Research Progress Report

1962

Research Committee
Western
Weed Control Conference

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PREFACE

This Report, prepared for distribution at the 1962 meeting of the Western Weed Control Conference, consists of brief reports of recent research carried out in the Western states. Many of the reports are preliminary and will require further corroboration. They should be so considered in making citations. The reports, however, are valuable in helping us keep abreast of current research. This Progress Report is not intended to supplant more detailed publication of completed research in the various technical journals.

Reports are divided into eight basic projects, as listed in the table of contents. Whenever a common name for a herbicide has been accepted by the Weed Society of America, the compound is so listed. If it has not yet been accepted, it is listed by trade name (capitalized) and/or chemical name. All herbicidal concentrations mentioned are presumed to be the acid equivalent or active ingredient, unless otherwise specified. WSA-accepted herbicides are listed by both common and chemical names in the introductory table. Abbreviations used in the Report are those recommended by the Terminology Committee of the WSA (Weeds 8:487-521, 1960).

The late date of assembly of this Report (in order to include most current research) has largely precluded coordination between authors and Project Leaders, and between Project Leaders and the Research Section Chairman. Consequently, many editorial changes were made without consultation with the authors. It is hoped that these changes, made largely to obtain uniformity, will be generally acceptable.

Grateful acknowledgement is made to every author and to every Project Leader who, together, have made this Report possible.

Herbert M. Hull
Chairman, Research Committee
Western Weed Control Conference

Crops Research Division
Agricultural Research Service
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HERBICIDE INDEX AND NOMENCLATURE

In this combined index and herbicide list all names beginning with numerals are indexed as if spelled out. Proper capitalization is indicated, i.e., trademarks are capitalized and common names which have been accepted by the Terminology Committee of the Weed Society of America are lower case (except for initials, such as MH).

This list is based essentially on the report of the Terminology Committee of the WSA (Weeds 8:487-521) and includes the additional common names and abbreviations recommended by the Committee at its meeting in St. Louis, December 10, 1961. Many of the previous trademarks have been designated as common names, which is ideal in that change is avoided. Some new abbreviations have also been recommended. The new names and changes are indicated by a preceding asterisk.

A

B

C

F

Falone--trademark for 2,4-DEP
fenac--2,3,6-trichlorophenylacetic acid 2,15,35,73,87
fenuron--3-phenyl-1,1-dimethylurea 2,12,16,18,68,89
fenuron.TCA--3-phenyl-1,1-methylurea trichloroacetate (Urab) 2
4-chlorophenoxyacetic acid 14
4-chlorophenoxybutyric acid 14
4-chlorophenoxypropionic acid 14
4-(MCPB)--4-(2-methyl-4-chlorophenoxy)butyric acid
4-(MCPB)-MCPA mixture (Tropotox Plus)
4-(2,4-DB)--4-(2,4-dichlorophenoxy)butyric acid 60
4,6-dinitro-3-*sec*-butylphenol acetate (N-5778)

G

G-30026--code for 2-chloro-4-isopropylamino-6-methylamino-*s*-triazine
G-32292--code for 2-methoxy-4-methylamino-6-isopropyl-*s*-triazine 17
G-34161--code for *prometryne
G-34162--code for *atrametryne
G-34361--code for 2-allylamino-4-chloro-6-isopropylamino-*s*-triazine
G-34696--code for 2-chloro-4-ethylamino-6-(3-methoxypropylamino)-*s*-triazine
General Chem. 6691 35,37

H

Herbisan 5--trademark for EXD
HN-1688--code for methyldichlorobenzoic acid

I

IAA-indole-3-acetic acid 90
ipazine--2-chloro-4-diethyl-6-isopropylamino-*s*-triazine 39
IPC--isopropyl-*N*-phenyl carbamate 40,43,45,46,61,85,90

K

Karsil--trademark for *N*-(3,4-dichlorophenyl)-2-methylpentanamide
Kleen-up--trademark for calcium arsenate 29,30,33
KOCN-trademark for potassium cyanate 34

M

MCPA--2-methyl-4-chlorophenoxyacetic acid 14,23,45,53,60
MCPA-2,4,5-T mixture (Celatox)
Methoxy propazine 34
*methuron--3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea (DuPont 326) 7,46,47,62
methyldichlorobenzoic acid (HN 1688)
MH-maleic hydrazide (1,2-dihydropyridazine-3,6-dione) 72
monuron--3-(*p*-chlorophenyl)-1,1-dimethylurea 16,37,46,71,76,89,90
monuron.TCA--3-(*p*-chlorophenyl)-1,1-dimethylurea trichloroacetate (Urox) 2,16,76
Mylone--trademark for DMTT

N

O

R

S

T

PROJECT 1. PERENNIAL HERBACEOUS WEEDS

John H. Miller, Project Chairman

SUMMARY

Eight reports representing research at three locations (California, Oregon and Wyoming) were received. Of the reports, one dealt with research relative to control of Russian knapweed, one with studies on field bindweed, two with Canada thistle, two with studies on purple nutsedge, one with sheep sorrel, and one with quackgrass.

Russian knapweed (Centaurea repens). Research in Wyoming showed that eleven herbicides used at various rates provided 100% control of Russian knapweed two years after herbicide treatment. Three of the herbicides eliminated the weed without marked damage to grass populations. The remaining eight herbicides provided complete control of the knapweed.

Field bindweed (Convolvulus arvensis). Wyoming research showed 95% control of field bindweed two years after the application of several different herbicides. Different formulations of 2, 4-D used at 2 lb/A provided 85% control one year after treatment.

Canada thistle (Cirsium arvense). Results from a large soil-sterilant study in Wyoming revealed that eleven of 56 treatments provided 95% control of Canada thistle two years after treatment.

An interesting study on dissemination of Canada thistle seed showed that winds varying up to 29 mph were capable of transporting seed at least 800 feet. However, the numbers of viable seed transported beyond 200 feet were markedly reduced.

Purple nutsedge (Cypress rotundus). California research showed that effective control of purple nutsedge was obtained with several herbicides when incorporated in soil and irrigated.

Translocation studies of herbicides in nutsedge rhizomes showed that three herbicides were not effectively translocated from a nutsedge tuber planted in herbicide-treated soil to an adjacent tuber in the rhizome chain planted in untreated soil. Two of the three herbicides were effective in preventing the emergence of the tuber planted in the treated soil.

Sheep sorrel (Rumex acetosella). Excellent kill of sheep sorrel in Oregon has been accomplished with 2-methoxy-3, 6-dichlorobenzoic acid. Used at one pound per acre, this compound gave complete kill of sorrel but did not injure chewings fine fescue.

Quackgrass (Agropyron repens). Further studies in Oregon involving the use of 15 different herbicides applied with a logarithmic sprayer have demonstrated control of quackgrass ranging up to 90 percent. Some of the more promising herbicides were used in combination with cropping practices, involving corn and potato production.

Evaluation of soil sterilants for control of Russian knapweed (Centaurea repens). Alley, H. P. Soil sterilant plots were established in Laramie, June 23, 1959, to evaluate the effectiveness and residual of several chemicals. Evaluation of all chemicals was made in 1960 and 1961. Readings made in 1961, two years following treatment, show fenac powder at 5, 10, and 20 lb/A ae; fenac (liquid) at 5, 10, and 20 lb/A; 2,3,6-TBA at 5 and 10 gpa; atrazine at 20 and 40 lb/A ai; borate-benzoic acid mixture (8% 2,3,6-trichlorobenzoic acid) at 3/4 and 1 1/2 lb/sq rod; borate-monuron mixture (94% sodium borate plus 4% monuron) at 4 and 6 lb/sq rod; chlorate-2,4-D (15% 2,4-D) at 5 and 10 lb/sq rod; Chlorea granular (40% sodium chlorate, 57% sodium metaborate, and 1.25 % monuron) at 6 and 9 lb/sq rod; Urox (TCA-monuron) 14.5 and 22 gpa; Urab (TCA and fenuron) at 6 and 9 gpa; 2,4-D amine at 40 and 80 lb/A ae; and fenuron (25% ai pellets) at 1 and 2 lb/sq rod as giving 100% control of Russian knapweed. The plots treated with fenac, 2,3,6-TBA; borate-benzoic acid mixture, and 2,4-D amine had a good stand of grass remaining on the treated area. All other treated plots were completely denude of vegetation. (Wyoming Agricultural Experiment Station)

Chemical control of field bindweed (Convolvulus arvensis). Alley, H. P. Field bindweed plots were established July 8, 1959 and July 18, 1960. Visual ratings were made in 1960 and 1961. The 1961 readings, two years following chemical application, show that borate-benzoic acid mixture (8% 2,3,6-TBA) at 1 1/2 lb/sq rod; 2,3,6-TBA at 10, 20, and 40 lb/A ae; fenac w.p. at 12 lb ai/A; and 2,4-D amine at 2 lb/A ae plus X-77, all gave better than 95% control of bindweed. Amitrole at 8 lb ai/A; 2,4-D (L. V. ester) at 2 lb/A ae; fenac (liquid) at 12 lb/A ae; and borate-2,4-D mixture (BDM) at 6.6 lb/sq rod gave outstanding control but they were not as effective as the previously mentioned treatments.

The 1960 treatments evaluated in 1961 show emulsifiable acid of 2,4-D (Weedone 638) at 2 lb ae/A; butoxyethanol ester of 2,4-D (Weedone 629) at 2 lb ae/A; propyleneglycolbutylether ester at 4 lb ae/A + Plyac as giving 85% and better control of bindweed. (Wyoming Agricultural Experiment Station)

Control of Canada thistle (Cirsium arvense). Alley, H. P. Plots were established June 12, 1959, on the CB&Q railroad rights-of-way in southeastern Wyoming. Most of the compounds used were soil sterilants. Readings were made in 1960 and 1961.

Of the 56 treatments included in the tests, fenac (4% pellets) at 400 lb/A; 2,3,6-TBA at 5 and 10 gpa; a chlorate-2,4-D mixture (15% 2,4-D) at 1 lb/sq rod; Chlorea gran. 1 at 9 lb/sq rod; Chlorea gran. 3 at 3 and 4 1/2 lb/sq rod; fenuron (25% pellets) at 2 lb/sq rod; TCA-monuron mixture (Urox) at 14 1/2 and 22 gpa and 2,4-D amine at 4 lb/A ae (re-treated three times) gave 95% or better control of Canada thistle two years after treatment. A good cover of grass is present on the fenac; 2,3,6-TBA; and 2,4-D amine-treated plots. (Wyoming Agricultural Experiment Station)

Dissemination of Canada thistle fruit by wind. Alley, H. P. and Chamberlain, E. W. Numerous observations are recorded in literature on the facilities for dissemination of the plumed fruit of many species. Concern has been expressed relative to the actual movement of Canada thistle seed by wind. No accurate data were available. A preliminary study was conducted to obtain information pertinent to the spread of Canada thistle seed by wind.

An isolated patch of Canada thistle (Cirsium arvense) was selected. The nearest infestation was over one mile away. No Canada thistle was present to the west, southwest, or northwesterly direction of the study site within a 4-mile radius. A "catch board" 10 inches wide and 100 inches long was constructed. The board was covered with alternate two-inch strips of contact paper and tanglefoot to catch the wind-blown pappus and fruit. Two rows of the "catch boards" were used, one row facing southwest and the other row facing northeast. They were adjacent to, and 50, 100, 200, 400, and 800 feet from, the infestation. The experiment was initiated August 18, 1961, and terminated September 17, 1961. Winds are predominantly from the southwest and reached a velocity of 29 mph during the study period.

Results indicate that a small percentage of the fruit was blown as far as 800 feet from the study site. The percentage of fruit to pappus decreased as the distance from the site increased.

Close observation during the study showed that viable fruit fell from the pappus upon the slightest contact. Non-viable fruit remained attached to the pappus indefinitely. Plans are to extend the distance and construct the "catch board" of window screen for 1962. (Wyoming Agricultural Experiment Station)

Number of seeds and pappus caught at different distances from the selected site, per 1000 square inch of surface.

	0'	50'	100'	200'	400'	800'
Viable seed	222	158	109	111	5	2
Pappus	1220	901	810	645	53	59
Per cent seed vs pappus	18.2	17.5	13.5	17.2	9.4	3.4

Field tests of herbicides for purple nutsedge control. Jordan, L. S., Day, B. E., and Welch, Norman. A field containing a uniform thick stand of nutsedge was thoroughly disked. Herbicides were sprayed on dry, sandy soil with a bicycle sprayer using 50 gpa volume. The herbicides were incorporated within 15 minutes after application with a power roto-tiller. Three replications were used. The plots were sprinkler-irrigated two days after treatment. Regrowth of nutsedge was rated one month after treatment. The results are shown in Table 1.

Table 1. Control of nutsedge one month after treatment with various soil-incorporated herbicides[1].

Herbicide	Rate (lb/A)	Control	Herbicide	Rate (lb/A)	Control	Herbicide	Rate (lb/A)	Control
EPTC	5	9+	1870	6	8	Atratone	5	1
EPTC	6	9+	1870	9	8	Atratone	10	6
EPTC	9	9+	1870	12	10	Atratone	15	9
1607	3	9+	Casoron[3]	5	10	Prometone	5	5
1607	6	10	Casoron	10	10	Prometone	10	5
1607	9	10	Casoron	15	10	Prometone	15	6
1856	6	3	Atrametryne	5	3	TCB	50[2]	9
1856	9	5	Atrametryne	10	7			
1856	12	9	Atrametryne	15	8	CK	-	0

1/ 0 = No control. 10 = No growth of nutsedge.

2/ Gallons of commercial trichlorobenzene formulation per acre.

3/ 2,6-dichlorobenzonitrile.

(Citrus Research Center and Agricultural Experiment Station, University of California, Riverside, California)

<u>Studies of translocation of herbicides between nutsedge tubers.</u> Jordan, L. S., Day, B. E., and Clerx, W. A. Experiments were performed to determine if EPTC, Casoron or amitrole moves through rhizomes from one nutsedge (*Cyperus rotundus*) tuber to another in sufficient amounts to affect the growth of the untreated tuber. Uniform pairs of tubers, connected by rhizomes, were selected. One tuber of each pair was planted in soil (Vista sandy loam) in which EPTC, Casoron, or amitrole was incorporated. The other tuber of each pair was planted in untreated soil. Concentrations of 0.5, 1.5, and 4.5 ppm, based on the weight of air-dried soil, were chosen, as former experiments showed that these concentrations were not likely to kill the tubers. In one-half of the cultures, the terminal tuber was planted in treated soil and in the other half, the tuber nearest the parent plant was planted in the treated soil. Five replications were employed with three tuber pairs per replication.

After eleven days the tubers in the untreated soil had germinated, but no germination of tubers occurred in the soil treated with 0.5, 1.5, and 4.5 ppm EPTC or 1.5 and 4.5 ppm Casoron. Also, no tubers germinated in soil treated with 0.5 ppm Casoron except in one out of five replications where the terminal tuber was planted in treated soil. Amitrole at all three concentrations did not prevent germination from the tubers in the herbicide-treated soil. Germination in the treated soil in some cases was even slightly better than in their untreated counterparts. Height and general appearance of the germinated plants were similar in both treated and untreated soil. Healthy appearance and failure to show signs of deterioration when held in a germinator at 85°F indicated that the tubers from the treated soil were still alive.

As all plants failed to differ in any way from the controls, there was apparently not sufficient translocation of the applied herbicides to affect germination or growth of the tubers in the untreated soil. (Citrus Research Center and Agricultural Experiment Station, University of California, Riverside, California)

PROJECT 2. HERBACEOUS RANGE WEEDS

J. Major, Project Chairman

SUMMARY

Reports of work on medusahead ecology and control have come from Idaho, Oregon, and California. Control of the plant is being studied in the context of the range vegetation which medusahead has invaded or which can replace it. Means to tip the balance against medusahead have included differential responses to herbicides and N-fertilization. The Idaho group is continuing to add to knowledge of the ecology, physiology and life history of this and other grass species.

Biological control of a great variety of range weeds is being investigated, and prospects are very hopeful.

Ecology and control of medusahead (*Elymus caput-medusae* subsp. *asperum*). Hironaka, M., Heller, T. and Tisdale, E. W. 1. Newly ripened seed of medusahead stored under normal room temperatures remained strictly dormant for about 100 days and did not reach peak laboratory germination until 135 days after date of harvest. Seed of *Bromus tectorum* under similar treatment began germination just under 100 days and reached a peak in 120 days.

2. Fresh medusahead seed gradually lost its viability with increasing time of submergence in water, but after four weeks of complete immersion as much as 19 percent of the seed was still viable and produced vigorous seedlings. Apparently water could be an important method of seed dispersal for this species.

3. The regenerative ability of medusahead plants clipped below the growing point appeared directly related to phenological development at time of clipping and to soil moisture. Only 46 of 100 plants survived and produced seed after having been clipped in the early boot stage. Similar procedure one week later when the plants were in the mid-boot stage of development left only five survivors. Plants clipped in later growth stages died without producing any regrowth.

4. Four grass species, medusahead, cheatgrass, squirreltail (*Sitanion hystrix*) and desert wheatgrass (*Agropyron desertorum*) were seeded in sterilized medusahead litter that had been placed over soil. The litter ranged in depth from 1/4 to 3 inches. The survival of all species was adversely affected by increasing depth of litter with the greatest mortality occurring in medusahead and desert wheatgrass. At the 3-inch litter depth, the number of surviving desert wheatgrass plants was reduced more than 50 percent. Cheatgrass survived slightly better than the squirreltail, but the plants were small and lacked vigor. Squirreltail produced the most vigorous seedlings of all four species under each treatment.

5. The relative response of three grasses to five nitrogen levels (20, 50, 100, 200 and 400 ppm.) was tested in the greenhouse using sand culture as a medium. The grasses used were medusahead, cheatgrass and desert wheatgrass. The yield of the latter two species was closely correlated with increasing nitrogen. At the highest nitrogen rate medusahead exhibited an inverse relationship and yield decreased to less than that recorded for the plants that had received 100 ppm. Growth differences within the three species from 20 through 100 ppm of nitrogen were slight. At the 100 ppm level the yield curve of the desert wheatgrass and that of medusahead began to flatten with increasing nitrogen, but the curve of cheatgrass continued to climb. The nitrogen concentration in harvested plant material was not in keeping with yield results. The medusahead plants continued to assimilate nitrogen beyond the 200 ppm mark although yield dropped sharply after this point. The nitrogen content of cheatgrass was the lowest of the three species while that of the desert wheatgrass was the highest. (Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow, Idaho)

Studies of controlling quackgrass (*Agropyron repens* (L) Beauv.) Baldwin, R. W., Furtick, W. R. A series of logarithmic sprayer plots were established on a quackgrass infested field in the Willamette Valley under fall conditions. In this trial 15 herbicides were screened alone, and in every possible combination, for quackgrass phytotoxicity. The volatile herbicides were incorporated with a rototiller immediately after application. Casoron (2,6-dichlorobenzonitrile) was the most active of the herbicides screened, giving 90% control the next season at approximately 5 lb/A. (Casoron did not give satisfactory control when applied in a similar manner under summer conditions.) The next most active herbicides were atrazine and simazine which gave 90% control at approximately 7 1/2 lb/A and 8 1/2 lb/A respectively.

Several attempts were made to fit promising quackgrass-controlling herbicides into cropping practices. The most satisfactory practices were found to be centered around corn and potato production. Treating quackgrass two weeks prior to discing with either 2 1/2 lb/A of amitrole T or 10 lb/A of dalapon, followed by seeding corn and a pre-emergence treatment of 2 lb/A of atrazine gave good quackgrass control. An application of 10 lb/A of dalapon two weeks prior to working the soil and planting potatoes, followed by a pre-emergence treatment of 1 1/2 lb/A of Du Pont Herbicide No. 326 (3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea) and a post-emergent directed spray was also used. Application of Du Pont Herbicide No. 326, gave good quackgrass control with no apparent damage to the potatoes; on soils of high organic matter content it was found a single post-emergent application of 3 lb/A of Du Pont Herbicide No. 326, replacing the split application, was most effective.

A preplant treatment of 4 lb/A of EPTC gave good control of quackgrass in some areas but failed in others; this is probably due to a soil-herbicide interaction. (Oregon Agricultural Experiment Station).

Sheep sorrel (Rumex acetosella). Furtick, W. R., Phipps, F. E. Herbicide (I) 2 methoxy-3,6-dichlorobenzoic acid has given excellent kill of sheep sorrel Rumex acetosella in Oregon. Complete kill was obtained from March 1961 application at the rate of 1 lb/acre.

Application was made on a dense stand of sheep sorrel infesting a field of chewings fine fescue. There was no damage apparent on the fescue. The fescue was a three year old field abandoned for seed production because of the sorrel. Observations in October 1961 prior to plowing of the field did not detect a single recovered plant of sorrel. (Oregon Agricultural Experiment Station)

Rehabilitation studies of medusahead range. Gould, W. L., Phipps, F. E. and Furtick, W. R. A research project was initiated on the rehabilitation of medusahead (Taeniatherum asperum) infested range land by means of chemical and cultural practices as well as re-seeding to adapted grasses and legumes. The first year work included the preparation of a suitable seedbed by burning, plowing and disking, and through chemical treatments. Also, an evaluation test of 16 chemicals was applied as post-emergence treatments to a dense stand of medusahead during the last week of March, 1961. The same treatments were applied to two stands of established crested wheatgrass and to a native range site which was in excellent condition class. Intermittent showers occurred during the week of chemical application.

Dalapon at 1, 2 and 3 lb/A, and atrazine at 1.6 and 3.2 lb/A were the most effective treatments in controlling medusahead. However, the above rates of dalapon were very injurious to the crested wheatgrass, Idaho fescue (Festuca idahoensis) bluebunch wheatgrass (Agropyron spicatum) and Sandberg bluegrass (Poa secunda). The degree of injury to these grasses increased as the herbicide concentration increased. Atrazine was not injurious to the crested wheatgrass even at the 3.2 lb/A rate. The effect of atrazine on the native grasses will be observed next summer.

Combinations of amitrole and 2,4-D at rates of 2 + 1 and 4 + 2 lb/A were quite ineffective on medusahead, but gave very good control of cheat (Bromus tectorum). (Oregon Agricultural Experiment Station)

Reaction of medusahead to fertilization on a California annual range. Major, J. and McKell, C. M. Plant yields for the 1961 growing season from an experiment on soil moisture use and plant growth are summarized below. Three 1-ft^2 areas were clipped at ground level in each of the 4 replicates of 4 fertilizer treatments. The yield figures are for the third year of identical fertilizer treatment. The figures are average dry weights in g/m^2. To convert to lbs/A multiply by 8.92183.

Plant species	Fertilizer treatment No N	50 lbs N/A	(all with 200 lbs/A of P_2O_5) 150 lbs N/A	300 lbs N/A	Aver.
Medusahead	11.5	6.3	3.0	0	5.2
Other grasses	24.8	19.0	139.0	130.7	78.4
Avena fatua	84.3	161.4	421.1	928.3	398.8
Legumes	49.1	92.6	0.7	0	35.6
Forbs	196.5	320.3	347.0	39.6	255.9
Total	366.4	599.6	910.7	1098.7	743.8

Obviously plant yields on this soil, an Olcott solonetz, respond strongly to a combination of N and P fertilization. Although medusahead (Taeniatherum asperum (Simk.) Nevski or Elymus caput-medusae L. ssp. asperum) decreased to zero amount with increasing fertilization, we know from other work that this plant responds by increased growth to N-fertilization. The figures in the table make it obvious that medusahead is not as strong a competitor as Avena fatua.

Stand surveys of the plots showed that medusahead was still present under the heaviest N-fertilization with at least estimable cover in one replicate. Under 150 lbs/A of N,medusahead cover was less than 5%. Under no N (but still with P_2O_5) medusahead was down to 25% cover or less while wild oats had come up to 25%. When the area was selected for experimentation and fenced 3 years previously it had a seemingly almost pure stand of medusahead with only occasional depauperate plants of wild oats. Elimination of grazing increased wild oats and decreased medusahead.

We conclude that appropriate fertilization will reduce a medusahead population and can reduce it drastically. It will not eliminate it.

Explanation of other trends shown in the table is difficult since the groups of species are not ecologically uniform.

"Other grasses" included Bromus mollis, B. rigidus, Lolium multiflorum, Hordeum hystrix, Gastridium ventricosum, Festuca (Vulpia) dertonensis, F. (Vulpia) megalura, and Phalaris paradoxa--8 species. Some are vernal, others are aestival species. Some are nitrophiles. All are annuals. Bromus mollis was always less abundant than Avena sativa. The others occurred in small amounts.

N fertilization eliminated legumes. Species included Lotus purshianus (= americanus), Lupinus bicolor, Trifolium bifidum, T. microcephalum, T. amplectens, T. tridentatum, T. microdon, T. ciliolatum and Medicago hispida--9 species. Again, the group is not ecologically homogeneous. Some are vernal, some aestival, some ruderal, some plastic in growth depending on seasonal climate, others unvarying.

The "forbs" groups is least homogeneous. Eighteen species were noted in 1961 early in June. They included aestival natives, ubiquitous exotics, even geophytes and vernal pool annuals.

The variations in amounts of all the groups of plant species can best be explained in terms of competition, primarily with Avena fatua but also with each other, and not in terms of innate and solo physiological properties. (California Agricultural Experiment Station, Davis, California)

Biological control of weeds - 1961. Holloway, James K. Scotch broom (Cytisus scoparius Link): An introduced twig mining moth, Leucoptera spartifoliella Hub., has become established in California. Additional supplementary releases were made in 1961 from imported moths. Work continues in the foreign field with particular emphasis on the possible introduction of seed insects.

Tansy ragwort (Senecio jacobaea L.): The cinnabar moth, Tyria jacobaeae L., has been recovered in Oregon, so it is now established there as well as in California. Studies are being undertaken on the effect of the larval feeding on plant vigor and seed production. Supplementary releases will be made in California during 1962.

Puncture vine (Tribulus terrestris L.): Two species of weevils, Microlarinus lareyniei, which attacks seeds, and M. lypriformis, which attacks stems of puncture vine, have been released in Washington, Nevada, Utah, Arizona, and California, and the seed weevil only was released in Colorado. In all locales they were recovered and demonstrated considerable ability to destroy seeds and plants. Their future, however, cannot be estimated until it is known if both species can overwinter, and in sufficient numbers to allow for an early build-up in the spring when puncture vine growth begins.

Halogeton (Halogeton glomeratus C. A. Mey): During the past season, experiments were conducted to determine the specificity of a moth, Heterographis fulvobasella Ragonot, which causes considerable destruction to Halogeton sativus Moq. in Morocco. So far, tests indicate that the moth will be sufficiently specific so that it may be considered for introduction. It is anticipated that the specificity investigations will be completed in 1962.

Thistle complex: The foreign and domestic workers are making extensive field collections to determine and compare qualitatively and quantitatively the insects found on the thistles here and abroad. Preliminary findings indicate that in this country the introduced weedy species are very deficient in destructive insects, while in their native home, they are attacked by several destructive species.

Dalmatian toadflax (Linaria dalmatica (L) Mill.) and Mediterranean Sage (Salvia aethiopis L.): Both of these species appear to have an eastern Mediterranean distribution extending into the Near East. Both have been observed in the central Mediterranean area but all indications are that this is the western periphery of the distribution. In 1962, an exploratory expedition will be made to Greece, Turkey, Iraq, and Iran to study the two species and insects associated with them.

In the overall research program, 17 species of weeds, including hydrophytes, are being investigated in some capacity. Those specifically reported above are high on the priority list and are of interest among the workers of the Western Weed Control Conference. (Biological Control of Weeds Investigations, Insect Identification and Parasite Introduction Research Branch, Entomology Research Division, ARS, USDA, Berkeley, California)

PROJECT 3. UNDESIRABLE WOODY PLANTS

R. H. Schieferstein, Project Chairman

SUMMARY

Fourteen reports on the control of undersirable woody plants were received by the Project Chairman. Of these, eight reported work carried out in Arizona, three, work in Oregon, two work in California and one report was on work in Wyoming. The predominance of the reports are concerned with woody plant control as an aid to range management and water conservation. There were eleven papers on these subjects indicating the high level of interest in these important areas of study. The remaining three papers are concerned with selective chemical brush and mistletoe control as a silvicultural tool in forest management. This area of work is also extremely important, and certainly warrants a stepped up rate of research activity.

Species-wise, turbinella oak predominates the scene with six reports concerned primarily with chemicals and methods for controlling this important, very difficult to kill plant. These papers report definite progress toward finding an effective economical method of combating turbinella oak and with the attention it is receiving from competent research workers we can expect a major breakthrough in the near future. Other important species including big sagebrush, rabbit brush, salt cedar, chamise and others, appear to be receiving less attention than they have in previous years. With many of these species however, basic methods of control have been worked out and current research is concerned more with refining these methods and to some extent, measuring the benefits that can be expected from control.

The testing of new chemicals and older chemicals that have not previously received much attention in woody plant control is reported in five of the papers received. The selectivity of various chemicals toward important desirable timber species was at least part of the subject of all three papers concerned with brush control in forest management.

Turbinella oak growth responses to different rates of fenuron. Wagle, R. F. The growth responses of two classes of turbinella oak plants, mature plants and 6 month old sprouts were observed for two years after treatment with 5 rates of fenuron (1 - 2 - 4 - 8 - 16 lbs. of active material/A). The mature plants were treated with fenuron and then burned 6 months later after the first series of observations. The sprouting plants were the result of a burning treatment followed by reseeding to grass. The results obtained lead to the following conclusions:

1. Fenuron, within a few months after application, had leached

into the soil and root zones of the turbinella oak plants, then fairly large proportions were absorbed and moved via the transpirational stream into the aerial tissues of the plant.

2. Within 6 months after application, fenuron had largely leached on through the root absorption zones of the plants in the area and into the lower layers of subsoil.

3. Fire had an inhibiting effect on the action of fenuron which must have been stored, or residual, in the plant stem, twig, and foliar tissues.

4. Fenuron appeared to increase the palatability of the grasses growing on the treated plots.

5. Physiological injury to turbinella oak plants was probably much more extensive for the lower rates of fenuron than was indicated by the data presented.

6. Fenuron is much more effective in killing turbinella oak sprouts resulting from fire than it is in killing mature plants.

7. A 100% kill could be obtained on 6 month old turbinella oak sprouts by using 16 lb/A or more of active fenuron, but the cost would be prohibitive.

8. Turbinella oak can be removed or severely set back from its position of dominance for over 2 years in the vegetational cover in areas similar to the study area by treatment with fire, reseeding to grass, and treatment of sprouts with fenuron. (University of Arizona Agricultural Experiment Station, Tucson, Arizona)

Aerial spraying of shrub live oak-dominated chaparral watersheds in Arizona. Pase, C. P., Glendening, G. E., and Lillie, D. T. In June 1959, a wildfire occurred in central Arizona which consumed or killed the aerial portions of the dense, mature chaparral cover. The area burned included 3 watersheds on which stream-flow and plant cover records had been kept since 1956. Of these 3 watersheds one is being allowed to revegetate naturally, a second was seeded to a mixture of lovegrasses, while the third was seeded to lovegrasses and is being sprayed annually with 2,4,5-T (1.5 lb/A in 7.5 gallons oil/water emulsion).

The 76 acre sprayed watershed was so steep that a helicopter was employed for the spraying. Application cost was $2.50 per acre in 1960, and $5.70 per acre in 1961. In spite of steep terrain and deep canyons, the spray coverage was considered excellent in both years.

Fall 1960 and 1961 measurements show few shrub live oak (Quercus turbinella Greene), bushes were killed by the treatments. However, average stem length of treated oak was reduced to 20.7" as compared with 30.2" on the control watershed (mean difference significant at the 1% probability level). Crown growth of shrub species was substantially inhibited on the sprayed watershed "C" when compared with the control watershed "D", as shown below:

PERCENT CROWN COVER

	1958		1959 1/		1960		1961	
	C	D	C	D	C	D	C	D
Shrubs	72.9	70.2	7.0	7.0	8.5	21.4	7.5	23.5
Forbs	0.35	0.76	0.76	17.0	6.3	9.1	8.6	7.7
Grasses	0.41	1.52	1.52	0.28	0.99	1.5	3.9	2.4

1/ Area burned in June. Measurements made in October.

Water and sediment yields increased sharply on all watersheds following the fire. Both Watershed "C" and "D" maintained a small but continuous flow of water until the summer of 1961. At that time the untreated watershed ceased flow during the midday while the sprayed watershed maintained a continuous flow. (Rocky Mountain Forest and Range Exp. Sta., USFS, and Crops Research Division, ARS, U. S. Dept. of Agriculture, Tempe, Arizona)

Phenoxycarboxylic acids for the control of shrub live oak in Arizona. Davis, Edwin A. The phenoxycarboxylic acids are among the most effective foliage spray chemicals for the control of shrub live oak (Quercus turbinella). In this group the standard of comparison is 2,4,5-T. However, 2,4,5-T is unable to prevent sprouting effectively. Since slight changes in chemical structure frequently result in major changes in biological activity as well as in alterations in herbicidal specificity, a study was made to determine whether other chemicals in the phenoxycarboxylic acid group were more effective than 2,4,5-T for the control of shrub live oak. Besides various phenoxycarboxylic acids several different ester and amine formulations were evaluated. The study was conducted on seedlings in the greenhouse.

The following phenoxy analogs of acetic acid, propionic acid, and butyric acid were studied: 2,4,5-trichloro-, 2,4-dichloro-, 2-methyl-4-chloro-, 3,4-dichloro-, and 4-chloro. The 2,4,5-trichloro- substitutions on the ring resulted in greater activity than other ring substitutions evaluated. Acetic, propionic, and butyric acid side chains of the

2,4,5-trichlorophenoxy radical were initially equally effective in acid form. Likewise, the 3 side chain groups were equally effective when compared on the basis of the average effectiveness of the 5 analogs in each side chain group. When the 2,4,5-trichlorophenoxy herbicides were formulated as the butoxy ethanol esters, the acetic acid side chain represented by 2,4,5-T was superior to the propionic acid side chain represented by 2-(2,4,5-trichlorophenoxy) propionic acid (silvex). No formulation of 2,4,5-T was superior to the low volatile ester, which in these studies was the butoxyethanol ester. The diethanol amine salt gave poor results and the oil-soluble amine and emulsifiable acid formulations were not superior to the butoxyethanol ester.

Invert (water-in-oil) and conventional (oil-in-water) emulsion formulations of 2,4,5-T or silvex were equally effective. The invert emulsion has not been found to offer any advantages over the conventional emulsion for the control of shrub live oak. In the control of shrub live oak in Arizona the reduction of spray drift with the invert emulsion is not important since there is no crop-hazard problem in areas occupied by oak brush.

Fluoro-substituted phenoxy compounds were highly active, but they were not superior to the comparable chloro-substituted analogs. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Tempe, Arizona)

Substituted benzoic acids and phenylacetic acids for the control of shrub live oak in Arizona. Davis, Edwin A. Substituted benzoic acids and phenylacetic acids are herbicidal when applied to leaves or roots. A survey of 40 chemicals in this group was conducted to determine the most effective chemicals when applied to foliage or soil for the control of shrub live oak. The study was conducted on seedlings in the greenhouse.

Foliage-applied treatments.--The standard against which other chemicals were compared was 2,3,6-trichlorobenzoic acid (2,3,6-TBA). Two types of ring substitution patterns, 2,3,6-trichloro- and 2,3,5,6-tetrachloro-, conferred activity on the chloro-substituted benzoic acids. Deviations from either of these basic patterns resulted in a major loss of activity on shrub live oak. By replacing chlorine in the 2-position by the methoxy radical to give 2-methoxy-3,6-dichlorobenzoic acid, the activity of 2,3,6-TBA was retained; but when chlorine was changed from the 6-position to the 5-position to give 2-methoxy-3,5-dichlorobenzoic acid a loss in activity occurred. 2,3,5-TBA was also less active than 2,3,6-TBA. 2-methoxy-3,5,6-trichlorobenzoic acid, as well as other methoxy analogs tested, was less active than 2-methoxy-3,6-dichlorobenzoic acid. Replacement of the methoxy group in 2-methoxy-3,6-dichlorobenzoic acid by a methyl group resulted in a loss of activity. And the introduction of a nitro group in the 5-position of 2,3,5,6-tetrachlorobenzoic acid caused considerable inactivation.

2,3,6-trichlorophenylacetic acid (fenac) retained the activity of 2,3,6-TBA, but 2-methoxy-3,6-dichlorophenylacetic acid was much less active than 2-methoxy-3,6-dichlorobenzoic acid. 2-(2,4,5-trichlorophenoxy) ethyl 2,3,6-trichlorobenzoate was less effective than either 2,4,5-T or 2,3,6-TBA.

The three most effective chemicals as foliage sprays in this study were 2-methoxy-3,6-dichlorobenzoic acid, 2,3,6-TBA, and fenac. These compounds will form the basis for additional work to determine the usefulness of this class of chemicals for the control of shrub live oak. The most active chemicals approached the effectiveness of 2,4,5-T at the rate of 4 lb/A; however, the threshold rate of the substituted benzoic acids for effective control of seedlings was at least 5 times that of 2,4,5-T.

Soil-applied treatments.--In general, the chemicals most active as foliage sprays were also most active when applied to soil. On 8-month-old seedlings, 2-methoxy-3,6-dichlorobenzoic acid and fenac were the most effective chemicals, and at the rate of 4 lb/A they were as effective as fenuron. Fenac was the most persistent chemical in soil whether formulated as the acid, sodium salt, or butoxyethanol ester. Fenac was also more persistent than fenuron. The next most persistent chemicals were 2-methoxy-3,6-dichlorobenzoic acid and 2,3,6-TBA.

Conclusions.--The substituted benzoic acids and phenylacetic acids are promising as foliage-applied and soil-applied chemicals for the experimental control of shrub live oak. But continuing research is needed to determine their practical usefulness. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Tempe, Arizona)

Control of shrub live oak (Quercus turbinella Greene) with granular and pelleted herbicides. Lillie, D. T. Granular or pelleted forms of 2,4-D, 2,4,5-T, silvex, simazine, monuron-TCA, 2,3,6-TBA, monuron, and fenuron were applied to 35' x 35' plots at the rate of 4, 8 and 16 lb/A ai during December 1958. 2,4-D, 2,4,5-T, silvex, and simazine had no apparent effect on shrub live oak. Monuron-TCA and 2,3,6-TBA resulted in good initial effect and some stem kill, but, current (1961) regrowth is normal and recovery of the shrubs seems assured.

Both monuron and fenuron at 16 lb/A resulted in excellent control of shrub live oak with only a few individual stems surviving in bushes at the edges of the plots. Replacement ground cover generally survived in 1961 on the 16 lb/A fenuron plots, but soil surface remained bare on 16 lb monuron plots. Monuron and fenuron were about equally effective at 8 lb/A with most bushes killed and only occasional stems alive in others. Replacement ground cover was again more severly affected by monuron than fenuron. Control of shrub live oak was poor with 4 lb/A of monuron. Fenuron at 4 lb/A killed most stems on individual bushes, but few plants were completely killed. Density and growth of ground cover (forbs and grasses) were generally stimulated, particularly in the litter under dead or severely injured bushes. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Tempe, Arizona)

Herbicide combinations for the control of shrub live oak. Lillie, D. T. Shrub live oak (*Quercus turbinella* Greene) dominates 4 to 5 million acres of chaparral in Arizona and has been difficult to control due to its ability to sprout after top removal.

This test was applied in 5 replications of single-bush plots June 1, 1960, and the evaluations were made September 6, 1961. The following herbicides, in 20 gpa of aqueous solution, were applied to 1 year old sprouts that came up following fire.

Herbicide	Rate, lb/acre	Mean stem kill, inches[1]	Herbicide	Rate, lb/acre	Mean stem kill, inches[1]
Check	0	0 a[2]	Amitrole + GC-32292	6 + 8	4 b
Dalapon + GC-32292	10 + 8	0 a	2,4,5-T + Dalapon	2 + 10	6
Dalapon + Prometone	10 + 8	0 a	2,4,5-T + Amitrole	2 + 6	9 c
Dalapon	10	0 a	2,4,5-T	2	11 c
Prometone	8	0 a	2,3,6-TBA + GC-32292	6 + 8	14 d
GC-32292	8	0 a	2,4,5-T + Prometone	2 + 8	15 d
Amitrole + Dalapon	6 + 10	1 a f	2,3,6-TBA	6	20 e
Amitrole	6	1 a f	2,3,6-TBA + Amitrole	6 + 6	22 e g
Amitrole + Prometone	6 + 8	2 f	2,3,6-TBA + Prometone	6 + 8	26 g
2,4,5-T + GC-32292	2 + 6	3 b	2,3,6-TBA + Dalapon	6 + 10	30

1/ Represents the mean distance in inches from tip of the stem to live wood. The three tallest stems in each bush were measured so each number represents the mean of 15 observations.

2/ All means not followed by the same letter differ at the 5% probability level.

Only 2,4,5-T and 2,3,6-TBA whether applied singly or in combination with other herbicides had any appreciable effect on oak. None of the combinations with 2,4,5-T were more effective than 2,4,5-T alone, except the combination with prometone. Prometone also enhanced the activity of 2,3,6-TBA.

The combination of 2,3,6-TBA and dalapon was the most effective treatment in the test.

In general 2,3,6-TBA produced the greatest amount of topkilling under the conditions of this experiment. None of the treatments completely killed shrub live oak and recovery of even the most severely damaged shrubs is expected. (Crops Research Division, Agricultural Research Service, U. S. Dept. of Agriculture, Tempe, Arizona)

Chemical Control of Salt Cedar (*Tamarix pentandra*). Arle, H. Fred, Bowser, C. W. and McRae, G. N. Previous experimental work has shown that applications of esters of 2,4-D and 2,4,5-T, and combinations of these chemicals and silvex resulted in good control of salt cedar. It was also indicated that time of application influenced results.

During the Spring of 1959, old growth salt cedar was mechanically destroyed by bulldozer operations and burned about 2 months later. The area was then divided into 45 quarter-acre plots which were separated by 12-foot access lanes. Each plot was 300 feet long x 36.5 feet wide (approximately 1/4 acre).

Initial applications of silvex were made during May 1960 on regrowth which was 10 months old and during October 1960 when regrowth was 15 months old. Other plots were initially treated during the spring or fall of 1961. Survival counts were made immediately prior to retreatment, approximately one year after the first application. Following are the results of applications made during 1960:

Treatment	Initial population	Population 1 year later	Percent kill
Silvex 4 lb/A May 1960	362	38	90
Silvex 4 lb/A Oct. 1960	365	203	44
Silvex 10 lb/A May 1960	306	0	100
Silvex 10 lb/A Oct. 1960	257	155	40

Spring applications of silvex at the rate of 10 lb/A gave a complete kill of salt cedar while the same rate as a fall application killed only 40 percent. Regardless of treatment rate, results of fall applications were essentially equal and much inferior to those obtained from spring applications. The advanced age of regrowth was not a prime factor for the poor results of the fall applications. Preliminary counts made on plots treated during May 1961 when regrowth was 22 months old have indicated a 75 percent kill. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture and the Bureau of Reclamation, U. S. Department of Interior)

A large-scale treatment of alligator juniper with fenuron. Clifton, John E. and Layter, Wendell. Apache Indian youth lack adequate opportunity for summer employment. Youth work camps, financed primarily by Indian grazing association, provide some opportunity for work but is often limited by the physical capabilities of the young people. The advent of Dybar fenuron pellets as a tool for tree and brush control appeared to provide a useful and feasible usage for young people. Therefore, in the summer of 1960 fenuron application to trees was selected as a summer work project.

Point-of-Pines is a high grassland on the San Carlos Apache Indian Reservation. The margins have been invaded by alligator juniper, which also encroaches into ponderosa pines in the area. The area provided a variety of tree sizes, stand densities and soil types. Results varied considerably, inasmuch as the dosage was marginal for larger tree sizes according to our present knowledge.

Each of the two camp sessions consisted of 30 boys, ranging from 12 to 16 years of age. They were divided into 5-member teams, each team with an adult Apache supervisor. The team worked a strip 50-75 yards wide, marking the edges with twine. The supervisor followed behind, aiding in the treatment and making sure no trees were missed.

Statistics of interest include the following: (1) 15,690 pounds of Dybar were applied to 5760 acres for an average of 2.72 pounds per acre; (2) The acres per boy per hour was 1.2, and; (3) Cost per acre was $3.94, which did not include camp costs.

Results 16 months after treatment varied from poor to excellent. Scattered trees of over 10 feet height on clay loam soil (30% clay) suffered only minor dieback and recovery is expected. Smaller trees in these sites appeared to be adequately treated. Alligator juniper trees in ponderosa pine sites did not respond satisfactorily even though the lighter soils should favor better results. The pine trees showed considerable yellowing and apparently "robbed" the juniper trees of the fenuron. Also the abundant litter on the ground undoubtedly interfered seriously with fenuron activity.

The highest kills, approaching 100%, occurred where a relatively dense stand of junipers occurred. This area had clumps of juniper which approached stand densities of 600 trees per acre or more. The trees were up to 15 feet height but were not of dense foliage because of plant competition. Apparently the good kills obtained here are due to two reasons: (1) The additive effects of fenuron applied to a number of stems over a small area, and: (2) The lesser foliar density of each tree.

Factors which helped insure the excellent coverage obtained in the area are: (1) a two-day training session for the adult supervisor prior to the camp session; (2) keeping each work team small; (3) Careful daily mapping of treated areas, and: (4) proper arrangements to keep each team supplied with chemicals.

Factors interfering with good kill of trees in some areas were heavy clay soil types, sub-normal rainfall for the 12 months following treatment, and inadequate dosage on trees with dense foliage. (Arizona Agrochemical Corporation and San Carlos Indian Agency)

Preliminary evaluation of 4(2,4,5-trichlorophenoxy) butyric acid and 4(2,4-dichlorophenoxy) butyric acid as selective silvacides. Schieferstein, Robert H. These two new chemicals, which will be referred to as 2,4,5-TB and 2,4-DB, were applied to clumps, 20 x 40 ft. plots, or individual young trees with a back pack mist-blower at a calculated rate of 2 pounds acid equivalent per acre on brush species and 4 pounds acid equivalent per acre on desirable tree species. The low-volatile (isooctyl) ester formulation was utilized and diluted in each case with white diesel oil to 10 gallons per acre total spray volume. Dormant applications were made in late March and foliage applications were made in June and July. Tests were located near Cornelius, Oregon and near Else, Oregon. Preliminary evaluations were made in July and September.

Results:

Tree or brush species	Timing*	Effect with 2,4,5-TB	Effect with 2,4-DB
Bigleaf maple,	DS	Very promising	Promising
Acer macrophyllus	SF	Very promising	Promising
Vinemaple,	DS	Very promising	Little effect
Acer circinatum	SF	Promising	Some promise
Red alder,	DS	Very promising	Very promising
Alnus rubra	SF	Very promising	Very promising
Madrone,	DF	Very promising	Very promising
Arbutus menziesii	SF	Very promising	Very promising
Salmonberry,	DS	Some promise	Little effect
Rubus spectabilis	SF	Some promise	Little effect
Thimbleberry, *Rubus* sp.	DS	Little effect	Little effect
	SF	Some promise	Little effect
Snowbrush,	DF	Very promising	Little effect
Ceanothus velutinus	SF	Very promising	Little effect
Blackberry,	DS	Very promising	Little effect
Rubus laciniatus	SF	Very promising	Some promise
Willow, *Salix* sp.	DS	Some promise	Promising
	SF	Promising	Very promising
Douglas fir,			
Pseudotsuga	DF	No effect	Little effect
taxifolia	SF	No effect	Little effect
White fir,	DF	Some injury	Serious injury
Abies concolor	SF	Moderate injury	Serious injury
Western hemlock,	DF	No effect	Some injury
Tsuga heterophylla	SF	No effect	Moderate injury
Red cedar,	DF	Some injury	Moderate injury
Thuja plicata	SF	Some injury	Moderate injury

*DS - dormant stem; DF - dormant foliage; SF - Summer foliage

Rates of 1 and 2 lb ae/A of 2,4,5-TB and 1 pound 2,4,5-TB plus 1 pound 2,4-DB were applied to 5 acre plots by helicopter in the Chetco district of the Siskiyou National Forest. The plots were treated in early April and work was carried out cooperatively with the U. S. Forest Service. The low volatile (isooctyl) ester formulation was sprayed in a water carrier at a total volume of 8 gallons per acre. None of these treatments showed promise as a dormant foliage treatment on tanbark-oak, Lithocarpus densiflorus, canyon live oak, Quercus chrysolepis, or golden chinquapin, Castanopsis chrysophylla var minor. None of the treatments showed any effect on Douglas fir. All three treatments showed promise on madrone and varnish-leaf ceanothus, Ceanothus velutinus var. laevigatus. In addition the mixture of 2,4-DB and 2,4,5-TB showed promise on greenleaf manzanita, Arctostaphylos patula and hoary manzanita, Arctostaphylos canescens. (Chipman Chemical Company, Inc., Palo Alto, Calif.)

Effect of ester type on the kill of woody plants by basal and foliar application techniques. Leonard, O. A. The isooctyl esters of 2,4-D and 2,4,5-T have become commercially available in recent years. Other very common low volatile esters are the butoxyethanol (BE) and propyleneglycolbutylether (PGBE) esters. The purpose of the tests was to compare the isooctyl ester (an alkyl ester) with the BE ester (as an example of the ether esters) with respect to their relative effectiveness as herbicides against woody plants in California. Both basal and foliar application techniques were used.

Interior live oak (Quercus wislizenii) was bulldozed in 1953. The sprouts had attained a length of 6-12 feet when the basal spray applications were made on February 2, 1960. Approximately 50 ml. of spray mixture was applied for each one-inch of stem diameter. The spray mixtures consisted of 8 and 16 pounds of 2,4-D plus 2,4,5-T (equal quantities of each) made to 100 gallons with diesel fuel. Plant kills as of June 8, 1961 were 7% and 50% for the 8 and 16 aehg treatments with the BE ester and 50% and 80% with the isooctyl ester. These figures represent clumps of bushes that were completely killed; each clump consisted of 15-30 stems. The results from these tests suggest that the isooctyl ester was equal and maybe superior to the BE ester with respect to bark penetration. Further testing will be required, however, before a firm conclusion can be drawn.

Two foliage spray tests were conducted on interior live oak sprouts in which the BE and isooctyl esters of 2,4-D were compared using 4 and 8 aehg of water (including one-half gallon of diesel fuel). The first test was put out on February 19, 1960, while the plants were dormant. The average kill of the clumps of live oak (consisting of 20-100 stems each) was 52% for the BE ester and 50% for the isooctyl ester (a clump was considered as alive, unless every stem in the clump was killed and there was no sign of regrowth when the observations were made on June 1, 1961). The second test was put out on June 14, 1960 and was identical to the test already mentioned except for date of treatment; shoot growth was active. Clump kill was 8% for the BE ester and 0% for the isooctyl ester. A general appraisal of the clumps of stems which were not completely killed did not indicate that there was any difference in the effectiveness of the two esters. One interesting fact that might be noted is the difference in kill with respect to season of application; dormant application of sprays to live oak sprouts was far more effective than spray applications during the growing season. Such observations are not new; however, it is known the precise kills that are obtained are influenced by a variety of factors. For example, severe frosts and loss of leaves by live oak would have resulted in poor kills during the dormant period.

An aircraft spray application test was conducted on a chamise covered area, in cooperation with W. L. Larramendy of the Bureau of Land Management. The test was on shallow serpentine soil in the Coast Range of Napa County. The brush was crushed and burned in 1959; however, the burn was rather poor, so many of the old chamise stems were not killed by the fire. The area was drill-seeded to grass, including perennials, in the fall of 1959. The sprays were applied on May 6, 1960. The regrowth chamise was 2-5 inches long. The soil was moist from recent rains. The spray mixture consisted of 2 pounds of 2,4-D plus 2 pounds of 2,4,5-T (equal to 1 gallon of commercial brush killer), 1 gallon of diesel fuel and 3 gallons of water. The actual spray output by the airplane was 6-6.5 gallons per acre or about 5 pounds of acid equivalent. The swath widths were 35 feet. Duplicate plots of the BE and the isooctyl esters were flown. The area adjacent to the plots was all sprayed with the PGBE ester of the same composition as the other two esters.

Results of the spray applications were recorded on March 1, 1961 using a random transect method of determining plant kill. The results from these observations are recorded in the table below. It is not regarded that the differences in the results between the 3 esters should be considered as significant----especially considering kills obtained on all species. There are possibly differences in kills as influenced by plant species and stage of growth; however, further testing would be required to reveal such differences, if they exist.

Ester type	Plant kill: Chamise, Regrowth	Plant kill: Chamise, Old plants	Toyon	Leather oak	Silktassel
	%	%	%	%	%
Butoxyethanol	90	27	67	13	--
PGBE	100	46	55	21	66
Isooctyl	94	48	45	21	60

Chamise--Adenostoma fasciculatum; toyon--Photinia arbutifolia; leather oak--Quercus durata; silktassel--Garrya sp.

Other aircraft comparisons are under observation, but no conclusions have been drawn as of this time. (Department of Botany, University of California, Davis)

Chemical control of dwarfmistletoe in California's coniferous forests. Quick, Clarence R. A project to develop an effective method for direct chemical control of dwarfmistletoe (Arceuthobium sp.) continues in the montane forests of California. In 1959, 43 tests were initiated on 298 trees; in 1960, 100 tests on 885 trees; and in 1961, 39 tests on 496 trees. This is a total of about 180 tests on 1,680 trees. Sugar pine, ponderosa pine, Jeffrey pine, white fir, and red fir trees have been treated. Phenoxy acid herbicides have been emphasized, but other chemical types--erbon, sym-triazine, sulfamate, and miscellaneous--also have been tested.

Two general methods of application commonly have been used: (1) individual dwarfmistletoe cankers were sprayed in attempts to kill the treated infestations; and (2) the basal portions of boles of infested trees were sprayed in attempts to kill all dwarfmistletoe infestations in the tree by "systemic" translocation of the herbicide. Three spray carriers commonly have been used, (1) kerosene or stove oil, (2) water to which 10 to 30 percent of miscible agricultural spray oil has been added, and (3) water to which 10 to 30 percent of a polyglycol has been added.

Experimental tests on dwarfmistletoe mature slowly. Cankers treated in the fall of 1959 appear dead but may yet resprout from extensive endophytic systems of the parasite within the trees. Ester formulations of 2,4-DA, 2,4-DP, 4-CDA, and MCPA at 2,000 to 3,000 ppm ae applied in 1959 in kerosene or stove oil apparently killed all individually treated cankers without damage to the trees but showed little systemic effect on untreated cankers. In 1960, concentrations up to 1.0 to 1.5 percent of these and other phenoxy acid herbicides (2,4-DB, 2,4,5-T, 2,4,5-TP) in light petroleum oil killed some trees of all five listed species when applied in basal-bole treatments.

Oil-in-water and glycol-in-water carriers appear to be considerably less severe than petroleum oil carriers on trees treated by the basal-bole method, but they may not penetrate as effectively as oil. At the present time, 2,4-D, 2,4-DB, MCPA, and 2,4,5-T seem to offer little chance of effective systemic control of dwarfmistletoe in California because of an apparent lack of adequate specificity.

Plans and tests are continuing. (U. S. Forest Service, Berkeley, California)

The effect of flight elevation and herbicide carrier on control of range brush. Gould, W. L., Phipps, F. E. and Furtick, W. R. On relatively smooth sites on rangeland, big sagebrush and rabbitbrush have been successfully controlled with aerial treatments of 2,4-D when applied from a low flight elevation. In rough terrain a low flight can be very hazardous which may necessitate making the application of herbicides from a higher elevation. This experiment was designed to determine the effect of flight elevation and various materials as carriers on degree of sagebrush or rabbitbrush control. Water, Uran (urea and ammonium nitrate solution), diesel oil or SAE 10 motor oil, and the invert emulsion formulation were used as carriers at rates of 5 gpa. The water and Uran were applied from elevations of 25 and 100 feet. The other materials were applied only from 100 feet. Sagebrush and rabbitbrush were sprayed respectively with 2 lb/A and 3 lb/A of the butyl ester of 2,4-D in the spring of 1960.

The results obtained on the three sagebrush sites in August, 1961, were quite variable. The trend was toward better control at the 25 foot elevation, with the water and Uran being equally effective. At the 100 foot flight elevation none of the treatment gave sufficient control but Uran was best.

Difficulties in application were encountered with the invert emulsion and SAE 10 oil, which partially explains the low degree of control encountered on these plots.

In the rabbitbrush area all the treatments provided very good control of the rabbitbrush. In contrast to the sagebrush, the application from the 100 foot level appeared to be slightly more effective than from the 25 foot level. Again, Uran appeared to be more effective than the other carriers. (Oregon Agricultural Experiment Station)

The effects of low-volume herbicide applications on potted Douglas-fir seedlings. Newton, Michael. In many situations where young conifers exist beneath dense brush cover, it is necessary to use herbicides to kill the brush, yet to do so without seriously damaging the conifers. While Gratkowski (1961) has reported serious effects from summer application of low-concentration, high-volume sprays of 2,4-D and 2,4,5-T in water and emulsions, Rediske (1961) reports that 2,4,5-trichlorophenoxy butyric acid (2,4,5-TB) is of low inherent toxicity to Douglas-fir. The experiments reported here compare the effects on Douglas-fir of 2,4-D, 2,4,5-T and 2,4,5-TB esters in oil and 2,4,5-T amine and amitrole-T in water as 1, 2 and 4 pound applications in five gallons of solution per acre.

The treatments were applied at two-week intervals from late August. The apparatus used was an electrically driven, squirrel-cage blower with a spray nozzle in the center. The spray volume was metered according to the area in the spray pattern. On each seedling was placed a spray sampling card to insure uniform treatment comparable to five gallons per acre by helicopter.

The effects were rated according to a five point scale in which class 0 indicated no visible effect and class 4 indicated dead trees. Intermediate grades were based on severity of defoliation and bud killing. The results shown in tables 1 and 2 reveal the importance of seasons in planning brush sprays. Both early-season and late treatments produced negligible effects with phenoxy herbicides, but mid-season treatment caused some damage. Low application rates produced negligible effects at any time with these chemicals. Amitrole-T, on the other hand, showed much less variation with season, and had noticeable effects even at low application rates. 2,4,5-TB and 2,4,5-T amine failed to cause appreciable damage under any of the conditions tested. While these tests indicate that 2,4,5-T may have been more damaging than 2,4-D, this is contrary to past findings by the author and by Lauterbach. The difference, if any in either direction, is probably slight.

An important conclusion from these tests is that in no case was mortality observed as the result of the herbicides. The effects were recorded at the time when prior tests showed the trees to be at their poorest condition. Recovery during the next season probably will offset damage in nearly all instances. The generally low effect may be attributed partly to the fact that the trees were grown in pots. However, the effects noted would probably develop in the field, but with possible differences in degree. It is highly probable that trees in the shelter of brush would escape the full effect of the spray. Direct treatment of openings would be likely to cause damage during summer months unless 2,4,5-TB ester or 2,4,5-T amine were used. While the amitrole-T caused no mortality, one might be cautious about using this for a release spray until further research proves its merit. (Oregon State University, School of Forestry.)

TABLE 1

Comparisons of four herbicides applied to Douglas-fir seedlings at the rate of two pounds per acre at two-week intervals from April 28 to August 31. Numbers indicate average condition of seedlings within treatments.

CHEMICAL FORMULATION & CARRIER

DATE	LOW-VOLATILE ESTERS IN OIL 2,4-D	2,4,5-T	2,4,5-TB	AQUEOUS SOLUTIONS 2,4,5-T Amine	Amitrole-T	Mean of phenoxy esters
April 28	0.25	0.75	0.00	0.00	1.25	0.33
May 11	1.50	1.00	0.50	0.00	2.00	1.00
May 25	0.75	1.50	0.00	0.00	1.00	0.75
June 8	0.25	1.75	0.00	0.50	1.75	0.67
June 22	0.50	1.25	0.00	0.25	2.00	0.58
July 6	0.00	0.50	0.00	0.00	1.50	0.17
July 20	1.00	0.75	0.00	0.00	1.50	0.58
August 3	0.25	0.50	0.00	0.00	1.50	0.25
August 17	0.25	0.25	0.00	0.00	1.25	0.17
August 31	0.25	0.00	0.00	0.00	0.50	0.08
MEAN/ CHEMICAL	0.50	0.82	0.05	0.07	1.42	0.46

0.95 LSD among chemicals 0.205
0.95 LSD among dates 0.295

TABLE 2

The effects of various application rates of 2,4-D; 2,4,5-T; 2,4,5-TB as esters in oil; 2,4,5-T amine; and amitrole-T at four different seasons.

DATE	RATE Lb/A	2,4-D ester	2,4,5-T ester	2,4,5-TB ester	2,4,5-T amine	Amitrole-T
	1	0.25	0.25	0.00	0.00	1.25
April 28	2	0.25	0.75	0.00	0.00	1.25
	4	0.50	0.50	0.25	0.00	2.25
	1	0.00	0.25	0.00	0.25	1.00
June 8	2	0.25	1.75	0.00	0.50	1.75
	4	1.50	2.25	0.50	0.50	2.25
	1	0.00	0.50	0.00	0.00	1.00
July 6	2	0.00	0.50	0.00	0.00	1.50
	4	0.50	1.00	0.50	0.25	2.25
	1	0.25	0.00	0.00	0.25	1.00
August 17	2	0.50	0.25	0.00	0.00	1.25
	4	0.75	0.50	0.00	0.50	1.50

0.95 LSD among rates = 0.78 (within chemicals)

Snow cover on sprayed sagebrush lands. Alley, H. P. Two previously sprayed sagebrush (*Artemisia tridentata*) areas were selected for snow cover studies. The Red Desert area which was sprayed in 1957 and the Big Horn Mountain site sprayed in 1950. The Red Desert site has an elevation of 7200 feet and receives approximately 10 inches precipitation per year, whereas, the Big Horn plots are located at 8200 ft elevation and receive approximately 20 in. precipitation per year.

Snow cover studies include four years with three surveys being made in 1961. The sprayed areas on the Big Horn Mountains are covered with an average of twice as much snow resulting in approximately twice as much water as the unsprayed areas. Considerable snow is intercepted by live sagebrush clumps and is evaporated into the dry winter air. The four years' data are giving a good picture of the effects of sagebrush control on snow cover relationships.

No differences in snow cover between sprayed and unsprayed areas was found on the Red Desert study area. (Wyoming Agricultural Experiment Station)

Snow cover and moisture in the snow on Big Horn study site

Year	Month	Unsprayed		Sprayed	
		Snow depth in inches	H_2O content in inches	Snow depth in inches	H_2O content in inches
1958	April	6.7	2.5	23.6	6.9
1959	May	8.3	2.1	9.3	3.3
1960	March	10.1	2.8	17.8	5.1
1961	February	8.7	1.8	14.0	3.6
1961	March	9.9	2.9	17.7	5.4
1961	April	5.4	1.5	16.0	5.2
Average		8.2	2.3	16.4	4.9

PROJECT 4. WEEDS IN HORTICULTURAL CROPS

Garvin Crabtree, Project Chairman

SUMMARY

Contributions to the research report for weed control in horticultural crops covers a wide range of ornamental, fruit, and vegetable crops. All studies reported are concerned with weed control by means of herbicides. Twenty-four papers from workers in six states were contributed.

Ornamentals. Most of the lawn or turf weed control research reports deal with control of crabgrass. One paper lists the response of a number of weed species to several herbicides. Two papers report tolerance of bluegrass to herbicides used for crabgrass control. One abstract is concerned with herbicide testing techniques for crabgrass control, and one reviews crabgrass herbicide programs in relation to cultural practices. A number of new crabgrass herbicides appear to show promise in the tests reported.

A paper on control of weeds in fall planted bulbs lists herbicide programs of interest for the Pacific Northwest. In the several papers dealing with ornamental shrubs and nursery plantings, several herbicide programs are listed that have been found to be of value for selective control of weeds in a large number of ornamental species. Considering the large number and diverse types of plants, from turf grasses to trees, involved in ornamental plantings, the size of the research problem in this field is large; but the amount of work in this field in the western states is encouraging.

Fruit Crops. Three abstracts report research in tree fruit and nut crops. This is an area where development of herbicide programs has come relatively recently but considerable progress has been made. One or two applications of herbicides with long residual life give year around control. The removal of weed competition from newly established trees has resulted in marked tree growth increases.

Three papers on weed control in strawberries also deal with year around weed control from the time of transplanting through the several harvest seasons. Although reasonably satisfactory weed control programs are available for strawberry culture, the cost of hand weeding in this crop justifies further research to refine the programs in order to deal with as wide a range of problems as is possible.

Vegetable Crops. Papers reporting weed control research in vegetable crops include work on asparagus, carrots, peas, spinach, sweet potatoes and tomatoes. Some of these studies were concerned with the control of a specific weed problem while others involve selective control of a wide range of weed species.

Two reports are concerned with a comparison of application methods. Often times the method of application, subsequent irrigation, or other controllable environmental variables may be as important as the herbicide, both from the standpoint of activity and of selectivity. More of this type of study with a critical evaluation of factors needs to be carried out.

Chemical control of lawn weeds. Erickson, L.C. This preliminary study was designed to determine primarily the most desirable rate and date for the application of 12 herbicides or combinations. All materials were applied as single replications at three rates (given below) and at three dates--May 15, 30 and June 15. Only the early treatment, May 15, proved satisfactory for crabgrass control. The following Table illustrates the relative mean performance of the herbicides. It does not indicate the most desirable rate of application. (Idaho Agricultural Experiment Station)

Reduction of stand of weedy species to 12 herbicides applied May 15 on an established bluegrass lawn. (Ranks, 1=90 to 100% control, 10=no control.)

	Avg. 3 rates lb/A.	Smooth chickweed	Mouse ear chickweed	Dandelion	*Mean other broad-leaved	Crab-grass
DCPA	10, 15, 20	4	2	8	5	2
DMPA	10, 15, 20	1	2	2	2	1
Bandane	15, 20, 25	2	3	5	3	3
Silvex LV	1, 2, 3	2	3	3	3	10
Silvex K salt	1, 2, 3	1	2	6	3	7
2,4-D amine	1, 2, 3	1	1	1	1	8
T B A	2, 4, 6	1	5	1	2	7
2,4-5 T amine	2 3, 4	5	8	1	5	9
2,4-5 T ester	1, 2, 3	5	3	2	3	10
Silvex salt &	½, 1, 1½	1	1	1	1	9
2,4-D amine	½, 1, 1½					
Stam 34		10	10	10	10	10
2,4-D oil sol.	1, 2, 3,	7	1	1	3	8

* Plantains, speedwell, heal all, black medic, etc., not in sufficient numbers to justify inclusion.

The effects of five pre-emergence crabgrass herbicides on Kentucky bluegrass seeded at intervals after herbicide treatment. Chamberlain, H. E., Fults, J.L. and Ross, M. A. These tests were started April 15, 1961 at the Botany and Plant Pathology experimental farm at Fort Collins, Colorado, to determine the minimum length of time necessary to wait to seed Kentucky bluegrass after the use of a pre-emergence crabgrass herbicide. This information should be of value primarily where new bluegrass lawns must be established on soils containing large amounts of viable crabgrass seed. It should also be of value in selecting the best pre-emergence herbicide to use on open, poor-quality, established bluegrass turf which contains large amounts of viable crabgrass seed. This report compares the data taken October 26, 1960 and data taken on July 18, 1961. Final data will be taken in July 1962. A preliminary report of the October 26, 1961 data appeared in the 1961 Research Progress Report W. W. C. C. pp. 45.

On July 18, 1961--one year and three months after treatment--Zytron appeared to remain toxic to bluegrass seedlings at the 0 to 20 week treatment dates. This was the same trend as shown by the line transect data and field evaluation on October 26, 1960. However by July 18, 1961, the severity of toxicity had decreased and the bluegrass population appeared adequate to provide an acceptable turf cover after the 8-week planting date.

Dacthal was very toxic to bluegrass seedlings from 0 to 20 weeks old during the first year as evidenced by the 1960 data. This toxicity was still evident in the 0, 2 and 4 week planting date plots on July 18, 1961. Little or no toxicity was evident in the 8, 12 and 20 week plots. On the basis of these results, reseeding following Dacthal treatment can be expected to produce acceptable turf if reseeding is done no sooner than 8 weeks after treatment.

Balcite, PAX and Kleen-up demonstrated toxicity to bluegrass seedlings the first year when seeding was done at 0 and 2 weeks after treatment. This reduction in bluegrass populations carried over to the second year. There was also some reduction in bluegrass turf the second year when bluegrass was planted 4 weeks after chemical treatment. Bluegrass turf seeded 8, 12 and 20 weeks after chemical treatment exceeded or paralleled bluegrass populations in the control plots. Both the 1960 and 1961 data are shown in the following table. (Colorado Agricultural Experiment Station)

Table 1. The length of time that five pre-emergence pre-plant crabgrass herbicides remain toxic to new seedings of Kentucky bluegrass.

	Number of weeks after chemical treatment--bluegrass seeded											
	0 weeks		2 weeks		4 weeks		8 weeks		12 weeks		20 weeks	
	1960[1]	1961[1]	1960	1961	1960	1961	1960	1961	1960	1961	1960	1961
Control	47.0*	56.4	26.0	36.2	22.5	67.6	24.5	61.8	28.0	67.9	39.5	70.2
Zytron	20.0	41.0	12.0	30.0	8.2	52.0	20.0	56.0	13.0	50.0	18.0	57.5
Dacthal	9.0	27.5	10.0	32.5	3.5	27.5	14.0	79.0	13.5	67.0	23.0	70.0
Kleen-up	39.0	44.5	29.0	24.5	32.0	60.5	42.0	63.0	27.0	71.0	43.0	82.5
PAX	39.0	21.5	23.0	14.5	15.0	46.0	19.0	87.5	24.0	72.5	41.0	74.5
Balcite	22.0	30.0	16.0	21.5	19.0	43.5	19.0	62.0	19.5	65.5	37.0	72.0

[1]Evaluation dates: 1960--October 26, 1960
1961--July 19, 1961

*Average number of "hits" per 5 feet of line transect--blades touching one edge of tape.

The effect of pre-emergence crabgrass herbicides on bluegrass seedlings of different ages. Chamberlain, H. E. and Fults, J. L. This study was initiated to determine the minimum time interval needed between the planting date of Kentucky bluegrass and the application of seven pre-emergence crabgrass herbicides, and to determine the phytotoxicity of these herbicides to hairy crabgrass (*Digitaria sanguinalis*) seedlings. All the chemicals tested have been designed as pre-emergence crabgrass control herbicides for use in established bluegrass turf and are not suited to immediate application on newly seeded turf.

Chemicals tested were: DMPA emulsifiable concentrate at 20 lb/A; DCPA, 50 percent wettable powder at 10 lb/A; PAX, at 20 lb dry formulation/1000 sq ft (lead arsenate, other arsenicals, nitrogen and carrier); Kleen-up, at 20 lb dry formulation/ 1000 sq ft (calcium arsenate, nitrogen and carrier); Balcite, at 20 lb dry formulation/1000 sq ft (chlordane 7%, thiram 1%, nitrogen 7%, phosphate 5%, 75% carrier, chelated "9% iron sulfate" 5%); Bandane, at 30 lb emulsifiable concentrate/A (polychlorodicyclopentadiene isomers); trifluralin, dry formulation at 2 lb/A.

A level area was selected on the Colorado State University Exp. Sta., Bay Farm, Fort Collins, Colorado. Soil was slightly alkaline and clay-loam. The seed bed was floated and packed prior to seeding. The experiment was designed so there would be three planting dates. The first planting of Kentucky bluegrass was June 9, 1961 at a rate of 3 lb/1000 sq ft and hairy crabgrass at a rate of 1 lb/1000 sq ft. The second planting was conducted August 31, 1961 at the above mentioned rates. A third planting is scheduled for early spring 1962 at the previous rates.

The seven test chemicals were applied in strips running in an east-west direction and applied at the designated intervals on plots 4' x 5'. Each treatment was duplicated in each planting but in non-adjacent plots. Treated strips were in pairs with an untreated control strip adjacent to each two treated strips.

The entire experimental area was adequately sprinkler irrigated from April through October. Line transects were run October 20, 1961 on the June 9, 1961 planting. Counts were not taken on the August 31st planting. In the following table is a summary of the line transect counts.

As a result of field evaluation, supported by data from line transects given in the above table, the following trends at the end of the 1961 growing season for the late spring experiment are apparent: (1) It may be feasible to apply certain pre-emergence crabgrass herbicides at time of planting bluegrass in late spring but not others; (2) DMPA and trifluralin are toxic to 0 to 16 week-old bluegrass seedlings; (3) DCPA is toxic to 0, 2, and 4 week-old bluegrass seedlings but not to 8, 12 and 16 week-old seedlings; (4) PAX, Kleen-up and Balcite (all of which contain available nitrogen fertilizer) are relatively non-toxic to bluegrass seedlings if they are at least 8 weeks old. Balcite and Kleen-up may be fairly safe to use on 4 week-old seedlings; (5) Bandane is very toxic to 0 and 2 week-old seedlings and somewhat toxic to 4, 8 and 12 week-old seedlings; 16 week-old seedling populations are equal to the controls.

Little toxicity is shown to exist to crabgrass after the "0" week treatment except for DCPA and DMPA, which are somewhat effective if used 2 to 4 weeks after planting. The data strongly suggests that in general all chemicals tested must be used pre-emergence to crabgrass growth to be effective.

Treatment	Rate	Counts on bluegrass and crabgrass — Time treated after planting-June 9, 1961 planting											
		0 weeks		2 weeks		4 weeks		8 weeks		12 weeks		16 weeks	
		BG*	C**	BG	C	BG	C	BG	C	BG	C	BG	C
DMPA	20 lb/acre	0	0	10	0	16	0	21	2	48	11	45	15
DCPA	10 lb/acre	0	0	23	0	47	3	80	13	73	20	72	17
PAX	20 lb form./ 1000 sq ft	17	7	34	12	60	12	81	19	124	5	107	8
Kleen-up	20 lb form./ 1000 sq ft	61	15	75	13	91	6	103	14	125	6	107	8
Balcite	20 lb form./ 1000 sq ft	16	39	105	13	64	16	133	18	172	7	99	12
Bandane	30 lb/acre	3	7	30	8	67	17	63	9	57	7	75	9
Trifluralin	2 lb/acre	0	0	17	9	39	13	37	20	52	36	56	20
Control	-	71	10	75	11	74	17	75	17	71	16	67	17

*Kentucky bluegrass

**Hairy crabgrass

As a result of field evaluation of the fall experiment (August 31, 1961) the following trends at the end of the growing season in early November 1961 are apparent: (1) No crabgrass germination; (2) DMPA reduced bluegrass stand by 98 percent at the 0 and 2 week treatment dates and 60 percent at the 4 week treatment date; (3) DCPA reduced bluegrass stand by 98 percent at the 0 weeks, 90 percent at the 2 week and 25 percent at the 4 week date; (4) PAX reduced bluegrass stand by 60 percent at the 0 and 2 week dates but none on the 4 week date; (5) Kleen-up produced no toxicity at any date; (6) Balcite reduced the bluegrass stand by 90 percent at 0 weeks, 30 percent at the 2 week date, no injury by the 4 week date; (7) Bandane reduced the bluegrass stand by 95 percent at 0 weeks, 55 percent at the 2 week date and no injury by the 4 week date; (8) Trifluralin reduced bluegrass stand 100 percent at the 0 week date, 99 percent at the 2 week date and 10 percent at the 4 week date. At the 8 week treatment date no toxicity to bluegrass was apparent for any of the chemicals in this test. (Colorado Agricultural Experiment Station, Colorado State University, Fort Collins, Colorado)

An evaluation of several techniques for the greenhouse evaluation of pre-emergence crabgrass herbicides. Chamberlain, H. E. and Fults, J. L. A series of experiments were designed to determine which technique promoted the greatest precision for carrying out a testing program in the greenhouse on candidate crabgrass herbicides.

Bandane (polycholodicyclopentadiene isomers) emulsifiable concentrate containing 4 lb ai per gallon was employed as the test chemical and was used in conjunction with vermiculite as a mulching agent. Rates of 0, 6, 8, 10, 15, 20 and 30 lb ai per acre were used. Greenhouse flats measuring 14" x 17" x 3" deep were used, giving a sprayed area of 1.653 sq ft per flat. Each rate was replicated three times. Flats were filled to within three-fourths inch of the top with a standard greenhouse soil mix. One hundred seeds from each of two species (Digitaria sanguinalis and Digitaria ischaemum) were planted per flat with 50 seeds being planted per row.

Treatment methods tested included: (1) Plant the seed, cover with a thin layer of finely sifted soil (225 ml per flat by volume), then spray on the chemical, then water with a fine spray from the top; (2) Same as No. 1 but watered by sub-irrigation; (3) Plant the seed, cover with a thin layer of soil, then spray chemical, then add vermiculite (one pint per flat of plaster's grade), then water from the top; (4) Same as No. 3 but watered by sub-irrigation; (5) Plant the seed on the soil surface, then spray on the chemical, then add vermiculite, water with a fine spray from the top; (6) Same as No. 5 but watered by sub-irrigation; (7) Prepare the seed bed, add part of the vermiculite ($\frac{1}{2}$ pint per flat), then plant the seed in vermiculite, cover with vermiculite ($\frac{1}{2}$ pint per flat), water with a fine spray from the top, wait one day, then apply chemical, continue watering with a fine spray from the top. (The test chemical was applied as a very fine spray from an atomizer using air pressure to form the mist).

The results of these test indicated that differences in chemical toxicity exist between the various techniques of using vermiculite as the mulching agent, and the method of watering. Best results (greatest phytotoxicity) were obtained when the seeds were planted, then covered with a thin layer of soil, then chemical applied and then the vermiculite added, and subsequently watered by sub-irrigation (This was treatment No. 4 mentioned above.). Plant growth in sub-irrigated flats was more uniform in all treatments and at all rates than plant growth in top watered flats. Sub-irrigation also promoted more phytotoxicity throughout the entire experiment. Sub-standard results received from flats receiving no mulching material strongly suggests that a mulching material is beneficial in promoting the phytotoxicity of the test chemical. This also suggests that most toxicity under field conditions can be expected where there is present some surface organic mulch as compared to bare soil.

A secondary result of these tests bears out earlier experience in indicating that smooth crabgrass (Digitaria ischaemum) requires a lower rate of Bandane for a given level of phytotoxicity than does hairy crabgrass (Digitaria sanguinalis). Of the two species, smooth crabgrass is probably much more common as a turf weed than is hairy crabgrass. (Colorado Agricultural Experiment Station, Colorado State University, Fort Collins, Colorado)

The crabgrass problem--a progress report. Fults, Jess. Research on crabgrass began at Colorado State University in 1950. It has been vigorously pursued since 1953. The most intense work and the greatest amount of laboratory, greenhouse and field testing has been done in the period of 1959 to 1961. Although numerous tests have been made on plots located on the CSU campus and at home owners' residences in Fort Collins, most of the field testing has been in cooperation with the park department of the City of Greeley, Colorado. Plots have been located in Luther Park on the west side of town.

From the beginning of the intensive work started in 1959, we had in mind, not only to select the best crabgrass herbicides for our conditions, but to study their interrelations with fertilization and renovation used alone or together. In the study of these factors as they affect crabgrass populations we were not able to vary the usual watering and mowing practices of the regular maintenance crews at Luther Park. Sprinkler irrigation was generous throughout the growing season during the period of the tests (1959, 1960 and 1961). Mowing was on the conservative side during 1959 and 1960, i.e., at a height of 2 to $2\frac{1}{2}$ inches with mowing intervals of about 7 days. In 1961 the mowing interval was about the same but height of cut was much shorter--$1\frac{1}{4}$ to $1\frac{1}{2}$ inches. At the end of the 1961 season, it was clearly evident that none of the combinations of fertilization, renovation, watering and mowing used <u>without</u> a crabgrass herbicide produced acceptable crabgrass control. This is in sharp contrast to results reported elsewhere, particularly in the midwestern states where high mowing combined with a good fertilization program has been claimed to give excellent crabgrass control. A part of the reason for this conflict may lie in the severity of the crabgrass invasion and the quality of the initial cool-season grass turf. Under really severe test conditions such as was the case at Luther Park, fertilization, renovation, watering and mowing used alone has not given satisfactory control. All plots, regardless of 1959 treatment or degree of crabgrass control in 1959 (and many plots showed very good to excellent control), showed some crabgrass by the end of 1960. By the end of the summer in 1961 almost every plot of even the best crabgrass herbicides in 1959 had moderate to severe crabgrass populations. The lesson to be learned from these tests is that regardless of how good a single pre-emergence crabgrass herbicide is, it would seem to be necessary to follow-up during the second and perhaps third year to maintain a crabgrass-free turf. Another lesson is that the best results from any of the good pre-emergence crabgrass herbicides were on those plots where a good fertilization program accompanied their use.

However, the very best control by a small but definite margin has come from the use of any one of several pre-emergence herbicides when its use has been combined with an adequate fertilization and spring renovation program followed by conservative mowing and adequate sprinkler irrigation, particularly during the months of June, July and August.

An ideal crabgrass herbicide for use in turf would be one that is safe, easily applied, highly selective and effective against crabgrass, that does not injure established perennial turf grasses and that is cheap. Our experience would indicate that we still have a long way to go before we attain this goal completely. However, we do now have some excellent crabgrass herbicides that give very good control the first season if used pre-emergence (before the crabgrass seed germinates in the spring). To be satisfactory some follow-up the second and third spring after treatments seems necessary. Included among the pre-emergence chemicals which we have tested and found to be satisfactory on Kentucky bluegrass turf are chlordane (1,2,4,5,6,7,8,8-octochloro-4-7-methano-3a,4,7,7a-tetrahydroindane), (Belcite, Green Velvet and Halts are trade names); lead arsenate (PAX); calcium arsenate, $Ca_3(AsO_4)_2$, (Kleen-up; DCPA; and DMPA. Rates, timing of application and turf preparation are all important in securing dependable results.

Of the newest candidate materials which appear satisfactory, but which need a longer period of testing, are polychlorodicyclopentadiene isomers (Bandane); trifluralin; and dipropalin. In the whole national effort there are several others which may turn out to be superior in the next year or two.

Of the post-emergence chemicals, those applied during the summer after crabgrass plants are established, none of the long used types, i.e., phenyl mercuric acetate, or potassium cyanate or disodium methyl arsenate formulations, have given as satisfactory results as the pre-emergence chemicals. Of the three types long in use, potassium cyanate (KOCN) has given the most positive, good results. Formulations containing KOCN have the added advantage of producing a stimulating nitrogen fertilizing effect on the perennial cool season grasses at the same time that it kills annual grasses like crabgrass. However, it has the distinct disadvantage of turf burn on perennial grasses that is not always acceptable. Two new post-emergence chemicals, whose names are not yet disclosed by the manufacturers, show promise of being much better than the ones now generally available. (Colorado Agricultural Experiment Station, Colorado State University, Ft. Collins, Colorado)

Annual weed control in tulips with pre-emergence applications of chemical herbicides. Peabody, Dwight V., Jr. Tests have been undertaken the past several years in bulbous iris and narcissi as well as tulips; however, only tulip data will be reported herein. The principal objective of these tests was to find a pre-emergence herbicide which will persist through the winter and the following spring and summer, maintaining control of a wide range of annual weed species while causing no injury to the growth of ornamental bulb crops.

This test was located at the Northwestern Washington Experiment Station on Puget silt loam soil having a pH of approximately 6.0. All herbicides at the designated rates of application (see table) were applied with a small tractor-mounted plot sprayer at a pressure of 50 psi in a total volume of water equivalent to 80 gpa. All applications were made in mid-October of 1960. Experimental design was a randomized complete block, replicated five times. Plot size was one row 15 feet long. Equal weights of tulip bulbs of the same size (8 cm) were planted in each plot. Variety was Olaf. All bulbs were planted in late September. The following spring, the plots were rotovated twice - once in April and once in May without disturbing the hills. Estimates of annual weed control were made on the hilled portion of the row two weeks before harvest by means of a rating system wherein zero denoted no control to ten denoting complete elimination of all weed growth. In late July, all bulbs were dug (tulip bulbs were sized in two categories - salables and planting stock) and were weighed to the nearest .01 pound. Tulip salables were 10 cm and larger; planting stock 9 cm and smaller. The following table summarizes the experimental results obtained on weed control and salable tulip bulb yield.

Diphenamid, methoxy propazine, and all rates of diuron utilized in this experiment resulted in excellent control of the broadleaved annual weed population present from the time of application in October until early July, a period of approximately nine months. Diuron at four pounds per acre caused no significant reduction in the yield of salable tulip bulbs, and was the only treatment which resulted in selective control of the annual weeds all season without causing bulb injury. (Northwestern Washington Experiment Station, Washington State University)

Estimates of broadleaved annual weed control and mean yields of salable bulbs of pre-emergence herbicide test in tulips

Treatment: Herbicide	Rate[1]	Ratings of brdl. annual weeds June 28, 1961	Salable bulb yield lb/plot
G. C. 6691	3.0	5.5	5.08 a[2]
Casoron	16.0	6.0	4.97 a
DNBP + CIPC	4.5+4.0	0.8	4.89 a
Stam	20.0	0.0	4.77 a b
Diuron	4.0	7.5	4.57 a b
Diphenamid	16.0	8.0	3.84 b c
Methoxy propazine	12.0	7.5	3.80 b c
Diuron	6.0	9.3	3.42 c d
Diuron	10.0	10.0	2.54 d
Fenac	3.0	5.5	0.00 e
Mean			3.791
CV			15.4 %

1 All rates of application expressed in pounds active ingredient per acre.

2 Duncan Multiple Range Test of significance at the 5% level.

The use of simazine for selective weeding of landscaped areas along state highways in Oregon. Kosesan, W. H. Weeds are an ever-present problem in plantings of ornamental shrubs in western Oregon. Selective control of the weeds without injury to the desirable plants has been studied.

After two years of testing and three years of field applications, the following observations have been made on the effects of simazine on shrubs and ground cover plants used for landscaping purposes along state highways in Oregon.

In all the field applications, simazine was applied as a water spray uniformly covering the soil surface. Applications were made during the months of March and April. No applications were made to shrubs planted less than six months.

SHRUBS THAT TOLERATE 4 LB/ACRE ACTUAL SIMAZINE WITHOUT INJURY

Acer circinatum - Vine maple
Arctostaphylos columbiana - Hairy manzanita
Arctostaphylos uva-ursi - Bearberry
Cornus alba sibirica - Siberian dogwood
Cornus stolonifera - Red Osier dogwood
Cytisus praecox - Praecox broom
Cytisus scoparius var. - Hybrid broom
Gaultheria shallon - Salal
Hedera helix - English ivy
Ilex aquifolium - English holly
Juniperus chinensis - Chinese juniper
Juniperus chinensis pfitzer - Pfitzer juniper
Juniperus sabina tamarix - Tamarix juniper
Libocedrus decurrens - Incense cedar
Mahonia aquifolium - Oregon grape
Malus spp. - Flowering crabapple
Myrica californica - California waxmyrtle
Pinus contorta - Shore pine
Pinus mugho mughus - Mugho pine
Pinus ponderosa - Ponderosa pine
Prunus spp. - Flowering plum
Prunus laurocerasus zabeliana - Zabel's laurel
Prunus lusitanica - Portuguese laurel
Pseudotsuga taxifolia - Douglas fir
Rhododendron spp. - Rhododendron
Rhus typhina - Staghorn sumac
Rosa multiflora - Japanese rose
Thuja accidentalis pyramidalis - Pyramidal eastern arborvitae
Viburnum tinus - Laurestinus

SHRUBS THAT TOLERATE NO MORE THAN 2 LB/ACRE ACTUAL SIMAZINE

Buxus sempervirens truedwarf - Dwarf boxwood
Cotoneaster microphylla - Rock Cotoneaster
Holodiscus discolor - Creambush rockspirea
Hypericum calycinum - Aaronsbeard St. Johnswart
Ligustrum vulgare - Common privet
Lonicera japonica halbana - Hall's honeysuckle
Rhododendron spp. - Evergreen azaleas
Rhododendron molle - Mollis azaleas
Syringa vulgare - Common lilac
Symphoricarpus alba - Snowberry

SHRUBS INJURED BY RATES LESS THAN 2 LB/ACRE ACTUAL SIMAZINE

Forsythia spp. - Forsythia
Ligustrum amurense - Amur River privet
Philadelphus spp. - Mockorange
Spiraea douglasi - Douglas spirea

Weed control in shelterbelts. Alley, H. P. Fall treatments were made at the Cheyenne Horticultural Station in 1959. The chemicals were applied to areas of established windbreaks of seven tree species. These included Chinese elm, Russian olive, hackberry, green ash, American elm, honey locust, and boxelder. The chemicals included monuron, 2 and 4 lb/A; simazine, 2 and 4 lb/A; atrazine, 2 and 4 lb/A; propazine, 2 and 4 lb/A; dalapon, 10 and 20 lb/A; Casoron (2, 6-dichlorobenzonitrile), 2 and 4 lb/A; diuron, 4 and 8 lb/A; and neburon, 4 and 8 lb/A. All rates of chemicals are expressed on an active or acid basis.

The 1960 readings showed good control of downy bromegrass (*Bromus tectorum*) and broadleaved weeds with considerable damage resulting to all species of trees with all rates and chemicals except Casoron and neburon. The 1961 survey, two years following treatment, found all chemicals except Casoron and neburon causing severe damage to all the trees but Chinese elm. Percentage control with Casoron and neburon ranged from 0% to 85%. Chinese elm seemed to be the most resistant species of the seven. The simazine and atrazine treated plots were still void of any weed growth with no apparent damage to the Chinese elm. The soil at the Cheyenne Horticultural Station is a sandy loam. (Wyoming Agricultural Experiment Station)

Herbicide timing study on ornamental shrub liners. Ticknor, R. L. Herbicides were applied as directed sprays at different intervals following planting of several types of ornamental plants. 2,4-DEP at 4 lb/A was applied two weeks after planting. Simazine at 1 lb/A was used in the other treatments as follows: application immediately after planting followed with 1½ inches of irrigation water; application following the irrigation and an additional ½ inch of water applied; application one week after planting; application two weeks after planting; and application four weeks after planting. Four replications were used for each treatment.

All plants for this experiment, which were grown in 3-inch bands, were planted on July 2, 1961. The species used included: *Chamaecyparis lawsoniana elwoodi*, *Juniperus communis*, *Jacki*, *Ligustrum vulgare*, *Prunus laurocerasus Zabeliana*, *Pieris floribunda*, *Pyracantha coccinea lalandi*, and *Rhododendron obtusum*.

Chlorosis developed in some plants of *P.l. Zabeliana* in the group sprayed with simazine two weeks after planting. This was soon outgrown and no permanent effect was noted. Weed control was excellent in all plots in October at which time they were cultivated and another set of treatments applied.

On October 14, 1961, the following herbicide treatments were applied as a non-directed spray: Casoron 2 and 5 lb/A, simazine 1 and 2 lb/A, atrazine 1 lb/A, General 6691 5 lb/A, Stauffer N2547 4 lb/A and a cultivated check. To date all plots are essentially weed free, however plant damage occurred to the *Chamaecyparis*, *Juniperus*, and *Prunus* following the application of General 6691. No other plant damage has been observed to date. (North Willamette Experiment Station, Oregon State University)

Weed control in tree seedlings. Ticknor, R. L. One year old seedlings of apple, Mahaleb cherry, Mazzard cherry, Norway maple, Myrobalan plum, and pear were planted during April, 1960. Six weed control programs with four replications were set up in these plots: diuron at 1 lb and 2 lb/A, simazine at 1 lb and 2 lb/A, a cultivated check and a noncultivation plot using simazine at 1 lb/A plus amitrole at 8 lb/A applied to any weeds which developed. In plots of the first four above treatments herbicides were reapplied following cultivation whenever a weed population developed. During March 1961, the tops of the trees were cut back to 3-4 inches. Only one bud was permitted to develop so that the growth was comparable to a budded tree.

Measurements of the heights of these trees were taken during January, 1962. Differences in average growth were observed only in the non-cultivation and diuron 2 lb/A plots. These treatments caused a small reduction in growth. Diuron caused burning of the foliage particularly of Norway maple and Mazzard cherry when it contacted the developing foliage in the spring. Amitrole, even when applied as a directed spray, caused some chlorosis. (North Willamette Experiment Station, Oregon State University)

Annual weed control in newly planted fruit trees. Bayer, D. E. and Roberts, Kim O. Applications of atrazine, simazine, and diuron were applied in combination with amitrole at 2 pounds amitrole plus 4 pounds of the other herbicide. Applications were made in the spring, fall, and a combination fall-spring on four tree fruit species, apples, pears, cherries, and prunes. Weed control with all combinations was excellent, giving 90 percent control or better. No tree injury was observed except with the combination of amitrole plus atrazine on prunes. (University of California Agricultural Extension Service)

Annual weed control in established orchards. Bayer, D. E. and Meith, Clem. Trials were established for two consecutive years using diuron and simazine for weed control in established bearing almond trees. Atrazine was used one year. Application in 1959 was made during the winter time pre-emergence to any weed growth. Weed control was excellent (98 percent) with both diuron and simazine. In 1960 the application was delayed until the weeds had emerged approximately one inch. Diuron and simazine killed most of the shallow germinating weeds but did not kill any of the deep germinating weeds, while atrazine killed both the shallow and deep germinating weeds in this test. At harvest time atrazine gave near 98 percent control, while both simazine and diuron gave only 75 percent control of the annual weeds. No injury to the trees was evident either year. (University of California Agricultural Extension Service)

The effect of weed competition on the growth of young apple trees. Mellenthin, W. M., Rauch, F. D., and Crabtree, G. A planting of Starking Red Delicious on East Malling I rootstock was established in 1959 in an area infested with quackgrass. The first herbicide application was one month after planting and subsequent applications were in the fall or spring with some split applications, fall and spring. The herbicide programs were based on diuron and simazine alone, or in combinations with amitrole. Tree response was measured by trunk circumference increases, shoot growth, and leaf color was rated. Ratings of general weed control were made and persistent species noted.

The most significant response noted to date is the good correlation of weed control observations with the measures of tree response. As measured by trunk circumference increases, trees that had been kept free of weed competition grew at a rate almost three times that of trees with severe weed competition.

Another response that was evident was the development of one or a few weed species tolerant to a particular herbicide when applications of that material were repeated over a period of two or three years. This would suggest the desirability of a rotation of herbicides in an orchard chemical weed control program. (Mid-Columbia Experiment Station, Oregon State University)

Yield study in strawberries receiving pre-planting, soil incorporated herbicidal treatments. Peabody, Dwight V., Jr. One of the primary weed problems in the management practices of strawberry plantings is the control of summer annual weeds during the first few months in the life of a strawberry planting. Up to 1961, no effective weed killer could be used safely in new strawberry plantings, and the removal of these early-germinating weeds in recently planted strawberries by mechanical methods did not always prove satisfactory. After several years' testing, certain herbicides have shown promise as pre-planting, soil incorporated materials in new strawberry plantings.

In early spring of 1960, a test was initiated in order to determine the effect of several different herbicidal applications made as pre-plant, post-plant, and pre- and post-planting treatments on the growth, vigor and yield of Northwest strawberries. It was also necessary to determine the effect of these treatments on the stand and vigor of the annual weed population present (only that part of the test dealing with pre-planting treatments is reported herein). On May 23, 1960, pre-planting treatments were applied to the prepared seed bed. Immediately after application, all treatments were rotovated to a depth of three inches. Four days later, on May 27, 1960, strawberry plants of the variety Northwest were set out in a modified spaced planting system with rows three feet apart, the plants spaced 15 inches within the row. Estimates of growth and vigor of strawberry plants were made throughout the growing season of 1960; also estimates of weed control were made during this time. These results have been reported elsewhere; however, the following table summarizes the yield results obtained from these plots during the spring picking season of 1961. Five separate pickings were made from each plot during the harvest season. Weight of marketable berries was recorded to the nearest ounce. Yields have been converted to tons per acre and are recorded in the following table.

Strawberries have proven highly resistant to pre-planting treatments of DMPA; yield results of this test add further evidence to this conclusion. The lower rate of ipazine, although causing no significant reduction in yield, has been erratic in other tests, and at rates only slightly higher than one pound active ingredient per acre have injured strawberry plants. Casoron, amiben, Stam, 24-DEP and sesone at the rates used in this test probably did not adversely affect strawberry plant growth; however, the annual weed competition which developed in these plots six to eight weeks after application did interfere with strawberry growth and is probably reflected in lowered yields. Atrazine at one and ipazine at four pounds per acre caused extensive injury to young strawberry transplants. (Northwestern Washington Experiment Station, Washington State University)

Strawberry fruit yields of 1960 pre-planting herbicidal treatments

TREATMENT Herbicide	Rate[1]	YIELD Tons/Acre	
DMPA	20.0	6.9	a[2]
DMPA	10.0	6.0	a b
Ipazine	1.0	5.4	a b c
Casoron	2.0	5.1	b c
Amiben	8.0	5.1	b c
Check	---	5.0	b c
Amiben	4.0	4.8	b c
Stam	4.0	4.8	b c
2,4-DEP	4.0	4.7	b c
Sesone	3.6	4.2	c
Atrazine	1.0	0.6	d
Ipazine	4.0	0.5	d
Mean		4.43	
CV		24.1 %	

1 All rates of application expressed in pounds active ingredient per acre.

2 Duncan Multiple Range Test of significance at the 5% level.

Fall applications of chemical herbicides for winter annual weed control in strawberries. Peabody, Dwight V., Jr. The use of the chemical herbicide simazine as a replacement for the previously recommended DNBP and/or IPC herbicides has proven to be effective and safe to use on strawberries for the control of germinating winter annual weeds. However, simazine has its limitations, and other, better chemical weed control practices are being sought.

To determine the effect of fall-applied herbicides on the growth and yield of strawberries as well as on the winter annual weeds present, several tests have been undertaken over the past five years. The following tables summarize strawberry fruit yields obtained from one of these field trials. On October 17, 1960, treatments as given in the following tables were applied to an established strawberry planting. Fall treatments were applied with a small tractor-mounted plot sprayer in a total volume of water equivalent to 50 gpa at a pressure of 40 psi. Experimental design was a randomized complete block, replicated six times. Plot size in each variety was one row 30 feet long. Treatments were applied to two varieties of strawberries, Northwest and Puget Beauty. This planting was maintained in a modified hill system, runners being removed by hand periodically during the life of the planting. Fruit was thus harvested only from "mother" plants. The tables summarize the yields taken from strawberry plants receiving herbicidal treatments the previous fall. These yields are the result of five separate pickings from each plot. Weight of marketable berries was recorded to the nearest ounce. Yields were calculated on the basis of number of plants per acre and were then converted to tons per acre for tabulation. Principal weed species present were Stellaria media (chickweed), and Senecio vulgaris (groundsel).

Results of this experiment indicate that fall treatments of atrazine at low rates of application (1 lb ai/A) do not cause yield reduction in Northwest or Puget Beauty strawberries. Atrazine has the advantage of controlling annual weeds that have germinated and become established and that have proven resistant to simazine treatments. The other herbicides included in this test, with the possible exception of diphenamid, have not given as good winter annual weed control as atrazine when applied in the fall to established plantings. (Northwestern Washington Experiment Station, Washington State University)

Strawberry (Northwest) fruit yield of 1959 planting treated with chemical herbicides October 17, 1960.

Treatment Herbicide	Rate[1]	Marketable Fruit Yield Tons/Acre	
Diphenamid	8.0	12.3	a[2]
Simazine	1.0	12.1	a
Sesone	5.4	11.9	a b
Simazine	2.0	11.4	a b c
Propazine	1.0	11.1	a b c d
Atrazine	1.0	10.9	a b c d
Casoron	4.0	10.7	a b c d
Atrazine	2.0	10.0	b c d
Amiben	4.0	9.4	c d
Propazine	2.0	8.9	d
Amiben	8.0	6.2	e
Atrazine	4.0	3.9	f
Mean		9.89	
CV		15.0 %	

[1] All rates of application expressed in pounds active ingredient per acre.

[2] Duncan Multiple Range Test of significance at the 5% level.

Strawberry (Puget Beauty) fruit yield of 1959 planting treated with chemical herbicides October 17, 1960.

Treatment Herbicide	Rate[1]	Marketable Fruit Yield Tons/Acre	
Simazine	1.0	6.7	a[2]
Atrazine	1.0	6.6	a
Simazine	2.0	6.3	b
Propazine	1.0	6.2	b c
Atrazine	2.0	6.1	c
Amiben	4.0	6.0	c
Atrazine	4.0	5.8	d
Diphenamid	8.0	5.8	d
Casoron	4.0	5.8	d
Sesone	5.4	5.8	d
Propazine	2.0	5.6	e
Amiben	8.0	4.8	f
Mean		5.95	
CV		20.0 %	

1 All rates of application expressed in pounds active ingredient per acre.

2 Duncan Multiple Range Test of significance at the 5% level.

Weed control in strawberries. Crabtree, G. A planting of strawberries made in 1959 included Siletz and Northwest varieties. A series of herbicide treatments designed to provide weed control from time of transplanting through the life of the planting were applied. These are listed in the table along with total crop yields for the 1960 and 1961 harvest seasons. EPTC was applied as a soil incorporated preplant application and the other spring applications were made a week after transplanting. None of the materials applied in the spring appeared to result in a yield different from the untreated check. Ratings of weed control two months after planting showed good weed control from simazine or the sesone-Vegedex combination. Weed control with EPTC was only slightly better than the check. Prevalent weed species included redroot pigweed (Amaranthus retroflexus), lambsquarters (Chenopodium album), and henbit (Lamium amplexicaule).

The principal yield response is the reduction in yield of both varieties and for both harvest seasons with the winter application of IPC and Dinitro general. These applications were made in January or February at a time the berry plants were at a stage of maximum dormancy for the area; and although no visual symptoms of injury were apparent, the yield reductions are quite definite.

Another experiment similar to the one just described was initiated in 1961 and weed control during the establishment season was evaluated. Herbicide treatments included 2,4-DEP, 4 lb ai/A, applied preplant and incorporated shallowly into the soil and amiben, 4 lb ai/A, applied one week after transplanting. Both of these were followed with one pound of simazine one month after planting and compared to simazine without a previous herbicide application. Both 2,4-DEP and amiben provided excellent weed control until the time of the simazine application, and the simazine maintained good control through the rest of the summer. In plots not given earlier herbicide applications, it was necessary to remove weeds mechanically before applying simazine one month after transplanting.

Yields of Strawberries in Weed Control Experiment

Chemicals and Rates (pounds active per acre) Spring 1959	Fall 1959 & 60	Winter 1960 & 61	Yield of Siletz[1] 1960	1961	Yield of Northwest 1960	1961
Simazine 1	Simazine $1\frac{1}{2}$		73	75	88	98
EPTC 3	"		78	71	92	99
Sesone 2.7 + Vegedex 2	"		74	69	99	107
" "		IPC 6 + Dinitro-General 2	47	51	66	87
Untreated check			72	74	94	102

[1]Yield in pounds per plot

(Agricultural Experiment Station, Oregon State University)

Nutsedge control in asparagus. Jordan, L. S., Day, B. E., and Russell, R. C. On March 10, 1960, nutsedge infested asparagus plots near El Centro were treated with EPTC, 1607, and DATC. Prior to treatment the plots were rototilled. Plots 5 feet wide and 75 feet long were used. The herbicides were applied with a logarithmic dilution sprayer which diluted the spray solutions to one-half concentration every 25 feet. DATC was applied with a high rate of 40 lb/A and low rate of 5 lb/A. EPTC and 1607 were applied with a high rate of 20 lb/A and low rate of 2.5 lb/A. Four replications of duplicate plots were treated. The soil was dry when treatments were made. The plots were evaluated eight weeks later. Asparagus was injured by EPTC at 7.5 lb/A, or more. The average number of pounds of each herbicide required to obtain over 97% seasonal control of nutsedge was as follows:

		Replication			
Herbicide	1	2	3	4	Ave.
EPTC	3.8	3.2	2.5	2.5	3.0
1607	4.2	6.0	6.8	4.2	5.3
DATC	18.4	24.0	22.8	18.0	20.8

(Citrus Research Center and Agricultural Experiment Station, University of California, Riverside, California)

Annual weed control in carrots with late pre-emergence herbicidal treatments. Peabody, Dwight V., Jr. Use of herbicides with high contact activity and low soil residuality present a possibility for gaining control of annual weeds in carrots which germinate slowly and erratically under western Washington conditions. Paraquat and diquat, which have been reported to possess these characteristics, were applied to a carrot seeding 15 days after planting. At this time approximately 10 per cent of the carrots had emerged, and a heavy infestation of annual weed seedlings composed principally of Polygonum pennsylvanicum, Chenopodium album, Stellaria media, and Senecio vulgaris was present. Paraquat and diquat were applied at three rates of application: 0.375, 0.75 and 1.5 lb ai/A. One month after treatment application, diquat at 1.5 lb had almost completely eliminated the annual weed population, and no injury to seedling carrots could be detected. Paraquat at rates low enough to cause little or no carrot injury resulted in very poor weed control; higher weed controlling rates caused extensive carrot injury. Diquat would seem to be worthy of further testing as a late pre-emergence herbicide in carrots. (Northwestern Washington Experiment Station, Washington State University)

The control of wild oats and broadleaf weeds in peas. Anderson, W. P. and Renfrow, J. F., Jr. The following information is based upon results obtained in 1961, at two locations in eastern Washington, one in the canning pea area near Dayton and the other in the dry pea area near Pullman. Yield data were obtained at the location near Dayton but not at the one near Pullman. The key points gained from this research are as follows:

1. DATC, soil incorporated at rates of 1 and 1½ lb/A, gave essentially 100% control of wild oats. The wild oats were seeded in the plots. In addition, the same treatment also gave 100% control of henbit (Lamimum amplexicaule). Indications are that in eastern Washington, DATC may be applied at rates lower than 1 lb/A and still retain its effectiveness. Pea yields were not adversely affected by applications of DATC when applied at rates of 1 to 2 lb/A.

2. Barban is an effective wild oat herbicide when applied as an early post-emergence treatment. Ninety to 100% wild oat control was obtained with this material applied at rates of 1/4 to 1 lb/A. However, the amount of water used as a carrier and applied per acre greatly affected the effectiveness of the dosage used. In 5 gpa, the ¼ lb/A rate was just as effective as the 1 lb/A rate, both giving 100% control. In 10 gpa, the ¼ lb/A rate was a little less effective, while in 30 gpa, the ¼ lb/A rate was almost 50% less effective than the 1 lb/A rate. Essentially 100% control was obtained with the 1 lb/A rate at all three gallonages per acre. In general, barban was applied when the wild oats were in the 1 to 2 leaf stage. This is the recommended stage for application. However, in one experiment, excellent control was obtained with barban

applied to wild oats in the 3 leaf stage at rates of ½ to 1 lb/A in 12½ gallons of water per acre. This would indicate that by reducing the volume of water carrier applied per acre (i.e., increasing droplet concentration) wild oats may be effectively controlled at a later stage of development than previously recommended. Barban gave no broadleaf weed control in these tests.

3. Combinations of MCPA (¼ lb/A) and barban (2 lb/A) were very injurious to peas.

4. In the Dayton area, IPC, soil incorporated at the recommended rate of 4 lb/A, was about 50% less effective than either DATC, soil incorporated at 1 lb/A, or barban, applied post-emergence at ½ to 1 lb/A.

5. A comparison was made of the effectiveness of barban applied with a TeeJet twin-fan nozzle tip and a TeeJet single-fan tip. Rates of application were 1/8, 1/4, 1/2, 3/4, and 1 lb/A in 5 gallons water per acre per orifice. There was no difference in degree of wild oat control obtained with the different tips.

6. The best of the herbicides tested for selective broadleaf weed control in peas was trietazine. This material gave 100% control of broadleaf weeds with no injury to the peas. Trietazine was applied pre-emergence at rates of 1½ and 3 lb/A. Since 1½ lb/A resulted in 100% control, indications are that lower rates may be used effectively. (Washington State University Agricultural Experiment Station)

Pre-planting, soil incorporated herbicidal treatments for annual weed control in spinach. Peabody, Dwight V., Jr. Twenty-three different herbicides or herbicide combinations were applied, each at three rates, prior to seeding spinach (variety, Badger Savoy), in order to determine a possible selective activity of the herbicidal treatment between the broadleaved annual weed population present and the spinach crop. Immediately after treatment application, one-half of all plots were rotovated three to four inches deep and the other half were spike-tooth harrowed. The day following treatment application all plots were seeded to spinach.

None of the treatments resulted in selective weed control. At application rates which resulted in good broadleaved annual weed control, extensive injury to seedling spinach plants was observed. At rates of application low enough to cause no serious injury to seedling spinach, broadleaved annual weed control was poor. Depth of incorporation did not materially influence these results. Principal weed species present were Polygonum pennsylvanicum, P. aviculare, P. convolvulus, Chenopodium album, Stellaria media, Senecio vulgaris, Capsella Bursa-pastoris, and Matricaria matricarioides.

Differential of susceptibility between germinating spinach seed and most of the germinating broadleaved annual weed species common to western Washington was very small or non-existent to pre-plant, soil incorporated herbicides. Different methods of herbicidal application other than pre-planting, soil incorporation treatments may offer a greater chance for selectivity in spinach. (Northwestern Washington Experiment Station, Washington State University)

List of herbicides utilized in the pre-planting, soil incorporated herbicide test in spinach

R-3400	Tillam	326
R-3408	IPC (emulsive)	B-792
R-3441	IPC (flowable)	Proban
R-4518	IPC (wettable)	Diphenamid
R-1856	CIPC	N-2547
R-1870	CIPC + CDEC (2)	Banvel D
R-2007	Monuron	Banvel T
		NIA 2995

Nutsedge control in sweet potatoes. Jordan, L. S., Shadbolt, C. A., Day, B. E. and Clerx, W. A. Casoron, EPTC and Tillam were applied at 3 lb/A, in 100 gpa of water, pre-plant to sweet potatoes. The soil was disked to a depth of six inches before treatment and a disk-cultipacker combination was used to incorporate the herbicides to a depth of four inches. The sandy loam soil was moist when treatments were made. Four replications of 1200 sq ft plots were used.

Nutsedge started regrowing first in the furrow bottoms. This was probably due to the treated soil being thrown out when the beds were formed. The sweet potatoes were killed by Casoron but apparently were not injured by EPTC or Tillam. One month after treatment, no nutsedge was growing in the beds treated with EPTC or Casoron, 2 shoots per square foot were growing in Tillam-treated plots and 22 shoots per square foot were growing in the control plots. Four months after treatment, nutsedge control was rated excellent in the Casoron plots, good in the EPTC plots, and poor in the Tillam plots. (Citrus Research Center and Agricultural Experiment Station, University of California, Riverside, California)

Evaluation of herbicides for pre-plant use in direct-seeded tomatoes. Ross, Merrill A. and Foskett, Richard L. Liquid formulations of endothal analog TD-66 (di oleyl amine of 3,6 endoxohexahydrophthalic acid) at 3 and 6 lb/acre, Tillam (n-propyl ethyl-n-butylthiolcarbamate) at 4 and 6 lb/acre, diphenamid at 6 and 10 lb/acre, R-1856 (t-butyl di-n-propylthiolcarbamate at 4 and 6 lb/A, DCPA at 6 and 10 lb/acre, DMPA at 8 lb/acre and CDEC at 4 lb/acre were sprayed broadcast on the soil surface. Plots treated with Tillam and R-1856 were double-disced following application of chemicals. Prior to planting of tomato seeds (Fireball variety) all plots were rolled with a cultipacker and then bedded. *Setaria* spp. and *Amaranthus retroflexus* were the dominant weed species.

Treatments of DCPA and DMPA produced severe damage to both tomatoes and weeds. No appreciable damage to the tomatoes was observed with other herbicides in the test. Tillam and diphenamid were effective against both broad-leaved and grass-weeds. CDEC was somewhat less effective than the Tillam and diphenamid. R-1856 was toxic to grass species but ineffective against *Amaranthus*. TD-66 showed very little weed control. Of the compounds tested, Tillam, diphenamid and CDEC merit further testing for use as pre-plant herbicides in direct seeded tomatoes. (Colorado State University, Ft. Collins, Colorado)

Effect of method of irrigation and soil incorporation of herbicides. Jordan, L. S. and Day, B. E. Field trials have been conducted to compare herbicides under combinations of: (1) soil incorporation or surface applications and (2) furrow or sprinkler irrigation. Herbicides were applied to 100 sq ft plots with a bicycle sprayer, using 50 psi pressure and 50 gpa volume. A roto-tiller was used to incorporate herbicides to a depth of two inches within 15 min after application. Water was applied with sprinklers at the rate of .92 in/hr, and in the furrows until completely subed across the beds. Millet was planted to insure the presence of a grass, but normal growth of broad-leaf weeds was used to determine the effectiveness of the herbicides. All combinations were replicated three times. Results were evaluated by stand counts and control ratings. Some of the herbicides tested were: amiben, DATC, Casoron, CDAA, CDEC, CIPC, diphenamide 326, EPTC, and DMPA.

Many of the herbicides were more effective under sprinkler irrigation than under furrow irrigation. Incorporation increased the effectiveness of some herbicides, but not others. With some herbicides there appeared to be an interaction between type of irrigation and application. In some instances, the differences due to type of irrigation and application could be overcome by increasing rate of herbicide applied. Table 1 summarizes the control ratings for several of the herbicides used.

Table 1: Average rating[1] of grass and broad-leaf weed control with several pre-emergence herbicides either applied to the soil surface or incorporated and either furrow irrigated or sprinker irrigated.

Herbicide	Year	Rate lb/A	Grass[2] FS[4]	FI[5]	SS[6]	SI[7]	Broad-leaf[3] FS	FI	SS	SI
Amiben	1960	6	8	8	9	9+	4	4	9+	10
EPTC	1960	3	5	8	9	9+	5	4	9+	10
DMPA	1960	10	4	7	7	9	10	10	9+	10
Control	1960	-	2	3	2	3	-	1	1	1
CDAA	1961	8	0	5	5	5	2	4	1	2
CDEC	1961	8	4	7	8	9	7	7	8	9
CIPC	1961	4	5	8	8	9	1	5	6	8
Casoron	1961	2	8	9	10	10	6	9	10	10
326	1961	2	10	9	9+	10	10	9	10	10
Diphenamide	1961	2	6	8	10	10	7	6	9+	10
Control	1961	-	0	0	0	0	0	0	0	0

1/0 = no control; 10 = complete control.

2/Primarily Proso millet.

3/Primarily *Amaranthus blitoides*, *Amaranthus graecizans*, *Amaranthus retroflexus* *Chenopodium album*, and *Chenopodium Berlondieri*.

4/FS = furrow irrigation + surface application.

5/FI = furrow irrigation + soil incorporation.

6/SS = sprinkler irrigation + surface application.

7/SI = sprinkler irrigation + soil incorporation.

(Citrus Research Center and Agricultural Experiment Station, University of California, Riverside, California)

Application methods for volatile herbicides. Crabtree, G. EPTC (Eptam 6-E) and Tillam 6-E were applied as preplant treatments to red beets and sweet corn. A comparison of methods of application included disking twice to a depth of approximately three inches, rotary tilling to a depth of three inches, and spraying from a blade moving through the soil at a depth of two inches.

At rates of two and four pounds active herbicide per acre neither of the materials caused important crop injury with any of the application methods.

Evaluation of weed control (lambsquarters, *Chenopodium album* and redroot pigweed, *Amaranthus retroflexus*) showed no differences between the rotary tiller and disking as a means of incorporating these herbicides but the control obtained with the subsurface blade applicator was significantly inferior to that obtained by the other methods. This is contrary to results obtained in some other experiments and the reason for this difference in response is not known.

In another experiment with sweet corn, EPTC at the rate of 3 lb ai/A and CDAA-T (Randox-T) at the rate of 4.5 lb ai/A were applied by spraying on the soil surface and disking in or sprayed from a subsurface blade. A comparison of planting depths was made to determine possible interactive effects with EPTC applications. With the favorable germination conditions existing at the time of planting, the deep planting emerged only about one day after the shallow planting. The weed population was light and consisted primarily of redroot pigweed. All herbicide treatments resulted in satisfactory weed control. Ratings of crop response were made four weeks after planting and crop yields measured at normal time of harvest. This information is presented in the table. It will be noted that injury symptoms were noted in the plots in which EPTC was incorporated by disking, but no loss of yield resulted. All applications of CDAA-T that were soil incorporated showed crop injury in response ratings but serious yield losses occurred only in shallow disking or deep blading incorporations. Here again, disking appears to result in the greatest degree of activity as measured by crop response.

Sweet Corn Response to Applications of EPTC and CDAA-T

Chemical	Method of Application	Planting	Crop response rating [1]	Yield per plot [2]
EPTC	disk deep	deep	3	18.8
"	" "	shallow	2	19.0
"	blade deep	deep	1	15.9
"	" "	shallow	1	18.2
"	blade shallow	deep	2	18.0
"	" "	shallow	1	19.8
CDAA-T	disk shallow	"	3	8.3
"	blade shallow	"	3	16.6
"	blade deep	"	5	11.9
"	surface (post-plant)	"	0	17.7
Untreated check		"	0	17.8

[1] Rating scale: 0 = no effect, 10 = complete kill.

[2] Pounds of graded husked ears.
(Agricultural Experiment Station, Oregon State University)

PROJECT 5. WEEDS IN AGRONOMIC CROPS

H. Fred Arle, Project Chairman

Summary

Twenty-four papers were presented for publication in this section. Abstracts were received from personnel in 8 states and pertained to weed problems in 11 crops. Three papers regarded weed control by chemical summer fallow. The reports are briefly summarized below:

Alfalfa. Pre-emergence applications of Dacthal to established alfalfa controlled dodder in California.

Barley. A Montana study involving the response of 22 commercial varieties of barley to seven selected herbicides has suggested a possibility of improving weed control through the use of varieties having maximum herbicidal resistance.

Field beans. EPTC was more effective than Tillam for controlling broad-leaved and grassy weeds in field beans of Wyoming. Amiben also reduced weeds but was somewhat injurious to the beans.

Pinto beans. Incorporated applications of EPTC in Colorado gave excellent control of annual weeds. Amiben was effective on broadleaved weeds and all grasses except wild oats.

Corn. Pre-emergence applications of atrazine at 1 lb/A gave season-long control of weeds in Wyoming. On heavy textured soils residual toxicity was noted on a following barley crop.

Cotton. California studies showed that subsurface applications of herbicides in horizontal bands provided better weed control than surface application followed by rototilling. With some chemicals, cotton susceptibility was also increased. DMPA and R 1856 were very effective in the control of barnyard grass without injuring cotton.

In Arizona diuron reduced cotton stands when applications were made prior to listing. Applications over the listed beds were not injurious. Yields of all treated plots were significantly higher than those of untreated checks.

Grain sorghum. Pre-plant and pre-emergence applications of atrazine and propazine effectively controlled broadleaved weeds and grasses in California and Colorado. Grain sorghum was sometimes temporarily retarded; however, yield of sorghum seed was usually increased.

Grass. Experimental work in Washington indicated that DCMA was promising for the control of certain annual broadleaved weeds in perennial grasses. DNBP was also effective without causing undue injury to the grasses. Seedling timothy and creeping red fescue were injured by applications of silvex, orchard grass was somewhat more tolerant. Downy brome was controlled by post-emergence applications of simazine and atrazine. Stage of growth was an important factor in minimizing crop injury. Optimum rates were influenced by soil type.

Initial experimental work in Oregon has shown pre-plant applications of DATC to be effective in controlling downy brome with negligible injury to wheat or barley.

Sugar beets. Work in Colorado and Wyoming showed pre-plant applications of EPTC, Tillam and DATC effectively controlled various annual weeds with no injury to sugar beets.

Work in Utah compared the effectiveness of soil incorporated or surface applications of EPTC and endothal with soil incorporated applications made during spring. Data indicated that neither chemical remained over winter in significant amounts.

Wild oats and rye. Barban controlled wild oats and rye infestations in wheat and barley in several states. Work in Oregon indicated that high relative humidity during the period of application might be an important factor in obtaining best results.

Chemical fallow. Atrazine has been very effective for controlling downy brome grass in Wyoming. A following crop of winter wheat has shown increased yields on treated plots. In Orgeon atrazine-amitrole combinations have injured spring-sown and winter cereals. Atrametryne was very effective against annual weeds at one location in Montana; in another area control was less satisfactory. Moisture following application is a necessity for maximum results.

The use of DCPA for dodder control in alfalfa. Bayer, D. E., Hoffman, E., and McNeely, G. Applications of DCPA were made to established alfalfa stands at two locations in California just prior to germination of the dodder. Rates used were 5, 10, and 20 lb ai/A. Evaluations made later in the season indicated 90 percent control at the 5 lb rate, 98 percent at the 10 lb rate, and 99 percent at the 20 lb rate. No effect of the DCPA was evident on the alfalfa. (University of California Agricultural Extension Service)

The response of 22 commercial 2-row barley varieties to seven selected herbicides. Hodgson, J. M. Recent experiments have indicated wide variations in response of certain plant species to herbicides. If varieties with a high degree of herbicidal immunity or resistance within a crop species could be found, improvements in weed control in such crops could be made. In 1961 twenty-two of the recommended commercial 2-row barley varieties in the United States were subjected to a screening test to measure responses to seven herbicides.

The varieties were seeded at random in single rows 1 ft apart, using 3 replications. Herbicide plots were established by spraying across the varieties with a heavy rate of chemical in 30 gallons of water per acre. Treatments were made when barley had 5 to 8 leaves. The barley was grown on a huffine silt loam that had been fallowed the previous year and was irrigated once. Results were assessed by harvesting 8 ft of row for yield and comparing with an untreated check for each variety.

The response of the 22 varieties with the 7 herbicidal treatments are summarized in the accompanying table. Although the data were variable, the analysis showed that there were real differences among the varieties in response to 6 of the 7 treatments.

The results show there is differential response among varieties of barley to certain herbicides and emphasize the possibility of improving weed control through use of varieties with greater herbicidal resistance. (Cooperative weed control investigations, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture and Plant and Soil Science Dept. of Montana State Agricultural Experiment Station)

Weed control in fieldbeans. Alley, H. P. Heavy infestations of ground cherry (*Physalis heterophylla*) is of major concern in fields of Wyoming. Plots were established using promising and new herbicides for evaluation toward this weed.

Stand counts of treated plots were compared to untreated plots as a means of obtaining percentage stand of beans and percentage weed control. EPTC at 3 and 4 lb/A gave better than 90% weed control of both the broadleaved and grassy weeds without reducing the fieldbean stand. Tillam (propyl ethyl-N-butylthiolcarbamate) was not as good as EPTC. Amiben at 4 lb/A controlled 80% of the broadleaved weeds and 66% of the grasses, but showed toxicity toward the fieldbeans. Late emerging weeds were common on all plots. (Wyoming Agricultural Experiment Station)

Weed control in corn. Alley, H. P. Pre-emergence tests were conducted in 1960 and 1961. Plots treated in 1960 were observed for residual toxicity to succeeding crops.

Atrazine at 1 lb ai/A gave season long control both years. Ester of 2,4-D (propyleneglycolbutylether ester) at 2 lb ae/A gave early season control; however, late emerging weeds were prevalent on the treated plots. EPTC and CDAA did not give satisfactory results.

Simazine and atrazine maintained residual toxicity from 1960 to 1961 in the heavy textured soils. Damage to barley plants in 1961 on the 1960 treated plots was evident. On light sandy-soil, no damage due to residual was found on the atrazine treated plots. Simazine was more residual and resulted in damage to barley. (Wyoming Agricultural Experiment Station)

The subsurface application of herbicides for selective grass control in irrigated cotton. Kempen, H. M. and Miller, J. H. Because rainfall does not consistently occur after cotton is planted in many irrigated areas, surface applications of pre-emergence herbicides are generally ineffective. Recent research at the U. S. Cotton Field Station indicated soil incorporation of certain herbicides into moist soil at time of planting could insure early weed control. Present research indicates subsurface applications of certain herbicides are effective in obtaining selective weed control in irrigated cotton.

Twenty-two herbicides were evaluated during the fall season of 1960 and the spring season of 1961. The herbicides were logarithmically applied in a 10-inch horizontal band 1.5 or 3 inches below the soil surface at time of planting, while cotton was planted at a 2-inch depth. Soil moisture was adequate each year for germination of planted barnyard grass and cotton. Rainfall (0.5 inches) occurred 13 days after planting in 1960, but no rain fell after planting in 1961. Soil type was Hesperia fine sandy loam.

Results of 1960 studies indicated only DMPA and t-butyl-di-n-propylthiolcarbamate (R1856) were effective in controlling barnyard grass without cotton injury. 2,6-dichlorobenzontrile; ethyl, ethyl-n-butylthiolcarbamate; propyl ethyl-n-butylthiolcarbamate; and n-propyl-di-n-butylthiolcarbamate were effective in controlling barnyard grass at rates as low

Summary of response of barley varieties to herbicide treatments

Herbicide Name	Rate per acre	Three varieties affected least: Name	Relative yield 1,2/	Three varieties affected most: Name	Relative yield 1,2/	Avg. relative yield of 22 varieties 1/
	Lb.		Percent		Percent	Percent
2,4-D	5	Compana	117 a	Betzes	60 g	
		Munsing	112 a	Charlottetown	45 g	
		W. Smyrna	98 a	Alpha	43 g	76.5
MCPA	5	Compana	105 a	Erie	63 e	
		Otis	99 a	Charlottetown	60 e	
		Munsing	98 a	Alpha	60 e	81.3
2 methoxy-3, 6-dichloro- benzoic acid	3	Compana	26 a	Hannchen	1 d	
		W. Smyrna	24 a	Alpha	1 d	
		Munsing	19 a	Charlottetown	1 d	9.7
barban	5	Munsing	136 a	Betzes	51 i	
		SS Smyrna	127 a	Hannchen	43 i	
		Vance	123 a	Freja	12 j	86.9
DMPA	8	SS Smyrna	130 a	Hannchen	80 d	
		Hanna	116 a	Stiegum	72 d	
		Munsing	114 a	Compana	72 d	98.2
3,4-dichloro- propionanilide	8	Stiegum	105 a	Herta	51 f	
		Horn	98 a	Moravian	50 f	
		Spartan	98 a	Charlottetown	41 f	74.6
2-chloro-4- allylamino- 6-isopropylamino- s-triazene	4	Otis	109 ns	Sanalta	69 ns	
		Spartan	104	Heins Hanna	66	
		SS Smyrna	102	Moravian	65	80.8

1/ Gram yield of treated plot divided by gram yield of untreated same variety and averaged for 3 replications.

2/ Letters indicate groups that are significantly different for a single herbicide at .05 level.

as 0.5 lb/A but were toxic to cotton. CIPC, CDAA, CDEC, and diuron were intermediate in effectiveness and were variable in selectivity.

Investigations in 1961 confirmed the results obtained in 1960 with DMPA and R1856. Of herbicides not evaluated previously, a coded analog of CDAA (CP 18978) and 2-methylmercapto-4-ethylamino-6-isopropylamino-s-triazine (34162) showed promise when applied in this manner. Each of these four herbicides controlled barnyard grass until the first irrigation at rates as low as 0.75 lb/A. Residual control continued following first irrigation at twice the lowest rate originally required for weed control. Cotton was not injured by any rates of DMPA or the analog of CDAA (0.75-16 lb/A), by 0.75 to 8 lb/A of R1856, or by 0.5 to 4 lb/A of 34162.

When compared with applications of these four herbicides which were rototilled into moist soil, subsurface applications of these herbicides were three to six times as effective against barnyard grass; whereas effects on cotton were not appreciably altered. When CIPC or CDAA were subsurface-applied, effectiveness was likewise increased three-to-sixfold, but the herbicides were more toxic to cotton.

The results indicate that much lower rates of certain herbicides provide more effective and more selective pre-emergence weed control when applied in a horizontal band in moist soil than when rototilled into moist soil. The effects on crops of (1) depth of band; (2) rainfall; (3) furrow irrigation; and (4) soil type require more research. (California Agricultural Experiment Station and Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Shafter, California)

Effects of pre-planting applications of diuron on two Upland cotton varieties. Arle, H. Fred., Hamilton, K. C. and McRae, G. N. In 1961 pre-planting applications of diuron in two Upland cotton varieties (Acala 44 and Deltapine) were carried out at the Cotton Research Center, Tempe, Arizona. The field was level on March 3, when diuron was applied to the soil at rates of 1.2, 1.6, 2.0 and 2.4 lb/A. The area was then furrowed for the pre-planting irrigation. On March 9 diuron was applied to other plots (over the tops of furrows) at rates of 1.2, 1.6 and 2.0 lb/A. The area was irrigated on March 13 at the rate of 1 acre foot of water per acre. On April 6 the seed bed was prepared by harrowing and cotton was planted in moist soil. The drill row was covered "capped" with disk hillers trailing the planter. The soil over the seed row was removed on April 12.

The soil in the experimental area was a McClellan clay loam (sand 31% silt 45% and clay 24%). Panicum fasiculatum, Sorghum vulgare var. sudanense and Physalis wrightii were the most frequent annual weeds. Plots consisted of 4 rows, 38 feet long. Treatments were replicated 4 times. The plot area was not cultivated or hoed during the growing season. The area was furrowed between the drill rows before the first post-emergence irrigation, on May 19.

Emergence of cotton seedlings appeared normal on all plots. However, when seedlings were about 7 days old many developed chlorosis on plots treated prior to furrowing out and some died. No adverse effect was evident when diuron was applied after furrowing (over the top of listed beds). The control of weeds was good on all treated plots, but by mid-summer those treated before furrowing had fewer weeds than plots treated after furrowing. Although the seedling populations of both cotton varieties were significantly reduced by diuron applications before furrowing, yields of these plots were significantly greater than those of plots not treated. The seedling populations and yield data are summarized in Table 1.

Table 1. Effects of pre-planting applications of diuron on cotton seedling survival and total yield

Variety	Diuron applied	Rate (lb/A)	Seedling count per 10' of row April 21	Seedling count per 10' of row May 16	Seed cotton yield (lb/76' of row)
Acala 44:	Before furrowing	1.2	34	24**	23.8**
	Before furrowing	1.6	35	23**	20.7*
	Before furrowing	2.0	31	14**	22.5**
	Before furrowing	2.4	34	12**	21.4**
	After furrowing	1.2	28	26	25.2**
	After furrowing	1.6	34	32	24.3**
	After furrowing	2.0	28	24	26.0**
	None	0.0	32	29	14.8
LSD.,	5%		4.9		4.4
	1%		6.7		6.0
Deltapine:	Before furrowing	1.2	57	45*	22.8**
	Before furrowing	1.6	44	28**	19.9**
	Before furrowing	2.0	52	27**	19.4**
	Before furrowing	2.4	48	20**	17.6
	After furrowing	1.2	56	52	21.7**
	After furrowing	1.6	49	45	23.3**
	After furrowing	2.0	48	45	23.5**
	None	0.0	51	46	15.3
LSD.,	5%		10.6		3.3
	1%		14.3		4.7

(Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture and the Arizona Agricultural Experiment Station)

Selective control of water grass in grain sorghum with triazine herbicides. Foy, Chester L. and Sailsbery, Robert. Field and greenhouse studies of several chemicals in 1959 and 1960 indicated potential for the selective use of propazine and atrazine in grain sorghum. Additional studies were conducted in 1961 using 0, 1, 2, and 4 lb/A of each material. Propazine was applied pre-emergence following planting in dry silty clay loam, then irrigated in as the crop was (border) flood irrigated up. Atrazine was applied as a post-emergence spray when sorghum was 3-4 inches and water grass 2-3 inches high; each was in the 3-leaf stage. The water grass infestation was dense and uniform, and eventually obscured the sorghum in untreated portions of the field.

Propazine (4 lb) caused some early chlorosis and measurable height reduction in sorghum; at 1 and 2 lb/A, slight and temporary reduction in vigor. Soon thereafter, all plots were equal in vigor or more vigorous than untreated checks, which were then suffering considerably from weed competition. Atrazine caused no adverse effects at any time.

Both compounds were highly effective against water grass, as indicated by the following weed control ratings at harvest time: propazine - 4 lb/A (95-100%), 2 lb/A (70-80%), 1 lb/A (more than 50%); atrazine - 4 lb/A (95-100%), 2 lb/A (50%), 1 lb/A (40%). Only the 4 lb/A rate provided effective season-long control in each case. Because of the irrigation one week after spraying with atrazine, it must be concluded that weed control was partially effected through root uptake as well as through post-emergence action.

Yields and related data are given below for the two experiments.

I. Treatment	Ave. no. heads/4'x4'	Grain size no./10 gm	Grain yield lb/A
Untreated check	30	708	299*
Propazine, 1 lb/A	52	726	1470
Propazine, 2 lb/A	56	739	2260
Propazine, 4 lb/A	60	649	2886
	LSD .05 for yield -		653 lb/A

*In one replication there was no grain to harvest due to water grass competition.

II. Treatment	Ave. no. heads/4'x4'	Grain size no./10 gm	Grain yield lb/A
Untreated check	0	---	0
Atrazine, 1 lb/A	10.5	393	109
Atrazine, 2 lb/A	48.5	571	1960
Atrazine, 4 lb/A	56.0	469	3975
	LSD .05 for yield	(with check) -	1460 lb/A
		(without check) -	1715 lb/A

Samples from similar studies in 1960 (pre-plant soil incorporated treatments) showed slight residues of propazine and atrazine in the grain. This will probably necessitate the establishment of suitable tolerances before these materials can be used for feed grain. Additional research is also necessary on the problem of soil residues and the potential hazard to succeeding crops. (Botany Department, University of California, Davis)

Chemical control of annual weeds in seedling grass stands. Peabody, Dwight V., Jr. Objectives of this test were to determine the effect of early post-emergence applications of certain herbicides on the growth of three perennial grass species as well as to determine whether these same herbicidal treatments resulted in adequate control of the broad-leaved annual weed population present.

This experiment was located at the Northwestern Washington Experiment Station on Puget silt loam soil. The following species and their respective varieties were planted June 10, 1960: (1) orchard grass (S-143), (2) timothy (Climax), and (3) creeping red fescue (Illahee). All ten treatments were applied on July 5, 1960, when the perennial seedling grasses were in the three- to four-leaf stage of growth. All treatments were applied with a small tractor-mounted plot sprayer in a total volume of water equivalent to 70 gpa at a pressure of 50 psi. For materials used and their rates of application, see the following table. Experimental design was a randomized complete block, replicated four times. Plot size was three rows, each 20 feet long. On May 8, 1961, a five-foot section of the center row of each plot was cut at a uniform height, and leaf and stem growth from this sample was weighed to the nearest ounce. The preceding year on August 2, 1960, visual estimates of crop vigor and weed control were made using a rating system wherein zero denoted no control and no effect on grass growth to ten, denoting complete elimination of all weeds and/or perennial grass crop. The principal weed species present were: Polygonum pennsylvanicum, P. aviculare, Stellaria media, Senecio vulgaris, Chenopodium album, and Capsella Bursa-pastoris.

The results of this experiment are summarized in the following tables. The only herbicidal treatments that gave adequate weed control were DNBP amine and DCMA at the higher rates of application. By late August, based on visual ratings, neither one of these treatments caused undue injury to any species of perennial grass. The high CV's obtained in the measurements of shoot growth made in the spring following treatment indicate a high variability in this experiment. Even so, these results indicate that silvex, especially the ester formulation, when applied at the higher rate to seedling timothy and creeping red fescue causes extensive injury. Orchard grass is not as adversely affected by ester formulations of silvex. DCMA is probably worthy of further testing in seedling perennial grass stands during their establishment period. (Northwestern Washington Experiment Station, Washington State University)

Effect of growth-regulating herbicides on seed yield of four grass species. Peabody, Dwight V., Jr. The principal objective of this test was to determine the effect of six different growth-regulating type herbicides (see table) on the seed yield of the following grass species: (1) orchard grass, (2) timothy, (3) creeping bent grass, and (4) creeping red fescue. The experimental procedure in 1961 is essentially the same as reported in the Research Progress Reports for 1960 and 1961, treatments being applied again on April 10, 1961.

The three-year means of seed yields, with the exception of bent grass, are given in the table. Yields (not shown) obtained from the 1961 cropping year are included in the three-year means and did not alter the trend observed over the previous two years. Major conclusions derived from this test are as follows: (1) None of the treatments included in this test reduced seed yield of orchard grass, timothy, or bent grass. (2) Seed yield of creeping red fescue is reduced by silvex and 2,4,5-T applications made in the early spring. Either one or both of the following factors may have influenced this reduction: (a) These particular herbicides were ester formulations while the other materials were either amines or an acid. (b) Creeping red fescue matures earlier than the other three grass species; hence, treatment applications in the early spring are being applied during the susceptible growth stage of this particular species. (Northwestern Washington Experiment Station, Washington State University)

Control of 2,4-D resistant dicots in winter wheat and barley. Phipps, F. E. and Furtick, W. R. Herbicides (I) 2-methoxy-3,6-dichlorobenzoic acid and (II) 2-methoxy-3,5,6-trichlorobenzoic acid showed a wide range of selectivity for the control of corn cockle, Agrostemma githago in winter sown wheat and barley. (I) gave 100% control at 1/4 lb/A; injury was observed at the rate of 3/4 lb/A and was estimated at 20% reduction in cereal growth. (II) gave 100% control at 1/2 lb/A with only 20% injury at the 1-1/2 lb/A rate.

Estimates of crop vigor and weed control of 1960 grass seed planting treated with post-emergence herbicides

TREATMENT Herbicide	Rate[1]	Weed stand rating[2] Aug. 2, 1960	Crop vigor rating[3] Aug. 2, 1960
DNBP amine	1.5	6.3	2.8
2,4-D amine	0.5	4.8	2.0
Silvex amine ("Sta-Set")	0.5	2.5	2.8
Silvex amine ("Sta-Set")	1.0	4.5	1.8
Silvex amine ("Dow-M-213")	0.5	3.8	2.3
Silvex amine ("Dow-M-213")	1.0	4.3	2.8
Silvex ester ("Kuron")	0.5	4.0	1.5
Silvex ester ("Kuron")	1.0	4.5	1.0
DCMA	1.6	4.5	2.5
DCMA	3.2	7.3	3.5

[1] All rates of application expressed in pounds active ingredient per acre.

[2] 0 - no control, to 10 - complete elimination of all weeds.

[3] 0 - no effect on crop growth and vigor, to 10 - complete elimination of all crop plants.

Fresh weight of shoot growth of three grass species treated with post-emergence herbicides in the seedling stage of growth

TREATMENT Herbicide	Rate[1]	FRESH WEIGHT OF SHOOT GROWTH[3] Timothy lb/plot	Orchard lb/plot	Fescue lb/plot
DNBP amine	1.5	6.33 a[2]	10.18 a[2]	3.71 a[2]
DCMA	3.2	5.74 a b	9.53 a	3.19 a
2,4-D amine	0.5	5.44 a b	9.38 a	3.50 a
Silvex amine ("Dow-M-213")	0.5	5.07 a b	7.86 a b	2.89 a b
Silvex ester ("Kuron")	0.5	4.94 b	7.31 a b	2.67 a b
Silvex amine ("Sta-Set")	0.5	4.60 b c	7.91 a b	2.85 a b
Silvex amine ("Dow-M-213")	1.0	4.56 b c	5.55 b	2.66 a b
DCMA	1.6	4.50 b c	8.52 a b	2.81 a b
Silvex amine ("Sta-Set")	1.0	4.49 b c	8.31 a b	2.66 a b
Silvex ester ("Kuron")	1.0	3.50 c	9.88 a	1.58 b
Mean		4.921	8.381	2.832
CV		15.5 %	26.4 %	29.7 %

[1] All rates of application expressed in pounds active ingredient per acre.

[2] Duncan Multiple Range Test of significance at the 5% level.

[3] Weighings made eleven months after treatment application.

Seed yields of timothy, orchard grass, creeping red fescue, and bent grass treated with growth-regulating herbicides

TREATMENT		THREE-YEAR MEAN SEED YIELD			
Herbicide	Rate[1]	Timothy lb/A	Orchard lb/A	Fescue lb/A	Bent[2] lb/A
MCPA (amine)	2	513	498	610	277
2,4-D (amine)	2	542	539	548	252
4-(2,4-DB) (amine)	2	538	482	533	269
2,4-D (acid)	2	538	473	600	263
Check	-	519	481	571	254
2,4,5-T (ester)	2	520	481	476	295
Silvex (ester)	2	530	431	370	263

[1] Rate of application expressed as pounds parent acid per acre.

[2] Bent grass seed yields are means at two years.

These materials will be explored further during 1962 to determine the best time for application, dosage rate, and margin of crop tolerance. (Oregon Agricultural Experiment Station)

The selective control of downy brome in winter wheat. Anderson, W. P. and Muzik, T. J. Intensive research has been conducted in eastern Washington for the past two years on the control of downy brome or cheat grass (*Bromus tectorum*) in winter wheat fields.

Results of this research indicate that simazine and atrazine are the most promising of the more than twenty herbicides tested and that rate and time of application are critical.

Indications are that simazine is most effective when applied during the period extending from the last week of November through the first two weeks of January. At this time, both the wheat and downy brome were in the 3 to 5 leaf stage and had begun to tiller. Optimum rate of application varied with soil type. Rates of 1/2 to 3/4 lb/A (ai) were most effective on sandy soils of low organic matter contents and 3/4 to 1 lb/A on soils with relatively high organic matter content. When applied during February and later, simazine had no apparent influence on the growth of either the wheat or downy brome.

In contrast to simazine, atrazine was most effective when applied during the period extending from the last ten days of February through the first ten days of March. This is a post-emergence treatment to both the wheat and downy brome. Atrazine applied earlier than this generally resulted in severe wheat injury and when applied later resulted in poor control of downy brome. As with simazine, soil type influences the rate of application. The optimum rate of atrazine in sandy soils was 3/4 lb/A (ai) while that in heavier soils was about 1/2 lb/A. Excellent selective control was obtained with atrazine at rates as low as 1/4 lb/A on the heavier soils.

IPC has continued to show a potential for selectively controlling downy brome in winter wheat with time and rate of application being very critical as to its effectiveness. An application made post-emergence on March 9 at rates of 1 to 2 lb/A gave 90 to 100% control of downy brome with no effect upon the wheat. However, applications made about ten days on either side of this date resulted in either poor control or severe wheat injury or both. The short soil residual life of IPC and its effectiveness at low rates continue to make this material of interest. (Washington State University Agricultural Experiment Station)

Selective downy brome control in cereals. Appleby, A. P., Phipps, F. E., and Furtick, W. R. Downy brome (*Bromus tectorum*) is a serious weed problem in the grain-producing areas of the Columbia Basin. In greenhouse trials, 2,3-dichloroallyl-di-isopropylthiolcarbamate gave excellent control of downy brome at rates ranging from 1/2 lb/A to 3 lb/A.

In the fall of 1960, a pre-plant application of this compound was made in the field and disked into the soil immediately after spraying. Downy brome control was excellent with neglible injury to wheat and barley. Similar results were obtained in the fall of 1961 from pre-plant application followed by sprinkler irrigation. Research is continuing in order to determine the optimum rate and method of application. (Oregon Agricultural Experiment Station)

Evaluation of herbicides for weed control in small grain, pinto beans, corn and sorghum. Ross, Merrill A. and Thornton, B. J. Separate trials were designed to evaluate some of the more promising herbicides available for weed control in wheat, barley, pinto beans, corn and sorghum. Each treatment in all of the tests was replicated four times.

Pinto beans: EPTC, amiben, CDEC, DATC and the DATC analog CP 23426 were applied pre-plant broadcast in the soil and incorporated by double disking. Barban was applied post-emergence. Dominant weed species present were *Amaranthus retroflexus*, *Setaria* spp., *Echinochloa crusgalli*, *Avena sativa* and *Portulaca* spp. All of the pre-plant incorporated chemicals gave 90% or better weed control without reducing yields. EPTC was very effective against all weed species. Amiben was effective against all but oats. DATC and CP 23426 gave excellent control of oats but lacked some degree of effectiveness against broad-leaved weeds and small-seeded grass weeds. The use of barban resulted in poor control of weeds and damage to the beans. Chemicals rated in decreasing order of their overall effectiveness are EPTC, amiben, CDEC, DATC and CP 23426.

Corn: Chemicals used pre-plant in corn included atrazine, simazine, duPont 326, Randox T, Stauffer R 1856, EPTC and DATC. Weed species present were the same as for the bean plots. Excellent control of all weeds present, with no damage to the corn, was obtained with atrazine at 2 and 4 lb/A, simazine at 2 lb/A and EPTC at 4 lb/A. duPont 326 at 1-1/2 and 3 lb/A was effective against the weeds but was injurious to corn. DATC at 1-1/2 lb/A and R 1856 at 4 lb/A controlled species of grass weeds but lacked effectiveness against broad-leaved species. Good overall weed control was obtained with Randox T at 5 lb/A. Randox T was less effective than the atrazine, simazine and EPTC.

Sorghum: Atrazine, simazine, propazine all at rates of 1-1/2 and 3 lb/A and duPont 326 at rates of 3 and 5 lb/A were evaluated for pre-plant weed control in two hybrid sorghums grown in Colorado. All of these chemicals controlled small-seeded grass weeds and broad-leaved weeds. Only atrazine at 1-1/2 lb/A and propazine at 1-1/2 and 3 lb/A did not injure the sorghum. Atrazine at 3 lb/A caused slight injury to the sorghum. Both rate of simazine and duPont 326 proved to be quite toxic to the sorghum.

Small Grain: Excellent control of wild oats was obtained from applications of DATC and its analog CP 23426 at rates of 1 and 1-1/2 lb/A in Moravian malting barley. Slight damage to barley was observed in plots treated with 1-1/2 lb/A of DATC. No damage was detected in plots treated with CP 23426 at the same rate. Spring wheat plots treated with DATC at 1 lb/A were damaged considerably. CP 23426 at 1 lb/A caused very little, if any, injury to the wheat. The chemicals were applied prior to planting and incorporated into the soil by double disking. (Colorado State University Experiment Station, Fort Collins, Colorado)

Comparison of pre-emergence herbicides for weed control in sugar beets. Ross, M. A., Chamberlain, H. E. and Fults, J. L. This study was designed to evaluate several herbicides for pre-emergence weed control in sugar beets. Chemicals used were: endothal, endothal TD66 (di oleyl amine of 3,6-endoxohexahydrophthalic acid), EPTC, Tillam (n-propyl ethyl-n-butylthiolcarbamate), DATC, CP23426 (2,3,3-trichlorallyl diisopropylthiolcarbamate), dalapon and Bandane (polychlorodicyclopentadiene isomers). All chemicals were applied prior to planting. Tillam was incorporated by double disking, all others were incorporated with Howrey-Berg tillers mounted in front of the planter. Great

Western Sugar Company monogerm sugar beet seed was planted at 8 lb/A, May 17, 1961. Plots were four rows wide (20 inch rows) and 30 feet long. The center two rows were harvested October 16, 1961 for total yield of roots and of sucrose. Weed and beet counts were taken from 100 inches of each of the two center rows of each plot prior to thinning. The sugar beets were hand thinned and blocked June 15, 1961.

A summary of the 1961 data yielded the following results: Tillam applied at the rate of 4 lb/A gave the best over-all weed control without injury to the sugar beets or without lowering the yield of total sucrose. Tillam at 6 lb/A reduced total sucrose. DATC applied at 1-1/2 lb/A approached Tillam at 4 lb/A in general performance. This chemical showed little control of broad-leaved weeds but adequately controlled Setaria and oats without reducing total sucrose. Avadex at 3 lb/A significantly reduced the sucrose yield. The performance of CP23426 was similar to that of DATC at the same rates. EPTC at 1-1/2 lb/A gave excellent control of Setaria and oats without reducing yields. Endothal at 6 lb/A gave fair control of Setaria but not of oats and broad-leaved weeds. Sucrose production was reduced slightly by endothal. Bandane proved to be quite toxic to sugar beets at 16 lb/A. Of the compounds included in this test, Tillam, DATC and CP23426 were the most promising for pre-plant weed control in sugar beets. (Colorado State University Experiment Station, Fort Collins, Colorado)

Weed control in sugar beets. Alley, H. P. Plots were established in the four major sugar beet growing areas of Wyoming in 1961. Treatments were replicated four times at each location. Each plot was four rows 100-150 feet long. Both the granular and liquid formulations were applied on a six-inch band and incorporated by equipment developed by the Agricultural Engineering Section.

Chemicals included as pre-emergent soil incorporated compounds included EPTC, endothal, dalapon, DATC, propyl ethyl-N-butylthiolcarbamate (Tillam) and TD66 (endothal analogue). All granular materials, except EPTC, were formulated by the Agricultural Engineering Section.

Tillam and DATC were the most outstanding chemicals in the 1961 tests. Good control of both grassy and broad-leaved weeds was obtained. Considerable damage to sugar beets resulted on the sandy soils with a 0.5 lb/A (in a six-inch band) rate and higher of Tillam and DATC. (Wyoming Agricultural Experiment Station)

Effects of barban, DATC, and endothal on weed control in sugar beets. Tingey, D. C. An experiment was initiated to compare barban, DATC, and endothal for weed control in sugar beets. Weeds involved were wild oats (*Avena fatua*), green foxtail (*Setaria viridis*), lambsquarter (*Chenopodium album*), and prostrate red root (*Amaranthus blitoides*).

Rate of application in pounds per acre were as follows: barban - 1/2, 1, and 3; DATC - 1, 1-1/2, 2, and 4; endothol - 2,4, and 8. Both liquid and granular forms of Avadex and endothal were used.

DATC and endothal were applied as a pre-plant treatment incorporated with the soil by disking and harrowing; barban was applied as a post-emergence treatment when the wild oats were in the two to three leaf stage. The barban was applied in water at the rate of five gpa. Liquid forms of the other herbicides were applied in water at 40 gpa. A three-gallon hand-compression sprayer, operated at 30 psi was used in making applications. The granular materials were applied with a Gandy fertilizer distributor. Plots were 6' x 20'. Treatments were replicated five times.

The experiment was located about one and one-half miles northeast of the Utah State University campus. From the time the sugar beets were planted until they emerged, there was no precipitation. A water shortage prevented the experiment from continuing for yield data.

The land had been fall-plowed and a mixture of wild oats and other weed seeds were planted on the experimental area just prior to seed-bed preparation. Estimates were made of the stand and damage to the sugar beets and to the stand of weeds. These estimates were made about two to three weeks after the beets were ready to thin. At this time, the wild oats were from four to six inches tall.

Barban caused little or no damage to the beets. At the 1 and 2 lb rates, barban reduced the stand of wild oats about 50 percent but had essentially no effect, at any rate, on the stands of green foxtail, lambsquarter, and prostrate red root.

DATC caused no visible thinning or stunting of sugar beets nor reduction in stands of lambsquarter or prostrate red root at any rate but gave satisfactory wild oat control at all rates used.

Endothal at all rates gave no reduction in stand or damage to sugar beets and no reduction in stands of lambsquarter and prostrate pig weed. There was a slight reduction in stand of wild oats and green foxtail at all rates. However, there was no consistent reduction with rate of application.

There was no difference in effectiveness between the liquid and granular forms of either DATC or endothal. (Utah State Agricultural Experiment Station, Logan, Utah)

<u>A comparison of fall and spring applications of EPTC and endothal for weed control in sugar beets</u>. Tingey, D. C. An experiment was conducted to determine if EPTC and endothal, applied late in the fall, would be comparable to spring applications for weed control in sugar beets. Liquid forms were applied in water at 20 gpa and granular forms were applied with the Gandy fertilizer distributor.

Fall rates of EPTC were 4,8,16/A and spring were 2,4,8/A. Fall rates of endothal were 8,16/A and spring were 4,8/A. Part of the fall applications were incorporated with the soil by disking and part were left on the surface over winter. Part of the spring applications were incorporated by disking and part by harrowing. Plots were 6' wide and extended over 4 rows of beets. There were 6 replications. Results were based on plant count.

Tillage operations in the spring to incorporate the herbicides did a fairly good job of weed control method of incorporation had the most pronounced effect on stands of beets. Disking dried the soil more than did harrowing and this resulted in fewer beets per row by about one-third.

Spring applications of EPTC reduced the stand of beets about 50 percent. Endothal, either fall or spring applied did not reduce the stand of beets. Spring application of EPTC and the 16 pound rate of the fall applications were free of wild oats. Endothal, even at the highest rate, had no effect on the number of wild oat plants. There were about one-sixth as many green foxtail plants on the EPTC treated plots as on the controls. Endothal had little or no effect on either green foxtail or wild oats, and neither herbicide reduced the number of erect red root, prostrate red root, or lambsquarter.

Data from this experiment indicates that neither EPTC nor endothal remained either in the soil or on the surface over winter in any significant amounts. (Agricultural Experiment Station, Utah State University, Logan, Utah)

Use of barban for control of rye (*Secale cereale*). Phipps, F. E. and Furtick, W. R. Rye is becoming an increasing problem in winter wheat and barley throughout the Columbia Basin, because of dockage received from contaminated grain.

Observations made in 1960 on barban treated barley infested with rye indicated selectivity similar to that reported for wild oats (*Avena fatua*). Similar plots were established during the fall of 1960 which gave the results shown in the table below. Treatments were made during the 1-1/2 leaf to early stooling stage of growth. Observations made on older plants indicate root development stopped at all stages of growth. Follow-up work is being established in the winter of 1961-62 to incorporate tillage following treatment in an attempt to pull the stunted plants out before adventitious roots are developed which will sustain the plant and allows flowering.

Treatment	Rate, lb/A	Seed count Ave % barley	Ave % damage Barley	Ave % damage Rye	Test wt, lb/bu
Barban	1/2	96	0	87.5	47.25
	1	95	12.5	80	45.50
	2	76.5	52.5	47.5	44.75
Check	0	82	0	0	48

(Oregon Agricultural Experiment Station, Corvallis)

A comparison of two thiolcarbamate, wild oat controlling herbicides. Appleby, A. P., Baldwin, R. W. and Furtick, W. R. Herbicide I (2,3,3-trichloroallyldiisopropylthiolcarbamate) and herbicide II (2,3-dichloroallyldiisopropylthiolcarbamate) were compared for toxicity to wild oats in spring wheat and spring barley. Herbicide I was found to give consistently greater wild oat control while resulting in less crop damage to both cereals. The results shown below are the averages of data gathered for both crops at two Oregon locations, Corvallis and Medford.

Rate lb/A	% wild oat control		% crop injury	
	Herbicide II	Herbicide I	Herbicide II	Herbicide I
1/2	47	23	7	7
1	58	72	0	0
$1\frac{1}{4}$	65	89	11	0
$1\frac{1}{2}$	68	91	5	0
3	70	80	47	3

(Oregon Agricultural Experiment Station)

Possible influence of environmental conditions on barban toxicity to wild oats. Appleby, A. P., Furtick, W. R. and Baldwin, R. W. Large variations in wild oat control and cereal injury from barban have been observed at various test locations throughout Oregon. It was noted that control was generally excellent in areas of high relative humidity and poor in drier areas. Table I illustrates the difference in results obtained at three locations. Of the three sites, Corvallis was the most humid during the period of application, followed by Oregon City, with the Medford area being the driest.

Table I. Summary of Wild Oat Control with Barban at Three Oregon Locations.

Rate	Winter wheat			Winter barley			Spring wheat	Spring barley	
(lbs/A)	Corv.	Ore. City	Med.	Corv.	Ore. City	Med.	Medford	Corv.	Med.
1/4	98	40	27	92	17	43	20	95	23
1/3	--	--	--	--	--	--	40	90	47
1/2	99	78	86	88	72	32	43	90	50
1	97	90	50	85	87	35	--	75	--
2	97	94	55	85	96	3	--	--	--

While the above observations do not constitute conclusive evidence of the effect of relative humidity on barban toxicity, they are pointed out with the hope that more definite information can be obtained by other research workers. It is possible that in the future, exact rates of barban used in wild oat control will depend on the particular environmental conditions at the time of application. (Oregon Agricultural Experiment Station)

Control of wild oat in wheat with barban. Hamilton, K. C., Arle, H. F. and McRae, G. N. Wild oat is the most serious annual grass in small grains in Arizona. Field experiments in 1960 indicated that barban controlled wild oat in wheat.

In January, 1961, barban was applied at five rates when Ramona wheat and wild oat were 4 inches high and had 2 leaves. At Mesa barban at all rates stunted or killed wild oat and 0.5 or more lb/A caused temporary stunting of wheat. At Yuma barban at all rates stunted both wild oat and wheat.

In May the grains were combined and 100-gram samples collected from each plot and separated to determine the amount of wild oat in harvested grain. Yield data are summarized in the following table.

	Mesa		Yuma	
Barban (lb/A)	Wild oat (% of grain)*	Wheat (% of check)*	Wild oat (% of grain)*	Wheat (% of check)*
None (check)	21.5 a	100 a	.6 a	100 ab
.25	12.9 b	128 b	.6 a	117 a
.50	11.3 b	121 b	.3 a	118 a
.75	7.4 c	138 b	.8 a	102 ab
1.00	6.7 c	132 b	.6 a	88 bc
1.25	5.7 c	126 b	2.1 b	74 c
Grain yield on checks in lb/A		1,426		1,530

*Values with the same subscript letters are not significantly different.

At Mesa, where barban controlled wild oat and wheat was competitive late in the season, the amount of wild oat in harvested grain was reduced and wheat yields were increased. At Yuma, with a lower wild oat infestation and severe stunting of the wheat, the wheat yield was reduced and the amount of wild oat in harvested grain was increased by the 1.25 lb/A application of barban. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture and the Arizona Agricultural Experiment Station, cooperating)

Chemical summer fallow results, 1961. Baker, Laurence O. and Guenthner, H. R. Sixteen treatments were applied to soil, that had just been cultivated, on May 29 at Moccasin on Danvers clay loam soil and May 31 at Willow Creek on a silt loam soil. Plots were 8.25 x 16.5 feet in size and were triplicated. Water was used as the carrier for all chemicals and was applied at a rate equal to 20 gpa. A 3-gallon knapsack sprayer equipped to spray at a constant air pressure was used with an 8-foot boom and 8002 Teejet nozzles. Precipitation received during the 10 days following treatment amounted to 1.81 in. at Moccasin, but only 0.13 in. at Willow Creek. The May through September rainfall of 6.44 in. at Willow Creek and 8.05 in. at Moccasin was about 80 percent of normal; however, the distribution pattern was somewhat abnormal with June, July, and August receiving less than usual.

At Willow Creek five treatments gave satisfactory season-long control of the weeds present which included volunteer wheat, *Bromus tectorum*, *Salsoli kali*, *Solanum nigrum* and *Amaranthus albus*, with a small number of *Chenopodium album* and *Euphorbia glyptosperma*.

Results at Moccasin were less satisfactory. Volunteer barley was the principal plant present. *Salsoli kali* and *Thalaspi arvense* were irregularly and thinly distributed and were the only broad-leaf weeds encountered.

Treatments and final season reading at each location are found in the table on the following page.

Treatment	Rate in lb/acre	Vegetation control[a/] *Moccasin 8/24	**Willow Creek 9/19
Atratone	1.5	7.3	6.3
Atratone	3	9.7	8.2
Atrametryne	1.5	3	9.6
Atrametryne	3	2	9.9
Atrametryne +	1.5	1.7	9.9
TBA	1		
Diquat +	2	1.7	9.1
TBA	1		
Diquat +	4	3.7	9.4
TBA	1		
Atrazine +	1	6	8.3
TBA	1		
Fenuron +	1	4.3	6.8
TBA	1		
Atrazine +	1	7.3	8.7
Banvel D	1		
Fenuron +	1	8	8.3
Banvel D	1		
TBA	2	2.7	6.3
Check	Cultivated 6/21 and 8/14		9.8

a/ Average of 3 replications. Rating of 0 represents no effect and 10 complete control.
* Cultivated and later seeded to winter wheat.
** To be seeded to spring wheat.

In an area chemically fallowed in 1960 only the check plots produced normal small grain growth in 1961. One pound, or higher, rates of atrazine, prometone, fenuron, atratone, simetryne, atrametryne and prometryne caused serious damage or eliminated the small grain stands. Two pound rates of TBA and Banvel D (2-methoxy-3,6-dichlorobenzoic acid) caused extensive development of deformed grain plants. The 1960 growing season was very dry with only about 60 percent of the normal precipitation being received. (Montana Agricultural Experiment Station)

Chemical summer fallow. Alley, H. P. The chemical atrazine has been outstanding for complete control of downy brome grass (*Bromus tectorum*), volunteer wheat and many broad-leaved weeds over the past three years. At 2 lb ai/A, either as a fall or spring application, virtually 100% control has been maintained for the growing season. Moisture is necessary for activation of the chemical; therefore, fall treatments have been more successful. Amitrole in combination with atrazine has been used with good success in the spring after growth has started.

At the Archer Experiment Station and at LaGrange, 1961, the winter wheat yield on atrazine treated plots was 29.0 bu and 50.8 bu/A respectively, and for the conventionally fallowed land the yield was 25.0 and 40.0 bu/A. Yields have been reduced on clay type soils. (Wyoming Agricultural Experiment Station)

Chemical fallow. Phipps, F. E., Swan, D. G. and Furtick, W. R. Work on complete chemical fallow by use of atrazine at 1.6 lb/A plus amitrole at 1 lb/A has indicated there is too much soil residue for a general recommendation on grain land in the Columbia Basin of Oregon. Damage to spring-sown cereals of 45% to 90% and a 25% reduction of stand on winter cereals sown on shallow calcareous soils has caused a change in the direction of new research from a complete fallow to a short residual program. A rate of 0.4 lb atrazine + 0.5 lb amitrole has given excellent control of vegetation until mid-summer. This gives longer chemical fallow than the present recommendation of amitrole at 1 lb/A + ester of 2,4-D 2 lb/A. Preliminary indications are that the low rates of atrazine do not give residual injury to grain if spring seeded the year following treatment. (Oregon Agricultural Experiment Station)

PROJECT 6. AQUATIC AND DITCHBANK WEEDS

Richard H. Hodgson, Project Chairman

Summary

Five herbicides tested for control of miscellaneous ditchbank weeds appear to have only limited usefulness. Ten and fifteen pounds ai/A of diuron, atrazine, simazine and propazine, and 5 pounds ai/A of atrazine, simazine, and propazine gave satisfactory control of weeds above the waterline. Effectiveness at the waterline was lower and more variable, depending somewhat upon the water regime of the ditch.

Studies have been made of suppression of ditchbank weeds with a view toward limiting general plant growth without denuding the ditchbanks. Successful suppression of vegetation was obtained in a number of treatments in which dalpon and 2,4-D or dalapon and silvex were applied.

One major factor influencing the efficiency of aromatic solvent treatment of submersed aquatic weeds is the success with which emulsion stability is achieved and maintained during application to the canal. Laboratory tests reveal that desirable emulsion stability is obtained with certain blends of nonionic and anionic emulsifiers.

Treatment of American and sago pondweed with aromatic solvent reduces propagule number, mass, and percent dry weight.

Greenhouse and field studies of herbicides applied to canal soils indicate that this may be an effective method of controlling submersed weeds in irrigation waters. The sodium salt and amide derivatives of fenac applied at the rate of 20 lb/A ai gave satisfactory season-long control of sago pondweed.

Grade B industrial xylene has proven effective in controlling a number of aquatic weeds, but conditions of the plants, water quality, and emulsion stability are also important. Xylene, when emulsified with two new anionic-nonionic blended surfactants, was more effective than when emulsified with mahogany soaps or nonionic surfactants.

An experiment involving a number of different herbicides applied both pre- and post-emergent to two species of pondweed demonstrated the rather high herbicidal resistance of these plants. Only endothal at 13 lb/A gave any degree of control to one of the species.

A number of detailed ecological and physiological investigations on sago pondweed have been undertaken at Montana. These include the production potential of seeds and tubers, the effect of foliage removal on axillary and subterranean tuber formation, the effect of storage conditions on tuber survival, and variation in tuber production during the May-October growing season.

Evaluation of five soil-sterilant-type herbicides for the control of miscellaneous ditchbank weeds. Comes, R. D. and Timmons, F. L. The herbicides diuron, 2,3,6-TBA, atrazine, simazine, and propazine were evaluated for their effectiveness in controlling miscellaneous ditchbank weeds. Weeds in the experimental area included smooth brome grass, various mustards, curled dock, dandelions, cheat grass, rough pigweed, and Kochia.

All chemicals were applied at rates of 5, 10, and 15 lb/A ai in a total volume of 120 gpa, with water as the diluent. Initial treatments were applied in the spring of 1960 and reapplications of the original treatments in the spring of 1961.

Each treatment was replicated three times on 16½-x11-ft plots. The plot area included both banks and the bottom of the ditch. Two replications were located in a ditch that carried water continuously through the growing season and one replication in an intermittently used ditch.

Weed control was significantly better at the waterline in the intermittently used ditch than in the continuously used ditch with all treatments except the 5- and 10-lb/A rates of 2,3,6-TBA. These two treatments gave no control at the waterline in either ditch. Diuron at 10 and 15 lb/A, atrazine at 15 lb/A, and all rates of simazine and propazine gave 85 to 100 percent control of the weeds at the waterline in the intermittently used ditch. Diuron and simazine at 15 lb/A were the only treatments that gave over 20 percent control at the waterline in the continuously used ditch. These two treatments gave 42 and 40 percent control, respectively.

Diuron at 5 lb/A and 2,3,6-TBA at all rates tested were the only treatments that did not give satisfactory season-long weed control on the ditchbank above the waterline in the continuously used ditch. All treatments except the 5- and 10-lb/A rates of 2,3,6-TBA gave satisfactory control of the weeds above the waterline on the intermittently used ditch.

These results indicate that the herbicides tested do not hold a great deal of promise for the control of miscellaneous weeds growing along irrigation ditches except in limited situations. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture and Wyoming Agricultural Experiment Station)

Suppression of growth of ditchbank vegetation with herbicides. Hodgson, J. M. Complete removal of ditchbank vegetation that interferes with water delivery has consistently been achieved with such chemicals as monuron, diuron or simazine. However, denuded ditchbanks resulting from such treatments are more easily eroded and are subject to invasion by undesirable noxious weeds. In this experiment a series of treatments were chosen that might limit general plant growth and not destroy desirable soil binding grasses.

In May 1960 an old alfalfa stand was plowed, prepared, and seeded with a mixture of alfalfa, orchard grass and smooth brome grass. The seeded area was prepared for irrigation with dikes 10 in high and 8 ft apart to simulate a ditchbank situation. Irrigation water was conveyed through the diked areas once each week through the summer of 1960 and 1961. During the summer of 1960 a heavy uniform stand of alfalfa, dandelion, and orchard and brome grass became established.

Several treatments involving chemicals alone and in various combinations were applied in May 1961 when the vegetation was 6 to 8 in high and growing vigorously. The treatment effects were assessed by visual estimate and by taking yield samples of vegetation 1 month after treatments were applied.

The six treatments that gave greater than 70 percent reduction of growth of sprayed vegetation in order, with the highest first, were: Paraquat 1.5 and 2,4-D 2.5 lb/A, dalapon 20 and silvex 2.5 lb/A (esters), dalapon 10 and silvex 1 1/4 lb/A (esters), dalapon 10 and 2,4-D 2.5 lb/A (esters), herbicidal oil 40 gpa and dalapon 5 and 2,4-D 2.5 lb/A, and herbicidal oil 120 gpa. Paraquat and diquat applied alone were significantly less effective than when applied to the above combination with 2,4-D and/or dalapon. MH at 5 lb/A alone or with 2.5 lb/A of 2,4-D was unsatisfactory as was amitrole T at 2 lb/A, atrametryne at 4 lb/A, and dalapon at 5 lb/A.

Regrowth data obtained on these plots in August showed that the above treatments containing 10 or more pounds of dalapon with 2,4-D or silvex were most effective in limiting vegetation regrowth. (Cooperative Investigations of Crops Research Division Agr. Res. Service, U.S.D.A. and Plant and Soil Science Dept. Montana Agricultural Experiment Station)

<u>Evaluation of emulsifiers by laboratory test method for use with aromatic solvent aquatic herbicides</u>. Bartley, T. R. A laboratory study has been conducted on the development of a satisfactory test method for evaluating emulsifying agents for use in dispersing aromatic solvent aquatic herbicides. Emulsifiers are tested to determine the stability of water-xylene emulsions. It is important to have a stable dispersion of the aromatic solvent (contact herbicide) during field application to insure uniform contact with the submersed aquatic weeds.

The test procedure devised for evaluating emulsifiers briefly consists of injecting a small volume of the emulsifiable concentrate under pressure through a small orifice into flowing water of a standard hardness. A portion of the emulsion formed is transferred to a milk test bottle. After the emulsion stands for 4 hours the amount of cream and oil layers rising to the surface are recorded as divisions on the stem of the bottle. Stability of the emulsion is rated on basis of total amount of cream and oil. The greater the amount of these two phases the less stable the emulsion. Emulsifiers are tested in duplicate at levels of 1, 1.5, and 2 percent by volume in xylene.

Only a limited number of emulsifying agents evaluated by this test method over the past few years have produced emulsions having a high degree of stability. These materials have been used in field applications of aromatic solvents with good results, thus, corroborating findings of the laboratory test method. Most of the products tested failed to produce any degree of emulsion stability. Many of the emulsions "break" immediately after formation. Certain blends of nonionic and anionic types emulsifiers are the products that presently produce the more stable emulsions of xylene.

The evaluation of new emulsifying agents has resulted in the finding of better materials for dispersing aromatic solvents. Use of these better products have enabled applicators to reduce the quantity of emulsifier required and have shown an improvement in efficiency of the aromatic solvent aquatic herbicide. (Division of Engineering Laboratories, Office of the Assistant Commissioner and Chief Engineer, Bureau of Reclamation, U. S. Department of the Interior, in cooperation with the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Denver, Colorado)

Pondweed propagule production as affected by repeated aromatic solvent treatment. Otto, N. E. Greenhouse experiments are being conducted to study the effects of repeated aromatic solvent treatments on vegetative propagule production of sago pondweed, *Potamogeton pectinatus* L., and American pondweed, *P. nodosus* Poir. Tubers of sago pondweed and winter buds of American pondweed are cultured in 6-inch soil-filled pots, placed in steel drum aquaria, and allowed to develop to treatment stage. In the preliminary experiments, plants were subjected to a replicated series of two treatments, allowing for regrowth between Treatments 1 and 2. Determinations were made of numbers of propagules produced and their fresh and dry weights. Untreated plants were utilized for comparative standards. Resulting data were analyzed for statistical significance.

In the first aromatic solvent treatment, the number of sago pondweed tubers were reduced, but no significant differences occurred between one and two treatments. A slight reduction in the average dry weight per tuber was noted between treated and untreated plants. However, a comparison of the average percent dry weight per tuber shows that untreated plants differed significantly from treated plants.

Untreated American pondweed plants produced a greater number of winter buds than did treated, but again little difference occurred between one and two treatments. There were significant reductions in the average dry weight per propagule in treated plants, but few differences were noted between the first and second treatment. Average percent dry weight per winter bud differed significantly between control plants and the two treatment series, but did not differ between controls and one treatment.

Additional greenhouse studies are underway to further evaluate the effects of multiple herbicidal treatments on pondweed propagule production. (Division of Engineering Laboratories, Office of the Assistant Commissioner and Chief Engineer, Bureau of Reclamation, U. S. Department of the Interior, in cooperation with the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Denver, Colorado)

Evaluation of soil-applied herbicides for control of submersed aquatic weeds in irrigation canals. Frank, P. A., Hodgson, R. H., Comes, R. D. and Timmons, F. L. Previous greenhouse evaluations indicated that silvex and the sodium salt and amide derivatives of fenac were quite active on several species of pondweed. Field trials were made in an irrigation canal in eastern Wyoming to verify greenhouse results and to evaluate the effectiveness of these herbicides on rooted submersed aquatic weeds.

Replicated series of plots were established. Each plot was 50 ft long and 12 ft wide. The plots were separated by 50-ft borders. The sodium salt and amide derivatives of fenac were applied at 5 and 20 lb/A. Granular sodium salt of silvex was applied at a single rate of 40 lb/A. To determine the most appropriate time for making herbicide applications to the canal soil, treatments were made in the fall after water was turned out of the canal and in the spring before water was turned into the canal. It was originally planned to compare soil incorporation of the herbicides versus no incorporation in both the fall and spring series, but the heavy soil dried very slowly and prevented soil incorporation in the fall tests. The granular silvex was applied with a fertilizer spreader while the fenac derivatives were applied with a constant-pressure sprayer using water as the carrier. The herbicides were incorporated to a depth of about 2 inches with a rototiller. From the time treatments were applied until water was turned into the canal in the spring a total of 8.76 and 4.11 in of precipitation was received on the fall and spring series plots, respectively.

Water was turned into the canal on June 1, 1961, and observations were made on July 6. The stand of untreated weeds was very dense and 4 to 7 ft in length at the time of observation. The principal weed was sago pondweed (Potamogeton pectinatus L.). The effect of the treatments was determined by estimating the percent stand in the treated plots as compared with that in the upper and lower untreated borders. Data with respect to the weed control obtained are shown in the following tabulation:

Treatment 1/ rate (lb/A)	Season of application	Herbicide incorporation	Percent stand reduction 2/		
			Fenac sodium salt	Fenac amide	Silvex sodium salt
5	Fall	No	34	10	--
5	Spring	No	22	22	--
5	Spring	Yes	58	3	--
20	Fall	No	93	95	--
20	Spring	No	48	49	--
20	Spring	Yes	80	46	--
40	Fall	No	--	--	70
40	Spring	No	--	--	31
40	Spring	Yes	--	--	45

1/ Treatment rates were based on lb/A of active ingredients.
2/ Percent control figures represent the mean of three replications.

The 20 lb/A rates of the fenac derivatives applied in the fall gave the best weed control. The surviving plants were small and were virtually no hindrance to water flow. The 5-pound rate of the fenac derivatives did not provide adequate control. Some benefit was derived from incorporation in the spring silvex and fenac sodium salt treatments, but it is doubtful whether incorporation in a canal bottom would be practical. Fall applications of silvex at 40 lb/A were superior to spring applications at the same rate but less effective than fall treatments with fenac at 20 lb/A.

Stand density reduction, the only criterion used to determine the effectiveness of the herbicides, did not always give a true expression of the effectiveness of treatments. In many instances a moderate reduction in stand was accompanied by a weed population very much reduced in size and vigor. It was not unusual to observe that, in plots having no more than a 50-percent stand reduction, the weeds were not a serious obstacle to the flow of water. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture; Division of Engineering Laboratories, Bureau of Reclamation, and the Wyoming Agricultural Experiment Station)

Factors influencing the effectiveness of aromatic solvents used to control submersed aquatic weeds in irrigation channels. Yeo, R. R., Comes, R. D., Timmons, F. L., Bruns, V. F. and Hodgson, J. M. Aromatic solvents were effective in controlling submersed aquatic weeds in 1947. Since that time their use in controlling waterweeds in irrigation systems has steadily increased. Grade B industrial xylene has proved to be very effective in waterweed control. Condition of waterweeds, water quality, and stability of the emulsion influenced results of the treatments. Recent experiments have shown that xylene treatments emulsified in irrigation water with anionic-nonionic blended emulsifiers more effectively controlled waterweeds than previously when mahogany soaps or nonionic emulsifiers were used.

Two recently developed anionic-nonionic blended emulsifiers, calcium dodecyl benzene sulfonate plus a mixture of nonyl phenol ethylene oxide (Emcol AD-410) and alkyl aryl sulfonate plus polyglycol ether (Toximul H), were tested in Montana, Washington, and Wyoming. Twenty-two irrigation canals varying in capacity from 7 to 50 cfs of water flow were treated with Grade B xylene emulsified with Emcol AD-410 at 1 and 2 percent. Ten similar canals were treated with Toximul H emulsifier in xylene at 1 to 2 percent. Ten gallons of xylene per cubic foot per second of water was used in all treatments. The canal widths ranged from 4.2 to 16.0 feet, and velocities of flow varied from .5 to 1.67 feet per second. Temperatures, pH, and conductivity ranged from 50° to 76° F., 7.2 to 8.9, and 2.3 to 11.8 millimhos per sq cm, respectively.

Weeds treated included sago pondweed (*Potamogeton pectinatus* L.), Richardson pondweed (*Potamogeton richardsonii* (Ar. Benn.) Rydb.), horned pondweed (*Zannichellia palustris* L.), waterplantain (*Alisma gramineum* (Torr.) Sam. var. Geyeri), and chara (*Chara* sp.). Sago pondweed predominantly infested all canals. Plant stage for all treatments was pre-bloom to early bloom before growth had reached the water surface.

The results of most of the treatments were satisfactory. Control of weeds was obtained for distances ranging from a trace to 6 miles. Average distance of control was 3 miles. In canals where rate of flow, width of canal, and plant stage of growth were considered more ideal the distance of satisfactory control averaged 3.6 miles. Many variables were found in the different test canals and it was not possible to show that one emulsifier was better than the other; however, the higher rate of emulsifier evidentally gave better results at 3 of the 4 locations.

The average percentages of topkill of leaves and stems were 89 and 66 percent. The average percent sloughing of leaves was 72, and that of stems 53 percent. New leaves appeared within one week after treatment. For all treatments there was an average of 1 percent regrowth the first week after treatment, 8 percent the third week, 20 percent the fourth week, 40 percent the fifth week, and 57 percent the eighth week. The average control was estimated at 91, 97, 92, 84, 77, 75, 42, and 36 percent after 1, 2, 3, 4, 5, 6, 7, and 8 weeks, respectively.

All the species mentioned except waterplantain, which was found to be resistant to xylene treatments, were effectively controlled.

Other factors than weed species that appeared to affect the efficiency of the treatments were channeling of the emulsions at the time of treatment, densely turbid water due to silt and clay in wasted irrigation water, and density of waterweed infestations probably causing a depletion of concentration of xylene and limiting movement of the emulsion. Temperature and pH did not seem to affect the results. However, the range of variation of these factors was somewhat limited in the canals treated.

Another factor particularly observed in small canals in Wyoming was the relation of the canal width to the total amount of xylene applied, or the gallons applied per width ratio. In general, satisfactory control was obtained in all canals treated with 10 gallons of xylene or more per foot width of canal. As width of canal increased so that there was more than 1-foot width per 10 gallons of xylene results were less effective. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture; Bureau of Reclamation, U. S. Department of Interior; and the Wyoming, Washington, and Montana Agricultural Experiment Stations, cooperating)

Effect of herbicides on two aquatic weeds in a farm fish pond. Yeo, R. R. Several chemicals were compared for control of two aquatic weed species in a farm fish pond during 1960 and 1961. The area of the pond surface was approximately 60 acres and water was supplied to the pond by winter run-off from surrounding slopes. The pond was stocked with rainbow trout and small mouth bass. Growth of these fish was limited by the heavy weed infestations in some years. The dominant weed species were leafy pondweed (*Potamogeton foliosus* Raf.) and Richardson pondweed (*Potamogeton richardsonii* (Ar. Benn.) Rydb.).

On March 23, 1960, the following herbicides in granular formulations were applied on open plots 2 x 2 rods in size before the weeds had emerged: propylene glycolbutylether ester of 2,4-D at 40 lb/A, propylene glycolbutylether ester of silvex at 40 lb/A, simazine at 40 lb/A, monuron-TCA at 44 lb/A, endothal at 82.5 lb/A, and monuron at 40 lb/A. The average depth of water in each plot at the time of treatment was 6 feet.

On May 30, 1960, after emergence of weeds more treatments were applied to open plots 4 x 4 rods in size. These treatments were silvex granular at 40 lb/A, monuron-TCA granular at 40 lb/A, endothal granular at 100 lb/A, and sodium salt of silvex at 80 lb/A. A third series of treatments, monuron-TCA granular at 80 lb/A, sodium salt of silvex at 114 lb/A, and endothal at 7.5 and 15 lb/A were applied on June 8.

In 1961 three plastic enclosures of 2 square rods each were constructed in the pond to contain the treated water. Open plots 4 x 4 rods were also staked. The average depth of the water was 4 feet. On July 6 the enclosed plots were treated with sodium salt of silvex at 71 lb/A, monuron-TCA at 23 lb/A, and endothal at 13 lb/A. The open plots were treated with diquat at 51 lb/A, fenuron-TCA at 23 lb/A, and monuron-TCA at 15, 23, 30, and 38 lb/A on July 8.

Neither of the weed species showed any effects of the treatments in 1960. By the first week in July all the weeds in the pond, both treated and untreated, had slumped to the bottom because of their early maturity as a result of an unusual heat wave. In 1961 the only treatment that gave any control was endothal at 13 lb/A in the enclosed plot. Seven days after application the leafy pondweed had slumped to the bottom and in 14 days had completely decayed. The Richardson pondweed in the same plot was unaffected and remained in the plots until maturity. None of the treatments made in open plots showed any effects on either weed. No injury to the fish was observed. (Cooperative investigation of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture; Bureau of Reclamation, U. S. Department of Interior; and the Montana Agricultural Experiment Station, Huntley Branch)

Seasonal production of propagules of cultured sago pondweed (*Potamogeton pectinatus* L.). Yeo, R. R. Sago pondweed produces 3 types of propagules: seeds, axillary tubers, and subterranean tubers. Axillary tubers are similar in structure to the subterranean, but they form at the axils of the stems late in the summer. For study of the productive potential of sago pondweed large subterranean tubers were planted in variously sized containers. On May 1, 1960, a tuber was planted in a container with a diameter of 6 feet. In 1961 two containers with diameters of 2 and 18 feet were planted with tubers. Soil in the smaller container was 28 inches deep and in the larger containers 12 inches deep. One seed of sago pondweed was planted in a fourth container having a diameter of 3 feet and a soil depth of 6 inches. All containers had 12 inches of water above the soil surface. The fruits were collected as they matured. The tubers in the smaller container were harvested on October 15 and those in the others on November 1. The axillary tubers were removed from the axils of the stems and counted. The subterranean tubers were washed from the mud through a series of screens and running water and counted.

As shown in the table the yields of tubers varied greatly as the volume of the containers varied. Under certain conditions a single tuber could greatly extend its area of infestation in a single season. Fruits and axillary tubers did not form the first year on the plant grown from a seed. However, a plant grown from a seed produced many tubers.

Yield of propagules of sago pondweed from tubers grown in different size containers and from a seed

Propagule planted	Volume of soil in container	Number of propagules produced by		
		Fruits	Axillary tubers	Subterranean tubers
	cubic feet			
tuber	7.3	378	36	2,149
tuber	28.3	1,375	252	5,522
tuber	254.3	6,048	804	36,012
seed	3.5	0	0	304

(Cooperative investigation of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture; Bureau of Reclamation, U. S. Department of Interior; and the Montana Agricultural Experiment Station, Huntley Branch)

Effect of cutting foliage on development of sago pondweed (*Potamogeton pectinatus* L.). Yeo, R. R. The effect of removal of foliage from sago pondweed plants on the formation of tubers was studied. On May 1, 1961, a tuber was planted in each of seven 50-gallon drums filled with soil to 12 inches from the top. The drums were then filled with water, and fresh water was added as needed through the growing season. During the growing season the foliage was cut and removed from the containers at different times as indicated in the table. On October 15 the tubers were harvested and counted and the length and weight of the foliage in each drum were recorded.

Effect of cutting foliage on production of tubers and new growth of sago pondweed harvested October 15, 1961

Cutting date	Axillary tubers	Subterranean tubers	Foliage	
			Length	Oven-dry weight
	number	number	inches	grams
July 6	23	1257	16	57
July 6 and Aug. 3	93	591	15	19
July 20	69	672	17	45
July 20 and Aug. 17	3	388	16	10
August 3	4	1006	15	29
August 3 and 31	0	197	0	0
None (check)	36	2149	18	84

Axillary and subterranean tubers develop late in the summer; consequently tuber and foliage production were decreased most by cutting on August 3 and 31. Early cuttings allowed the plants to recover and grow numerous tubers. (Cooperative investigation of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture; Bureau of Reclamation, U. S. Department of Interior; and the Montana Agricultural Experiment Station, Huntley Branch)

<u>Effect of storage conditions on survival of sago pondweed tubers</u>. Yeo, R. R. The effect of overwintering on survival of sago pondweed tubers was studied. Large subterranean tubers were selected and separated into 8 groups of 20 each. Tubers in two lots were coated with paraffin and placed in plastic bottles, 2 were placed in plastic bottles containing dry soil, 2 were placed in plastic bottles with wet soil, and 2 lots in plastic bottles with water. On December 9, 1960, all the bottles were taken outdoors and one bottle from each lot was buried 6 inches deep and the other bottles 12 inches. The bottles were excavated and brought into the laboratory on April 25, 1961, and the ability of the tubers to grow when placed in water was checked. Part of the paraffin was removed from the coated tubers.

Effect of overwintering on survival of treated tubers placed at different soil depths

Treatment of tubers	Number of tubers surviving at 6 inches	12 inches
Paraffin coated	20	18
Dry soil	18	14
Wet soil	11	17
Water	2	17

Tubers coated with paraffin were more resistant to the winter cold than the other tubers. Those buried 6 inches deep in dry soil survived just as well, but survival of those in wet soil was only fair. Most tubers stored in water at 6 inches were readily killed. The survival of tubers at the 12 inch depth appeared to be unaffected by storage conditions. (Cooperative investigation of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture; Bureau of Reclamation, U. S. Department of Interior; and the Montana Agricultural Experiment Station, Huntley, Branch)

Tuber production of cultured sago pondweed by monthly intervals in 1961. Yeo, R. R. Because tubers provide an important means of year to year survival of sago pondweed a study of the monthly tuber production was initiated. A medium-size tuber was planted in each of six 50-gallon drums on May 1, 1961. Each container was filled with soil to within 12 inches of the top and then filled with water. The containers were occasionally flushed with water to remove any algae and to replenish water losses due to evaporation. The tubers in one container were harvested on the first day of each successive month from June through October and results are given in the following tabulation.

Monthly production of subterranean tubers of sago pondweed

Month	Number of tubers harvested	Estimated number of tubers developed during month
May	0	0
June	14	14
July	279	265
August	1247	968
September	2043	796
October	2380	337

The formation of subterranean tubers increased slowly during the second and third months. There was a large increase in the formation of tubers during September when the greatest number of tubers were produced. Tuber production decreased considerably in October, when water and air temperatures below 50°F apparently hastened the death of the mature foliage. (Cooperative investigation of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture; Bureau of Reclamation, U. S. Department of Interior; and the Montana Agricultural Experiment Station, Huntley Branch)

PROJECT 7. CHEMICAL AND PHYSIOLOGICAL STUDIES

C. L. Foy, Project Chairman

SUMMARY

The continuing interest in the application of chemical and physiological studies to weed control is clearly indicated by the number and range of subject matter of abstracts submitted to this section this year. The abstracts run the gamut, including studies on the following: (a) foliar and/or root absorption and translocation of amitrole, simazine, atrazine, 2,4-D, orthoarsenic acid and dalapon; (b) principles involved in the soil behavior of EPTC, Herbicide I, IPC and atrazine; (c) herbicidal properties of glycol and polyglycol esters of dalapon, and volatility determinations of various formulations of 2,4-D, 2,4,5-T, 2,3,6-TBA, and fenac; (d) metabolism and detoxification of triazine derivatives; (e) photodecomposition of substituted ureas; (f) effects of herbicides on high energy phosphates; and (g) biochemical characterization of a toxic compound from Astragalus miser.

Further reports describe the effect of light intensity and temperature on dalapon toxicity, the physical properties of EPTC, and the effect of 2,4,5-T on translocation of a surfactant - a new approach indeed. A comprehensive English study indicates that although increasing light intensity and temperature enhances the growth rate of two aquatic weeds, relative growth repression was maximum at the higher light intensities and temperatures. The dalapon-induced repression was primarily due to a reduction in the number of leaves or fronds formed, rather than to a depression of their individual size. Although dalapon absorption was temperature dependent, light intensity was without effect on uptake, suggesting that light enhances toxicity by modifying internal factors other than those associated with absorption. A contribution dealing with the physical properties of EPTC indicates that this compound, as well as Tillam, has a negative heat of solution. This results in an increased adsorption on soil at higher temperatures. EPTC, having a higher vapor pressure and lower heat of vaporization than the isopropyl ester of 2,4-D, was lost more rapidly from soil. One additional study indicated that just as a surfactant may increase the absorption and/or translocation of 2,4,5-T, so the reverse may be true. In the latter case, however, the enhanced surfactant translocation (induced by 2,4,5-T) appeared to be primarily basipetal in nature.

It is apparent that the usefulness of such data in achieving more effective results in practical weed control is beginning to receive due recognition.

Uptake and distribution of labeled triazines and amitrole in grape shoots and fruit resulting from root and soil applications. Leonard, O.A., Lider, L.A., and Ashton, F.M. Three year old Zinfandel vines were removed from the field to barrels in a greenhouse on March 6, 1961. The vines were dormant when transplanted. Randomly ring-labeled simazine, atrazine, and 1.36 mg of amitrole (3-amino-1,2,4-triazole-5-C^{14}) were dissolved in 14 ml of ethanol. Ninety-five percent enthanol was used with the simazine and atrazine and 50% ethanol was used with the amitrole. These solutions were applied to the surfaces of all of the larger roots before the roots were covered with Yolo fine sandy loan in the barrels. Fifteen µc of radioactivity was applied per plant.

Leaves, stems, and fruit clusters were sampled for autoradiography April 6, July 20 and September 19. Portions of the fruit clusters were saved for counting. No label from either simazine or atrazine was apparent in the shoots on April 6; the leaves and stem cross sections were labeled by July 20, but no label appeared to be present in the fruit at any time (either by autoradiography or by counting). Label was present in the entire shoot of the grape from the amitrole treatment, including the flower cluster on April 6 and a trace on April 25 (counting data only on this date). Small amounts of label appeared to be present in the older stems and leaves on July 20, but no label was evident in the fruit--by either autoradiography or by counting.

A companion test to that reported above was conducted on January 11, 1961, in a University vineyard at Davis containing Folle Blanche grapes growing on Yolo fine sandy loam. Approximately 100 µc (20 mg) of simazine were made to 1000 ml with 95% ethanol. Ninety-five µc of amitrole (6.3 mg) were made to 1000 ml with 5% ethanol. These solutions were uniformly applied to 10 sq ft of soil at the base of grape vines. The soil was sampled for radioactivity at different intervals following treatment. Label from amitrole had essentially disappeared from the soil by one month following treatment; however, simazine persisted throughout the period sampled (through April), with traces of activity being found to a depth of 9 in. All autoradiographs from the simazine and amitrole treatments were negative; further, no activity was evident in the flower clusters or fruit by counting. (University of California, Davis)

Translocation of herbicides in skeleton weed (Chondrilla juncea L.). Greenham, C. G. Skeleton weed is a deep-rooted perennial weed difficult to control with herbicides. Some studies were made on the movement of 2,4-D and orthoarsenic acid into the roots, usually from the leaves.

Poor translocation of orthoarsenic acid is to be attributed to some factor other than poor oxygenation of the soil, probably unfavorable source-sink relationships.

The apparently anomalous unimpaired translocation after old plants have been subjected to darkness for four days is ascribed to sustained high carbohydrate content of the leaves and to enhanced cuticular penetration.

Other factors also affect translocation. Thus orthophosphate will increase the translocation of 2,4-D, possibly by increasing the ATP content of the leaves.

Maximum radioactivity was found in the roots some seven days after labelled 2,4-D was applied to the leaves, showing that absorption and translocation are prolonged. Radioactivity within treated young plants progressively lessened from the leaves to the roots, there being no focal point of concentration limiting translocation.

For maximal translocation to the roots there are optimal values for 2,4-D concentration and pH of the applied solution. Injury to leaf tissues and/or phloem is regarded as a major factor limiting the movement of such poisons to the roots. (C. S. I. R. O., Division of Plant Industry, Canberra, A.C.T., Australia)

Influence of spray additives and environment on foliar penetration of dalapon-Cl^{36} in Tradescantia. Foy, Chester L. Earlier studies (Weeds 10(2), Apr. 1962, in press) showed that dalapon was absorbed through the cuticle and through large open stomata of hypostomatous leaves of *Tradescantia fluminensis* Vell., var. *variegata*. Both cuticular and stomatal penetration (the most expeditious route of entry) were enhanced by the addition of a surfactant. Studies were continued with the same species to determine the influence of temperature, relative humidity, and spray additives on foliar penetration.

Rooted cuttings growing in nutrient cultures in the greenhouse were transferred into constant environment chambers. After a suitable preconditioning period, 8 to 12 days, plants were treated with dalapon-Cl^{36} by drop placement (10 µl) on either the upper or the lower surface of one or more leaves. Experimental variables were as follows: Treatment time - 2 hrs., 16 hrs; treatment solutions - (A) dalapon only, (B) dalapon plus 0.1% X-77 (surfactant), (C) dalapon plus 0.1% R-163 X (humectant), (D) dalapon plus surfactant and humectant; environment - (1) 100°F, 25-40% R.H.; (2) 80° F, 25-40% R.H.; (3) 80° F, 80% R.H. All applications were made early during the light period of an 18 hr light - 6 hr dark regime. At the end of the experiments, leaves were washed free of nonabsorbed dalapon, and autoradiographed to determine gross distribution. The leaves were later quantitatively assayed for absorbed dalapon by counting.

After 2 hr almost all of the radioactivity was still in the treated leaf; after 16 hr, approximately 6 to 29% of that absorbed was found outside the treated leaf. Quantitative data were quite variable among replications under most of the experimental conditions. Penetration was generally greater through the lower than through the upper surface (except at 100° F where stomata were essentially closed). These differences were far more dramatic at 80% than 25-40% relative humidity. At 80° F (25-40% and 80% R.H.) the surfactant seemingly enhanced both stomatal and cuticular penetration (a slower process), whereas the humectant seemed less advantageous, had no effect, or was even detrimental on occasion. At 100° F, however, the humectant apparently enhanced penetration slightly, but equal to or greater than the surfactant. Differences in results among treatments were not as great as anticipated. Tentatively, it is proposed that relative humidity, temperature (and possibly light), just prior to and during treatment, exert their most pronounced influence on the stomatal component of absorption. (Botany Department, University of California, Davis)

The influence of soil moisture on the movement of the herbicide EPTC in soil. Omid, Ahmad and Furtick, William R. This study was conducted in the laboratory to determine the influence of two soil moisture levels (at the time of application) and three methods of application upon the movement of EPTC in soil.

The soil used (Newberg sandy loam) was brought from the field, dried to a moisture content of 1.6% (by weight) and stored for five months before use. The soil moisture was brought to 7.33% and 19.63% for low and high moisture levels respectively just before EPTC application.

The application methods consisted of: (1) Injection one in below the soil surface; (2) Application to the soil surface; (3) Application to the soil surface and plugging the top of the container with a rubber stopper.

The soil column containers were 12 in long pyrex tubes with an inside diameter of 37 mm. Nine in of soil was placed in each container. The soil column containers were assembled in a manner that each one could be separated into three equal sections.

EPTC was extracted from the soil by steam distillation. Recovery determinations were made with the use of a Beckman GC-2 Gas Chromatograph.

To test the efficiency of the analytical method, EPTC determinations were made immediately after the soil was treated. The results indicated a complete recovery from an amount of soil equal to a column section. However, the recovery from soil equal to a whole column was not more than 82.56%.

The analysis made from high moisture level columns a week after treatment resulted in 4.88% and 44.66% EPTC recovery for surface application and injection one inch below the surface, respectively. The same recovery from low moisture level columns was 39.95% and 57.72% respectively.

The EPTC was found to be confined to the top three in of soil. This indicates a lack of extensive downward movement by diffusion. (Department of Farm Crops. Part of a thesis completed by the senior author in partial fulfillment of requirements for the M.S. degree at Oregon State University.)

A technique for controlled exposure of imbibing seeds and roots and shoots of germinating grasses to soil-active herbicides. Appleby, A. P. and Furtick, W. R. Recent research by J. H. Dawson, P. C. Hamm, H. A. Friesen, and others has dealt with the differential toxicity of various herbicides between the roots and emerging shoots of grasses. Since this type of information may be useful in regard to depth of placement of herbicides, etc., the device described below was developed to effectively separate roots, seeds, and emerging shoots of grasses. The technique is a refinement of a method originally developed by Jean Dawson and allows treatment of each plant part separately or any combination of parts.

Polyethylene of .004" thickness was used to make small cones with slits in the tip to allow penetration of roots or coleoptiles (Fig. 1).

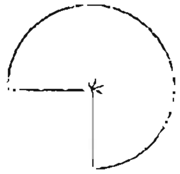
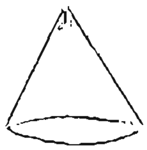


Figure 1



Two of these cones were slipped together, base to base, and the edges cut off. One edge was closed with tape (Fig.2).

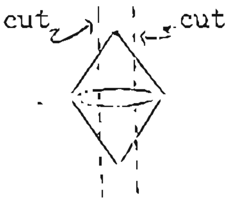


Figure 2

A seed can be inserted into the open edge which is then closed by tape. This plastic "envelope" containing the seed is then taped to a large sheet of plastic with one end protruding through a slit in the larger sheet (Fig. 3).

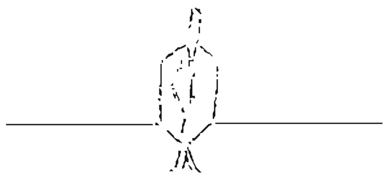


Figure 3

Before being placed in the plastic envelopes, seeds can be allowed to imbibe in either treated or untreated soil. With the above technique, coleoptiles can be exposed to a herbicide, even a relatively volatile one, with the roots growing into untreated soil or vice versa. (Oregon Agricultural Experiment Station)

Differential sensitivity of seeds, roots, and emerging shoots of oats to EPTC and other carbamate type herbicides. Appleby, A. P. and Furtick, W. R. Using a plastic barrier technique to selectively expose different tissues of germinating oat seeds, treatments were made with EPTC, Herbicide I (2,3-dichloroallyldiisopropylthiolcarbamate), and IPC. Seeds which were allowed to imbibe in both treated and untreated soil were used in the EPTC trial while only untreated seeds were used with Herbicide I and IPC. EPTC was uniformly mixed through the soil at a rate of 1.0 ppm., Herbicide I at a rate of 2.0 ppm, and IPC at a rate of 3.0 ppm. The results of the EPTC experiment are given in Table I.

Table I. Selective Exposure of Oats to EPTC.

Tissues exposed	Percent survival	Dry wt/plant (mg)
Coleoptile, seed	7.1	9.4
Coleoptile, seed, root	0	0
Seed, root	80.0	323.8
Seed	100.0	674.2
Coleoptile	6.7	1.3
Coleoptile, root	0	0
Root	84.6	371.2
Untreated check	100.0	562.9

It can be seen that, at the rate used, no appreciable injury was caused from uptake by the seed. Almost complete kill was obtained from coleoptile exposure, whether or not the roots were exposed also. While a reduction in weight resulted from root exposure, this was largely due to an early delay in growth and was followed by normal, healthy development.

The results from treatment with Herbicide I and IPC are given in Table II.

Table II. Selective Exposure of Oats to IPC and Herbicide I.

	Dry wt/plant (mg)	
Tissues exposed	Herbicide I	IPC
Coleoptile	0	6.1
Coleoptile, root	0	0
Root	205.2	91.3
Untreated check	303.8	302.8

Results of this experiment are very similar to those obtained with EPTC. While toxic effects from root exposure to IPC were noticeable, the difference in sensitivity between roots and shoots is apparent.

The above information illustrates the importance of placing these carbamate herbicides above weedy grass seeds in the soil for most efficient control. (Oregon Agricultural Experiment Station)

Persistence and movement of atrazine. Alley, H. P. Studies on the movement and persistence of atrazine were conducted in soils collected from areas previously treated with 2 and 4 lb/A. Soils from four areas were collected, moved to the greenhouse and planted to oats. The oats were clipped and green weight used as a factor in determining the presence of the chemical. The soils were a sandy loam, sandy clay loam, and clay loam.

Soils obtained from the sandy loam sites, nine months following chemical application, show that the chemical had moved to the three-inch soil depth. Approximately 13 in of moisture was received during the nine-month period. Movement studies with soil collected from the clay soils indicated that atrazine was more residual than on the sandy soils. On the clay-loam soil the chemical was still in the top 2 in 19½ months following treatment. During this 19½ months, 18.35 in of moisture was received. (Wyoming Agricultural Experiment Station)

Herbicidal properties of glycol and polyglycol esters of dalapon. Day, B. E., Jordân, L. S., Hendrixson, R. T. and Jolliffe, V. A. Some herbicidal properties of the propyleneglycol bis ester (PG), dipropyleneglycol bis ester (DPG), diethyleneglycol bis ester (DEG), and triethyleneglycol bis ester (TEG) of dalapon were determined in comparison with dalapon acid and sodium salt. Weighed quantities of the esters and acid were spread on glass plates and exposed to evaporation for 60 hours on a hot plate at 38°C and reweighed periodically. Rates of evaporation in lb ae/A/hr were: acid 180.4, PG 27.2, DEG 1.60, DPG 0.834, and TEG 0.612.

The comparative effectiveness of the compounds as foliar herbicides was determined by measuring the growth response of Kanota oat seedlings sprayed when 10 cm tall with emulsions or solutions of the esters, acid, and sodium salt containing 2000 ppm of dalapon acid equivalent and 0.1 percent Tween 20. On the basis of the sodium salt as 100, phytotoxicity (growth suppression) of the other herbicides were PG, 25; acid, 40; DPG, 61; DEG, 78; sodium salt, 100; TEG, 126. All differences were significant ($P = 0.05$). Thus dalapon formulated as the triethyleneglycol ester is about one-fourth more active than dalapon in the salt form.

In field tests on Bermuda grass 8 replicate plots 5 ft by 15 ft in a randomized block design were treated with the esters (except DPG) at the rate of 6 lb/A acid equivalent and rated over an eight-week period. After six weeks control on a scale of 10 (0 = no control, 10 = complete control) was: TEG, 7.8; sodium salt, 7.2; DEG, 6.2; PG, 4.4. The latter two figures differ significantly from each other and from the first two but the enhanced action of TEG over the sodium salt was not significant. After 8 weeks ratings were: TEG, 8.6; sodium salt, 8.4; DEG, 7.5; and PG, 6.1. Thus the results on Bermuda grass verify the phytotoxicity data obtained on oats in the laboratory but not significantly so in all cases.

When the esters, acid and sodium salt were applied in quartz sand culture to the rooting medium of germinating oats at the rate of 2.0 mg ae per culture, essentially equal growth suppression resulted regardless of the formulation of dalapon employed. In view of the great differences in phytotoxicity of the same dalapon derivatives as foliar sprays, it was considered that the essentially equal activity in sand culture could likely be due to the hydrolysis of the esters to the acid and its dissociable salts. This hypothesis was verified in the case of the DEG ester by preparing dilute solutions of the ester in water over a range of pH values, extracting the ester from the water with hexane after 24 hr, transferring to CS_2 and determining the residual ester by calibration of the infrared absorption peak of the ester linkage at a wave number of 1750 cm^{-1}. The percentage of original amount of ester remaining after 24 hr in water solution ranged from 6.6% at pH 6.60 to 81.5% at pH 2.25. (Department of Horticultural Science, University of California, Riverside, California)

Volatility of formulations of 2,4-D, 2,4,5-T, 2,3,6-TBA and fenac under field conditions. Day, B. E., Jordan, L. S. and Russell, R. C. The relative volatility of nine herbicidal materials was observed under midsummer temperature conditions in the Coachella Valley, California. Plots 10 ft square, widely spaced in a 5-acre cotton field, were sprayed with herbicidal formulations at the rate of 4 lb/A ae in a volume of 100 gpa. The herbicides were sprayed at low pressure from a coarse nozzle under calm wind conditions. Spray drift was further limited by making applications within a plastic enclosure having side walls five ft high. Relative volatility was assessed on the basis of the area of surrounding cotton affected by varying degrees of symptoms.

A portable weather station was set up in the field and continuous records of air temperature and wind direction and velocity for the duration of the experiment were obtained. The mean maximum temperature for the first six weeks of the experiment, during which period most of the volatility is judged to have occurred, was 98°F. During the first two weeks the mean maximum was 101°F with 109°F the highest temperature recorded. No rainfall occurred during the nine weeks of the experiment.

Treatments were made on July 7 and detailed maps of the degree and distribution of herbicide symptoms on cotton surrounding the plots were made on July 14, July 21, August 4, August 18, and September 12. Results ranged from no injury to cotton plants in rows immediately adjacent to the plots treated with 2,3,6-TBA, fenac and the oil-soluble amines of 2,4-D to recognizable symptoms on 0.9 acres surrounding the plot treated with the isooctyl ester of 2,4-D. The formulations tested are listed in order of decreasing volatility except for the last four for which no order could be established.

1. Commercial formulation containing a mixture of isooctyl esters of 2,4-D and 2,4,5-T (moderately volatile).

2. Weedone LV-4, butoxyethanol ester of 2,4-D (moderately volatile).

3. Weedone 638, emulsifiable acid of 2,4-D (slightly volatile).

4. Dow formula 40, alkanolamine salts, ethanol and isopropanol series (very slightly volatile).

5. Weedar 64, alkylamine 2,4-D (very slightly volatile).

6. ACP M-740 primene salt (oil-soluble amine salt) of 2,4-D (nonvolatile).

7. ACP M-422 primene salt (oil-soluble amine salt) of 2,4,5-T (nonvolatile).

8. Benzac 1281, amine salt of 2,3,6-TBA (nonvolatile).

9. Fenac, sodium 2,3,6-trichlorophenylacetic acid (nonvolatile).

Prevailing winds were from the southeast during daylight hours and from the northwest at night. Herbicide symptoms were distributed in fan-shaped patterns to the northwest of the plots indicating that evaporation occurred primarily under high daytime temperatures. The observation that the oil-soluble amine salts of 2,4-D and 2,4,5-T are free of volatility hazard to an adjacent, highly-sensitive crop offers the promise of extending the use of these important herbicides into agricultural areas where their use has previously been found to be hazardous. (Department of Horticultural Science, University of California, Riverside, California)

The metabolism of atrazine by different plants. Freed, V. H. and Montgomery, M. The metabolism of atrazine by different plants was measured to gain some insight as to the reason for susceptibility or resistance of these plants. The degree of metabolism was measured by determining the amount of $C^{14}O_2$ given off by plants placed in an aqueous solution of the labelled chemical. Since this method doesn't quantitatively show how much is metabolized, but only that which is completely oxidized to $C^{14}O_2$, corn, which is very resistant, was used as a standard. The following table shows the results obtained.

The metabolism of triazines by various plants as measured by $C^{14}O_2$ evolution (ratings are based on corn as 100%)

Plant	Chemical	Rating
Corn	Atrazine	100
Oats	Atrazine	14
Alfalfa	Atrazine	12
Cucumber	Atrazine	12
Oats	Hydroxyatrazine	100

As would be expected, the more susceptible plants are much less active than corn. Also, it is interesting to note that the oat plant is able to degrade the hydroxy derivative of atrazine as rapidly as corn does atrazine. This evidence suggests that susceptibility is the result of a slow rate of conversion of the atrazine to its hydroxy analog. (Department of Agricultural Chemistry, Oregon State University, Corvallis, Oregon)

Triazine detoxification studies in *Sorghum vulgare* and *Avena sativa*. Foy, Chester L. Numerous bases of herbicidal selectivity are known. Apparently important in the selective action of the triazine derivatives is the fact that some species are capable of degrading the herbicides within their tissues whereas others are not. *Zea mays* is known to possess a nonenzymic detoxification system that readily converts simazine to the 2-hydroxy analog, which is nonherbicidal.

Oat, a highly susceptible species, lacks this system or at least the system is ineffective. Based on field and greenhouse observations, certain other crop species exhibit similar tolerances to simazine and closely related compounds. It is reasonable to expect, therefore, that other species may also be able to (protectively) degrade these herbicides.

A similar (though perhaps slightly different) detoxification mechanism for propazine and atrazine does, in fact, exist in Sorghum, but not in Avena. Five types of studies support his contention:

1. Field studies show marked herbicidal selectivity in sorghum and low triazine residues in the grain despite ready uptake through the roots.

2. Uptake, distribution and metabolic rate studies using ring C^{14}- labeled herbicides, autoradiography, solvent extraction, counting and chromatography show extensive metabolism of propazine and atrazine in Sorghum, but considerably less rapid breakdown in Avena. The level of nonmetabolized triazine in all sorghum tissues remained very low but was not quite zero at harvest.

3. $C^{14}O_2$ evolution following uptake of radio-labeled herbicides from water or nutrient solution showed that several factors (light or dark, flush gas used, nutritional status of roots, concentration of herbicide, etc.) may influence the absolute rate of $C^{14}O_2$ released. Also extensive breakdown of propazine or atrazine could occur in plant tissues with little or no release of $C^{14}O_2$. Indications are that differences between sorghum and oat may be more quantitative than qualitative. In recent studies both sorghum (tolerant) and oat (susceptible) evolved $C^{14}O_2$ but sorghum released it in relatively greater amounts.

4. A naturally occurring "corn sweet substance" isolated by Hamilton et al., and chemically identical to Roth's and Knüsli's "simazine resistance factor" was highly active in degrading simazine, propazine and atrazine in vitro. Sorghum likely contains glucosides of this or a similar compound which are also active.

5. Toxicity series in nutrient culture showed sorghum not affected or only temporarily suppressed and oat severely injured or killed by increasing concentrations of propazine. In a similar series methoxypropazine caused severe injury or death to both species and hydroxypropazine (a probable first detoxification product of propazine) was harmful to neither. Apparently the stronger $C\text{-}CCH_3$ bond is not as readily broken as the C-Cl bond by a mechanism which converts the herbicidal triazine to its innocuous OH-analog. The importance of such a mechanism in the matter of herbicidal selectivity is apparent. (Botany Department, University of California, Davis)

Photodecomposition of herbicides. Jordan, L. S., Day, B. E. and Clerx, W. A. This study involved the determination of absorption curves with a DU photospectrometer and the rate of decomposition by ultraviolet light of substituted urea herbicides in solid state. Solutions of known molarity, of recrystallized samples, were used to deposit fenuron, monuron, diuron or neburon on filter paper of photometric uniformity. The paper locked into plexiglass frames and placed in cell-holders served as a medium for direct absorption measurements. This allowed multiple treatment without disturbance of the material, eliminated dissolving and redissolving procedures and gave the advantage of similarity, in some aspects, to soil.

Fenuron, monuron, diuron and neburon, both in solution and in solid phase, had distinct absorption maxima at 2410 Å, 2485 Å, 2505 Å and 2520 Å, respectively. Exposure of the herbicides to ultraviolet light resulted in progressive decrease of absorption at the characteristic wave length. An example is given in the following table for 1 x 10^{-3}M solutions.

Exposure to U. V. (min.)	Absorption			
	Neburon	Diuron	Monuron	Fenuron
0	1.19	1.22	1.08	.673
1	1.22	1.24	.980	.672
2	1.22	1.23	.920	.672
4	1.18	1.20	.880	.663
8	1.12	1.18	.835	.612
16	1.08	1.07	.771	.560
32	1.03	.980	.715	.495
64	.980	.882	.650	.450
128	.905	.835	.590	.435

The rate of breakdown was rapid during the first thirty minutes of exposure to ultraviolet light and became gradually less when the time of exposure was increased. According to this experiment, monuron showed the most rapid photochemical change while the others ranked in the following order: fenuron, diuron and neburon.

Gradation of the herbicides in each case resulted in an increase of absorption at the higher wave lengths and a decreased absorption at the wave lengths where maximum absorption for the pure chemical occurred. (Citrus Research Center and Agricultural Experiment Station, University of California, Riverside, California)

Effects of herbicides on high-energy phosphates in whole plants. Ross, Merrill A. and Salisbury, Frank B. A charcoal-adsorption acid-hydrolysis method was employed to measure acid-labile nucleotide phosphate from trichloroacetic acid homogenates of whole leaves. Greenhouse-grown plants treated with napthaleneacetic acid (NAA), indoleacetic acid (IAA), dalapon, 2,4-dichlorophenol, 75-90% acetone, and cobaltous chloride produced increases in levels of high energy phosphate.

These results coupled with similar ones obtained previously from plants treated with 2,4-D, IPC, and monuron, may indicate that the observed increase of high energy phosphate is a rather general response of plants to injury.

Preliminary results with NAA, IAA and dalapon indicated that O^2 uptake may increase at the same time high energy phosphate is increasing. (Colorado State University Experiment Station, Fort Collins, Colorado)

Biochemical investigations on the toxic compound in timber milk vetch, *Astragalus miser*. Williams, M. Coburn. Timber milk vetch is common on the high mountain ranges of Utah, Colorado, and Wyoming. The species is highly toxic to cattle but may be eaten in moderate quantities by sheep without ill effect. The poisonous compound is unknown. Analyses for alkaloids, selenium, glucosides, and saponins have yielded negative results. The poison is soluble in ethanol, butanol, and acetone, but insoluble in ether, benzene, and chloroform. Once extracted from plant tissue, the toxic substance is very soluble in water.

Small chickens (100-250 grams) are used to determine the presence of the toxic substance in a given separation. The extract is administered into the crop in a water solution via a catheter. If the poison is present, the birds become torpid, soon lose balance, become paralyzed, and finally die. Body temperature drops steadily from a normal of 106 to 107 degrees F to as low as 85 degrees F during the paralytic stage. The heart and other vital organs are markedly damaged.

The purest separation to date yields a thick light yellow syrup which may be dried to white crystals under vacuum. The yield of the current product is less than 1 percent of the weight of the original plant material. Further chemical analysis and purification will be conducted. A detailed study of the pathological effects on cattle will be undertaken in a few weeks in cooperation with the Animal Disease and Parasite Research Division of the Agricultural Research Service. (Utah State University, Logan, Utah)

The influence of light intensity and temperature on the phytotoxicity of dalapon to Lemna minor and Salvinia natans. Blackman, G. E. and Prasad, R. In a detailed analysis of the effects of light intensity and temperature on the reductions in the growth rate induced by sublethal concentrations of dalapon, experiments were carried out with two aquatic weeds Lemna minor and Salvinia natans. The advantage of using these two aquatic species is that they directly float on the toxicant solution and respond well to varying levels of light intensity and temperature. Moreover, since they maintain an exponential rate of growth under constant conditions of light, temperature and nutrition the interpretation of the inhibitory effects of phytotoxic compounds is very much facilitated.

When Lemna minor and Salvinia natans were treated with a range of concentrations (100 to 600 mg/l of dalapon) at 25°C and under a constant illumination of 300 foot candles, it was found that the effects of the compounds were "cumulative", that is, the reduction in dry weight over the first three days was not appreciable but thereafter the depression became progressively greater. Using the technique of growth analysis it was established that reductions in the relative growth rate caused by dalapon were not so much due to a lowering of the net assimilation (photosynthetic) rate but due to a diminition in the leaf-area ratio. A further analysis showed that dalapon operated by reducing the number of leaves or fronds formed rather than by depressing their individual size.

To study the interacting effects of light intensity and temperature, comprehensive multifactoral experiments were undertaken each involving three levels of light (300, 600 and 900 foot candles), three levels of temperature (20, 25 and 30°C), four concentrations of dalapon (0, 100, 300 and 600 mg/l for Lemna minor and 0, 100, 200 and 400 mg/l for Salvinia natans) and four sampling occasions (0, 3, 6 and 9 days). All treatments were replicated four times. It was found that light intensity and temperature not only enhanced the rate of growth of the control cultures but also the magnitude of the depression in growth rates of the treated cultures. For example under a condition of 300 f.c. and 20°C when the rate of growth of the control culture was low, the reductions in the dry weight were also small but when the growth rates rose to ca. 40-44% under a condition of 900 f.c. and 30°C, the degree of inhibition was also increased.

In order to separate out the effects of the environmental factors on toxicity and growth, two mathematical procedures were adopted whereby the growth rates of all control cultures drawn from each set of light and temperature were equated to a standard rate. Because the involved calculations were long, the data were analysed on a Mercury (electronic) computer and it was found that the relative depressions in growth rate increased with temperature and light. On general grounds it was concluded that light intensity and temperature might operate either by arresting the meristematic activity or by increasing the amounts of dalapon accumulated in the tissues.

Further investigations employing dalapon-Cl^{36} showed that whereas temperature doubled the rate of uptake ($Q_{10}2 \cdot 3$), light intensity did not, either directly or indirectly influence the rate of absorption. It was therefore concluded that light enchances the phytotoxicity by modifying internal factors other than those concerned with the uptake mechanism. (Department of Agriculture, University of Oxford, England)

Physical properties of EPTC. Freed, V. H. and Vernetti, Jack R. Investigation of the solubility measurements of EPTC and Tillam in water solutions show that they have negative heats of solution, that is, more of the chemical dissolving at a lower than a higher temperature. This behavior was further substantiated by adsorption studies of EPTC from saturated solutions, which show an increase of adsorption on soil with higher temperatures. The effect that this negative ΔH solv. has on the soil behavior of EPTC is summarized in the following table in comparison with CIPC, a herbicide with normal behavior.

	Solubility rate with decreasing temperature	Heat of solution	Adsorption rate with decreasing temperature	Adsorption rate with decreasing concentration	Leaching rate with decreasing temperature
CIPC	-	+	+	+	-
EPTC	+	-	-	-	+

Demonstration of the effect of vapor pressure on the loss of chemical from soil was shown by studies of EPTC in comparison with isopropyl ester of 2,4-D. The higher vapor pressure and lower heat of vaporization of EPTC resulted in a 25% increase in loss from soil over that of 2,4-D in a 24-hour period.

The data given here was shown the importance of physical properties of chemicals and their relation to use in the soil. Other factors, such as micro-biological breakdown, have not been investigated here but plans for future work include this important aspect. (Department of Agricultural Chemistry, Oregon Agricultural Experiment Station)

Movement of C^{14} surfactant and 2,4,5-T in bean plants. Norris, Logan A. and Freed, V. H. Some preliminary results have been obtained concerning the movement of surfactants in plants as affected by the addition of herbicides.

Black Valentine beans, *Phaseolus vulgaris*, were grown in sand in the green-house. They were divided into four groups, each group receiving a separate treatment.

Treatment per plant:

1. 0.25 ml 1.0% C^{14} Pluronic L-62
2. 0.25 ml 220 ppm C^{14} triethanol amine 2,4,5-T
3. 0.125 ml 440 ppm C^{14} triethanol amine 2,4,5-T and 0.125 ml 2.0% unlabeled Pluronic L-62
4. 0.125 ml 2.0% C^{14} Pluronic L-62 and 0.125 ml 440 ppm unlabeled triethanol amine 2,4,5-T

The treatments were applied with a syringe in droplets to a single leaflet of the first trifoliate leaf when fully expanded. After 72 hours the plants were harvested and sectioned. The treated leaflet was washed with 80% ethyl alcohol to remove any non-absorbed material from the surface. The tissues were then dried, ground, and counted in a gas flow Geiger-Muller counter.

Plants treated with only the labeled surfactant, treatment 1, showed over 90% of the applied C^{14} in the washing and about 8% in the treated leaflet. Movement to other parts of the plant was limited, but distributed about equally through the tissues.

Plants receiving only the labeled 2,4,5-T, treatment 2, showed 98% of the activity in the washing and 1.5% in the treated leaflet. There was evidence of some movement both acropetally and basipetally, but it was slight.

Plants receiving labeled 2,4,5-T and the unlabeled Pluronic L-62, treatment 3, showed 95% of the applied C^{14} in the washing and 1.5% in the treated leaflet. Movement to all parts of the plant was enhanced from 5 to 50 times in the different tissues by the addition of the surfactant.

Plants receiving unlabeled 2,4,5-T and the labeled Pluronic L-62, treatment 4, showed definite increases in surfactant movement. However, the movement seemed to be primarily downward. The upper stem and upper leaves showed no gain in activity; the lower stem, primary leaves and roots showed increases of 2 to 200 times the activity found in plants treated with only the labeled surfactant.

These preliminary data show the usual enhancement of herbicide uptake and translocation with the use of a surfactant. But more significant in this study is the definite increases in the movement of the surfactant when it is applied along with a herbicide. This indicates once again that some sort of interaction between the herbicide and the surfactant does exist.

Whether or not the surfactant actually moves in direct association with the herbicide is not yet evident. The fact that upward translocation of the herbicide was enhanced while that of the surfactant was not, may indicate that they do not necessarily move together. However, this point is not yet fully evident from the data available. Furthermore, the form in which the surfactant exists once in the plant has not been determined. This information depends on the results of paper chromatography studies of extracts from the treated tissues. More extensive studies are planned on the basis of these preliminary results. (Department of Agricultural Chemistry, Oregon State University, Corvallis, Oregon)

PROJECT 8. ECONOMIC STUDIES

D. C. Myrick, Project Chairman

(No reports submitted)