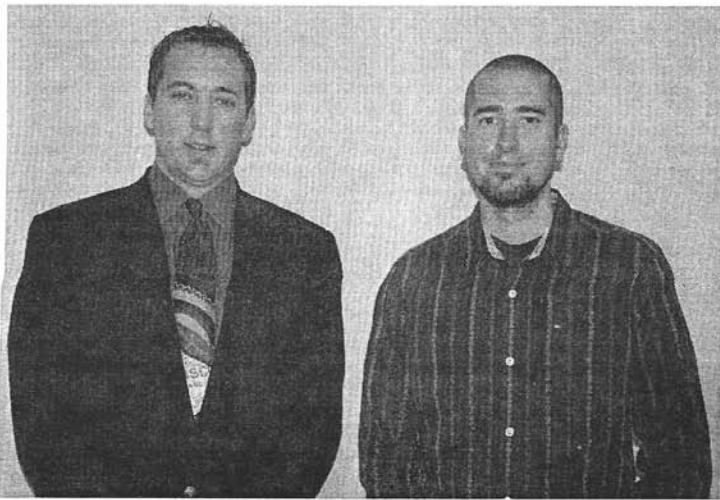


Student Paper Oral Paper Award: Range and Forest section, 1<sup>st</sup> Kevin Branum - New Mexico State University  
(left), 3<sup>rd</sup> Erik A. Lehnoff – Montana State University





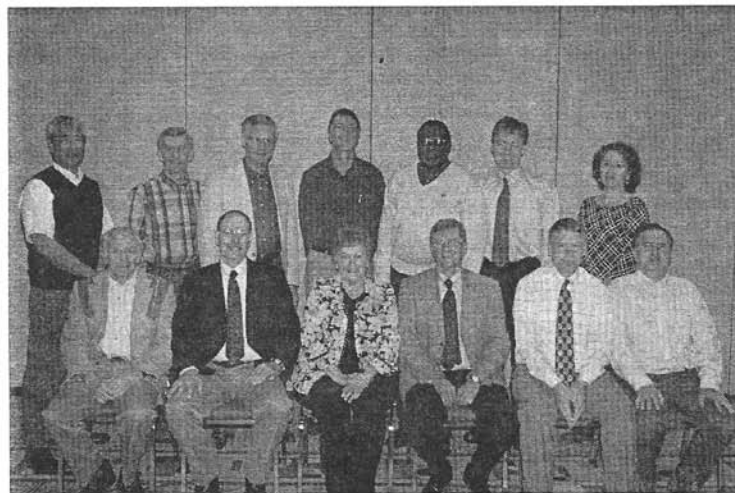
Student Contest Oral Paper Award: Range and Forest section, 2<sup>nd</sup> Sara B. Sweet – University of California, Davis



Student Paper Oral Paper Award:  
Crops Section, 1<sup>st</sup> Ryan Rector - University of Arizona (left), 2<sup>nd</sup> Fredric W. Pollnac – Montana State University



Tony White, 2005 Presidential Award of Merit



WSSW Board of Directors for 2005-06

(Front left to right) – Rod Lym, CAST representative; Phil Banks, President; Wanda Graves, Business Manager; Phil Stahlman, Immediate Past President; Tim Miller, Chair, Education and Regulatory Section; Kassim Al-Khatib, President-elect.

(Back left to right) – Kai Umeda, Representative for Constitution and Operating Procedures; Ron Crockett, Member-at-large; Vince Ulstad, Secretary; Joe DiTomaso, Chair-elect, Research Section; Nelroy Jackson, WSSA Representative; Corey Ransom, Chair, Research Section; Janet Clark, Member-at-large. (Not pictured Joe Yenish, Chair-elect Education and Regulatory Section)

#### NECROLOGY

**Elvin Kulp**, 67, of Ephrata, WA, retired WSU-Cooperative Extension Agent in Grant/Adams area, passed away on August 21, 2004. Elvin's professional career began in 1961 in Grant County. His passion for farming and farming techniques never diminished in his over 40 years with the extension office. He retired from the extension service as county chair and agronomy agent in April 2002 and then returned and served as interim Southeast District Director from January 2003 to July 2004.

**Gail Wicks**, 72, of North Platte passed away peacefully on Monday, Feb. 21, 2005. He was born May 26, 1932, in Carpenter, S.D. He grew up on the family farm, attending a one-room schoolhouse where he was the only student in his grade. He received a Bachelor's degree from South Dakota State University and a Master's degree from Iowa State University. He served as a second lieutenant in the Army during the 1950s. He was a professor of agronomy for the University of Nebraska, working at the West Central Research and Extension Center for 47 years. On Aug. 19, 1956, he married Gloria Jean King. Gail will be remembered as a loving husband, father, grandpa, researcher, and coach. Mr. Wicks was actively involved in many areas of his community. He was a member of First Evangelical Lutheran Church, serving in many capacities over the years. He and Gloria helped hundreds of girls grow to become successful women through the Belles softball teams for more than 35 years. He was inducted into the Nebraska Amateur Softball Association Hall of Fame in 1993. He was longtime Rotarian. Survivors include children Cynthia Schuch of Belton, Mo., Nancy Oerter of Hastings, David Wicks of Seattle, Wash.; six grandchildren; and brother Jerry Wicks of Carpenter, S.D. He was preceded in death by his wife Gloria. Memorials are suggested to First Evangelical Lutheran Church of North Platte, the Platte Valley Girls Softball Association, and the University of Nebraska West Central Research and Extension Center Foundation.

**Rodney Kepner** passed away July 19, 2004 in Fresno, CA. He was born on October 9, 1957 in Rochelle, IL. He was a Field Development Scientist for Gowan Company at the time of his death. He earned a B.S. in 1979 from Rockford College in IL and later a Master of Science and a PhD in Entomology from the University of Florida. Rodney worked on grasshopper control in South Dakota and the Sudan. He worked for American Cyanamid before going to work for Gowan Company in 1997. Rod is survived by his wife, Maria, and two children, Andi and Vinny; his mother, Leonce Carlson and sister, Denise McDermott of Rochelle, IL and his brother, Jeff Kepner of Milwaukee, WI.

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**WESTERN SOCIETY OF WEED SCIENCE  
2005-2006 SUSTAINING MEMBERS**

Agrilience LLC,

AGSCO, Inc.,

Arvesta,

BASF Corporation,

Bayer CropScience,

Dow Agrosciences, LLC,

Dupont Crop Protection

Marathon-Agricultural & Environmental Consulting, Inc.,

Monsanto Company,

Syngenta Crop Protection, Inc.,

Valent USA Corporation,

Wilbur-Ellis Company



## 2005-2006 Western Society of Weed Science Standing and Ad Hoc Committees

### Awards

Marvin Butler (2006)  
Ron Crockett, Chair (2007)  
Don Morishita (2008)

### Fellows and Honorary Members

Jeff Tichota (2006)  
Carol Mallory-Smith, Chair, (2007)  
Vanelle Carrithers (2008)

### Finance

Phil Munger (2006)  
Rick Boydston (2006)  
Jesse Richardson, Chair (2007)  
Steve Eskelsen (2008)

### Herbicide Resistant Plants

Mary Corp (2006)  
Jim Harbour (2006)  
Tom Beckett (2007)  
Kirk Howatt, Chair (2007)  
Steve Seefeldt (2008)  
Monte Anderson (2008)

### Legislative

Dawn Rafferty (2006)  
Eric Lane, Chair (2007)  
Sandra McDonald (2008)

### Local Arrangements

Tim Miller (2006)  
Tim Tripp (2007)  
Tom Lanini, Chair (2007)  
Jed Colquhoun (2008)  
Carol Mallory-Smith (2008)

### Necrology

Carol Mallory-Smith (2006)  
Steve Watkins, Chair (2007)  
Lisa Boggs (2008)

### Nominations

Bill McCloskey (2006)  
Jeff Koscelny, Chair (2007)  
Bob Parker (2008)  
Immediate Past-President  
Phil Stahlman

### Placement

Pam Hutchinson (2006)  
Bill Kral, Chair (2007)  
(Action to delete in 2006)

### Poster

Tony White (2006)  
Cheryl Fiore, Chair (2007)  
Linda Wilson (2008)

### Program

Kassim Al-Khatib, Chair (2006)  
Corey Ransom (2006)  
Tim Miller (2006)

### Public Relations

Brian Olson, Chair  
Mark Ferrell  
Milt McGriffen  
Brad Hanson  
Bill Cobb  
Erin Taylor

### Publications

Kassim Al-Khatib, Chair  
Joan Campbell,  
Proceedings  
Traci Rauch, Research  
Progress Report  
Pat Clay, Newsletter  
Tony White, Web Site

### Site Selection

Traci Rauch (2006)  
Mike Edwards, Chair (2007)  
David Vitolo (2008)

### Education-Ad Hoc

Distance Education:  
Tracy Sterling Chair  
Carol Mallory-Smith  
Scott Nissen  
Bill Dyer  
Kassim Al-Khatib  
Noxious Weed Shortcourse  
Celestine Duncan,

### Student Educational Enhancement

Bill Kral, Chair (2006)  
Kelly Luff (2007)

### Student Paper Judging

Vanelle Carrithers (2006)  
Steve Enloe, Chair (2007)  
Mark Renz (2008)

### Sustaining Membership

Dennis Tonks (2006)  
Lynn Fandrich, Chair (2007)  
Neil Harker (2008)

### Membership -Ad Hoc

Lisa Bogg, Chair  
Phil Stahlman ad hoc  
Vanelle Carrithers  
Jeff Koscelny  
John L. Baker  
Brenda Waters  
Ralph Whitesides  
Steve Fennimore  
Randy Smith  
Dirk Baker  
James Olivarez  
Eric Coombs  
Kai Umeda  
Dudley Smith