Research Progress Report

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RESEARCH COMMITTEE
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PREFACE

This Report, prepared for distribution at the 1963 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.

Whenever a common name for a herbicide has been accepted by the Weed Society of America, it is shown in the index and so used in the text. If it has not yet been accepted, it is listed by temporary designation (usually a series of capitol letters), trademark, or code number. Such designations are also shown in the index. Herbicides in which the chemical name of the active ingredient was not available to the author or editor at time of printing are listed in a separate index only by code number or trade name. Common names and most of the temporary designations are those accepted by the Terminology Committee of WSA and published in Weeds 10: 255-271, 1962. Plant names and abbreviations of terms used in weed control essentially follow the Committee recommendations also listed in the above report. All herbicidal concentrations are presumed to be the acid equivalent or active ingredient, if not specifically mentioned.

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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TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

PROJECT 1. PERENNIAL HERBACEOUS WEEDS

John H. Miller, Project Chairman

SUMMARY

Six reports representing research at four locations (Hawaii, Montana, New Mexico and Wyoming) were received. Of the reports, two dealt with research on the control of Canada thistle, and one each on the control of field bindweed, Russian knapweed, purple nutsedge, and torpedo grass.

Canada thistle (Cirsium arvense). Montana research showed excellent control of Canada thistle with Banvel D. July applications of 2,3,6-TBA at 20 lb/A likewise gave highly satisfactory control. Low rates of fenac fortified with 2,4-D were superior to similar rates of fenac alone for Canada thistle control.

Wyoming research involving 28 treatments showed six treatments that gave 100 percent control of Canada thistle. These treatments included fenac at 10 and 20 lb/A, Banvel D at 10 and 20 lb/A, 2,3,6-TBA at 20 lb/A and a borate-benzoic acid mixture at 1 1/2 lb/sq rd.

Field bindweed (Convolvulus arvensis). Wyoming researchers found that both 2,3,6-TBA and Banvel D were effective for the control of field bindweed.

Russian knapweed (Centaurea repens). A report from Wyoming (a continuation of a 1962 report on plots established in 1959) showed that eleven herbicides have eliminated Russian knapweed. Good stands of grass are growing on plots treated with three of these herbicides; grass is beginning to invade plots of four others, and plots of four of the herbicides are still free of vegetation.

Purple nutsedge (Cypress rotundus). In New Mexico observations made two months after treatment indicated that six of eight herbicides used do have promise for the control of purple nutsedge. The promising herbicides included EPTC, n-propyl-di-n-propylthiolcarbamate, Stauffer Chemical Company's coded material "R-4461", dichlobenil, H-82, and trifluralin.

Torpedo grass (Panicum repens). Research in Hawaii in which eight herbicides were applied to torpedo grass showed that none of the herbicides were effective in eliminating the grass.

1. Chemical control of Canada thistle (Cirsium arvense). Chamberlain, E. W. and Alley, H. P. Canada thistle plots were established June 30, 1961 near Laramie. Visual readings were made in 1962, one year after treatment. Six of the 28 treatments included in the tests gave 100 percent control at this early evaluation. These treatments were fenac (liquid) at 10 and 20 lb/A; Banvel D at 10 and 20 lb/A; 2,3,6-TBA at 20 lb/A and borate-benzoic acid mixture (8 percent 2,3,6-TBA) at 1 1/2 lb/sq rd. The 2,3,6-TBA and borate-benzoic acid plots were completely denuded, whereas a 10 percent grass stand was left on the other plots.

Other good treatments were 2,4-D butyl ester at 4 lb/A which gave 95 percent control and 2,4-D amine at 20 and 40 lb/A which gave 90 percent control of the established stand of Canada thistle. There was no indication of grass injury in these plots. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie).

2. Further evaluation of soil sterilants for control of Russian knapweed (Centaurea repens). Chamberlain, E. W. and Alley, H. P. This evaluation is a continuation of the report submitted by H. P. Alley in the Research Progress Report of 1962 on the effectiveness and residual of several soil sterilant plots established at Laramie, June 23, 1959. Readings made in 1962, 3 years following treatment, show fenac (powder) at 5, 10 and 20 lb/A; fenac (liquid) at 5, 10, and 20 lb/A; 2,3,6-TBA at 5 and 10 gpa; simazine at 40 lb/A; atrazine at 20 and 40 lb/A; borate-benzoic acid (8 percent 2,3,6-TBA) at 3/4 and 1 1/2 lb/sq rd; borate-monuron mixture (94 percent sodium borate plus 4 percent monuron) at 4 and 6 lb/sq rd; chlorate-2,4-D (15 percent 2,4-D) at 5 and 10 lb/sq rd; chlorea granular (40 percent sodium chlorate, 57 percent sodium metaborate, and 1.25 percent monuron) at 6 and 9 lb/sq rd; TCA-monuron at 14.5 and 22 gpa; TCA-fenuron at 9 gpa giving 100 percent control of Russian knapweed. The 3rd year reading on 2,4-D amine at 20 and 40 lb/A showed a 96 percent 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 growing on them and some grass had begun to grow on the simazine, atrazine, TCA-fenuron, and chlorate-2,4-D plots. All other plots were still completely denuded of vegetation. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie).

3. Control of field bindweed (Convolvulus arvensis). Chamberlain, E. W. and Alley, H. P. Field bindweed plots were established June 27, 1961. Visual readings were made June 28, 1962. The readings, one year following treatment, show that 2,3,6-TBA at 5 lb/A and Banvel D at 10 lb/A gave 90 percent control of field bindweed and a 50 percent reduction in desirable grass stand. The 2,3,6-TBA treatments at 10 lb/A and 20 lb/A gave 100 percent control of bindweed with 50 percent reduction in desirable grass stand. All four treatments gave a 60-80 percent control of downy bromegrass (Bromus tectorum) which was growing in the plots when they were established. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie).

4. Comparison of promising herbicides for control of Canada thistle. Hodgson, J. M. Several promising herbicides were applied to Canada thistle foliage in June and July 1961 as a part of continuing investigations in control of this weed. Plots were 1 square rod in size and all plot borders were treated with a high rate of sodium chlorate immediately following the treatments to inhibit border effects among the plots. The chemicals were applied in 36 gallons of water per acre on 3 replicate plots with a portable sprayer and boom. Effects of the various chemicals were determined by plant counts on 2 square yards at the center of each plot. These results are expressed as percent of similar counts on untreated plots and are listed with treatments in table 1.

Best results were obtained with Banvel-D where some replications provided 100 percent elimination of Canada thistle 16 months after treatment. All treatments at 10 or 20 lb/A averaged above 99 percent kill. 2,3,6-TBA was somewhat less effective.

The two benzoic acid derivatives were more effective at the full bloom stage in July than at the bud stage in June. 2,4-D was more effective at the bud stage and amitrole and amitrole T were quite variable on these two dates.

(Cooperative investigations of Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, and Plant and Soil Science Department, Montana Agricultural Experiment Station, Bozeman).

Table 1. Herbicide evaluation for Canada thistle control 1962

Chemical	lbs/acre	Percent control 16 months after treatment: Treated June 20 1961	Treated July 18 1961
2,4-D a/ acid	2	45	Not applied
2,4-D b/ acid	2	45	13
" acid	4	50	26
2,4-D amine	2	35	30
amitrole	4	83	37
amitrole-ammonium thiocyanate	2	73	Not applied
amitrole-ammonium thiocyanate	4	63	80
2,3,6-TBA	10	86	85
2,3,6-TBA	20	85	95
Banvel-D	10	99+	99+
	20	99+	99+
fenac + 2,4-D	4+2	93	96
fenac	4	79	Not applied

a/ and b/ from different sources

5. Effectiveness of various chemicals for control of torpedo grass. Rogers, B. J. Established stands of torpedo grass (Panicum repens) are very difficult to eradicate in Hawaii. This grass apparently reproduces only by means of rhizomes, and forms a thick mat when undisturbed. Herbicides were applied as foliage treatments (except as noted) to such a growth of this grass in April, 1962. Included were dalapon (sodium salt) 2 lb/A applied at intervals (total 8 lb/A), 4 lb/A applied at intervals (total 12 lb/A), 10 lb/A and 20 lb/A; TCA (sodium salt) 20 and 40 lb/A; diuron 2 and 100 lb/A; isocil 4 and 100 lb/A; simazine 10 and 100 lb/A; fenuron (pellets) 10 and 100 lb/A; neburon 10 lb/A; and a dalapon (4 lb/A)-diuron(2 lb/A) mixture. Only the dalapon and the 100 lb/A diuron, isocil, and fenuron treatments showed any grass injury. Yield data taken in October indicated reductions in the dry weight of grass of 35 to 65 percent from dalapon applied at 8 lb/A (2 lb increments), 12 lb/A (4 lb increments), and 20 lb/A, and from the 100 lb/A rates of diuron, isocil, fenuron, and simazine. It is noteworthy that 10 lb/A dalapon applied in April did not result in a stand reduction, although 20 lb/A was effective. The best treatments merely thinned out the grass and did not eliminate it. (Hawaii Agricultural Experiment Station, University of Hawaii, Hilo).

6. The control of purple nutsedge (Cyperus rotundus L.). Anderson, W. P. and Whitworth, J. W. An experiment was initiated in August 1962 on the use of soil-incorporated herbicides for controlling purple nutsedge.

Selected herbicides were sprayed on the surface of soil, that had previously been thoroughly disced, on August 31, 1962, and soil-incorporated by double-discing. The area was then flood-irrigated.

Of the eight herbicides tested, six were outstanding in their initial control of nutsedge. These materials are EPTC, R-1607, R-4461, dichlobenil, H-82, and trifluralin. Of the remaining two, PEBC was moderately effective at the highest rate applied and, though diuron did not prevent nutsedge emergence, the emerged nutsedge plants in the diuron plots were yellow and brown.

The following tabulated results are based upon visual evaluations made on October 31, 1962. In reviewing these results, it must be borne in mind that they were made just two months after application and, since a perennial plant is involved, should be taken only as an indication of effectiveness until additional evaluations can be made during the next two years. (New Mexico State University, Agricultural Experiment Station, University Park).

The control of purple nutsedge obtained with eight soil-incorporated herbicides two months after application on August 31, 1962

Treatment		Estimated control (percent)		
		Weeds		
Chemical	lb/A	Nutsedge	Broadleaf	Grass
EPTC	5	98	99	99
	10	99	100	100
R-1607	5	98	98	98
	10	99	100	100
R-4461	10	99	100*	100
	20	99	100*	100
PEBC	5	50	50	50
	10	80	80	80
dichlobenil	2	99	100	85
	6	100	100	100
H-82	1	95	95	98
	2	99	99	99
diuron	1	10**	100	50
	2	25**	100	95
trifluralin	2	10	95	100
	6	25	100	100
	8	95	100	100
	12	99	100	100

* 100% control of pigweed; no apparent control of mustard.
** Many nutsedge shoots emerged but are yellow and brown.

PROJECT 2. HERBACEOUS RANGE WEEDS

J. Major, Project Chairman

SUMMARY

The 13 reports received this year include a wide range of weeds, control methods, and ecosystems. Biological control of several western weeds, a topic which is now so prominent in discussions of pesticide uses, is reviewed and progress noted. Prickly pear cactus in Wyoming is now shown to be subject to chemical control. Work has been done on chemical control of Centaurea diffusa in Oregon. Herbicide treatments of Bromus tectorum in Nevada are reported. Medusahead and its associated species are the subject of the other 9 reports. Atrazine was helpful in establishing Agropyron desertorum on a medusahead-downy brome-six weeks fescue site in Washington. Fall seeding of wheatgrasses into medusahead-downy brome under a variety of soil preparations failed to produce a stand, but spring seeding combined with soil preparation was successful in Oregon. Dalapon, isocil, and atrazine gave good chemical control of medusahead in eastern Oregon and damaged perennial grasses. Ecological studies included a survey of the extent of medusahead infestation in Oregon, an unsuccessful attempt in Oregon to force cows to eat the weed in late spring, demonstration of phenological ecotypes in eastern and western Oregon populations of the weed, the finding that medusahead takes up soil nitrogen earlier and to a greater extent than does desert wheatgrass in Oregon, very marked decrease in germination percentage following even 1/2 inch soil burial for a year in Idaho, great variability in recovery of perennial grass cover in a protected medusahead area in Idaho, and demonstration that medusahead is an excellent competitor with Bromus tectorum at various soil nitrogen and phosphorus levels on two California soil types.

1. Biological control of weeds--1962. Andres, L. A., Drea, J. J., Force, D. C., Frick, K. E., Hawkes, R. B., Holloway, J. K., and O'Connell, T. B. Halogeton (Halogeton glomeratus C. A. Mey.): During the past two years laboratory tests have been conducted to determine the dietetic host range of the larvae of Heterographis sp. Tests also have been conducted to determine the ovi-positional preference of adults and the fate of newly hatched larvae when eggs are placed on plants other than Halogeton sativus.

It will be recalled that this moth had been previously reported to be fairly destructive to H. sativus in Morocco and Spain. Later surveys in Morocco have revealed that the insect is very heavily parasitized, sometimes as high as 80 percent of the larvae being attacked. In spite of this, it has consistently made noticeable inroads on H. sativus.

The results of larval feeding tests were negative except in the case of Kochia scoparia, an annual species used as an ornamental in Morocco. It is interesting to note that under artificial conditions the larvae could readily be reared to adult moths on this plant, but the same species under natural conditions was not attacked, even when it occurred in areas where the moth is abundant on H. sativus.

Completed tests indicate that this moth has no potential as a pest of economic plants. A request will, therefore, be made for importation of adult moths for further experimentation in quarantine. In addition to experimentation on H. glomeratus, any of the closely related range plants not previously tested will receive attention. If no unforseen difficulties arise, Heterographis sp. should be ready for trial releases in 1964.

Scotch broom (Cytisus scoparius (L.) Link.): During 1960 and 1961 the twig-mining moth, Leucoptera spartifoliella Hub., was released in five locations in California. The species became established in each. Besides these introduced colonies, four naturalized populations are now known - one at Tacoma, Washington, and three in California. Plants in the moth-infested areas are definitely unthrifty due to the continual stress placed upon the plants by the feeding of the twig-mining larvae. In the Sierra Nevada foothills in 1962, 2600 moths were released. Preliminary studies were made in 1962 on a seed beetle that attacks Scotch broom seed in the Atlantic Coast states.

Tansy ragwort (Senecio jacobaea L.): The two colonies of the cinnabar moth, Tyria jacobaeae (L.), in Oregon and the one in California increased in numbers in 1962 - the California population by an estimated four-fold. A release of 170 moths was made in northwestern California close to the Oregon line in 1962. Larvae were found later in the season and it is hoped that this colony also will become established. Steps have been taken to initiate the introduction of a seed fly, Pegohylemyia seneciella (Meade). The larvae of this fly feed upon the seeds, destroying from 80 to 100 percent of those in each attacked head. This insect has been introduced previously into New Zealand and Australia.

Purslane (Portulaca oleracea L.): A program to assay the biological control potential of this weed was begun in mid-summer, 1962. A sawfly, Sofus pilicornis (Holmgren), the larvae of which mine the leaves of purslane, is widely distributed along with the weed throughout the United States. The sawfly appears to be more effective in the warmer inland areas than near the coast, where the summers are foggy and cool. Since this weed is confined to irrigated crop areas in California, the general use of insecticides may adversely affect biological control measures. Other insects feeding on purslane are being sought in Europe, the native home of the plant.

Puncture vine (Tribulus terrestris L.): Puncture vine seed weevils, Microlarinus lareynii (Duv.) were released in Hawaii, New Mexico, and Texas during the summer of 1962. Late summer reports from these states indicated that the weevils had become established and populations were increasing.

Cooperators in Arizona, California, Nevada and Washington reported that seed weevils released in their states during the summer of 1961 had overwintered successfully and populations were multiplying well. This makes a total of seven states having seed weevils established and includes Arizona, California, Hawaii, Nevada, New Mexico and Texas.

The stem weevil, M. lypriformis (Woll.) was also released in 1961 and has become established in Arizona, California and Nevada; however, the population build-up of this species has been rather slow. Weevils were also released in Colorado and Utah during 1961, but apparently were not able to establish themselves in these two states, as neither species was recovered in 1962. (Entomology Research Division, Agricultural Research Service, U.S. Department of Agriculture, 1301 University Avenue, Berkeley 2, Calif.)

2. Chemical control of prickly pear cactus (Opuntia polyacantha) on Wyoming Rangeland. Chamberlain, E. W. and Alley, H. P. Test plots were established in the summer of 1961 to test 2,4,5-T, 2,3,6-TBA, and silvex for prickly pear control. Silvex and 2,4,5-T were used at 2, 4, and 12 lb/A and 2,3,6-TBA at 2 1/2, 5, and 10 lb/A in a carrier of 40 and 80 gpa with and without a wetting agent. Some treatments were applied with only water as a carrier and other treatments were applied with a water and oil emulsion as the carrier. Most treatments gave severe damage to native grasses. Silvex at 4 lb/A in 80 gpa of water, without a wetting agent, gave 90 percent control of prickly pear with

little damage to the native grasses.

One half of each plot was mechanically treated with a culti-packer to aid in the penetration of the chemical. In all treatments better control resulted on the mechanical treated plots. Silvex at 4 lb/A in 80 gpa of water, without wetting agent, was the outstanding treatment giving 96 percent control of prickly pear. 2,4,5-T at 4 lb/A gave 90 percent control of the common peppergrass (Lepidium densiflorum) growing in these plots. These results are only preliminary and further research is being conducted at this time. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie)

3. Control of diffuse knapweed in range. Appleby, Arnold P. Diffuse knapweed (Centaurea diffusa) has been spreading rapidly in the rangelands of North Central Oregon. In many cases, the infestation has reached the point where growth of desirable forage is severely suppressed.

An experiment was initiated in 1962 to determine the optimum rate and date for applying 2,4-D. Propyleneglycolbutylether ester of 2,4-D was applied at seven dates from April 19 to July 31. Rates included 0, 3/4, 1 1/2, 3, 6, and 12 lb/A. In addition, 18 other materials were applied on May 29 at various rates. These included several formulations of 2,4-D, 2,4,5-T, MCPA, 4-(2,4-DB), and 4-(MCPB), plus silvex, Banvel D, S-6000, atrazine, prometryne, G-34857, G-36393, amitrole-T, and dinitro amine.

Although the 2,4-D gave excellent control of the diffuse knapweed at all dates up to and including June 13, late-germinating seedlings became established in the plots sprayed before May 17. The optimum date proved to be May 29 when the knapweed was 6 to 8 inches tall and just starting to bud. On this date, 3/4 lb/A gave 99 percent control of established plants with very few seedlings becoming established later in the summer. All higher rates on this date gave 100 percent control of the established plants and essentially prevented seedling establishment. The increased growth of perennial grasses in those plots where the knapweed had been controlled was very striking.

Several of the other materials gave excellent results; however, none were as satisfactory and economical as the PGBE ester of 2,4-D.

Future suggestions for 2,4-D application will be approximately 2 lb/A applied at the very early bud stage. (Oregon State University, Pendleton Branch Experiment Station, Pendleton)

4. Control of downy brome by paraquat with and without surfactants. Evans, Raymond A. and Eckert, Richard E., Jr. Downy brome (Bromus tectorum L.) was sprayed with 1,1′ dimethyl-4,4′ dipyridylium di(methyl sulfate) at .09, .18, .36, and .72 lb/A in terms of the cation (paraquat) with no surfactant, with Plyac Spreader-Sticker[1] at .1 percent and with Colloidal X-77[1] at .1 percent. Herbicide-surfactant mixtures were applied in water at 40 gpa with 30 psi pressure. Spraying was done April 18, 1962, when downy brome plants were 2 inches high and in the multiple-leaf stage. Experimental design was a 4-replicated random-block factorial. Treatment plot size was 10′ x 20′. Downy brome plants were counted and clipped on four square-foot samples per treatment plot and weed control was visually evaluated June 13, 1962.

Results indicated that paraquat even at the highest rate (.72 lb/A) without surfactant did not reduce yield or numbers of plants of downy brome. With Plyac, paraquat at .72 lb/A reduced yield of downy brome from 633 to 273

[1]Use of trade names, Plyac Spreader-Sticker and Colloidal X-77, does not constitute recommendation or preference over comparable products.

lb/A, but did not decrease numbers of plants. Paraquat at .72 lb/A, with X-77, reduced downy brome yield from 633 to 12.6 lb/A and numbers of plants from 15.1 per square foot to less than one. Paraquat at .36 lb/A with X-77, reduced yield of downy brome to 153 lb/A from 633 lb/A on check plots and plant numbers to 11.9 from 15.1. Paraquat at .36 lb/A with no surfactant or with Plyac had no effect on downy brome yield or density. Lower rates of paraquat (.09 and .18 lb/A), with or without surfactants, were not effective in control of downy brome. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, University of Nevada, Reno, Nevada)

5. Effects of six herbicides on three annual grasses and on initial stand of seeded crested wheatgrass. Robocker, W. C. and Kerr, H. D. In October 1960 three replicates of herbicide treatments were established on 10- by 20-ft plots at Hooper, Washington. The area has an annual precipitation of 12 to 13 inches with 3 to 4 inches falling during the growing season. The soil is a stony, shallow, silt loam of variable depth overlying basalt. Primary objectives were to control medusahead wildrye (*Elymus caput-medusae* L.) and to subsequently establish crested wheatgrass (*Agropyron desertorum* (Fisch. ex Link) Schult.). Effects of herbicides on medusahead wildrye, downy brome (*Bromus tectorum* L.) and six-weeks fescue (*Festuca octoflora* Walt. var. *tenella* (Willd.) Fern. were estimated. Percentage cover for each species was estimated in four 9.6 sq ft sampling frames and averaged. Plant cover by this method may therefore total more than 100 percent.

Crested wheatgrass was drilled in rows 2 ft apart one year after application of the herbicides, at a rate of 12 to 15 live seeds per foot and at a 2-inch depth. An index of establishment was obtained by multiplying the vigor rating, 0 to 5 scale by the density rating, 0 to 5 scale.

First- and second-year effects of the herbicides on the annual grasses and potential stand of crested wheatgrass, as measured by the establishment index, are shown in the accompanying table. Atrazine was the outstanding herbicide from the standpoint of both the annual grass control and potential stand of wheatgrass. IPC at higher rates was also promising. Diuron treatments selectively favored the downy brome over medusahead wildrye, possibly because treatments were applied after some downy brome had germinated in October 1960. Because of variability in soil conditions from plot to plot, density of the annual grasses varied greatly. Generally the downy brome was dominant on the better sites and the medusahead wildrye and six-weeks fescue on the poorer sites. The vigor of the crested wheatgrass was also highest on the deeper soil. Plant cover increased for both downy brome and medusahead from 1961 to 1962 owing to dissipation of herbicides in the soil and increased soil moisture accumulation and/or nutrient element release during 1961. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, and the Washington Agricultural Experiment Stations, Pullman)

Average percentage cover by species on plots treated with herbicides in October 1960 and evaluated in May 1961 and June 1962; crested wheatgrass drilled October 1961 and evaluated June 1962.

Herbicide & rate (lb/A)	Percentage cover by species						Wheatgrass estab. index, 1962[1]
	Medusahead		Downy brome		Ann. fescue		
	1961	1962	1961	1962	1961	1962	
atrazine							
1/2	2	19	19	73	31	1	8
1	0	5	0	96	2	0	7
2	0	32	0	82	Tr	0	7
CIPC							
3	9	42	53	54	22	15	2
6	Tr	7	55	81	10	5	3
9	Tr	39	26	69	9	7	5
diuron							
3/4	8	40	65	70	23	6	1
1 1/2	2	23	78	92	2	1	1
3	0	2	30	93	5	0	4
endothal							
3	13	43	15	27	77	47	1
6	9	23	16	26	63	62	1
9	15	47	22	36	47	43	1
IPC							
2	3	35	55	83	5	0	1
4	1	51	35	76	4	0	1
8	0	40	2	51	6	0	10
2,3,6-TBA							
2	11	28	84	82	9	2	1
4	5	16	44	56	56	49	1
6	4	16	40	47	47	33	1
Control	11	22	63	70	22	13	1

[1]Establishment index is the product of vigor (0 = none, 5 = maximum) and density (0 = none, 5 = maximum) Maximum establishment potential = 25

6. Seedings made on medusahead (*Taenistherum asperum* (Sim.) Nevski) and cheatgrass (*Bromus tectorum* L.) infested range. Turner, R. B. A dense stand of medusahead and cheatgrass in Wasco County was seeded with three replications of crested wheatgrass (*Agropyron desertorum* (Fisch.) Schult.), pubescent wheatgrass (*Agropyron trichophorum* (Link) Richt.), and intermediate wheatgrass (*Agropyron intermedium* (Host) Beauv.) in the fall of 1961 and in the spring of 1962 using a standard grain drill with 6 inch row spacings. The following seedbed preparations and seeding dates were employed: (1) fall plowed, spring-tooth harrowed and fall seeded, (2) fall disced,

spring-tooth harrowed and fall seeded, (3) burned (the burning date for all mentioned burning treatments was July 21, 1961), and fall seeded, (4) burned, disced and fall seeded, (5) burned, fall disced, spring-tooth and drag harrowed in spring, and spring seeded, (6) burned in July, spring-tooth and drag harrowed in spring, and spring seeded, (7) plowed, spring-tooth and drag harrowed in spring, and spring seeded, (8) fall plowed, spring-tooth and drag harrowed in spring, and spring seeded, (9) fall disced, spring-tooth and drag harrowed in spring, and spring seeded.

All of the fall seeded treatments resulted in complete failure. Medusahead and cheatgrass came back abundantly and formed another dense stand. No perennial seedlings were found on any of the plots. There was considerable evidence of frost-heaving which may have contributed to the absence of the wheatgrasses.

After one summer's growth all three wheatgrasses became well established on all spring seeded treatments except the fall disced (treatment 9), on which a considerable amount of medusahead and cheatgrass germinated and competed vigorously. Control of these annual grasses was good on the other spring seeded plots. Only a few widely spaced but well-tillered plants of medusa-head and cheatgrass competed with the perennials. The most effective weed control resulted on the spring plowed (treatment 7). Furthermore, the perennial grasses made the most vigorous growth on these plots, where the soil moisture apparently was more favorable. Seedling establishment, however, was not as uniform as on the fall plowed (treatment 8) and on the (treatments 5 and 6) burned plots, owing to an insufficiently firm seedbed. This was obvious when one noted the better seedling establishment where the tractor tires had compressed the soil. (Oregon Agricultural Experiment Station in cooperation with the Bureau of Land Management, U.S. Department of Interior)

7. Effect of herbicide treatments on medusahead (*Taeniatherum asperum* (Sim.) Nevski) infested rangeland in eastern Oregon. Turner, R. B., Gould, W. L., and Furtick, W. R. Several herbicides were investigated on medusahead infested rangelands of eastern Oregon. Of these, dalapon, atrazine, and isocil have given good control of medusahead. Dalapon, applied in late March at 2 pounds (74 percent acid equivalent) of active material per acre in 10 gallons of water carrier, resulted in close to 100 percent control. By October, the activity of the herbicide was completely absent, as indicated by a lush stand of medusahead seedlings. Isocil applied in late March at 1 pound (80 percent, commercial product) of active material per acre in 40 gallons of water carrier, resulted in close to 100 percent control of medusahead. The broad-leaved annual forage plant, filaree (*Erodium cicutarium* (L) L'Her), was removed by isocil; however, the broad-leaved composite, sunflower (*Helianthus annus* L.), was resistant and increased vigorously in size. With dalapon, sunflower was not injured by the herbicide but was held in check by strong competition from filares, which increased abundantly after the annual grasses were removed. Atrazine, applied as a pre-emergence treatment in the fall at 1.6 pounds (80 percent, commercial product) of active material per acre in 40 gallons of water carrier, resulted in close to 100 percent control of medusahead. This herbicide was not quite as effective when applied post-emergence in the spring at a higher rate of 2 pounds per acre. Both isocil and atrazine applied in the spring remained active for controlling fall germinating medusahead. The persistance of atrazine in the soil has been evident for one year and longer, depending on the rate. The longevity of isocil activity in eastern Oregon is unknown but is suspected of being of rather long duration.

Dalapon, isocil and atrazine all showed a selectivity toward perennials.

Dalapon was the most damaging over a wide spectrum of native perennial grasses. Furthermore, crested wheatgrass (Agropyron desertorum (Fisch.) Schult.) was injured severely with 2 pounds per acre of active dalapon, while atrazine at 3.2 pounds of active material resulted in no apparent damage. Atrazine, applied in the fall at .8 pound of active material, resulted in good control of medusahead in a stand of pubescent wheatgrass, which showed no evidence of injury. Dalapon, isocil and atrazine all were injurious to Sandberg's bluegrass (Pea secunda Presl.) at rates of 2, 1 and 1/2 lb/A, respectively. This is an important species in eastern Oregon for competing with annual grasses and brush seedlings during a successional range recovery period.

Paraquat was tested on a medusahead-cheatgrass range. This herbicide is of interest owing to its short duration of residual activity and, therefore, its possible use in a seeding program. Results showed, however, that medusahead is tolerent - while cheatgrass is susceptible. The proportion of medusahead to cheatgrass increased markedly in favor of medusahead on the plots treated with paraquat. This herbicide did not, however, give effective control of cheatgrass at 1 lb/A on plots containing only dense cheatgrass. (Oregon Agricultural Experiment Station in cooperation with the Bureau of Land Management, U.S. Department of Interior)

8. The extent of medusahead (Taeniatherum asperum (Sim.) Nevski) infestations in Oregon. Turner, R. B. and Gould, W. L. According to estimates furnished by County Extension Agents, the Bureau of Land Management and the Bureau of Indian Affairs, a total area encompassing approximately 2 million acres in Oregon is infested with medusahead. One and one-half million of this total is in western Oregon (west of the Cascade Mountains) and includes clean cropland, cities and forests. Slightly more than 500,000 acres are infested in eastern Oregon where 13 of 18 counties have reported the weed. (Oregon Agricultural Experiment Station in cooperation with the Bureau of Land Management, U.S. Department of Interior)

9. Forced grazing of medusahead (Taeniatherum asperum (Sim.) Nevski) by cattle. Turner, R. B. A grazing study was initiated in eastern Oregon in an attempt to reduce medusahead by forced early spring grazing with subsequent deferment, and thereby release remnant perennials from competition.

Twenty-five angus cows were grazed from May 21 to June 9, 1962 on a 40 acre enclosure, half of which contained dense medusahead. The remainder of the enclosure contained cheatgrass (Bromus tectorum L.) and a few perennials. The medusahead was in the boot stage when the animals entered and in the early head stage when they were removed. The data of this study remain to be analyzed; however, it was clearly evident that a small degree of utilization of medusahead did occur in a few spots. This was, however, far short of being effective as a means of removing medusahead and reducing competition with the perennials. In a practical sense, the portion of the enclosure which contained medusahead was virtually ungrazed, and millions of heads went on to maturity. Possibly an earlier period of grazing would have been more effective.

The cheatgrass and few perennial grasses were utilized almost completely at the end of 19 days, which necessitated removal of the cattle. (Oregon Agricultural Experiment Station in cooperation with the Bureau of Land Management, U.S. Department of Interior)

10. Studies on ecotypic variation of medusahead (Taeniatherum asperum (Sim.) Nevski). Turner, R. B. and Thilenius, J. F. Medusahead seed collected from eastern and western Oregon was planted outside at Corvallis, Oregon, on February 27, 1962, in four replications of 100 seeds each grown under uniform environmental conditions. The eastern Oregon seed was from Wasco County and the western Oregon seed from Benton County. Seed from both sources germinated a few days after planting. In early May, the Wasco County plants showed signs of having been florally induced, which was evident by their increased elongation. By late May, these plants were in the boot stage and awns started to emerge. By late June, anthesis occurred at approximately the same time for all of the Wasco County plants. They went on to maturity uniformly in early July. The Benton County plants, on the other hand, showed no signs of inducement as late as mid-June. In early July, most of these were still vegetative, but a few heads started to emerge. Floral induction has been highly irregular for the Benton County plants and, therefore, heading has occurred steadily throughout summer and fall. At the time of this writing in early December, 1962, most of the Benton County plants have flowered and died. A few, however, are still flowering.

An attempt was made to vernalize medusahead ecotypes from eastern and western Oregon by subjecting ungerminated seeds and young seedlings to a temperature of 37° F. for periods of 6, 10 and 14 days in a cold chamber, under alternating light-dark periods of 12 hours (incandescent-florescent light). No floral initiation occurred over a three month period in the greenhouse. One replication of each ecotype was then subjected to an 18 hour photoperiod in a dark room. Another was forced to grow under droughty conditions in the greenhouse and the third remained under the standard greenhouse condition. After 172 days no flowering occurred for any of the treatments. (Oregon Agricultural Experiment Station in cooperation with the Bureau of Land Management, U.S. Department of Interior)

11. Nitrogen uptake by medusahead (Taeniatherum asperum (Sim.) Nevski) and crested wheatgrass (Agropyron desertorum (Fisch.) Schult.) Brown, D. A., Furtick, W. R., Turner, R. B. In the spring of 1962, 0 10, 40, and 80 lb/A of nitrogen were applied to an area infested with medusahead and to another area which had an established stand of crested wheatgrass. The top growth was harvested from each location every three weeks between the periods of April 23 to July 4. The micro-kjeldahl method was used to determine total nitrogen.

The data indicate that medusahead reached its maximum nitrogen uptake about three weeks earlier than did crested wheatgrass. Furthermore, nitrogen uptake on a pound per acre basis was greater for medusahead than for crested wheatgrass, which indicates that medusahead may be a luxury consumer of nitrogen. (Oregon Agriculture Experiment Station in cooperation with the Bureau of Land Management, U.S. Department of Interior)

12. Ecology and control of medusahead (Elymus caput-medusae subsp. asper?). Hironaka, M. and Tisdale, E. W. 1. Two-years' data are now available from a five-year seed longevity study established on two sites in southwestern Idaho. Quadruplicate lots of 100 seeds each buried at depths of 1/2, 1 1/2, 3 and 6 inches were recovered in the falls of 1961 and 1962 and tested for germination under laboratory conditions. Average results for the two sites were as follows:

	Percentage germination			
Depths buried	1/2 inch	1 1/2 inches	3 inches	6 inches
1961 recovery	8.4	11.1	12.3	3.4
1962 recovery	1.7	6.5	7.5	0

2. Intensive sampling of a 9-acre area recently fenced for study of medusahead-infested range under protection from grazing revealed great variability in distribution of relict perennial species. Sitanion hystrix, the principal perennial, averaged 1.02 percent basal area but varied from zero to 3.73 percent in various parts of the exclosure, while Agropyron spicatum and Poa secunda with less total area showed comparable variation. Subdivision of the area into 10 subtypes on the basis of topography and apparent vegetational differences revealed this variability and appears to provide an improved basis for measuring changes in vegetation cover which may occur in the future. (Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow)

13. Greenhouse pot tests of medusahead reactions to fertilization and competition. Major, J. The reactions of two kinds of medusahead and Bromus mollis L. to 5 N levels, 2 P levels, and to competition with each other were studied on two soil types. The medusaheads were the delicate Taeniatherum asperum (Sim.) Nevski which is a weed in the western U.S. and the coarse, robust North African to west Asian T. crinitum (Schreb.) Nevski which has not yet invaded the western U.S.

The soils were an Aiken and a Yolo, both clay loams. The Aiken is an old, red podsolic soil, acid in reaction, with kaolinitic clay, residually formed from basic igneous rocks under some 32 to 50 inches of rainfall at altitudes of 2000 to 5000 ft in the Sierra Nevada foothills and with native vegetation of Pinus ponderosa, Quercus kelloggii, Ceanothus integerrimus, etc. The Yolo is a young, non-calcic brown soil, neutral in reaction, with montmorillonitic clay, formed from sedimentary rock alluvium on gently sloping alluval fans of the Central Valley of California and in the valleys of the coast ranges under some 15-25 inches of rainfall per year. Native vegetation is unknown.

The three plant species were grown alone and in pairs at the rate of 10 plants per six inch pot between March 3-May 21, 1962, or for 80 days. The N levels were 0, 5, 10, 20, 40 g/m^2 (1 g/m^2 = 8.92 lb/A). The P levels were P_O and $N_{20}P_{40}$. Weights per plant air dry are set out in the following table.

Summary of pot test
(wgt/plant in)
Aiken soil

	N level (g/m^2)					
Species	0	5	10	20	40	$N_{20}P_{40}$
Bromus mollis	.42	.34	.20	.35	.10	.18
Taeniatherum asperum	.09	.05	.06	.08	.05	.16
T. crinitum	.09	.09	.16	.08	.05	.12
Brmo + Taas	.12	.03	.01	.01	.08	.13
" + Taas	.11	.11	.10	.02	.15	.39
Brmo + Tacr	.02	.02	0	.01	.08	.07
" + Tacr	.13	.11	.28	.23	.17	.51
Taas + Tacr	.02	.05	.04	.02	.02	.06
" + Tacr	.08	.12	.09	.06	.08	.24

Yolo soil

Brmo	.19	.43	.49	.78	.74	.20
Taas	.10	.44	.44	.65	.69	.72
Tacr	.14	.32	.39	.54	.57	.74
Brmo + Taas	.05	.15	.30	.22	.30	.37
" + Taas	.06	.26	.35	.37	.67	.63
Brmo + Tacr	.09	.11	0	.07	.11	.34
" + Tacr	.26	.56	.87	.56	1.09	1.02
Taas + Tacr	.08	.24	.30	.28	.27	.31
Taas + Tacr		.22		.41	.42	.42

On the fertile Yolo soil all three species respond positively to N-fertilization but only the medusaheads to P. The responses evidently follow the Mitscherlich curve with rate of increase of yield falling off as the maximum is approached. *Bromus mollis* is a poor competitor with either of the medusaheads. *Taeniatherum asperum* suffers in competition, but *T. crinitum* seems to thrive on it.

On the Aiken, which is found above the zone where all three grasses normally grow, all plants grow poorly. *B. mollis* even shows a negative response to increased N. However, the same general relationships to competition as on the Yolo soil are shown on the Aiken also. (Botany Department, University of California, Davis)

PROJECT 3. UNDESIRABLE WOODY PLANTS

Robert H. Schieferstein, Project Chairman

SUMMARY

Eight abstracts were submitted to the Chairman on the control of or effects of control of woody species. Four of these related to brush control as a range management tool and the remainder dealt with brush control as a forest management tool.

The emphasis, if conclusions may be drawn, appears to be away from development of techniques toward assessing the problem and evaluation of benefits that may be derived. This is probably because new chemicals with a potential place in brush control have not been forthcoming at the high rate in evidence with regard to herbaceous weeds. Only one paper submitted dealt with testing a compound that could be considered at all new, and only one with testing new formulations of the old timers, 2,4,-D and 2,4,5-T.

The potential brush control market remains a large one and usage of chemicals has not achieved nearly the level indicated by the need. A large fraction of usage is by government agencies. This indicates that the economics of brush control, costs vs. benefits, is marginal and further improvements of materials, tools and techniques are required. Thus is pointed out the challenge in brush research for the next few years.

1. Some microclimate, soil, and vegetation factors affected by two mesquite control methods. Hughes, Eugene E. Four methods of mesquite control are currently in use in Texas. They are individual-tree treatment with chemicals, chaining, rootplowing, and aerial spraying with chemicals. For large-scale treatment, the last two are the most effective; however, rootplowing costs 3 to 5 times as much per acre as aerial spraying. This study, conducted near Dickens, Texas, was designed to study the effect of these two treatments on the microclimate, soil and vegetation.

Three adjacent study areas received the following treatments in 1958: rootplowing and reseeding in February, aerial spraying with 1/3 pound ae of 2,4,5-T ester in June, and no treatment. Rootkill by aerial spraying was 46 percent at the time of the study.

Climatic stations were maintained in each of the three treatment areas for the period November 1, 1959 to October 31, 1960. Results of microclimate study were as follows: There were no differences in maximum or minimum air temperatures at 2- or 4-foot heights, or relative humidity (at 4-foot height) on the areas with trees. The rootplowed area had lower maximum and higher minimum temperatures. Maximum soil temperatures averaged 4°F. higher, while minimum soil temperatures averaged 13°F. lower on the rootplowed area than on the areas with standing trees. Average wind velocity was about doubled as a result of rootplowing with no difference in the areas with standing trees. Evaporation from a free-water surface was increased about 5 inches per year as a result of rootplowing. Increases in amount of light reaching the ground were also noted.

Soil-moisture studies showed that the sprayed and rootplowed areas had more available soil moisture than untreated areas during the 9 months of the study.

Sampling depth (inches)	Months out of 9 when moisture was below wilting percentage		
	No treatment	Spraying	Rootplowing
0-6	6	5	5
6-12	8	6	6
12-24	8	6	6
24-36	9	5	4

No differences were found in organic-matter content of soils from the three areas. Water-stable-aggregate analysis showed that rootplowing reduced the percentage of large soil aggregates (greater than 1.0 mm) and increased the small aggregates (less than .84 mm) in the 0 to 6 inch sampling depth. The reduction was much greater in the 6 to 12 inch depth. There was little difference in the sprayed and nontreated areas except the sprayed area had a greater percentage of large aggregates.

Large pore space in soils of the rootplowed area were greatly increased with little reduction in small pores. Again the sprayed and nontreated areas were quite similar. Infiltration rate was perhaps the most spectacular difference noted. The nontreated area had 2.9 inches per hour compared with 4.4 and 26.1 for the sprayed and rootplowed areas, respectively.

The vegetation study showed that a large percentage of the range forage on the sprayed and rootplowed areas consisted of annuals. No reseeded grasses were evident on the rootplowed area. Herbage production was 637 pounds per acre (106 pounds of annuals) on the nontreated area, 1544 pounds (400 pounds of annuals) on the sprayed, and 1284 pounds (758 pounds of annuals) on the rootplowed area. (Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, Los Lunas, New Mexico)

2. Low-cost but effective stump treatment of bigleaf maple and Pacific dogwood. Newton, Michael. Sprouting hardwood species often pose a serious problem for foresters and range improvement personnel. Bigleaf maple stumps in particular sprout very vigorously, with individual sprouts often reaching twelve feet during the first growing season. The usual recommendation of stump spraying with ester-in-oil solutions requires the purchase of sprayers, costly amounts of chemicals, and the investment in special laborers for application. Costs per acre for stump treatment involving basal-type applications have ranged between six and fifteen dollars, depending upon the number of stumps. While success has been good with this method, careless application has caused spotty results, and there has been considerable hesitation among land managers to invest in this treatment.

Based on the success of silvex amine concentrate in frill treatments on bigleaf maple, the assumption was made that this material would be taken up effectively by freshly-cut stump surfaces and translocated to the roots in toxic quantities. Initial trials were applied with small oil cans. After felling, the fresh surface of the sapwood and phloem tissues was circumscribed with a thin line of the concentrated amine. While this treatment was entirely satisfactory from the standpoint of results, oil cans were unsatisfactory for contract work due to their tendency to corrode when improperly cared-for and the difficulty of making uniform application. As an alternative, the contractor[1] assisted in the development of a method which eliminated this problem. Sixteen-ounce plastic liquid detergent bottles with snipped-off tips proved to be a handy size for keeping in the operator's pocket when not in use. The tip was cut off at a point which allowed a slow flow when pressure was applied to the inverted bottle. After felling a tree, the operator simply inverted the bottle and applied a thin line (not over 1/8 inch wide) of herbicide around the

[1] William D. Lyche, Corvallis, Oregon

perimeter of the sapwood.

Results of these treatments have only been under evaluation for one growing season. However, considering the tremendous sprout growth on untreated stumps, and the complete absence of sprouts on any treated maple or dogwood stumps on a fifty-five acre contract treatment, this method appears promising. In the above contract, the contractor was unable to calculate the very slight additional time required above that for felling the trees, and there was a total of roughly twenty dollars worth of herbicide needed for the fifty-five acres, or thirty-six cents per acre. In view of excellent results coupled with low cost for chemical and the negligible additional labor cost, this type of treatment appears very promising. (Forest Research Division, Oregon Agricultural Experiment Station, Oregon State University)

3. Deferred grazing studies on sprayed sagebrush lands. Chamberlain, E. W. and Alley, H. P. A study of the effects of deferred grazing on the forage production of chemically controlled sagebrush lands was initiated in 1959. An area of approximately 40 acres of dense sagebrush (Artemisia tridentata) in the Big Horn Mountains of Wyoming was sprayed by airplane in the spring of 1959. This area was divided into four equal sized pastures and fenced to enable the study of deferred grazing.

Pasture No. 1 was grazed the same year when chemically treated, pasture No. 2 (deferred 1 year), pasture No. 3 (deferred 2 years), and pasture No. 4 (deferred 3 years). Average production for the 4-year period expressed in lb/A of air-dry forage for each pasture was as follows: pasture No. 1 (1442 lbs.), pasture No. 2 (1221 lbs.), pasture No. 3 (1784), and pasture No. 4 (1778 lbs.). The unsprayed area originally produced 716 lb/A of air-dry forage. Livestock did not utilize pastures No. 3 and 4 as heavily as pastures 1 and 2 during the 1962 grazing season. This appears to be partially due to the old forage present in these deferred pastures. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie)

4. Success in Douglas-fir plantations as related to site and method of removal of bigleaf maple overstory. Newton Michael. The occurrence of heavy covers of undesirable hardwoods is generally considered a serious obstacle to reforestation with conifers. This experiment was designed to measure the effects of heavy cover of bigleaf maple on the survival of underplanted seedlings, and to evaluate the merits of three methods of maple removal.

Plantations of one hundred trees each were established in the centers of half-acre plots which were treated as follows: (1) clearcutting all standing trees without stump treatment, (2) clearcutting all trees with poisoning of stumps, (3) basal spraying all hardwoods, and (4) leaving the overstory trees undisturbed. These treatments were replicated on three different site conditions representing favorable, intermediate, and poor growing conditions for Douglas-fir. All were on the same aspect with similar soils, differing principally in depth.

After two years, the following results have been recorded: survival counts of the plantations after two years indicate that an undisturbed maple overstory can be expected to cause substantial mortality. Matting by leaf fall appeared to be responsible for much of the damage. The trees were able to tolerate sub-marginal light intensities for one year, but lacked stiffness as a result of very poor diameter growth. On the most favorable sites, the open-grown plantations in the clearcuts were vigorous and survival was very good, while the same treatment on the less favorable sites gave mediocre and poor results. Basal treatment of overstory hardwoods on the good site appeared to leave somewhat too much shade for proper stiffness of the seedlings, yet survival was satisfactory. On the poorer sites, the residual stands of dead and dying hardwoods appear to have provided a necessary measure of protection.

The survival data do not reflect any advantages from stump treatment. However, two years development is inadequate for sprouts to completely overtop the conifers; from the appearance of the plots at this time, one might predict that the sprouts will dominate the site within ten years.

In addition to confirmation that bigleaf maple stand are generally detrimental to seedling establishment, this study revealed several points in favor of hardwood poisoning without felling. Of the three methods of removal, basal treatment was the least costly of the three methods; planting was easier with the hardwoods standing than with the slash on the ground; and basal spraying can be accomplished by the same crew and in the same operation as planting. While shading of the planted seedlings may have caused some mortality in the most favorable locations, this was partly due to heavy stands of tall herbaceous weeds which developed after the overstory was opened up; the weeds did not occur in as great numbers or sizes on the drier sites. Clearcutting was a costly operation in all cases, but gave the best results of all when stumps were sprayed and when site conditions were inherently favorable for seedling survival and growth. Clearcutting on severe sites was found to result in over-exposure. This research was substantially supported by the Bureau of Land Management, U.S. Department of Interior. (Forest Research Division, Oregon Agricultural Experiment Station, Oregon State University, Corvallis)

Douglas-fir seedling survival in percent by treatment and site

Rep	Basal	Clearcut	Clear & S. spray	Untreated	Site conditions
I	79	90	87	40	Cove site, deep soil
II	57*	60	63	56	Moderate site
III	83	11	11	52	Shallow soil, dry site
All	73	54	54	49	

*Rep II basal plot partly destroyed

5. Chemical control of competitive grass associations in Douglas-fir plantations. Newton, Michael. Numerous study efforts to establish Douglas-fir seedlings on droughty south exposures have been complicated by confounding of factors when applied causing mortality. This study was designed to determine the influence of various densities of grass cover on soil moisture depletion. Weekly soil moisture measurements were made at 3-inch intervals in the top twelve inches of soil in a uniform area of grassy turf which had been aerially sprayed with a mixture of amitrole and simazin in the ratio of 1:3. Application rates of 1.2 to 12 lb ai/A resulted in dry weight yields of herbaceous weeds ranging from 60 lb/A at the highest rates to a maximum of 1200 lb at the lowest rates. The untreated plots supported stands ranging from 1800 lb to over 3000.

The effect on water conservation was very striking. In the untreated plots, soil moisture was withdrawn by transpiration to a much greater extent than by evaporation, which was assumed to be comparable on all treatments.

Transpirational loss accounted for a large share of the reduction of soil moisture from field capacity to the permanent wilting percentage in the surface twelve inches of soil in a period of 25 days, ending June 26. This represented a loss of 2.5 inches of water, compared to a loss of 1.5 inches during the same period in the plots of lowest vegetational diversity. Greater differences occurred from June 22 until the fall rains arrived in September. During this period, there was very little loss from the devegetated plots, which still held nearly one inch of available moisture in the surface 12 inches at the end of the summer, while the untreated plots remained at or below the permanent wilting point for three months.

Information regarding the effect of these treatments on the survival of planted seedlings was spotty for two reasons. On all except directly shaded plants and those on protected microsites, heat damage from excessively high surface soil temperatures was extensive. Furthermore, the seedlings were planted before treatment and showed various degrees of herbicide injury from the amitrole. It was noted, however, that in all cases where mortality was noted in plots with little residual vegetation, seedlings with dead tops were found to have heat lesions at the ground line, but to have succulent roots well distributed in moist soil. This is considered to be promising evidence that drought control with chemicals may ultimately become a practical means of afforestation of droughty sites if the seedlings can be properly protected from the heat, and if the seedlings can be planted after the application of the herbicide. Research supported by Geigy Chemical Co. and Amchem Products, Inc. (Forest Research Division, Oregon Agricultural Experiment Station, Oregon State University, Corvallis)

6. Studies on the rate of transpiration of Artemisia spp. Chamberlain, E. W. and Jones, W. G. A study on the rate of transpiration of certain Artemisia spp. was conducted in the summer of 1961. The study included big sagebrush (Artemisia tridentata) on the Red Desert area of Wyoming and black sagebrush (Artemisia nova) on the plains east of Laramie. Both areas have an elevation of 7200 feet and approximately 10 in of precipitation per year.

Studies of black sagebrush on the Laramie plains showed a general increase in transpiration rate from 8:00 am to 3:00 pm. The size of the plant didn't have as great an effect on transpiration rate as might be expected. The largest plant used in this study (20 inches in diameter and 11 inches in height) had a transpiration rate of 15.2 g/hr. A comparable area of blue grama grass (Bouteloua gracillis) with a basal density of 70 percent transpired at a rate of 14.8 g/hr.

Two measurements on big sagebrush indicated a transpiration rate of 9 g/hr at 9:30 am and 16.3 g/hr at 2:30 pm. The transpiration rate of a comparable area of Indian ricegrass (Oryzopis hymenoides) with a basal density of 70 percent indicated a constant 9.7 g/hr at 11:00 am and 4:00 pm with a temperature of 92°F. for both measurements.

According to the transpiration data obtained from the Red Desert, an acre of sagebrush containing 64 sagebrush plants per square rod and an average diameter of 10 inches per plant would assumingly transpire 23,415 gal of water per month or 93,660 gal of water over a four-month period. This is equal to 3.444 inches of precipitation. An acre of sagebrush at a higher elevation containing 32 sagebrush plants per sq rd and an average diameter of 30 inches per plant would assumingly transpire 29,269 gal of water per month or 117,075 gal of water over a four-month period. This is equal to 4.308 inches of precipitation. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie)

7. Bearmat regrowth control following a burn. Leonard, O. A. and Kaupke, C. R. Bearmat (Chamaebatia foliolosa) was burned in 1960 and the regrowth was sprayed June 14, 1961 using a back-pack mist blower. The plots were 100 feet long and 40 feet wide. The treatments were applied at a walking rate of 2 mph through the center and on one side of each plot; thus the swath widths covered were 20 feet and the area covered was calculated to be about 5 acres per hour. The volume of spray used per acre was 5 gallons containing the chemical plus water and one-half gallon of diesel fuel. A pgbe ester of 2,4,5-T was applied at the rate of 0.25, 0.5, 1.0 and 2.0 lb ae/A. An isoctyl ester of 4-(2,4,5-TB) was applied at 1.0 lb/A. A water soluble amine of 2,4,5-T was applied at the rate of 1.0 lb/A. Bearmat regrowth ranged from 3-7 inches in height at the time of treatment. Small ponderosa pine seedlings (Pinus ponderosa) and incense cedar seedlings (Libocedrus decurrens) were present on the plots, as well as deerbrush (Ceanothus intergerrimus) seedlings.

Results of the above treatments as viewed in 1962 indicated that a high degree of plant kill was obtained with 2 lb of 2,4,5-T per acre (ester), while the control was good with 1 pound. One pound of the amine of 2,4,5-T resulted in poorer control than with the ester. Control of bearmat with 4-(2,4,5-TB) was poor, although the shoots were killed to the ground; however, this was the only treatment which did not kill the ponderosa pine seedlings. Incense cedar seedlings were more tolerant of the treatments than were the ponderosa pine.

Further tests were conducted in 1962, the regrowth being in its second year of growth following the fire; bearmat control will be observed in 1963. At the present time it appears as though some ponderosa pine seedlings will survive some of the treatments, but it is not known yet whether the degree of injury would be acceptable or not.

The present results are significant from two standpoints. First, bearmat control is more easily obtained following a fire; secondly, low volume treatment with a mist blower is effective. Both aspects open up the feasibility of treating bearmat for reforestation purposes. (University of California, Davis)

8. Basal spray for control of salt cedar (Tamarix spp.). Hughes, Eugene E. Although usually occurring in thick stands covering large acreages, salt cedar is also found growing on irrigation ditch banks in most western states. Because these ditches are usually adjacent to crops susceptible to foliage-applied herbicides, individual plants must be treated by mechanical or special chemical means. Studies were initiated in the fall of 1961 near Los Lunas, New Mexico to determine what chemicals were effective against salt cedar and when they should be applied. All treatments were applied as a wetting spray from 18 inches above the ground to ground line at a rate of 6 lb ae per 100 gal of spray solution. The results of the 1961-62 treatments follow:

Application date	Chemical	Carrier	No. trees treated	Results as of 8/62 Dead	Part Dead[1]	Live
9/13-21/61	2,4,5-T amine	Invert[2]	3	1	2	0
	2,4-D amine	Invert[2]	3	1	2	0
	2,4,5-T and 2,4-D amine	Invert[2]	3	1	2	0
	silvex ester	Oil	3	1	1	1
	2,4-DP ester	Oil	3	0	2	1
	2,4-D ester	Oil	3	0	2	1
	2,4,5-T ester	Oil	3	0	1	2

Application date	Chemical	Carrier	No. trees treated	Results as of 8/62 Dead	Part Dead[1]	Live
10/26/61	2,4-D ester	Oil	5	0	4	1
	2,4,5-T ester	Oil	5	0	2	3
	2,4-D ester	Invert[2]	5	0	5	0
	2,4,5-T ester	Invert[2]	5	0	4	1
4/12/62	silvex ester	Oil	5	4	0	1
	2,4,5-T ester	Oil	5	4	0	1
	silvex O.S. amine[3]	Oil	5	2	3	0
	2,4-DP	Oil	5	1	3	1
	2,4-D ester	Oil	5	0	4	1
	2,4-D O.S. amine	Oil	5	3	2	0
	2,4,5-T O.S. amine	Oil	5	1	1	3

[1] Most of above-ground dead with one branch alive.

[2] Not a true invert, but a thick oil in water emulsion.

[3] Oil-soluble amine.

The previous tabulation shows that fall applications are less effective than early spring and that 2,4,5-T and silvex esters appear the most effective of the treatments tried.

In another study initiated on March 28, 1962, at a higher elevation (7500 feet compared with 4800 feet on the previous study) some of the same chemicals were tested. All chemicals were applied at 6 lb ae per 100 gal of diesel oil on a total of 20 trees.

Chemical	Dead	Live	% Kill	Nature of Live Growth
2,4,5-T ester	12	8	60	4 regrowth[1] 4 partially dead
2,4-D ester	11	9	55	5 regrowth 4 partially dead
silvex ester	17	3	85	3 partially dead
silvex O.S. amine[2]	18	2	90	2 partially dead
2,4-DP ester	14	6	70	6 partially dead
2,4-D and 2,4,5-T ester	14	6	70	4 regrowth 2 partially dead

[1] New shoots from root crown.

[2] Oil-soluble amine.

In this study silvex, whether in the ester or oil-soluble amine form, was superior to all other treatments. Regrowth occurred only when the acetic form of the phenoxy compound was used and the propionic form killed all the tree except for a twig or branch. There was also a difference in kill noted when the number and size of stems varied, with the larger stemmed plants being harder to kill. (Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture and New Mexico Agricultural Experiment Station cooperating, Los Lunas, New Mexico)

PROJECT 4. WEEDS IN HORTICULTURAL CROPS

Garvin Crabtree, Project Chairman

SUMMARY

Investigators in seven states contributed the 19 abstracts presented in the project report on weed control in horticultural crops. The areas of fruit crops, vegetable crops, and ornamental crops are nearly equally represented. With the wide diversity of crops and their specific problems it is difficult to make any generalizations about the information presented in this section.

Most of the abstracts represent field studies of a general evaluation of newer herbicides and comparisons with standard herbicide programs on one or more crops. Some studies make a more critical evaluation of crop tolerance under controlled conditions and some investigate the influence of environmental factors. For the most part, the work reported here would be classified as "applied" rather than fundamental in nature.

1. Pre-planting herbicidal treatments in new strawberry plantings. Peabody, Dwight V., Jr. During the early spring of 1962, vegetative and reproductive growth measurements were taken from strawberry plants that had been treated with 18 different pre-planting herbicides the previous spring. DMPA, even at rates as high as 36 lb/A, two coded compounds (R-4518 and R-3441), diphenamid, IPC and 2,4-DEP caused the least reduction in green weight of (1) leaves and stems, (2) green fruit and fruit spurs, and (3) number of crowns. Of these six compounds, only the diphenamid treatments resulted in long-term annual weed control.

This spring (1962) another pre-planting herbicide test was undertaken in strawberries which included the more promising treatments of 1961 as well as several newer herbicides. Two rates of each of the following herbicides: PEBC, R-1910, R-4461, isocil, "Swep", NIA 6370, "Alipur", OMU, diphenamid, trifluralin, amiben, 2,4-DEP, dichlobenil, prometryne, atrametryne, six different analogs of endothal, three coded Shell Development (SD) compounds and two combinations of 2,4-DEP, one with PEBC, one with amiben were applied to a prepared plant bed and incorporated to a depth of approximately two inches with a rotovator. Strawberry plants of the varieties Columbia and Northwest were set out in these plots the following day. Diphenamid again resulted in excellent annual weed control for a long period of time (3 months) with no concomitant strawberry plant injury. Another herbicide, "Swep" also proved to be selective in strawberries while resulting in excellent control of many different broadleaved annual weed species (smartweed, Polygonum persicaria; chickweed, Stellaria media; lambsquarters, Chenopodium album; groundsel, Senecio vulgaris; and shepherd's purse, Capsella bursa-pastoris). (Northwestern Washington Experiment Station, Washington State University, Mount Vernon)

2. Post-planting herbicidal treatment in new strawberry plantings. Peabody, Dwight V., Jr. Since diphenamid and trifluralin had shown promise in previous years' experiments, another field test was undertaken this spring (1962) wherein these compounds (and 3 others) were tried at several different times and rates of application after setting out strawberry transplants. Diphenamid and trifluralin both resulted in excellent annual weed control, however, only diphenamid caused little or no injury to strawberry plants. Another newer compound, isocil, also showed evidence of selectivity in strawberries, although this herbicide cannot be used soon after transplanting. Two coded compounds, SD 6623 and

FW 925, did not give adequate control of the broadleaved annual weed population present. (Northwestern Washington Experiment Station, Washington State University, Mount Vernon)

3. Fall herbicide applications to established strawberry plantings for winter annual weed control. Peabody, Dwight V., Jr. Six different chemical herbicides have been applied at various rates over a period of three years during mid-fall prior to strawberry dormancy. Simazine, propazine and atrazine, each a 1 lb/A, resulted in no reduction of marketable strawberry fruit yield the following spring (1962). However, doubling the rate of propazine and atrazine resulted in a significant yield reduction. All rates of these three s-triazine herbicides eliminated the winter annual weed population present - principally chickweed (*Stellaria media*) and groundsel (*Senecio vulgaris*).

The other herbicides (trifluralin, diphenamid, linuron and sesone) which were tested either resulted in strawberry plant injury or poor annual weed control, or both. (Northwestern Washington Experiment Station, Washington State University, Mount Vernon)

4. Post-harvest contact herbicide test in established strawberries. Peabody, Dwight V., Jr. The principal objective of this exploratory field trial was to show gross strawberry plant injury symptoms caused by various contact herbicides applied immediately after harvest. Diquat, paraquat, endothal, UC 15303, DNBP were all applied at 2 lb ai/A in mid July. All treatments, with the exception of UC 15303 caused immediate and extensive "burn" of both strawberry plant and weed foliage resulting in annual weed control until early fall. Of the five compounds, diquat and DNBP retarded strawberry plant regrowth the least and had little or no effect on runner production or "set" of new runner plants in the fall. (Northwestern Washington Experiment Station, Washington State University, Mount Vernon)

5. Weed control in papaya. Rogers, B. J. Papaya on the island of Hawaii is grown on aa land (rocks, with very little soil). Frequent applications of contact herbicides are best suited for weed control in these areas. Aromatic oil is the standard treatment. The two chemicals diquat and paraquat were tested at rates of 0.5 and 1 lb/A of ion. Three applications were made over a period of 4 months; 3 months after the last spray treatment weed counts were made. Weeds included *Sonchus oleraceus*, *Cuphea carthagenensis*, *Bidens pilosa*, *Emilia sonchifolia*, *Paspalum conjugatum*, *Ageratum conyzoides*, *Stachytarpheta cayennensis*, *Euphorbia hypericifolia*, *Vernonia cinerea*, and *Erechtites hieracifolia*. Paraquat at 1 lb/A gave superior control; only seedlings of *Cuphea* and *Ageratum* were found. Diquat did not eliminate mature plants entirely, and was completely ineffective in controlling the grass. Both rates of paraquat were superior to the aromatic oil treatments. Mature papaya trees were not injured by any of the treatments; the spray was directed away from the stems. (Hawaii Agricultural Experiment Station, University of Hawaii, Hilo)

6. Tolerance of walnuts to monuron, diuron, simazine, and atrazine. Day, B. E. and Jordan, L. S. Nursery-grown, bareroot, Paradox hybrid and California black walnut seedlings 18 inches tall were transplanted in January into screened soil (Vista sandy loam) in undrained cans. Some cans were equipped with tensiometers to serve as a guide for watering to prevent waterlogging. After three months, monuron, diuron, simazine, and atrazine were applied to four replicates of each variety by pipetting suspensions of the herbicides on the soil surface and watering-in. Monuron and atrazine were applied at rates

of 0.5, 1, 2, 4, and 8 ppm, and diuron and simazine at rates of 1, 2, 4, 8, and 16 ppm on the basis of air-dry soil. Plants were observed for symptoms of injury for four months at which time the plants were removed from the pots and the roots were examined and rated for vigor. In addition, replicate field plots treated with simazine and diuron were established in commercial walnut orchards in ten locations in California, extending from Riverside County in the south to Butte and Lake Counties in the north. Treatments were made semi-annually in fall and spring beginning in the fall of 1961 at 2 1/2, 5, and 10 pounds of 80 percent commercial formulation per acre at seven locations and 2 1/2 and 10 lb/A in three locations. The orchards were commercial varieties of English walnuts variously on Paradox and Black rootstocks.

Injury ratings for the potted seedlings are tabulated below.

Mean injury ratings[1] to Paradox hybrid and Black walnut seedlings from soil applications of herbicides in undrained pots

Herbicide	Rate (ppm)	Paradox	Black
monuron	0.5	2.0A	4.5A
	1	3.0A	0.2A
	2	7.2B	3.2B
	4	5.0B	6.0B
	8	6.8B	7.2B
diuron	1	0.5A	4.2A
	2	3.0A	6.0A
	4	6.0A	7.2A
	8	6.5A	6.5A
	16	8.0B	7.0B
simazine	1	2.0A	1.8A
	2	1.0A	1.0A
	4	3.5A	2.5A
	8	1.5B	1.5B
	16	3.0B	4.5B
atrazine	0.5	2.2A	3.5A
	1	4.8B	3.5B
	2	2.8B	4.0B
	4	6.2B	3.8B
	8	7.2B	5.8B

[1] Top injury was rated numerically on a scale of 10, with 0 = no injury, 10 = dead. Root injury was rated, A = stunted growth, B = normal

In the pot test all herbicides were to some extent phytotoxic at all rates, with Paradox less affected than Black. The herbicides were incressingly phytotoxic in the order monuron, diuron, atrazine, simazine.

In the field there has been no evidence of injury to walnuts from a total of 30 lb (80 percent formulation) applied in three applications over a period of a year and observed for 15 months. These data indicate that walnuts are not basically resistant to the substituted urea and triazine herbicides, but that observed tolerance in the field is likely due to localization of the herbicides in the surface soil above the main concentration of tree roots. (University of California, Citrus Research Center, Riverside)

7. Preplanting and preemergence herbicide treatments in cantaloupes. Menges, R. M. and Hubbard, J. L. A field experiment was conducted to (1) compare the performance of preplanting, soil-incorporated treatments and preemergence treatments of herbicides in cantaloupes and (2) to study the effect of a petroleum mulch on the performance of NPA.

Hidalgo sandy clay loam was disked and then listed into beds and furrows. To determine the distribution patterns of the rotary tiller, a fluorescent chemical was sprayed to the soil surface and was then incorporated. Herbicides were applied March 7, 1962, to the plateaus of beds, and were either incorporated with the surface 2 in of soil or were left undisturbed. Rio Gold No. 65 cantaloupes were seeded 1 1/4 in deep in 2 rows spaced 10 in apart on beds 38 in wide immediately before pre-energence treatment and 12 and 17 days after soil-incorporated treatments. Plots were furrow-irrigated 1, 17, and 35 days after treatment and periodically thereafter; recorded rainfall was 1.03 in, .02 in, .01 in, and .01 in 6, 7, 11, and 23 days after treatment, respectively.

The principal weeds were Palmer amaranth (Amaranthus palmeri S. Wats.) and common purslane (Portulaca oleracea L.); Sudangrass was seeded as a grassy weed indicator.

Preplanting, soil-incorporated treatments of CDEC and DAC-893 were outstanding. Both herbicides controlled weeds more efficiently when incorporated with soil, although the 6-lb rate of CDEC controlled broad-leaved weeds without incorporation. All treatments of NPA failed to control grassy weeds but broadleaved weed control was effective with incorporation. The performance of preemergence applications of NPA was poorer when covered with a petroleum mulch. EPTC and R-1870 controlled weeds better when incorporated with soil.

The stand of cantaloupe was reduced when 6 lb/A of EPTC was incorporated with soil 12 or 17 days before planting, but yield was not materially affected. Other preplanting treatments and preemergence treatments had no discernible effect on stand or yield. Herbicides had no effect on the size of fruit. CDEC and NPA treatments had no effect on soluble solids.

CDEC failed to penetrate the soil with rainfall after surface-treated soils had been furrow-irrigated and was not leached from the incorporated zone. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture and Texas Agricultural Experiment Station, Weslaco)

8. Control of annual weeds in table beets and bush snap beans. Crabtree, Garvin. Field plot studies in 1962 on table beets and bush snap beans included comparisons of standard herbicide programs now being used with several newer ones of interest.

In the beet trial, pre-plant soil incorporated applications of EPTC and PEBC and pre-emergence surface applications of "Alipur", CP32179, CDEC and endothal were made. With a weed complex consisting primarily of redroot pigweed, lambsquarters, and mustard (Brassica rapa L.) the best control was obtained with CP32179 at 4 lb ai/A and satisfactory control was obtained with EPTC at 2 lb ai/A and PEBC at 4 lb ai/A. Beets were separated for grade at the 2 1/2 in diameter size and weights of small beets and total beets obtained. Analysis of the yields from six replications showed that none of the herbicide treatments significantly affected yields as compared to the hand weeded check plots. All plots had been weeded following an early evaluation of weed control so that weed competition was not reflected in the yield data.

Beans (var. Tendercrop) received applications of amiben, DNBP (amine salts) and PCP (sodium salt). These materials were applied as spray or granular formulations pre-emergence to the crop or at early post-emergence (crook stage). Primary weed species present were redroot pigweed, mustard and lambsquarters. The best weed control was obtained with a post-emergence spray of 2 lb ai/A DNBP (amine salts) which is the standard commercial practice for the Willamette Valley bean growing area. Excellent control was obtained with pre-emergence applications of spray or granular formulations of amiben at rates of 2 to 6 lb ai/A. Satisfactory control resulted from pre- or post-emergence spray applications of PCP (sodium salt) at rates of 9 or 12 lb ai/A. Yields were obtained as fresh weights of ungraded pods from a single hand picking of the crop. Analysis of the yield data indicates that a significant reduction occurred from a pre-emergence application of the granular formulation of DNBP (amine salts) at the 3 or 6 lb ai/A rates and from post-emergence applications of 2 lb ai/A rate of DNBP (amine salts) and 9 lb ai/A rate of PCP (sodium salt). (Oregon Agricultural Experiment Station, Oregon State University, Corvallis)

9. Comparison of rate, times and formulations of sodium PCP to the standard DNBP recommendation for annual weed control in processing peas. Peabody, Dwight V., Jr. Granular and spray applications of the sodium salt of PCP at 4, 8, and 16 lb ai/A were made both before and after pre-emergence. These treatments were compared to the presently recommended DNBP post- and pre-emergence treatments both as to annual weed control obtained and to damage of pea plants.

Granular applications of both pre- and post-emergence of PCP resulted in poor weed control except at the highest rate which caused extensive injury to pea plants. Post-emergence sprays also resulted in poor control of the broadleaved annual weeds present with some pea plant injury at the highest rate of application. Pre-emergence applications of PCP at the 4 and 8 lb/A rates resulted in adequate or economic weed control but not equivalent to the control obtained with DNBP. The 16 lb/A rate, pre-emergence, caused a slight reduction in yield as compared to the two lower rates and to the standard DNBP treatments.

Further testing of pre-emergence spray applications of PCP at rates of 6 to 10 lb/A is warranted in processing peas for the control of broadleaved annual weeds. Although DNBP results in excellent control of the common annual broadleaved weeds with probably no injury to peas, the current market price of sodium PCP places this compound in a favorable competitive position with DNBP. (Northwestern Washington Experiment Station, Washington State University, Mount Vernon)

10. Pre-planting herbicides in spinach. Peabody, Dwight V., Jr. The following herbicides: H-7531, atrametryne, prometryne, barban, isocil, SD 7585, SD 6623, "Alipur", OMU, NIA 6370, "Swep", PEBC, R-4461, R-1910, TD 426, TD 428, TD 266, TD 271, TD 273, NP 1475 were applied, each at three different rates of application, as pre-planting, soil-incorporated treatments. Of these compounds only barban and H-7531 demonstrated selectivity; all others either resulted in poor broadleaved annual weed control or extensive spinach injury. (Northwestern Washington Experiment Station, Washington State University, Mount Vernon)

11. Chemical weed control with vegetable crops in Hawaii. Romanowski, R. R., Jr. and Jack S. Tanaka. A weed control project was initiated in 1962 to test chemicals cleared for use on the continental United States, as well as any new promising research herbicides. The experiments were conducted on the Islands of Oahu, Maui and Kauai. The following summary lists the chemicals tested and recommendations made for trial use by growers. Experimental results are available on request. Tomatoes (transplanted): Chemicals tested - amiben, dichlobenil, CIPC, DAC 893, diphenamid, diquat, neburon, prometryne, CDAA, N-(3-chloro-4-methylphenyl)-2-methylpentanamide, EPTC, trifluralin, CDEC, aromatic oil. Recommendations - CDEC (liquid and granular), EPTC, directed aromatic oil. Of the new chemicals trifluralin as a directed spray was exceptional. Cucumbers and watermelons: Chemicals tested - NPA (sodium salt), CDEC, PCP (sodium salt), alkanolamine salts of DNBP. Recommendations - NPA (sodium salt) for cucumbers and watermelons as preemergence liquid sprays and granular formulations at vining. CDEC 4 lb/A maximum for cucumbers. Pole beans, soybeans, peas: Chemicals tested - CDEC, CIPC, CDAA, DAC 893, trifluralin, alkanolamine salts of DNBP. Recommendations for beans - CDEC, DAC 893, alkanolamine salts of DNBP. Recommendations for peas - CDAA, alkanolamine salts of DNBP. The latter herbicide should be used as a broadcast spray at low concentrations before the pea leaves unfold. Lettuce (Great Lakes and Green Mignonette), Kai Choi, Pak Choi, Won Bok: Chemicals tested - CDEC, CIPC. Recommendations - CDEC 4 to 6 lb/A preemergence for all except Kai Choi, 4 lb maximum. Transplant bulb onion (Granex Hybrid): Chemicals tested - CIPC, EPTC, EXD, CDAA, CDEC, DAC 893, KOCN. Recommendations - liquid and granular formulations of CDAA and CIPC. Head cabbage, cauliflower, broccoli (transplated): Chemicals tested - CDEC, CDAA, DAC 893, trifluralin, amiben, TCA (sodium salt). Recommendations - CDEC, DAC 893. Trifluralin results were excellent in one experiment conducted. Sweet corn: Chemicals tested - atrazine, simazine, CDEC, CDAA, alkanolamine salts of DNBP. Recommendations - corn following corn, atrazine or simazine; otherwise CDAA, CDEC, alkanolamine salts of DNBP. (Hawaii Agricultural Experiment Station, University of Hawaii, Honolulu)

12. Annual weed control in Vanda Miss Joaquim nurseries. Rogers, B. J. The orchid Vanda Miss Joaquim is grown in fields in raised beds of fern fiber in Hilo. Due to the presence of seeds in the fern fiber and the local practice of fertilizing with chicken manure, the annual weed population is high and requires extensive handweeding. These chemicals were applied without causing visible injury to the Vandas: DCPA 10 lb/A; diphenamid 6 lb/A; fenuron, diuron, neburon 4 lb/A; linuron, atrazine, simazine 3 lb/A; amitrole 2 lb/A. The spray was directed at the base of the plants. Weeds were *Euphorbia* spp., *Paspalum conjugatum*, *Emilia sonchifolia*, *Digitaria* spp., and *Centella asiatica*. Diuron, linuron, and atrazine gave the best weed control, and were tested at higher rates (8 and 16 lb/A, 6 and 12 lb/A, 6 and 12 lb/A, respectively). There was no obvious injury. It was found, however, that repeated applications at low rates did reduce weekly flower production by 10 to 30 percent as compared with handweeded checks. Satisfactory control resulted only when the weeds were small. (Hawaii Agricultural Experiment Station, University of Hawaii, Hilo)

13. Annual weed control in ornamental bulbs with prometone. Peabody, Dwight V., Jr. Prometone continues to look promising as a pre-emergence selective herbicide in ornamental bulb crops - tulips, iris, and narcissi. This compound at relatively low rates of application (4 to 6 lb ai/A) results in the control of many different annual weed species the entire season -

October to the following July and August. However, certain varieties of tulips on the coarser or lighter, sandier soils have been injured by these pre-emergence prometone applications. However, no decrease in yield of salable bulbs of iris (Wedgewood) and narcissi (King Alfred) has been measured during four years of testing.

Bulbs have been taken from field plots treated with prometone, forced (in cooperation with Dr. Neil W. Stuart, USDA, Beltsville, Maryland) and no deleterious effect on quality or quantity of flower production was observed that could be attributed to pre-emergence prometone applications in the field. Persistence of this compound in various soil types is now being determined to establish whether or not it is still present in amounts which would be detrimental to crops grown in rotation with bulbs. (Northwestern Washington Experiment Station, Washington State University, Mount Vernon)

14. Carry-over effect of Bandane for the control of crabgrass. Chamberlain, H. E.; Fults, J. L.; May, J. W. A series of Bandane plots were established on turf heavily infested with crabgrass in the spring of 1961 and one-half of each plot was retreated in the spring of 1962. One-half of the treated area was fertilized in the spring of 1961 and 1962 with 2 lb of actual N per 100 sq ft. The chemical was applied as a dry formulation on attapulgite (clay base) and as an emulsifiable liquid. Both formulations were applied at rates of 5, 10, 15, 20, 25, 30, 40 and 80 lb ai/A. This design allowed an evaluation of the chemical treatment at varying rates for two successive years and an evaluation of the "carry-over" effect of one year following treatment.

Counts taken in 1962, 16 months after a single, early spring 1961 chemical application, showed very little crabgrass control at rates of 40 lb/A and less. At 80 lb/A there was an appreciable amount of carry-over crabgrass control. Results would also suggest that Bandane on attapulgite carrier had a greater carry-over potential than emulsifiable concentrate.

The 25 lb/A rate applied in the spring of two successive years gave 79 percent control of the crabgrass. Higher rates applied once, in both 1961 and 1962, gave progressively better control with 40 and 80 lb/A giving 95-100 percent control during the summer of the second year. Bluegrass was not damaged at any level of chemical application or with either formulation.

Fertilization was beneficial to the bluegrass when crabgrass control was accomplished. However, if the turf was heavily infested with crabgrass and no herbicide control measures were employed on crabgrass, fertilization benefited the crabgrass at the expense of the bluegrass. Fertilization increased the carry-over effect of Bandane at the 40 lb/A rate and below. (Colorado Agricultural Experiment Station, Colorado State University, Fort Collins)

15. A technique for the greenhouse evaluation of pre-emergence crabgrass herbicides. Chamberlain, H. E.; Fults, J. L.; May J. W. Greenhouse screening of candidate pre-emergence crabgrass herbicides has found wide usage in speeding up the evaluation of numerous new chemicals. Because of high variability in test results under green house conditions due to watering methods, light variation, and temperature variability, a technique to add precision to a testing program was necessary. The purpose of this experiment was to develop a method that would promote the greatest degree of uniform phytotoxicity and was not an attempt to duplicate field conditions. Previous work reported in the WWCC Research Progress Report in 1962 described differences in phytotoxicity as promoted by differences in watering method. Research on mulching agents in conjunction with watering methods will be reported here.

Plastic containers 6 1/4" x 4 3/4" x 3" were used. Containers were filled to within 1/2 inch of the top with pastuerized greenhouse soil. Fifty seeds of two crabgrass species (Digitaria sanguinalis and Digitaria ischaemum) were planted in rows one-eighth inch deep. The seeds were covered with a thin layer of finely screened soil. The containers were then treated with Bandane at rates of 0, 4, 6, 8, and 10 lb ai/A. Following chemical treatment mulching agents of vermiculite, perlite, ground organic thatch from Kentucky bluegrass turf, peat moss, and ground corn cobs were separately applied. These were compared to control containers mulched with finely screened soil. Part of the containers were watered from the top with a fine spray and the remainder were sub-irrigated. Results demonstrated quite conclusively that mulching agents altered the phytotoxicity of the test chemical.

Seedlings growing in containers treated with Bandane and mulched with vermiculite, perlite, or finely screened soil, were either killed or their growth retarded to a much greater degree than seedlings growing in containers mulched with organic thatch, or peat moss. Ground corn-cob meal was intermediate. For the purposes of greenhouse testing where maximum toxicity is desired, vermiculite or perlite would appear to be superior to organic thatch, peat moss or ground corn-cob meal. These tests further suggest that the natural thatch in bluegrass turf lowers the toxic character of threshhold dosages of Bandane. For maximum selective action, best results can be expected where as much thatch as possible is removed prior to pre-emergence treatment.

Bandane was consistently more uniformly phytotoxic to germinating crabgrass seed in those containers that were sub-irrigated as compared to top spray watering. These results confirm results of similar experiments reported in 1962. It was further demonstrated that hairy crabgrass (Digitaria sanguinalis) is more resistant to Bandane than smooth crabgrass (Digitaria ischaemum). (Colorado Agricultural Experiment Station, Colorado State University, Fort Collins)

16. The use of Banvel-D on miscellaneous turf weeds. Chamberlain, H. E.; Fults, J. L.; and May, J. W. Liquid formulation of Banvel-D was applied to turf infested with common chickweed (Stellaria media), mouse-ear chickweed (Cerastium vulgatum), knotweed (Polygonum aviculare), black medic (Medicago lupulina), white clover (Trifolium repens) and other common broad-leaved turf weeds.

Banvel-D was applied at rates of 1/2, 1 and 2 lb ai/A. This chemical was effective in controlling these weeds at the three rates used. However, common chickweed seed germinated freely after the established chickweed plants were killed and consequently required repeated applications to control. Chemical application was confined primarily to turf located away from the root zone of shrubs and trees. This was done because experience at other localities in the United States has indicated that presently available formulations of this chemical may be injurious to trees and shrubs at rates not toxic to established bluegrass turf. (Colorado Agricultural Experiment Station, Colorado State University, Fort Collins)

17. Weed control in conifers. Ticknor, R. L. A program to evaluate the effect of chemical weed control on ten species of conifers was started in the spring of 1960. The species were Abies concolor, A. grandis, A. magnifica shastensis, A. procera, Picea agies, Pinus contorta, P. nigra, P. ponderosa, P. sylvestris and Pseudotsuga Menziesii. The pines appear to be most resistant to herbicide damage, followed by P. abies, P. Menziesii, and Abies, in that order.

A total of eleven herbicide compounds were involved, many at more than one rate and in some cases in granular as well as liquid form. Black plastic mulch as well as a cultivated check treatment were also included.

Atrazine at 1 lb/A and simazine at 1 or 2 lb/A were the best herbicides in terms of plant survival and plant growth. These materials also gave satisfactory weed control. Diuron at 1 lb/A, as a spray or granular application, did not cause plant damage, but plantain became a problem on the plots. At 2 or 4 pounds, plant toxicity in the form of chlorosis, reduced growth, and reduced plant survival became evident. Several herbicides--Stauffer's R1607, 5 lb/A; DCPA, 10 lb/A; and CIPC, 8 lb/A--showed no phytotoxicity, but all failed to control mayweed, Anthemis coluta. Dichlobenil at 5 lb/A has been used after the plants were established for one year without phytotoxicity and with satisfactory weed control.

The cultivated check had below-average plant survival and below-average height. The black plastic had below-average survival because of loss of Abies; however, growth of the Pinus species was above average. (North Willamette Experiment Station, Oregon State University, Aurora)

18. Evaluation of herbicides for chemical weed control in shelterbelts. Guenthner, Harold R. and Laurence O. Baker. Results prior to 1961 indicated that simazine and diuron would provide satisfactory weed control in established Caragana and Russian Olive. In order to make a sound recommendation in newly planted shelterbelts additional investigations were planned.

In the spring of 1961, six species of trees were planted for this specific purpose. The species included were: caragana, Russian olive, green ash, Siberian elm, ponderosa pine, and Douglas fir. Plot size was 12 feet x 30 feet, 3 replications.

The following herbicides were applied immediately after planting in 1961: simazine at 2.5 and 5 lb/A; diuron at 2.5 and 5 lb/A; amiben at 2.5 and 5 lb/A; amiben at 2 lb/A plus dalapon at 3 lb/A; Premerge at 1.5 lb/A plus simazine at 2.5 lb/A; Premerge at 1.5 lb/A plus dalapon at 3 lb/A. Due to a dry growing season amiben at 5 lb/A was the most effective treatment in 1961. The 60 percent weed control obtained was still not satisfactory.

In the fall of 1961, the following herbicidal applications were made: simazine granular at 5 and 10 lb/A; diuron at 5 and 10 lb/A; amiben granular at 2.5 lb/A and Banvel D at 1 lb/A.

The spring of 1962, the following herbicides were applied: simazine granular at 5 lb/A; diuron granular at 5 lb/A; paraquat at 2 lb/A plus dichlobenil granular at 4 lb/A; ATAT at 1 lb/A plus simazine granular at 2.5 lb/A; paraquat at 2 lb/A plus simazine at 2.5 lb/A; Dinitro at 1.87 lb/A plus simazine granular at 2.5 lb/A; 2,4-D at 2 lb/A; and SD-7961 granular at 10 lb/A.

In addition to the 24 herbicidal treatments, two cultivated checks and one weedy check were included.

Results in 1962 were influenced by the abundant precipitation which was obtained throughout the growing season. Of the herbicides evaluated simazine and diuron provided the most satisfactory weed control. Comparisons of the simazine treatments indicated that simazine is leached thru the soil at a slower pace than corresponding diuron treatments.

Simazine appears to be more effective in controlling grassy species. Tree vigor determinations indicate that green ash, caragana, and Russian olive are injured and stunted by all simazine treatments. Comparisons of the Diruon treatments showed no adverse effects on tree vigor of the species evaluated.

Amiben which was effective in 1961 did not provide any weed control during 1962. Banvel D and prometone provided excellent weed control however considerable tree injury resulted in death of most of the tree species.

The data which will be collected in 1963 should provide substantial evidence for a sound recommendation for chemical weed control in newly planted shelterbelts or established shelterbelts in Montana. (Montana Agricultural Experiment Station, Central Montana Branch Station, Moccasin)

19. Herbicide residues in the soil. Crabtree, Garvin. A study of the residual activity of several herbicides was begun in 1960. Emphasis was placed on materials that are used at relatively high dosage rates for the control of perennial weeds. Herbicide applications were made in the fall or spring and one series of plots had applications repeated the second year. Fruit and vegetable crops were planted in 1961 and 1962.

Although this study is not complete, some interesting information has been obtained from the past growing seasons. Twenty lb ai/A of 2,3,6-TBA, as would be used in a field bindweed eradication program, resulted in severe injury to a sensitive crop such as beans two years after application, while sweet corn, a more tolerant crop, grew normally. Dicamba (2-methoxy-3,6-dichlorobenzoic acid) appeared to have a much shorter residual life and resulted in no injury to beans planted one year after application.

Where several herbicides were applied at logarithmically varying dosage rates and thoroughly incorporated into the soil, beans and strawberries were grown as test crops. Some of the information from this trial is presented in the table following. It is apparent that the major loss of herbicidal activity occurs during the warm part of the year. This would indicate that biological breakdown is an important means of dissipation of these herbicides. In general, strawberry transplants show more tolerance to these herbicides than do bean seedlings, particularly with simazine. (Oregon Agricultural Experiment Station, Oregon State University, Corvallis)

Application rate at which no apparent injury occurred to beans and strawberries following application of certain herbicides

	Bush beans	Strawberries
Atrazine		
Spring applied -- 1 mo. before planting	2.5	3.2
Fall applied -- 8 mo. before planting	2.9	3.3
Spring applied -- 1 yr. before planting	5.6	8.4
Fall applied -- 1 1/2 yr. before planting	4.0	8.4
Diuron		
Spring applied -- 1 mo. before planting	3.6	5.2
Fall applied -- 8 mo. before planting	3.8	4.3
Spring applied -- 1 yr. before planting	6.3	8.3
Fall applied -- 1 1/2 yr. before planting	5.9	12.6
Simazine		
Spring applied -- 1 mo. before planting	2.8	3.4
Fall applied -- 8 mo. before planting	3.5	5.1
Spring applied -- 1 yr. before planting	6.2	14.0
Fall applied -- 1 1/2 yr. before planting	6.2	14.2

PROJECT 5. WEEDS IN AGRONOMIC CROPS

H. Fred Arle, Project Chairman

SUMMARY

Thirty six papers were received for publication in this section from personnel in 8 states and pertained to weed control in 10 crops. Three papers concerned chemical fallow. Developments of the past year are briefly summarized:

Alfalfa. Control of field dodder was the objective in several experiments. A colloidal formulation of IPC was more effective than an emulsifiable concentrate in Eastern Oregon. Other papers received from Oregon, Washington and California reported on the effectiveness of several newer herbicides. Most investigators reported good control with DCPA, DMPA, and trifluralin.

Sugar beets. Initial results of a weed seed survey are reported from Colorado. Weed seeds are classified and correlated with field surveys and soil characteristics. Correlations could be useful in making weed control recommendations to growers. Several chemicals have given good control of annual weeds and under some conditions, combinations of chemicals were used to advantage. Efficiency of weed control and the effect on sugar beets is influenced by various environmental and cultural conditions and indicates a need for several herbicides to solve weed problems in sugar beets.

Corn. Most work was designed to overcome handicaps encountered by pre-emergence applications of herbicides in areas of uncertain rainfall after treatment. A California study involving two methods of soil incorporation showed herbicides to be generally more toxic and less selective when applied with a spray blade than when incorporated with a rotary tiller. Pre-emergence applications of atrazine and ametryne gave season-long control of annual grasses in Wyoming and EDITC controlled barnyard grass in Oregon.

Cotton. In New Mexico, pre-plant, pre-emergence and layby applications of diuron and DCPA have controlled annual grasses and broadleaved weeds without injury to cotton. Several other chemicals: dichlobenil, trifluralin, prometryne and Bayer 40557 have shown promising results as pre-emergence or layby applications. In Arizona, pre-plant applications of diuron caused higher seedling losses with Pima S-2 and Acala 44 than with DpSL and Acal 4-42. In skip-row cotton, layby applications of diuron gave better control of grassy weeds than did monuron or diphenamid. Work in Arizona showed that the placement of cotton seed in relation to the layer of diuron in the beds following pre-plant (preiist) applications of diuron was found an important consideration. Greatest loss of seedlings occurred when cotton seed was placed 1 or 2 inches below the diuron. Chemicals showing considerable promise as pre-plant applications included DCPA and trifluralin for annual grass control and prometryne symetryne for the control of annual broadleaved weeds.

Flax. Evaluations of several chemicals in Oregon indicated that pre-emergence applications of G-34698 (2-chloro-4-isopropylamino-6-(3 methoxypropylamino)-s-triazine) gave good broadleaf weed control in seed flax without crop injury.

Forage. In Washington, diquat applied at 1 lb/A effectively controlled annual weeds which had emerged during the 4-week period after seedbed preparation with no injury to grasses seeded 1 day after application. Post emergence applications of Banvel D to orchard grass and timothy resulted in excellent control of annual broadleaved weeds.

Peas. Little difference in wild oat control was noted in a Washington experiment which compared 5 methods of incorporating Avadex. Post emergence applications of barban were most effective when applied in low volumes of water carrier.

Peppermint. A screening experiment in Oregon indicated that isocil, trifluralin and possibly BSBMU may have value for the control of annual weeds.

Safflower. One paper, received from California, pertained to weed control in safflower. Topical applications of 2,4-bis(3 methoxypropylamino)-6-methylthio-6-triazine and 1-(3,4-dichlorophenyl)-3-isopropyl 3-(2-propynyl)urea gave excellent control of lambsquarters but were less effective on pigweed and totally ineffective against grasses.

Wheat. Considerable tolerance of Gaines wheat to applications of 2,4-D were noted by investigators in Oregon and Washington. A water soluble amine formulation showed slightly more selectivity than other 2,4-D formulations. Wild oats were controlled by 1/3 lb/A of barban in Washington, higher rates of this material reduced wheat and barley yields. Corn gromwell in Golden wheat was effectively controlled in Oregon by various formulations of 2,4-D at rates varying from .5 to 1.5 lb/A. Prometryne and ACP 62-70 were also effective. Downy brome in winter wheat was controlled in Washington by post-emergence applications of atrazine. However it was indicated that the use of this chemical will be limited to areas receiving in excess of 10 inches annual precipitation and where soil organic content exceeds 1.5 percent. Several other chemicals also appear promising and warrant further testing. Search for an herbicide to eradicate wild buckwheat in winter wheat continues in Montana. Evaluation of herbicides indicated ACP 62-70 and Banvel D as potential herbicides for wild buckwheat control.

Chemical fallow. Work in Wyoming and Oregon show that atrazine, combinations of atrazine and amitrol, simazine and propazine give lengthy control of downy brome on winter wheat land. On sandy soils, atrazine in excess of .8 lb/A caused a yield reduction of winter wheat. On the same soil, spring wheat yields were reduced by previous application of .4 lb/A of atrazine. Experimental work at two locations in Oregon indicated antagonism of chemicals when atrazine and Banvel D were applied in combination. Control of downy brome was much less effective when both materials were present on the same plot than where the same rate of atrazine was used alone.

1. Downy brome control in established alfalfa. Appleby, Arnold P. Downy brome (Bromus tectorum) is a serious problem in alfalfa hay and seed production in Oregon. In order to obtain further information on older compounds and to test new herbicides for the selective removal of downy brome from established alfalfa, a trial was initiated at Hermiston, Oregon in January, 1962. The site was located on Ephrata loamy sand. Applications were made on January 5 and March 6. In addition, paraquat was applied on April 6. An appreciable amount of downy brome had emerged by January 5 but most of it emerged between the January application and the March application. A considerable amount of the downy brome had reached the 5-6 tiller stage by

March 6. The experiment was flood-irrigated in late March. Percent downy brome control was estimated on May 2 and yields were taken May 9 from treatments giving nearly complete weed control. Alfalfa and grass were separated by hand for the check plots. Downy brome control and yield data are given in the following table.

Downy brome control in established alfalfa

Treatment	Lb ai/A	Ave. percentage Downy brome control	Ave. yield (tons/A)
Jan. 5 application			
isocil	.2	93	1.65
"	.4	100	1.75
"	.8	100	1.32
"	1.6	100	0.93
simazine	.4	98	1.66
"	.8	99	1.47
"	1.2	100	1.61
atrazine	.2	72	--
"	.4	98	1.60
"	.8	100	1.40
"	1.2	100	1.38
CP-31675	2	90	1.40
"	4	100	1.56
paraquat	2	70	1.56
paraquat + simazine	2 + .8	100	1.59
paraquat + atrazine	2 + .8	100	1.46
TD-305	4	100	1.29
"	6	100	1.38
March 6 application			
isocil	.2	100	1.96
"	.4	100	1.74
"	.8	100	1.63
"	1.6	100	1.13
du Pont 976	.2	98	1.71
"	.4	100	2.00
"	.8	100	1.85
"	1.6	100	1.27
paraquat + isocil	1 + .2	100	2.03
paraquat + isocil	1 + .4	100	1.52
paraquat + isocil	1 + .8	100	1.20
Check	0	0	(Alf.) 1.52 (Weeds) 0.70

January treatments giving unsatisfactory control were ACP 61-207 at 1-3 lb, trifluralin at 1-8 lb, FW-925 at 1-4 lb, paraquat at 1/2-2 lb, and endothal at 1-4 lb. Unsatisfactory March treatments were endothal at 1-4 lb, TD-191 at 1-4 lb, paraquat at 1/2-2 lb, and H-8043 at .8-3.2 lb.

Results from isocil, du Pont 976 (5-bromo-3-sec butyl-6-methyluracil), simazine, and atrazine appear particularly encouraging. Research on these compounds is continuing. (Oregon State University, Pendleton Branch Experiment Station, Pendleton)

2. Preliminary comparisons between two IPC formulations. Appleby, Arnold P. A regular 2 lb/gal emulsifiable formulation and a 4 lb/gal colloidal suspension formulation of IPC were included in two weed control experiments in 1962. One experiment was for the control of field dodder (Cuscuta campestris) in established alfalfa. Both formulations were applied at 6 lb/A immediately following sprinkler irrigation. The colloidal suspension was estimated to give 61 percent dodder control while the emulsifiable formulation gave 20 percent control.

The other experiment was for wild oat control in peas. Both formulations were applied both as pre-plant-incorporated treatments and pre-emergence applications at 5 lb/A. Applied pre-plant and incorporated into the soil, the colloidal formulation and emulsifiable concentrate gave 88 percent and 60 percent wild oat control, respectively. The pre-emergence treatments gave 78 percent and 65 percent with the colloidal formulation again giving the better results.

Although these results are preliminary, they tend to indicate that the colloidal formulation is superior to the emulsifiable concentrate under Eastern Oregon conditions. (Oregon State University, Pendleton Branch Experiment Station, Pendleton)

3. Dodder control in alfalfa. Brown, D. A., Furtick, W. R. An experiment was conducted to screen potential herbicides for use in established alfalfa stands infested with dodder. Herbicides were applied both pre and post-emergence to dodder germination at Corvallis, Oregon on a Chehalis sandy loam soil. The dodder was seeded over the alfalfa and irrigated with one inch of water by sprinkler. To determine the residual life of the chemicals the dodder was seeded at two different dates in the pre-emergence trial, and each date was evaluated separately.

The evaluation was made on November 13, 1962 when the alfalfa had started to lose its leaves, and the dodder was the most conspicuous. The data indicates that DCPA, trifluralin, and DMPA gave about equal dodder control with little or no noticeable alfalfa damage when applied pre-emergence. In the post-emergence trial only DCPA was applied. It gave good control with no visible damage to the alfalfa. The dodder remaining in the post-emergence plots was highly distorted and it is doubtful that it would set seed. Since the dodder was attached and spreading at the time of post-emergence treatment, it would appear the control was from systemic action through uptake of DCPA by the alfalfa. (Oregon Agricultural Experiment Station, Corvallis)

Dodder control in alfalfa when treated pre-emergence to dodder germination

Chemical[1]	Rate[2]	Percent dodder control[3]	Percent dodder control[4]	Percent alfalfa damage
DCPA	1	91	70	0
DCPA	2	100	100	0
DCPA	4	100	94	10
DCPA	6	100	100	0
DCPA	8	100	100	0
DCPA	16	100	100	0
CP 31675	8	100	50	30
trifluralin	4	100	88	0
trifluralin	8	100	100	10
DMPA	8	100	100	0
DMPA	16	100	100	0
2,4-DEP	8	91	13	40
isocil	2	98	100	90
OMU + BiPC	8	96	88	35
CIPC	8	96	30	15
dichlobenil	1	57	7	0
dichlobenil	2	80	70	35
dichlobenil	4	90	80	50
SD 7585	4	50	44	10
SD 7961	4	87	57	70
Check		0	0	0

Control of established dodder in alfalfa

Chemical[5]	Rate[2]	Percent dodder control	Percent alfalfa damage
DCPA	3	83	0
DCPA	6	94	0
Check		0	0

[1] Pre-emergence chemicals were applied July 29, 1962

[2] All rates of application expressed in lb ai/A.

[3] First dodder seeding July 29, 1962

[4] Second dodder seeding August 28, 1962

[5] Post-emergence chemicals were applied September 4, 1962

4. Dodder control in alfalfa using DCPA. Hoffman, E. C. and Bayer, D. E. A timing trial involving three dates, December 16, March 6, and May 11, was established in San Bernardino County to determine the most effective time to apply DCPA to established alfalfa for dodder control. Rates used were 5, 7 1/2, and 10 lb/A ai.

The results indicate that 7 1/2 lb/A applied in March provided satisfactory season long dodder control. In this trial the December application did not give satisfactory control throughout the entire growing season. Some control was evident early in the season, but by mid season there was no evidence of control. Applications made in May were too late as germination of the dodder had already started. (University of California, Davis)

5. Evaluation of herbicides for dodder control in alfalfa. Dawson, J. H. Since September 1961, initial greenhouse evaluations of herbicides for dodder control, using alfalfa as the host plant, have been conducted. Abundant seed of field dodder (Cuscuta campestris Yunck.) is mixed with the surface 2 inches of soil in 3-gallon cans in which 6 alfalfa plants are growing. Herbicides are applied to the soil surface or mixed with the soil to a prescribed depth. One week after application, emerged seedlings are counted, and two weeks later seedlings definitely attached to the host are counted. Critical evaluation of herbicidal activity against dodder is based on the counts of attached dodder.

Several herbicides completely prevented dodder attachment. These herbicides with the lowest rates which gave 100 percent control are as follows: CIPC, 3 lb/A; DCPA, 10 lb/A; CDEC, 6 lb/A; CDAA, 6 lb/A; dichlobenil, 2 lb/A; propynyl N-(3-chlorophenyl)carbamate, 6 lb/A; α-carbo-(2,4-dichlorophenoxyethoxy)ethyl N-phenylcarbamate, 12 lb/A; α-carbo-(2,4-dichlorophenoxyethoxy)ethyl N-(3-chlorophenyl)carbamate, 6 lb/A; isopropyl N-(3,4-dichlorophenyl)carbamate, 12 lb/A; and sec-butyl N-(3-chlorophenyl)carbamate, 6 lb/A. In addition, trifluralin at 4, 6 and 8 lb/A gave 81, 92, and 92 percent control and DMPA at 20, 30, and 40 lb/A gave 92, 93, and 98 percent control, respectively.

Herbicides were usually considered ineffective if the highest rate evaluated failed to give at least 80 percent control. Herbicides in this category with the highest rate tested are as follows: diphenamid, 8 lb/A; linuron, 4 lb/A; dalapon, 10 lb/A; prometryne, 8 lb/A; EPTC, 6 lb/A; endothal, 8 lb/A; simazine, 2 lb/A; diuron, 6 lb/A; diphenatrile, 40 lb/A; sodium PCP, 30 lb/A; and methyl N-(3,4-dichlorophenyl)carbamate, 12 lb/A.

Field research and farmer applications have shown that CIPC kills dodder seedlings selectively in alfalfa seed fields. The short soil life of CIPC limits its effectiveness in dodder control, however.

In 1962, DCPA at 6, 10, and 14 lb/A and dichlobenil at 1, 2 1/2, and 4 lb/A were applied in alfalfa seed fields. There was significant, but incomplete dodder control at all rates of DCPA with no injury to the alfalfa. Control was more effective as the rate of DCPA increased. In one study involving newly seeded alfalfa, DCPA at 6, 10, and 14 lb/A provided effective dodder control with only temporary injury to the alfalfa seedlings.

Based on counts of attached dodder one month after application, dichlobenil gave 100 percent control at 2 1/2 and 4 lb/A and 85 percent control at 1 lb/A. The alfalfa recovered satisfactorily from slight injury from the 1 and 2 1/2 lb/A rates of dichlobenil. Irrigation six weeks after application brought on a flush of dodder emergence. This dodder was not controlled by any rate of dichlobenil, suggesting that the effectiveness of dichlobenil, like that of CIPC, may be limited by lack of persistence in the soil.

Field and greenhouse studies will be continued until satisfactory methods of dodder control in alfalfa are developed. (Crops Research Division, U.S. Department of Agriculture, Irrigation Experiment Station, Prosser, Washington)

6. Annual weed control in alfalfa using diuron plus wetting agent. Torngren, T. S. and Bayer, D. E. A replicated trial was established using a logarithmic sprayer to investigate the possibility of controlling young annual weeds out of established alfalfa stands with diuron plus a wetting agent (Colloidal X-77). The wetting agent was used to increase the foliar activity of the diuron to control the established young weeds. The soil residual of the diuron would then

control the weeds for the remainder of the year.

The application was made on January 30, 1962 on dormant alfalfa (Lahonton). The weeds varied from emergence to nine true leaves. Treatments used were:

1.	diuron	3 lb/A	log		
2.	diuron	3 lb/A	log	wetting agent	1/4% constant
3.	diuron	3 lb/A	log	wetting agent	1/2% constant
4.	diuron	3 lb/A	log	wetting agent	1% constant
5.	diuron	3 lb/A	constant	wetting agent	2% log
6.	diuron	2 lb/A	constant	wetting agent	2% log
7.	diuron	1 lb/A	constant	wetting agent	2% log

Fog occurred every day following treatment until it rained on February 6. Temperatures ranged from a low of 29°F to a high of 69°F. Weeds present were Douglas fiddleneck, miners lettuce, shepherdspurse, field chickweed, common mallow, redstem filaree, mustard, curly dock, and annual sow thistle.

Observations one week following application indicated a slight increase in foliar activity with the 1/2 to 1 percent concentration of wetting agent. Three weeks after treatment, no differences could be observed. Weed control was observed at the following rates of diuron: Douglas fiddleneck, 1 lb/A; miners lettuce, 2 lb/A; shepherdspurse, 1 lb/A; field chickweed, 3 lb/A; and mustard, 1 lb/A. No control of the other species was obtained. (University of California, Davis)

7. Survey of weed seed potential common to sugar beet fields. Alley, H.P. and Fults, J. L. A cooperative project between The Great Western Sugar Co. and the Botany and Plant Pathology and Agronomy departments of Colorado State University was organized in the spring of 1962. Representative soil samples from Montana, Nebraska, Colorado, Wyoming and Ohio were collected by the sugar company fieldmen and forwarded to the University for analysis of weed seed content and soil characteristics. The purpose of the study was to classify and count all weed seeds in the soils and correlate these counts with field surveys and soil characteristics. Good correlation of weed seed infestation, field survey, and certain soil characteristics would enable the establishment of a firm basis for weed control recommendations for sugar beet growers in these areas.

Weed seed infestation of all samples were determined by, 1)water separation, whereby a representative portion of the soil was washed through a fine-mesh screen to separate the weed seed, and 2) greenhouse germination studies.

Assuming an average weight of 400,000 lbs. of soil per acre-inch, the water-separation study showed some soils contained as high as 254,000,000 pigweed seeds (Amaranthus retroflexus) per acre-inch of soil or 5830 pigweed seeds per sq ft of soil 1-inch deep, lambsquarter's (Chenopodium album) and green bristlegrass (Setaria viridis) 1040 seeds per sq ft of soil 1-inch deep.

Three replications of 150 g each of the 90 representative soil samples were germinated under greenhouse conditions. The temperature ranged from 72-80°F and the flats were sub-irrigated. This study showed a high of only 4 percent germination of pigweed when compared to the actual infestation of the water-separation study. This low germination may have been a result of the germination temperatures used or possibly due to germination periodicity which is a well established phenomenon in pigweed seed, according to Dr.

Barton of the Boyce Thompson Institute. The important point established is the tremendous annual weed potential present in many of the soils of this area. This study further indicates the pressing need for comprehensive studies of the biology of weed seeds, in order to develop the best weed control practices.

Temperature and correlation studies are being conducted but are not far enough along for inclusion in this report. (Colorado Agricultural Experiment Station, Colorado State University, Fort Collins)

8. Weed control in fall seeded sugar beets. Baldwin, R. W., and Furtick, W. R. A series of herbicide trials were set out in the Willamette Valley in a search for aids in sugar beet seed production. The results obtained from three locations will be summarized in this report.

The herbicides which were tested are: EPTC at 3 lbs/A, DATC at 3 lb/A, CP-32179 (preplant and pre-emergence treatments) at 1, 2, 4 and 6 lb/A, CP-31675 (preplant and pre-emergence treatments) at 1, 2, 4 and 6 lb/A, CTMU (3-cyclohexyl-5,6-trimethylene uracil) (preplant and pre-emergence treatments) at 2 and 4 lb/A, TD 191, TD 282, TD 283 all at 1 and 2 lb/A (as post-emergent treatments), endothal and IPC at 2 and 6 lb/A respectively.

There were three very interesting new compounds in this test, namely, CTMU and two coded materials of Monsanto Chemical Co. CP-32179 and CP-31675.

CTMU as a rule gave little sugar beet injury at 4 and 6 lb/A while it gave excellent (87-100 percent) weed control of Senecio vulgaris L., Stellaria media (L) Cyrill., Rumex acetosella L., Anthemis cotula L., Lolium multiflorum Lam, and Brassica species, however, this herbicide gave only fair control (20-40 percent) of Amaranthus retroflexus L.

CP-31675 tended to stunt the crop somewhat at first, however, it is believed that no reduction in yield will result. This herbicide gave more erratic results than the CTMU which is no doubt a reflection of the different soil types. Generally, the compound also gave excellent weed control on the species mentioned above with the exception of Anthemis cotula L. and Amaranthus retroflexus L.

CP-32179 also showed a tendency to stunt the crop temporarily. This chemical was more persistent in its phototoxic properties and gave excellent control of all species mentioned above with the exception of Anthemis cotula L. when the herbicide was applied as a preplant treatment.

The endothal derivatives TD 191, TD 282 and TD 283 were generally more effective than endothal. (Farm Crops Department, Oregon State University, Corvallis)

9. Chemical weed control in sugar beets. Chamberlain, E. W., Becker, C. F., Alley, H. P. and Costel, G. L. Sugar beet plots were established at three locations in 1962 to determine the effects of full coverage pre-emergent chemical treatment and other plots were treated with post-emergent chemicals. The pre-emergent treatment had PEBC at 3 lb/A or endothal at 6 lb/A on a 6-in band over the beet row with EPTC at 3 lb/A or EPTC at 3 lb/A and dalapon 6 lb/A on the 16-in band between the rows. The 6-in band treatment of PEBC gave better weed control than endothal. The control was better where EPTC or a mixture of EPTC and dalapon was used on the 16-in band between the row.

Equipment developed for post-emergent treatments consisted of a sprayer and granular applicator mounted on a small tractor along with an incorporation device consisting of a single row of tines. Post-emergent treatments of EPTC at 3 lb/A on the row gave one additional month of weed control. The grass-weed control for the PEBC pre-emergent treatment followed by a post-emergent treatment of EPTC, and a pre-emergent treatment of PEBC on-the-row and EPTC or an EPTC-dalapon mixture between the rows followed by a post-emergent treatment of EPTC were very nearly equal. The PEBC pre-emergent treatment followed by a post-emergent treatment of EPTC resulted in nearly as good broadleaved weed control in late June as the pre-emergent treatment of PEBC on the row and EPTC or an EPTC-dalapon mixture between the rows followed with a post-emergent treatment of EPTC. The sugar beet stand and yield were significantly reduced on the sandy loam soil treated with EPTC or EPTC-dalapon mixture between the rows but did not affect the stand or yield on the clay soils. The post-emergent treatment did not affect the stand or yield with no difference between the granular or spray formulations.

The endothal pre-emergent treatment followed by a post-emergent endothal treatment resulted in less control than PEBC-EPTC treatments. Further information on this research is available in the 1962 Progress report (Mimeograph Circular No. 179) published by the University of Wyoming. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie)

10. Field evaluation of selective herbicides in California sugar beets. Crowell, G. C. We can expect to find neither one herbicide nor one method of application that will prove economically feasible and effective for all areas of commercial sugar beet production. This conjecture is based upon reviewing results of chemicals that are now being or have been evaluated for this crop under various environmental and cultural conditions. The ingenuity of man may overcome this hurdle in the future, but we are searching for positive results in the present. Thus, we must continue to test potential herbicides under conditions of wide latitude.

In April 1961 an evaluation plot was established at our Tracy, California research facility. Here a comparison was to be made between various herbicides and two methods of soil incorporation. The treatments used included TCA, DATC, R-2061, the disodium salt of endothal (EWK), the dipotassium salt of endothal (TD-273), EWK plus R-2061, TCA plus EWK and various other amines of endothal. One method of incorporation thoroughly mixed the chemical with the top 2 inches of soil while the other layered the herbicide 1-2 inches below the soil surface. The former was accomplished with the Bye-Hoe, a power driven rotary tiller, and the latter with the Rus-Ken Chemical Placement Tool, a combination of the Sinner Weeder and a "V" shaped shoe.

The plots were 2 rows (30 inches) by 25 feet replicated twice. The herbicide was applied to the bed top in a 10 inch band for the Bye-Hoe treatment and a 6 inch band for the Rus-Ken. This was dictated by the bedtop width and the nature of the incorporating equipment. Immediately following the treatments, sugar beet seed was planted at 1/2 inch depth and at the rate of six seeds per foot. The field then received the first of two furrow irrigations that were necessitated to bring the crop to emergence. In both instances the beds received a complete wetting.

Five weeks after the first water had been applied, all treatments received a preliminary evaluation with respect to the control of the emerged weeds, common lambsquarters, Chenopodium album L. and redroot pigweed, Amaranthus retroflexus L. Out of a total of 36 treatments, only those involving a R-2061 manifested visual symptoms of control. All treatments of this herbicide at 4 and 6 lb ai/A and both methods of incorporation gave 90-95 percent weed control. There was a stunting of the beet seedlings only in treatments where the R-2061 had been layered beneath the soil.

Of all herbicides used, DATC and R-2061 move the least with water in the soil and were, no doubt, less affected by the first two heavy irrigations than were any of the others. DATC has been found to be very specific for wild oats and gave no control of the broadleaves in this test. R-2061 was possibly moved from its initial band in the layered plots by the heavy irrigations, but the amount was most likely negligible as indicated by the crop stunting.

A further indication of the lack of mobility of R-2061 in the soil is shown in a subsequent experiment. Here, 4 lb ai in 50 gallons of water was applied as an overall pre-emergent spray to one acre planted with sugar beet seed in dry soil on 30 inch beds. This was followed by sprinkler irrigation within one hour after the application was made. The initial water application wet the heavy clay soil to a depth of 18 inches. Five days later, the entire plot was again sprinkled so as to wet the soil to a depth of 12 inches. Upon emergence there was no crop injury and the treated areas were 90 percent free of redrood pigweed, Amaranthus retroflexus L. and common mallow, Malva neglecta Wallr., the two main weeds.

During January 1962, again at our research station in Tracy, California, an experiment was designed to evaluate several herbicides as pre-emergent sprays where the only subsequent moisture to the soil would be from natural rainfall. The herbicides were applied in a sprayed band 10 inches wide over the seed row on beds with 30 inch centers. Each treatment was 2 rows by 25 feet, replicated twice. The herbicides included were N-cyclooctyl-N'-dimethylurea (OMU), endothal, and the following amines of endothal: disodium salt (EWK), diammonium salt (TD-80), dipotassium salt (TD-273).

Both rates of TD-80 and the lowest rate of EWK were applied 1-17-62. First rainfall was 1-18-62 with a total of 6.70 inches to 3-7-62 when the weed control was rated. All other treatments were applied 1-26-62. The first date of rainfall following these treatments was 2-6-62 with a total of 5.99 inches until 3-7-62. The accompanying table indicates the final results.

In none of the plots could any visual damage to the emerged beets be detected. Similarly, there was no reduction in stand when compared to the check plots. (Agricultural Research Department, Holly Sugar Corporation, Brawley, California)

Comparison of some pre-emergent herbicides on sugar beets under rainfall conditions

Herbicide	Rate/A*	Weed control rating**
EWK	3.8	1
	4.8	7
	6.4	8
TD-80	4.8	2
	6.4	0
TD-273	4.8	8
	6.4	8
endothal	4.8	6
	6.4	9
EWK plus OMU	3.8 1.2	8
EWK plus OMU	5.1 1.6	9

* Rate is in pounds of acid equivalent per sprayed acre except for OMU which is expressed in pounds of active ingredient per sprayed acre.

**All ratings on a scale of 0-10; 0 = no weed control, 10 = complete control. Both are in comparison to paired check plots. Ratings were made on 3-7-62. Main weeds were burning nettle, *Urica urens* L., and London rocket, *Sisymbrium irio* L.

11. Selective weed control in corn under western Oregon conditions. Baldwin, R. W., Brown, D. A. and Furtick, W. R. Due to the marine type climate of western Oregon often there is not enough rainfall, following corn seeding to activate many pre-emergence herbicides. As a result there are many failures with herbicides such as atrazine, CDAA and mixtures of CDAA and TCBC (trichlorobenzyl chloride).

A series of experiments were set out to compare linuron (applied both as a pre-emergence and a directed spray post-emergence treatment), DPA (applied as a directed spray post-emergence treatment), atrazine (applied pre-emergence), a mixture of CDAA and TCBC (applied pre-emergence), EPTC and EDITC (ethyl di-isobutyl thiolcarbamate) (the latter two were applied as incorporated preplant treatments).

Linuron was generally more toxic to the crop and less toxic to the weed population than was atrazine, however, linuron did perform more satisfactorily as a pre-emergent treatment than did the mixture of CDAA and TCBC.

EDITC at 6 lb/A showed little if any damage to the corn while rates as low as 2 lb/A gave good weed control especially of barnyard grass (*Echinochloa crusgalli* (L.) Beauv.) which is a major weed problem in western Oregon corn fields.

EPTC gave similar weed control as EDITC, however, was much more injurious to the corn.

DPA was extremely toxic to the corn crop and was moderately effective in its weed control properties.

One additional small trial was set out to investigate using various materials as directed spray, post-emergent treatments.

The herbicides examined which gave no apparent corn injury and satisfactory weed control were diuron, linuron, (both with a wetting agent), at 2 - 3 lb/A, S-6000 at 3 or more lbs/A and 5-bromo-3-sec-butyl-6-methyluracil at 2 lb/A. (Oregon State Agricultural Experiment Station, Corvallis)

12. Chemical weed control in corn. Chamberlain, E. W. and Alley, H. P. Seven herbicides were tested during the 1962 growing season for pre-emergence weed control in field corn. The chemicals were tested on sandy loam soil and clay loam soil. Atrazine at 1 and 2 lb/A and ametryne at 2 lb/A gave 100 percent control of all grassy weeds and annual broadleaved weeds on both soils for the entire growing season.

Chemicals in this test which did not give satisfactory results were Lorox (3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea), 2,4-D butyl ester, CDAA, CDAA-TCBC, and prometryne. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie)

13. Evaluation of soil-incorporated herbicides for selective weed control in corn grown on delta soil. Foy, Chester L., Lyons, Torrey, Kempen, H. M. and Kaupke, Charles. Sixteen herbicides were evaluated for crop tolerance and control of mixed annual weeds in replicated paired row plots 120 feet long, involving two methods of soil-incorporation. Just prior to planting, the herbicides were applied (at rates shown in the table) in 9-inch bands in the rows by use of a tractor-mounted logarithmic dilution sprayer.

All chemicals were incorporated into the soil (A) with a power-driven rotary tiller which mixed uniformly 3 inches deep and (B) by use of a subsurface spray blade which placed the herbicide in a more concentrated vertical band at the 3-inch depth. Corn (Vinton 95) was planted approximately 3 1/2 inches deep. The soil was an Egbert muck (approximately 40 percent organic matter by analysis). The soil surface stayed dry, but just beneath moisture was available throughout the season from a high water table.

Treatments were rated independently by three observers as to rates of herbicide which provided satisfactory weed control and rates at which corn injury first occurred (see table).

The herbicides were generally more toxic and less selective when applied with the spray blade than when incorporated with a rotary tiller. With only one questionable exception (CDAA-TCBC on barnyardgrass), there were no instances of increased chemical control of monocotyledons (corn, barnyardgrass, nutgrass) by incorporation with the rotary tiller. On broad-leaved species, only five instances of improved weed control using the rotary tiller were noted. EPTC accounted for three of these, being more effective against all broad-leaved species when Bye-Hoe incorporated. The shallower depth of germination of broad-leaved species, the peculiar adsorption and volatility properties of EPTC and its greater toxicity against grasses may partially explain the results.

No new herbicides were more promising than atrazine, EPTC and CDAA-TCBC (tested earlier) as soil incorporated treatments for control of barnyardgrass in corn. Banvel-D shows some promise for selectively controlling annual

Rate of herbicide (lb/A) which adequately controlled weeds or first caused corn injury - subjectively weighted averages (4 replications x 3 independent observers) approximately 4 weeks after treatment

Herbicide	Starting (highest) rate (lb/A)	Subsurface spray blade						Powered rotary tiller					
		Corn	Barnyard grass	Nutgrass	Pigweed	Lambsquarters	Smartweed	Corn	Barnyard grass	Nutgrass	Pigweed	Lambsquarters	Smartweed
atrazine	24	24	6	-	4.5	4.5	-	24	6	-	1.5	4.5	-
ametryne	24	6	6	10	3	1.5	1.5	12	9	15	4.5	3	1.5
prometryne	24	10	5	10	3	-	3	9	6	-	6	-	-
linuron	20	10	15	-	10	5	10	20	20	15	10	10	10
EPTC	24	10	3	4.5	7	7	7	18	4.5	4.5	4.5	4.5	6
CDAA-T	16.8-42	12	12	-	1.5	1.5	1.5	24	9	-	1.5	1.5	3
2,4-dichlorophenyl-4-nitrophenyl ether	20	20	20	20	20	20	20	20	20	20	20	20	20
2,4-bis(3-methoxy-propylamino)-6-methyl thio-s-triazine	12	9	12	4.5	6	4.5	4.5	12	12	12	6	6	6
Banvel-D	8	8	6	-	2	2	-	8	6	6	4	3	3
DCPA	32	24	32	32	32	32	32	24	32	32	32	32	32
dichlobenil	12	4.5	9	-	9	6	-	4.5	9	-	9	-	-
isocil	20	2	1.7	7.5	3.5	1.2	10	2.5	2.5	7.5	3	3	3
1- 5-(3a,4,5,6,7,7a hexahydro-4,7-methanoindanyl) -3,3-dimethylurea	12	6	9	-	-	3	6	7.5	9	12	12	12	
Herb. 634*	12	2	-	-	-	0.8	-	2.2	6	-	4.5	3	3
1-(3,4-dichlorophenyl) -3-isopropyl-3-(2-propynyl) urea	12	12	12	12	-	9	12	12	12	12	-	-	12
t-butyl-di-n-propyl-thiolcarbamate	24	20	12	-	-	-	-	20	12	-	-	-	-

- No conclusion because of insufficient weeds or conflicting observations.

*Commercial code designation. Chemical structure still confidential.

broad-leaved weeds. Despite striking weed control in many plots, however, weed competition was not severe early in the season and control was adequate by cultural means in untreated portions of the field.

Based on its herbicidal potency and apparent lack of selectivity, isocil seemed promising for general weed control in noncropped areas in the delta. (Botany Department, University of California, Davis and the California Agricultural Extension Service)

14. Pre-planting chemical weed control in cotton. Anderson, W. P. and Whitworth, J. W. When applied to the soil surface prior to seeding and just before forming the raised seed beds, diuron and DCPA gave season-long control of annual grass and broadleaf weeds, without injury to the cotton crop, at rates of 1, 2 and 3 lb/A ai and 6, 9 and 18 lb/A ai, respectively.

On April 18, 1962, diuron and DCPA were applied as a broadcast spray in 45 gpa of water to the leveled surface of land prepared for cotton. Following application, the raised seed beds, upon which cotton is commonly grown in New Mexico, were formed by tractor-drawn listing-disks. The area was then irrigated. On May 9th, the cotton variety 1517D was seeded into the raised seed beds and a "soil-cap" formed over the seed row. On May 15th, after the cotton had germinated and the "crook" of the emerging seedling had just about reached the soil surface of the seed bed, the soil-cap was "struck-off" with a plank drawn behind a tractor. The cotton seedlings emerged soon after. Except for keeping the irrigation furrows open between beds, the soil remained undisturbed following the removal of the soil-cap. Additional irrigations were made on June 1, June 21 and August 9.

The experiment was terminated in August, due to a very poor stand of cotton, with the decision to continue with similar treatments in 1963. (New Mexico State University Agricultural Experiment Station, University Park)

The effectiveness of diuron and DCPA in selectively controlling annual weeds in cotton fields, variety 1517D, when applied as a broadcast spray to the soil-surface prior to forming the raised seed-beds

Treatment			
Chemical	lbs/A (active)	Weed control (percent)	Cotton injury (percent)
Untreated control		0	0
diuron	1	60	0
	2	85	0
	3	90	0
DCPA	6	90	0
	9	95	0
	18	95	0

15. Weed control in cotton from herbicide applications made at time of planting. Anderson, W. P. and Whitworth, J. W. Weed control was erratic when diuron and DCPA were applied, at time of planting, just under the "soil-cap" but over the covered cotton seed at dosages of 1, 2 and 3 lb/A ai and 6, 9 and 18 lb/A ai respectively.

On May 9, 1962, the cotton variety 1517D was seeded on raised single-row seed beds following established practices with the exception that a herbicide spray, containing diuron or DCPA, was applied in a 12 inch band over the seed row immediately after the seed was covered with soil, but before the soil-cap was formed. Spray nozzles were mounted on the cotton seeder between the press-wheel and the hiller-discs, and the compressed-air-type plot sprayer was also mounted on the seeder, so that planting and spraying were achieved in a single operation. On May 15, the soil-cap was "struck-off" with a plank pulled by a tractor. Other than reworking the furrows prior to each irrigation, the soil remained undisturbed for the remainder of the experiment. The experiment was discontinued in August due to a marked reduction of the cotton stand by Rhizoctonia and other seedling diseases.

Due to the erratic results obtained from this method of herbicide application, it is not planned to continue experiments with this method. In some instances, weed control was excellent, and in others, it was non-existant. In some cases, just the removal of the soil-cap appeared to give excellent weed control in the cotton row. In every case, additional cultivations would have been required for the control of weeds between the rows. (New Mexico State University Agricultural Experiment Station, University Park)

The effectiveness of diuron and DCPA in selectively controlling annual weeds in cotton fields, variety 1517D, when applied, at time of planting, just under the "soil-cap" but over the covered seed

Treatment		Weed Control (percent)				Cotton Stand Reduction (percent)			
	lb/A	Replication				Replication			
Chemical	(active)	1	2	3	Av.	1	2	3	Av.
Untreated control		95	0	0	32	65	99	99	88
diuron	1	0	95	95	63	99	99	99	99
	2	95	0	0	32	99	99	99	99
	3	0	95	0	32	99	99	99	99
DCPA	6	95	0	95	63	99	99	99	99
	9	0	95	0	32	99	99	99	99
	18	95	0	0	32	65	100	99	88

* Stand reduction was due to Rhizoctonia and other seedling diseases.

16. Field results from herbicide screening in cotton. Anderson, W. P. and Whitworth, J. W. Based upon results from field screening tests during 1962, four of the newer herbicides show promise for the selective control of weeds in cotton when applied pre-emergence or at lay-by.

These materials and the dosages applied are: dichlobenil - 2 and 4 lb/A ai; trifluralin - 4 and 6 lb/A ai; prometryne - 1 and 2 lb/A ai; and Bayer 40557 (N-(p-chlorophenyl) -O-N', N' - trimethylisourea)-2, 4 and 6 lb/A ai.

One new herbicide, isocil, was found to be extremely toxic to cotton when applied as a pre-emergence treatment or as a directed basal spray to cotton plants 24 to 30 inches tall at dosages of 1, 2 and 4 lb/A ai. Cotton plants in adjacent unsprayed rows were also killed or injured. Isocil symptoms on cotton plants not killed by harvest-time were leaf defoliation, failure of bolls to develop, and failure of bolls to open. (New Mexico State University Agricultural Experiment Station, University Park)

17. Chemical weed control in cotton with pre-emergence and lay-by applications. Anderson, W. P. and Whitworth, J. W. Pre-emergence and lay-by applications of diuron and DCPA were made in cotton on May 15 and July 6, 1962, respectively.

Pre-emergence. Diuron treatments at dosages of 2 and 3 lb/A ai resulted in 90 percent or better control of annual grass and broadleaf weeds when applied just prior to the emergence of the cotton seedlings. At the lower dosage of 1 lb/A ai, diuron was only about 50 percent effective in controlling the weeds. None of the dosages applied resulted in injury to the cotton plants. DCPA treatments at dosages of 6, 9 and 18 lb/A active were considerably less effective than those of diuron. The cotton plants were not injured by any of the dosages used. The first irrigation following these pre-emergence applications was on June 1.

Lay-by. Diuron and DCPA, applied at dosages of 1, 2 and 3 lb/A ai and 8, 16 and 24 lb/A ai, appeared to give excellent annual weed control with no cotton injury when applied at lay-by. However, shading of the soil surface by the cotton plants, where the plants were of such luxuriant growth as to shade the soil, was in itself extremely effective in preventing the germination and growth of weeds following the lay-by cultivation.

Diuron is being applied commercially for the control of weeds in cotton fields at lay-by in the Rio Grande Valley of New Mexico at dosages of 3/4 to 1 1/4 lb/A ai. (New Mexico State University Agricultural Experiment Station, University Park)

The effectiveness of diuron and DCPA in controlling annual weeds in cotton fields, variety 1517D, when applied as a broadcast spray just prior to the emergence of the weed and cotton seedlings

Treatment			
Chemical	lb/A (active)	Weed control (percent)	Cotton injury (percent)
Untreated Control	0	0	0
diuron	1	50	0
	2	90	0
	3	95	0
DCPA	6	30	0
	9	70	0
	18	70	0

18. Effect of diuron preplant treatment on four cotton varieties. Arle, H. Fred and Hamilton, K. C. An application of diuron was made at Phoenix, Arizona, on March 12, 1962. Surface soil on the test area was 32 percent sand, 43 percent silt and 25 percent clay. Diuron was applied to the soil at the rate of 1.8 lb/A and the field was then furrowed for the preplanting irrigation and irrigated on March 15. On April 5 the field was harrowed and three upland cotton varieties, DpSL, Acala-44, and Acala 4-42, and one Egyptian variety, Pima S-2, were planted in moist soil. Plots were 4 rows 38 feet long. Treatments were replicated four times. The test area received mechanical cultivation until normal layby. Cotton seedling counts were made within a marked 10-foot section of each plot after full emergence and repeated on the same areas 8 days later. Yields of seed cotton were obtained from the middle two rows of each plot.

Cotton emergence was normal for each cotton variety; however, 5 to 6 days after emergence many seedlings became chlorotic and died. Plant losses were higher with Pima S-2 and Acala-44 than with DpSL and Acala 4-42 (see table). Plant loss reduced the seedling stand to a lower population than would remain after standard thinning practices. Because of sub-normal plant populations on treated plots, yields of each variety were less than those of corresponding checks. Pima S-2 was more severely affected than other varieties; a 41 percent stand yielded 62 percent of normal. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, United States Department of Agriculture, and the Arizona Agricultural Experiment Station, Tucson)

Effects of diuron preplant application on four cotton varieties

Variety	Diuron (lb/A)	Cotton seedlings per foot of row 4/18	4/26	Yield of seed cotton lb/plot	% of check
DpSL	0	5.4	5.6	23.5	100
DpSL	1.8	5.6	2.5	20.0	85
Acala-44	0	3.1	3.2	17.7	100
Acala-44	1.8	3.9	1.0	13.9	79
Acala 4-42	0	4.1	4.1	19.3	100
Acala 4-42	1.8	3.7	1.6	17.5	91
Pima S-2	0	4.8	4.6	15.7	100
Pima S-2	1.8	3.7	0.8	9.7	62

19. Layby application of herbicides in ''skip-row'' cotton. Hamilton, K. C. and Arle, H. Fred. Skip-row plantings of cotton are common in the Southwest. The skip is usually 1, 2, or more rows wide and the planted strip is 2, 4, or more rows wide. Regardless of the skip-row pattern, control of weeds in the unplanted skip is a problem. Mechanical cultivation is effective early in the season, but often impossible after midsummer. In 1962 a test was conducted at Phoenix, Arizona, to determine the effectiveness of three herbicides for controlling weeds in skip-row cotton.

The surface soil of the test area contained 31 percent sand, 42 percent silt, and 27 percent clay. The most numerous weeds were Panicum fasciculatum, Physalis wrightii, Leptochloa filiformis, and Echinochloa colonum. DpSL cotton was planted in a plant two-skip two pattern. The area received normal cultivation until late June, when cotton was 16 to 20 inches high. Three herbicides, diuron and monuron, at rates of 1.2, 1.6, and 2.0 lb/A, and diphenamid at 6.0 lb/A, were applied as directed sprays to the soil before the third irrigation. Half of the plots were sprayed before and half were sprayed after the layby cultivation. Each plot contained 2 planted rows and 2 skip rows. The area was furrow-irrigated and every row was irrigated at each irrigation. Estimates of weed control in the skip rows were made during the summer and at harvest.

All applications of monuron caused temporary chlorosis of cotton foliage. In the skip rows diuron and monuron gave good control of broadleaved weeds, while diphenamid gave little control. Diuron gave better control of grassy weeds than did monuron or diphenamid. Cultivation after the herbicide application and before the next irrigation did not affect the weed control by most treatments.

All applications of monuron significantly reduced cotton yields. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, United States Department of Agriculture, and the Arizona Agricultural Experiment Station, Tucson)

20. Seed placement as a factor in cotton seedling survival following a diuron preplant treatment. Arle, H. Fred and Hamilton, K. C. Seed placement was studied as a factor in cotton seedling survival following the application of diuron as a preplant treatment in an experiment conducted at Phoenix, Arizona, during 1962. Surface soil on the test area was 33 percent sand, 43 percent silt, and 24 percent clay.

On March 3, 1962, diuron was applied to the soil at the rate of 1.8 lb/A. The area was then furrowed and irrigated March 15. After the irrigation the tops of the beds were 4 1/4 inches above the initial soil level. In preparing the seedbed on April 5, the harrow was set at different heights so that the cotton planter would place the seed 1 inch above the original soil level (level of the soil prior to furrowing), at the original soil level, and 1 and 2 inches below the original soil level. By this method the DpSL cotton seed was placed at various positions in relation to the layer of diuron in the beds.

Cotton seedling counts were made after full emergence and repeated on the same areas one week later. Yields of seed cotton were obtained from the two middle rows of each plot. Each treatment was replicated four times. Normal cultivation practices were used until layby.

Greatest loss of seedlings occurred when the cotton seed was placed above or in the diuron layer as indicated in the table. There was no effect of diuron preplant treatment on cotton yield when the seed was placed 1 or 2 inches below the diuron. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, United States Department of Agriculture, and the Arizona Agricultural Experiment Station, Tucson)

Effects of a diuron preplant treatment on cotton seedling survival and seed cotton yield

Seed placement[1]	Diuron treatment	Cotton seedlings per foot of row 4/18	4/26	Yield of seed cotton lb/plot	% of check
+ 1"	No	4.0	4.5	21.6	--
+ 1"	Yes	3.3	0.9	15.1	71
0"	No	5.2	4.8	21.8	--
0"	Yes	4.9	1.5	15.0	69
- 1"	No	4.2	4.2	21.0	--
- 1"	Yes	4.6	1.8	20.2	96
- 2"	No	4.3	4.3	18.1	--
- 2"	Yes	4.6	1.8	21.6	119

[1] In relation to original soil level

21. Preplant applications of herbicides in cotton. Hamilton, K. C. and Arle, H. Fred. Preplant applications of DCPA, diphenamid, diuron, prometryne, and trifluralin were evaluated in DpSL cotton at Phoenix, Arizona in 1962. On March 13, herbicides were applied to the soil before it was furrowed for

preplanting irrigation. The area was then furrowed and irrigated, and on April 5 cotton was planted in moist soil under a dry mulch.

The surface soil contained 29 percent sand, 43 percent silt, and 28 percent clay. The most numerous weeds were Panicum fasciculatum and Physalis wrightii. Plots were 4 rows 38 feet long. Treatments were replicated 4 times. The test area received normal cultivations until mid-June. Cotton stand counts were made after emergence. Estimates of weed control were made during the summer and at harvest. Cotton was hand-picked twice. Ten-boll samples for fiber analysis were taken from each plot before the first picking.

Emergence of cotton was not affected by preplant applications of herbicides. Ten days after emergence seedlings of cotton treated with diphenamid and trifluralin were stunted and many seedlings treated with diuron died as indicated in the table.

All herbicides except diphenamid gave excellent early-season control of annual weeds, but only DCPA and trifluralin controlled weeds until harvest. DCPA, diphenamid, and trifluralin were more effective for controlling grasses than for controlling broadleaved weeds. Diuron, prometryne, and simetryne were more effective for controlling broadleaved weeds.

The table summarizes the weed control and yield data which indicated that seed cotton yields reflected the weed control achieved by the preplant treatment. DCPA and trifluralin gave season-long weed control and the highest yields. None of the treatments affected boll components or fiber properties. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, United States Department of Agriculture, and the Arizona Agricultural Experiment Station, Tucson)

Effects of preplant applications of herbicides on weed control and cotton stands and yields

Herbicide name	Rate (lb/A)	Cotton stand[2] Plants per foot of row (4/26)	Estimated weed control (percent) 6/5	8/16	10/16	Yield of seed cotton as percent[2] of check[1]
Check	0	6.2a	0	15	25	100b
DCPA	8.0	6.5a	100	92	94	144a
DCPA	12.0	6.2a	100	100	99	153a
diphenamid	6.0	5.7a	0	0	20	82b
diuron	1.6	2.3b	100	10	0	86b
prometryne	1.6	6.6a	100	22	20	104b
simetryne	1.6	6.2a	100	5	0	100b
trifluralin	1.0	5.8a	80	96	95	133a

[1]Calculated yield of seed cotton on checks was 2,628 lb/A.

[2]Values with the same subscript letter are not significantly different.

22. Layby application of urea herbicides in DpSL cotton. Hamilton, K. C. and Arle, H. Fred. Directed applications of monuron or diuron after the last cultivation of cotton is an accepted practice in parts of the Southwest. Within the past 2 years many of these areas changed from Acala varieties to Deltapine Smooth Leaf (DpSL). In 1961 and 1962 tests were conducted at Phoenix to determine the effects of layby applications of monuron and diuron on DpSL.

The surface soil of the test area contained 31 percent sand, 42 percent silt, and 27 percent clay. The most numerous weeds were Panicum fasciculatum and Physalis wrightii. The area received normal cultivation until mid-June, when the herbicides at rates of 0.8, 1.6, 2.4, and 3.2 lb/A were applied as directed sprays to the soil. Treatment was before the second postemergence irrigation when cotton was 12 to 16 inches high. Plots were 4 rows 38 feet long. Treatments were replicated 4 times. Estimates of weed control were made during the summer and at harvest. Cotton was hand-picked twice. Ten-boll samples for fiber analysis were taken from each plot before the first picking.

Foliage of all cotton treated with monuron became chlorotic and the duration of chlorosis was related to the amount applied. Cotton plants treated with 2.4 and 3.2 lb/A of monuron were stunted. Data on weed control and cotton yields are summarized in the table. Weed control was satisfactory with both herbicides at rates of 1.6 lb/A or higher, except in 1962 when cotton stunted by monuron failed to maintain weed control achieved with the herbicide.

Seed cotton yields were not reduced by layby applications of diuron, but 2.4 and 3.2 lb/A of monuron reduced yields of DpSL in both years and delayed maturity in 1961.

Boll size, seeds per boll, and percent lint were reduced on plants treated with the high rate of monuron. Fiber from plants treated with 3.2 lb/A of monuron was finer, but fiber length and strength were not affected.

The tolerance of DpSL to layby applications of diuron was similar to the tolerance of Acala varieties under similar conditions. However, DpSL was less tolerant of monuron than were the Acala varieties. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, United States Department of Agriculture, and the Arizona Agricultural Experiment Station, Tucson)

Effects of layby applications of diuron and monuron on weeds and seed cotton yields of DpSL cotton

Herbicide		Weed control (Average percent estimated) for:		Yield of seed cotton as percent[2] of test average[1]		
Name	Rate (lb/A)	1961	1962	1961	1962	Ave.
diuron	0.8	78	72	99ab	104a	101 b
diuron	1.6	95	90	108ab	108a	108ab
diuron	2.4	98	96	106ab	116a	111ab
diuron	3.2	100	100	112a	116a	114a
monuron	0.8	88	76	97ab	109a	104ab
monuron	1.6	92	93	101ab	99ab	100 b
monuron	2.4	97	87	94 bc	84 b	89 c
monuron	3.2	98	85	82 c	63 c	73 d

[1] Calculated average yields of seed cotton were 3,529 and 3,444 lb/A.

[2] Values with the same subscript letter are not significantly different.

23. Selective annual weed control in seed flax. Beutler, L. K. and Appleby, A. P. Weed competition is a limiting factor in Eastern Oregon dryland flax production. Weed control in flax has been somewhat successful with such herbicides as 2,4-D and MCPA. However, when the rates of these herbicides

were high enough for weed control, there was also evidence of injury to the crop, thus removing some of the advantage gained. Evaluations of herbicides in 1962 indicated that G-34698 (2-chloro-4-isopropylamino-6-(3-methoxy-propylamino)-s-triazine) gave good broadleaf weed control in seed flax without injury to the flax.

Four herbicides were evaluated in this study. DATC and EPTC were soil-incorporated before planting while G-34698 was sprayed on pre-emergence when the flax seed had begun to sprout. The 2,4-D amine was applied when the flax was 4-5 inches tall. The principle weeds were lambsquarter (Chenopodium album), Russian thistle (Salsola kali var. tenuifolia), coast fiddleneck (Amsinckia intermedia), and black nightshade (Solanum nigrum).

The flax yields are given in the following table:

Herbicide	Pounds per acre	Seed flax yields*
	(ai)	(lb/A)
G-34698	6	1621a
G-34698	2	1572a
G-34698	4	1499ab
2,4-D amine	1/2	1455ab
**Hand-weeded check	0	1352ab
EPTC	3	1299ab
DATC	3	1195 b
Weedy check	0	1102 c

*Those treatment means followed by the same subscript do not differ significantly at the 5 percent probability level.
**The hand weeded check was weeded once but contained a few weeds at harvest.

The compound, G-34698, was the only herbicide which gave adequate weed control. It gave satisfactory control at 2 lb/A and complete control at the 4 and 6 lb rates. There was no apparent injury to the flax. (Oregon State University, Pendleton Branch Experiment Station, Pendleton)

24. Annual weed control in the establishment of new forage seedings with pre-planting applications of diquat. Peabody, Dwight V., Jr. Seed bed preparation for grass-legume seedings was completed (1) four weeks and (2) six weeks prior to planting. One day before each planting date the emerged annual weeds (smartweed, lambsquarter, chickweed, shepherd's purse, groundsel, pineapple weed) were sprayed with diquat at two different rates of application - 1/2 and 1 lb ai/A. The day following diquat spray application, one-half of all sprayed plots was planted with timothy and ladino clover; the other half with orchard grass and New Zealand white clover.

Diquat at both rates did not give adequate weed control in plots in which the annual weeds were permitted to grow for six weeks before spraying. In those plots where diquat was applied at the rate of 1 lb/A four weeks after seed bed preparation, excellent annual weed control was obtained and no injury to either seedling grass or legumes could be detected upon emergence. Diquat at the rate of 1/2 lb/A was not sufficient for annual weed control under the conditions of this experiment.

Therefore, the unique properties of diquat open up the possibility of a new method for establishment of new forage seedings, i.e., the herbicidal treatment applied to emerged weeds immediately prior to seeding. (Northwestern Washington Experiment Station, Washington State University, Mount Vernon)

25. Annual weed control in new grass seedings with post-emergent herbicides. Peabody, Dwight V., Jr. Banvel D, 2,3,6-TBA, PBA, amiben, fenac and DCMA each at three different rates of application were applied to new seedings of orchard grass and timothy when these crops were in the two- to three-leaf stage of growth. 2,3,6-TBA, PBA, amiben and fenac at the rates tested (1/2 to 2 lb ai/A) did not give adequate control of the broadleaved annual weed population present. DCMA, even at the lowest rate (2.4 lb/A) tested, caused extensive injury to the seedling timothy and orchard grass plants.

Banvel D, however, at 1/2 lb/A resulted in excellent control of all broadleaved annual weeds present and caused little or no injury to seedling timothy and orchard grass. Control of annual weeds with this treatment persisted until early fall with no concomitant injury to the timothy or orchard grass. (Northwestern Washington Experiment Station, Washington State University, Mount Vernon)

26. Wild oat (Avena fatua) control in peas and cereals with pre-plant, pre-emergence, and post-emergence herbicides. Rydrych, D. J., Muzik, T. J., and Renfro, J. R. Wild oats are a serious problem in both the green pea and dry pea areas of S. E. Washington where it is estimated that 60 percent of all pea fields have wild oat infestations. DATC, Avadex B. W., barban, sodium PCP, and R 4518 were applied at three different rates and at two locations in S. E. Washington.

DATC at 1 to 1 1/4 lb ai/A increased both green pea and dry pea yields from 10-40 percent where severe wild oat competition existed. Five methods of incorporation, including single harrowing, double harrowing, disk and harrowing, spring tooth and harrow, and spring tooth alone were tested. There was little difference in weed control or pea yield due to method of incorporation. The little difference between incorporation techniques was probably influenced by heavy rains that followed the treatments. A trial using a post-planting incorporation of DATC was not satisfactory due to mechanical injury to the sprouting peas.

Barban (1/4 lb/A) was more effective as a post-emergence spray when the wild oats were in the early 1 -3 leaf stage when applied in 5 - 10 gallons of water per acre than in 40 gallons. Sodium PCP (18-24 lb) gave good kill of the annual broadleaf weeds such as henbit and the mustards but was not effective on wild oats. R 4518 (3 lb/A) gave good control of the wild oats but unsatisfactory results on broadleaves, particularly henbit.

Tests in lentils, spring barley, and spring wheat for wild oat control indicate that DATC, Avadex B. W., and barban are effective with little damage to the crops. In lentils, DATC at 1 lb ai/A gave effective control and no injury but rates above 1 1/2 lb/A were deleterious. Avadex B. W. generally required higher rates than DATC. Barban at 1/3 lb/A gave good results in all crops although 100 percent wild oat control was not obtained. Yields were lowered with rates above 1/3 lb.

DATC, Avadex B. W., and barban in barley did not increase yields. The barley was able to eliminate most of the wild oats by natural competition. Barban lowered yields when rates above 1/3 lb were used. DATC and Avadex B. W. did not injure the barley at rates up to 1 lb/A.

In spring wheat DATC and Avadex B. W. at (1 - 1.5 lb) did not increase yields. However, barban at (1/3 lb) produced yield increases with little damage to the wheat.

No herbicide at the rates tested gave 100 percent control of wild oats. The barley gave good natural competition to the wild oats. Spring wheat, peas, and lentils were poorer competitors. Lentils, even with chemical treatment, had large populations of wild oats. (Washington State Agricultural Experiment Station, Pullman, and Green Giant Company, Dayton, Washington)

27. Weed control in peppermint. Baldwin, R. W., and Furtick, W. R. An experiment was established at Madras, Oregon to search for a herbicide which would be more suitable for peppermint production than the currently recommended diuron or dinitro amine.

The following herbicides were included in the trial: diuron, isocil, linuron, BSBMU (5-bromo-3-sec-butyl-6-methyluracil), trifluralin, atrazine, a mixture of OMU and BiPC, CP-31675, S-6000 and SD-6614.

Visual estimates were made of the control of lambsquarter (Chenopodium album L.) and barnyard grass (Echinochloa crusgalli (L) Beauv.) as well as the extent of crop injury. The results of the best treatments are listed below and are expressed as percent control or percent injury.

Herbicide	Rate (lb ai/A)	Percent injury or control: Peppermint injury	Echinochloa control	Chenopodium control
diuron	2	3	50	70
diuron	4	13	87	93
isocil	1	3	73	95
isocil	2	10	98	99
BSBMU	1	3	93	97
BSBMU	2	60	95	100
trifluralin	4	0	83	43
trifluralin	8	3	93	90
control	-	0	0	0

These data indicate that isocil at 1 to 2 lb/A, trifluralin at 4 to 8 lb/A and BSBMU at less than 2 lb/A may become important herbicides in peppermint culture. BSBMU, however, may be limited due to the narrow safety margin. (Oregon State Agricultural Experiment Station, Corvallis)

28. Control of annual broad-leaved weeds in safflower with topically applied post-emergence herbicides. Foy, Chester L., Torngren, T. S., and Buschman, L. L. Preliminary field and greenhouse studies in 1960 and 1961 indicated that three experimental herbicides warranted more extensive testing as broadcast topical post-emergence sprays in safflower. Thus during 1962, herbicides I [2,4-bis(3-methoxypropylamino)-6-methylthio-s-triazine], II [1-(3,4-dichlorophenyl)-3-isopropyl 3-(2-propynyl)urea] and III (trimethylsulfomium chloride) were evaluated in various locations for control of lambsquarters, pigweed, barnyardgrass and volunteer castor beans.

At treatment, safflower had 4-8 true leaves and weeds were in various stages of development from just emerging to five inches tall in some cases. Weed stands were dense and uniform and offered severe competition, especially in two fields of already low yielding safflower.

Exp. I.

Knapsack sprayer, 57.5 gpa.; lambsquarters and pigweed

Herbicide	Rate (lb/A)	No. heads per 4 x 4 ft quadrat	Seed yield lb/A
I	1/4	190	858
I	1/2	144	910
I	3/4	199	909
II	1/4	170	627
II	1/2	203	961
II	3/4	167	748
II	1	146	620
III	4	175	714
III	6	134	818
Untreated	-	125	464

Exp. II.

Trailer-type field sprayer, 40 gpa.; lambsquarters

Herbicide	Rate (lb/A)	Seed yield lb/A
I	1/4	1005
I	1/2	1161
I	3/4	1364
II	1/2	993
II	3/4	1005
II	1	1041
III	5	766
Untreated	-	599

Exp. III.

Various methods of application, spray volumes and weed species (see below)

Herbicide	Rate (lb/A)	Spray volume (gpa)	Method of application	Weed species present	Seed yield (lb/A)
I	1/2	40 68	ground rig	Lambsquarters,	2847
I	3/4	60		pigweed and barn-	3013
Untreated	-	--	-	yardgrass mostly.	2851
I	1/2	18 10	ground rig	Also nutgrass,	3038
I	1/2	40 68	ground rig	swamp knotweed,	2891
I	1/2	10	aircraft	etc.	2691
II	3/4	40 68	ground rig		3237
II	3/4	40 68	ground rig	Volunteer castor beans. Also some	2943 (2902)*
Untreated	-	--	-	lambsquarters.	3278 (3192)*

*Corrected for seed cleaning (calculated). Weed seed removed.

Both herbicides I and II gave excellent (90-100 percent) control of lambsquarters at appropriate rates, 1/2 and 1 lb/A respectively, but were much less effective (20-30 percent control) on pigweed and were totally ineffective against grasses. Both herbicides I and II caused some foliar burn or chlorosis, reduction in height and delayed maturity of safflower herbicidal rates. Volunteer castor beans treated with herbicide II were only slightly more injured than safflower and control was not satisfactory. Herbicide III was not particularly injurious to safflower but controlled lambsquarters (and pigweed especially) only when the weeds were very small. Timing appeared to be more critical in the use of herbicide III than either I or II, even for control of lambs-quarters. Head counts, seed yields, and other pertinent data for three separate experiments are summarized in the table (average of 4 replications each): (Botany Department, University of California, Davis and California Agricultural Extension Service)

29. Tolerance of Gaines wheat to various herbicides. Appleby, Arnold P. Several herbicides were applied to Gaines wheat, a recently-released semi-dwarf variety, at the 4-tiller stage. Plots were 10′ x 110′, replicated 4 times. The experimental area was nearly weed free. Yields were taken by means of a 7-foot self-propelled combine. Results are given below:

Effect of various herbicides on Gaines wheat

Treatment	Lb ai/A	Ave. yield (bu/A)	Ave. test wt. (lb/bu)
2,4-D amine	3/4	38.2	57.7
"	1 1/2	37.7	58.4
"	3	35.5	58.9
2,4-D PGBE ester	3/4	38.7	58.0
"	1 1/2	35.9	57.5
"	3	33.4	58.4
2,4-D oil soluble amine	3/4	39.4	58.6
"	1 1/2	38.9	57.9
"	3	32.0	57.3
2.4-D emuls. acid	1 1/2	36.6	57.4
"	3	33.4	57.6
silvex	3/4	38.8	57.9
"	1 1/2	36.8	57.9
"	3	37.2	57.8
Banvel D	1/4	39.0	58.6
"	1/2	38.9	59.3
"	1	34.9	60.3
"	3	13.1	60.3
Hand-weeded check	0	38.3	57.8
		C.V. = 9.5%	C.V. = 1.5%
		$LSD_{.05}$ = 4.7 bu/A	$LSD_{.05}$ = 1.2 lb/bu

It would appear that Gaines is not hypersensitive to 2,4-D. The water-soluble amine is somewhat less injurious to the wheat than the other three formulations. The PGBE ester, oil-soluble amine, and emulsifiable acid appear to be fairly comparable in their toxicity to wheat. (Oregon State University, Pendleton Branch Experiment Station, Pendleton)

30. Annual weed control in the new semi-dwarf wheat variety Gaines with post-emergence herbicides. Rydrych, Donald J. and Muzik, T. J. Gaines wheat, the new high yielding semi-dwarf wheat, is rapidly becoming one of the major winter wheat varieties in the Pacific Northwest. Yields of well over 100 bu/A have been reported. A year before this variety was introduced, 2,4-D as the amine salt and ester at one and two lb/A was applied in the five leaf and tiller stages of growth. Gaines and related semi-dwarfs appeared to be as resistant to 2,4-D as the standard wheat varieties.

For the last two years, field trials have been conducted with some of the common herbicides as well as certain new ones.

In 1962, the chemicals were sprayed in spring when the wheat was six inches high and well tillered.

Barban [S 847 PZ (f) and S 847 MI (f) formulations] at (1/3-1 lb), Banvel-D (1/8-1/2 lb), atrazine (1/2-2 lb), SD6623, SD 7585, and SD 7961 at (1/2-2 lb), trietazine (1/2-1 lb) and 2,4-D amine (1/2-2 lb) each at three different rates of application were applied at 30 psi in 40 gallons of water.

Weed population consisted of shepherds purse (Capsella bursa-pastoris), gromwell (Lithospermum arvense), Jim Hill mustard (Sisymbrium altissimum), wild oats (Avena fatua), fanweed (Thlaspi arvense), henbit (Lamium amplexicaule), fiddleneck (Amsinkia intermedia) and lambsquarters (Chenopodium album).

None of the materials tested gave good control of gromwell or fiddleneck, although the other annual weeds were well controlled by certain chemicals. Barban (1/3-1 lb, either formulation) gave excellent control of wild oats without injury to the wheat but failed to control other annual weeds. Trietazine (1/2-1 lb ai) gave only partial control of broadleaved weeds without serious injury to the wheat. Banvel-D (1/8-1/2 lb ai) gave good control of most of the annual broadleaved weeds. It caused some pre-harvest lodging in rates above 1/4 lb/A, but yield was equal to the control. SD 6623 was less effective against annual weeds than SD 7585 and SD 7961, but none of these herbicides injured the wheat.

2,4-D gave the best results of all materials tested. Yields were not increased with applications over 1 pound. However, the Gaines wheat was not injured with rates up to 2 lb/A.

The tests indicate that the new semi-dwarf winter wheat variety Gaines is as resistant to most herbicides as the standard varieties. (Washington State University Experiment Station, Pullman)

31. Gromwell control in wheat. Appleby, Arnold P. Corn gromwell (Lithospermum arvense) is a problem weed in grain fields in certain areas of the Columbia Basin. Several herbicides were applied in golden wheat near Condon, Oregon on April 24, 1962. Gromwell was present in stages of growth ranging from the cotyledon stage to early bloom. Percentage gromwell control and wheat injury were evaluated on July 3, 1962. Treatments giving 90 percent control or better with little or no wheat injury were: propyleneglycolbutylether ester of 2,4-D at 1/2 and 1 lb, oil-soluble amines of 2,4-D at 1 1/2 lb, 2,4-D emulsifiable acid at 1/2 and 1 1/2 lb, prometryne at .8 lb, G-36393 at 1 1/2 lb, and ACP 62-70 at 1 and 2 lb ai/A. Banvel D and Spencer 6000 were not effective at low rates and caused excessive wheat injury at rates of 1/2 lb ai/A and higher. Giving unsatisfactory control at their maximum rate were silvex up to 2 lb, 2,4-D amine up to 1 1/2 lb, atrazine up to .8 lb, and G-34857 up to .8 lb/A.

The two oil-soluble amines of 2,4-D, ACP-M-954 and Dacamine, appeared to be comparable in effectiveness and were intermediate between the water-soluble amine and the PGBE ester. (Oregon State University, Pendleton Branch Experiment Station, Pendleton, Oregon)

32. Downy brome (Bromus tectorum) control in winter wheat with post-emergence herbicides. Rydrych, D. J. and Muzik, T. J. Downy brome, commonly called cheatgrass in the Pacific Northwest, is the most serious weed in the dryland winter wheat areas. Atrazine, Banvel-D, IPC, DATC, SD-7585, SD 7961, FW 925, and isocil each at three different rates and at two different times of application (January 30 and March 15) were applied to downy brome and wheat each in the three leaf stage. These treatments were made at the Lind station with an annual rainfall of approximately 8 inches, and a sandy loam soil.

Atrazine, Banvel-D, and isocil lowered yields when applied at rates higher than 1/2 lb ai/A. All three materials gave excellent control of both broadleaved and annual grassy weeds except that atrazine failed to control Russian thistle.

DATC at (1/2 to 2 lb ai/A), IPC at (1 to 2 lb), and SD 7961, SD 7585, FW 925 at (1/2 to 2 lb ai/A respectively), resulted in yield increases and fair downy brome control. At the lower rates tested FW 925 was not effective against any weed species. None of the herbicides at the rates tested caused injury to the wheat, or differences in tillering. Further testing is warranted for SD 7585, SD 7961, FW 925, IPC, and DATC.

Atrazine was applied at fourteen locations in southeastern Washington during the period February 15 to March 15. All locations were one acre in size and atrazine was applied at 3/4 lb ai/A. Downy brome stands were dense. In addition, test strips with rates of 1/2 to 1 1/2 lb of atrazine were included. Yield increases were obtained at all but four locations. In areas of above 10 inches annual precipitation and with soil organic matter above 1.5 percent, yield increases were obtained. Severe yield reductions were caused in areas of less than 10 inches of annual precipitation and with less than 1.5 percent soil organic matter.

The test strips using atrazine at 1/2 to 1.5 lb ai produced similar results at the fourteen locations. Rates of 1 to 1.5 lb generally produced either no yield increase or severe yield reductions. The rates of 1/2 to 3/4 lb generally gave excellent results except at four locations. These tests indicate that atrazine will be limited in its use of downy brome control to areas of higher rainfall, silt-loam soils, and areas with organic content of the soils greater than 1.5 percent. (Washington State University Experiment Station, Pullman)

33. Evaluation of herbicides for control of wild buckwheat in cereals. Guenthner, Harold R. Wild buckwheat (Polygonum convolnulus) is resulting in a serious problem in the grain-producing areas of Montana. This weed can be partially controlled with 2,4-D if sprayed with .75 to 1 lb/A applied when the wild buckwheat is in the 2-leaf stage. A herbicide which could eradicate this weed certainly is in demand.

The following herbicides were applied in replicated plots to wild buckwheat located in winter wheat: Banvel T at .5 lb/A, Banvel D at .25 and .5 lb/A, 2,4-D amine at 1 lb/a, 2,4-D ester at 1 lb/a, and SD-7585 at 1 lb/A. The wild buckwheat was in the four to five-leaf stage at the time of application.

Banvel D at the .5 lb/A rate provided the most satisfactory control with

80 percent or better on all replications. The 2,4-D applications resulted in only 40 to 50 percent control. Banvel T and SD-7585 did not provide any control. No yields were taken due to a poor stand of winter wheat.

With the use of the variable rate plot sprayer, nine herbicides were evaluated for the control of wild buckwheat in spring wheat. Plot size was 8 feet x 60 feet with a half-dosage distance of 15 feet. Three replications were employed.

Results:

Treatment	Initial rate (lb/A active)	Rate for complete eradication	Rate for satisfactory control
ACP-62-158	12	1.75	1.25
ACP-62-70	6	.75	.75
duPont 1688	3	---	---
Emulsifiable 2,4-D	4	2.25	2
Oil soluble 2,4-D amine	4	2	1.75
2,4-D amine	4	2	1.75
2,4-D ester	4	1.75	1.50
Banvel D	1	.50	.4
Banvel T	1	---	---
Check	--	Excellent weed population	

Results indicate that ACP-62-70 is the most promising of the herbicides evaluated for the control of wild buckwheat. Banvel D provided satisfactory weed control but resulted in considerable reduction in plant height. Control of wild buckwheat with 2,4-D appears to require considerable higher rates than is presently being recommended. (Montana Agricultural Experiment Station, Central Montana Branch Station, Moccasin)

34. Chemical control of downy bromegrass (*Bromus tectorum*) on winter wheat go-back land. Chamberlain, E. W. and Alley, H. P. Plots at four locations were established on go-back land which was heavily infested with downy bromegrass and some annual broadleaf weeds. Thirteen herbicides were screened using two rates of each. Treatments were made in October 1961 and April 1962. Visual readings on the plots in September 1962, 11 months after treatment, show that atrazine at 1 and 2 lb/A; simazine at 1 and 2 lb/A; and propazine at 1 and 2 lb/A gave 100 percent control of downy bromegrass. The plots receiving 2 lb/A of each herbicide were completely denuded of vegetation whereas the plots receiving the 1 lb/A treatment had a small number of Russian thistle (*Salsola kali*), tumbling mustard (*Sisymbrium altissimum*), stinkgrass (*Eragrostis cilianensis*) and witchgrass (*Panicum capillare*) growing on them. The visual readings on the April 1962 treated plots showed that atrazine, simazine, and propazine at 1 and 2 lb/A and amitrole at 2 lb/A gave 100 percent control of downy bromegrass. Ametryne at 2 lb/A, dalapon at 8 lb/A, and amitrole at 1 lb/A gave 95 percent control of downy bromegrass. The amitrole and dalapon plots had a good stand of sweetclover growing on them at the time the readings were made. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie)

35. Chemical fallow with combinations of atrazine and amitrole. Gould, W. L., Phipps, F. E., and Furtick, W. R. In work on chemical fallow in the Columbia Basin combination treatments of atrazine at 0.4, 0.8 and 1.2 lb/A plus amitrole at 0.5 and 1.0 lb/A were compared with treatments of 2,4-D at 1 and 2 lb/A plus amitrole at 1 lb/A. The treatments were applied on three soil types:

Walla Walla silt loam, Ritzville sandy loam and Condon clay loam. Fall rains were late in 1960 so the first treatment was made in January, 1961, and a second set of plots was treated in March. The plots were tilled as necessary during the summer of 1961 to maintain good fallow conditions.

Seedings of winter wheat were made on all soil types after the fall rains began in 1961. Spring wheat was seeded in 1962 at one location on Ritzville sandy loam. Due to severe winter damage, plots on the Condon soil were abandoned. Some winter damage also occurred at the other locations seeded to winter wheat.

Weed control ratings were made in May, 1961, prior to the first tillage. As reported in 1962, very good control of downy brome and volunteer grain was provided by all rates of atrazine, the heavier rates being best. The results indicated that the most effective control was from applications made in January. The 2,4-D - amitrole treatments were less effective than atrazine - amitrole, with the March treatment being more effective than the January treatment.

There were no apparent differences in wheat yield due to date of herbicide application. On the heavier soil type yields were not affected by any rate of atrazine. On sandy soil rates of atrazine in excess of 0.8 lb/A caused a reduction in yield. In spring wheat on sandy soil the 0.4 lb/A rate of atrazine caused a slight reduction in yield while the 0.8 lb/A rate caused a 50 percent reduction. (Oregon Agricultural Experiment Station, Corvallis)

36. Possible antagonism between atrazine and 2-methoxy-3,6-dichlorobenzoic acid (Banvel D). Appleby, Arnold P. In searching for effective combinations of herbicides to be used for chemical fallow, atrazine and Banvel D were applied in combination at three locations. At two of these locations, atrazine was applied uniformly over large plots at three rates. Various materials, including Banvel D, were sprayed over the atrazine plots with a logarithmic sprayer. Rates of Banvel D ranged from a maximum of 5 lb ai/A to a minimum of 0.12 lb ai/A. It was noted that in almost every case, the Banvel D plots contained more downy brome than the plots with atrazine alone. In some cases, a reverse curve could be seen; i.e., as the rate of Banvel D decreased, the downy brome control increased.

At a third location, atrazine at .2 lb ai/A plus amitrole-T at 1 lb ai/A gave 93 percent downy brome control, 93 percent volunteer grain control, and 100 percent mustard control. These same treatments plus 1/4 lb ai/A of Banvel D gave 52 percent downy brome control, 73 percent volunteer grain control, and 90 percent mustard control. These percentage figures are averages of 3 replications.

Based on these observations, it appears that an antagonistic effect is being expressed from the combination of atrazine and Banvel D. (Oregon State University, Pendleton Branch Experiment Station, Pendleton)

PROJECT 6. AQUATIC AND DITCHBANK WEEDS

Richard H. Hodgson, Project Chairman

SUMMARY

Ditchbank Weeds. Investigations in Washington, Montana, and Idaho reveal that reed canarygrass on ditchbanks can be controlled successfully with repetitive treatments of amitrole at 8-12 lb/A or amitrole T at 4-6 lb/A. Na dalapon (20-25 lb/A + 2 lb 2,4-D) was somewhat less effective. MH (6-8 lb/A) was effective only on the ditchbank shoulder and crown. Lower treatment rates of all herbicides were less effective and all herbicides became less effective as the waterline was approached.

Selective control of reed canarygrass on ditchbanks is under study in Montana with several herbicides. Treatments made in May and July with either dalapon (20-40 lb/A) or amitrole T (5-10 lb/A) were effective when observed in September, with the dalapon ranking slightly above the amitrole T. Species survival during the 1963 growing season will indicate the selectivity of these treatments.

Effective Johnsongrass control was obtained on ditchbanks in Arizona with bi-weekly LP-Gas flaming at a season-long cost for gas of $177.52 per mile.

Repeat applications of dalapon (10 lb/A), dalapon + added emulsifier, dalapon plus amitrole (3 lb/A), and No. 2 fuel oil were all effective in controlling Johnsongrass on ditchbanks in New Mexico. Ranking of treatments and determination of overall effectiveness will be accomplished during the 1963 growing season.

The control of miscellaneous ditchbank weeds with the maintenance of a minimum desirable perennial grass stand was studied in Montana. Twelve combinations of six herbicides were used in single applications. In general, all treatments except 2,4-D alone gave fair control of Canada thistle and perennial grasses while leaving sufficient stands of grass to prevent bank erosion.

Aquatic Weeds. Laboratory studies of xylene-water emulsion stability were conducted in Montana. Two anionic-nonionic blended emulsifiers gave greater emulsion stability than did the anionic, cationic or nonionic materials tested. Emulsion stability decreased with temperature increase and with the introduction of ions into the system. Laboratory results were correlated with field treatment data relating emulsion stability to water temperature and emulsifier concentration.

The dormancy of American pondweed winterbuds was studied in Colorado. Buds harvested 4, 5, 6, 7, 8, and 9 months after planting were progressively less dormant; those from the first harvest required 7 weeks cold treatment before 80 percent of the buds would grow in 1 week, while buds from the last harvest showed little dormancy and their growth was little enhanced by post-harvest refrigeration. Buds harvested at 4 to 9 months and cultured at 45, 55, 65, or 75°F for 1 month grew best during that month at 75°F. No growth occurred at 45°F; however, when removed to the greenhouse, growth of these buds equalled or surpassed that of those kept at 75°F.

Herbicides were applied to the soil in aquatic environments in California. Winter preemergent applications were more effective than treatments made during the growing season. Control usually lasted through the growing season. Insufficient leaching into canal soils prior to the introduction of water reduces

the effectiveness of treatment and may obliterate plot boundaries. However, lateral herbicide movement apparently does not occur upon filling lakes and reservoirs, the soils of which have been treated in the dry state. Preemergent application of fenac (5-20 lb/A) appeared superior to 2,4-D (20-40 lb/A) and other treatments if it had been leached into the soil.

Fall applications of fenac to canal soils were effective in controlling sago pondweed in Montana. A granular formulation of Na fenac was 95 percent effective at 10 lb/A, while other formulations were equally effective at 20 lb/A. Spring treatments with endothal (20 lb/A) gave 93 percent control while equal rates of dichlobenil, Tritac, and fenac gave 85, 77, and 70 percent control, respectively.

Water samples were obtained from a Wyoming canal, 2,300 feet of which had been soil treated with 20 lb/A of Na fenac 5 weeks previously. Analyses of the samples revealed fenac concentration of 8.49 ppm in the first water flowing over the plot. This concentration dropped rapidly until it was below 0.01 ppm in 2 hours.

Control of Anacharis was attempted in three New Mexico lake trials with 13 herbicide formulations. Effective control was obtained by 5 percent endothal--5 percent silvex treatment at 2 ppm ai.

Ranunculus was effectively controlled by 9 out of 10 herbicides applied to 17 lake plots in New Mexico.

Five species of Potamogeton were treated with 15 herbicides applied to 56 plots established in eight New Mexico lakes. Two-thirds of the materials tested showed some promise for control of at least one species for 1 to 2 months.

Stands of Chara were treated with 14 herbicides applied to 35 plots in three New Mexico lakes. While the results are variable, it appears that some herbicides should be further tested.

1. Reed canarygrass control with amitrole, dalapon, and MH formulations. Bruns, V. F., Yeo, R. R., and Boyle, W. Dean. Reed canarygrass (Phalaris arundinacea) is spreading rapidly and is one of the most troublesome weeds along irrigation systems in the Pacific Northwest. Uniform experiments for the control or suppression of this grass were conducted during 1960 to 1961 near Prosser, Washington, Huntley, Montana, and Boise, Idaho. Amitrole at 4, 8, and 12 lb, amitrole-T (amitrole basis) at 2, 4, and 6 lb, the sodium salt of dalapon at 15, 20, and 25 lb, and MH at 4, 6, and 8 lb in 80 to 160 gallons of water per acre were applied initially in the spring when the canarygrass averaged about 10 inches high. A commercial, blended surfactant was added at rates of 6 to 10 ounces per 100 gallons of spray. Amine salts of 2,4-D at 2 lb/A were added to the dalapon and MH formulations for the control of broadleaved weeds. In general retreatments were made as necessary or practical for satisfactory control or suppression and possible elimination of the canarygrass. In Washington, comparative treatments were initiated in the fall after canarygrass had been controlled by burning or mowing during the summer.

In Washington, three treatments during the first year with amitrole at 8 or 12 lb/A or amitrole-T at 4 or 6 lb/A effectively controlled and greatly reduced the stands of reed canarygrass along the channels and nearly eliminated the grass on the shoulder and top of the banks. The canarygrass was controlled least effectively in the 2- to 3-foot zone immediately above the waterline, especially where berms had developed, and two or three retreatments were required the second year. Even after nearly three seasons of treatment, a few plants survived at the waterline. Continued retreatment of a narrow band just above the waterline would likely prevent rapid reinfestation and spread from a few surviving plants. The amitrole formulations were somewhat more effective than the sodium salt of dalapon. MH, particularly at the 6- and 8-lb rates, effectively suppressed canarygrass on the shoulder and top of the banks, but failed to suppress the growth satisfactorily in the wet zone immediately above the waterline. None of the herbicides provided satisfactory control at the lowest rates.

Results obtained in Montana and Idaho were similar to those obtained in Washington. At Huntley, four applications of the amitrole formulations over a 2-year period effectively suppressed and reduced the stands, particularly at the higher rates, but did not completely eradicate the reed canarygrass at Huntley. Five applications of the sodium salt of dalapon over the 2-year period suppressed the growth, but failed to eliminate the canarygrass. At Boise, early-spring applications of the amitrole and dalapon formulations at the highest rates effectively suppressed the canarygrass until early July when retreatments were made. Two treatments per year with the amitrole and dalapon formulations at the highest rates suppressed the growth satisfactorily during the season, eradicated the grass on the dry portions of the banks, but left a few surviving plants near the waterline. The middle rates were somewhat less effective than the highest rates. The lowest rates gave unsatisfactory suppression and little reduction in stands. The use of MH for the suppression of canarygrass along irrigation channels appeared impractical at both Huntley and Boise. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture; Bureau of Reclamation, U. S. Department of Interior; and the Washington and Montana Agricultural Experiment Station, cooperating)

2. Chemical control of reed canarygrass on ditchbanks. Hodgson, J. M. Several chemicals effectively control reed canarygrass on ditchbanks, however, these chemicals destroy all vegetation and leave banks unprotected by vegetation and open to erosion. Several chemicals were applied in May 1962 in an attempt to control canarygrass without destroying all vegetation so that banks might be recovered by vegetation in a short time.

The chemical treatments listed in the accompanying table were applied to reed canarygrass infestations on a drain ditch. Individual plots 15 x 15 square feet were sprayed with the designated chemical in 40 gallons of water per acre. Reed canarygrass was 16 to 24 inches high in the very early boot stage at the time treatments were first made.

Herbicide evaluation for control of reed canarygrass. First treated May 18, 1962

Chemical	lb/A	Date of 2nd treatment	Percent control on July 12, 1962	Percent control on Sept. 5, 1962
			Percent	Percent
MH	5	none	75	20
+ .05% surfactant	10	none	85	33
paraquat	2	July 12, 1962	57	62
paraquat	5	"	60	94
amitrole-T	5	July 26, 1962	92	85
amitrole-T	10	"	94	90
dalapon	20	July 26, 1962	97	96
dalapon	40	"	98	100
dalapon + 40 gal oil/A	20	July 26, 1962	90	99
Glytac + 40 gal oil/A	20	none	90	85

Dalapon and amitrole-T treatments were quite effective with dalapon at 20 and 40 lb/A appearing slightly better than amitrole-T at 5 or 10 lb/A. Survival in 1963 will indicate which of these chemicals was most effective in elimination of reed canarygrass. (Cooperative investigations of the Crops Research Division, and the Plant and Soil Science Department of Montana Agricultural Experiment Station, Bozeman)

3. Chemical control of Johnsongrass on ditchbanks. Anderson, W. P. and Whitworth, J. W. Dalapon, applied at a dosage of 10 lb ai in 80 gallons of water per acre, was just as effective in controlling established stands of Johnsongrass on irrigation ditchbanks during the year of application as were similar applications of dalapon made in combinations with additional wetting agent (Colloidal X-77 at 1 1/2 pints per 100 gal of water), or with additional wetting agent plus amitrole at 3 lb ai/A.

Repeat applications were made when the regrowth of Johnsongrass reached about 10 inches in height. These repeat applications were essential for effective control and were made 4 to 6 weeks apart during the growing season.

During the months of July and August, when temperatures were highest, applications of dalapon appeared to be less effective than when made during the relatively cooler months.

Repeat applications of No. 2 Fuel Oil (Humble Oil Co.) were very effective in controlling Johnsongrass. Applications were made when the regrowth was about 10 inches tall. Dosages were 100 to 160 gpa with the lower rate being very effective.

Evaluations of the relative effectiveness of the above treatments will be continued into the following year. (New Mexico State University Agricultural Experiment Station, University Park)

3A. Control of Johnsongrass (Sorghum halepense) by LP-Gas Flaming. Arle, H. Fred and Hamilton, K. C. New developments in LP-gas flaming equipment to improve efficiency and effectiveness for weed control have been reported by various concerns. During 1962 an experiment was conducted to determine the optimum interval between successive flamings for controlling Johnsongrass (*Sorghum halapense*) and sunflower (*Helianthus annuus*) along an irrigation ditch.

Experimental plots were 80′ x 12′ with 3 replications of each treatment. The various plots were burned at intervals of 1, 2, or 3 weeks throughout the Johnsongrass season. The initial flaming occurred on April 25 and retreatments were continued on schedule until October 17. Repeated flaming at 1, or 2-week intervals effectively controlled Johnsongrass and almost eliminated regrowth from rhizomes by the end of the season. Sunflower was easily killed as it emerged. When flaming was repeated at 3-week intervals, grass usually attained a height of 24 inches. Although this schedule maintained an orderly ditch appearance it did not substantially reduce the Johnsongrass stand and continued treatment would be required the following season. Considering effectiveness of control, time involved, and gas cost, burning every 2 weeks apparently produces optimum results.

Weekly flaming was initiated on an unreplicated plot on July 5, during the period when Johnsongrass rhizomes were at a minimum. Many of the rhizomes which had developed during the previous season had rotted and a new system was just beginning to grow. When the burning schedule was started during this period of apparent plant weakness, complete control was achieved by 11 flamings. The results are summarized as follows:

Flaming interval	1st flaming	No. of flamings per season	Percent kill	Gas used (lb/plot)	Gas cost* per mile
1 week	4/25	17	99	77.6	$180.80
2 weeks	4/25	14	95	76.2	177.52
3 weeks	4/25	10	40	71.2	165.88
1 week	7/5	11	100	63.5	147.94

*Gas cost - 3.53 cents per pound.

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

4. Control of miscellaneous ditchbank vegetation with herbicides. Hodgson, J. M. Several herbicides and combinations of herbicides found most promising for control of general ditchbank vegetation in experiments during 1959, 1960 and 1961 were tested again in 1962. The main objective was to prevent growth of bank vegetation from interfering with water delivery and to maintain a minimum stand of perennial grass which could prevent erosion of the bank. Plots of chemical treatments 10 feet wide and 20 feet long were established from the water line outward with a portable sprayer with a 10 foot boom. All treatments were applied in 36 gallons of water per acre, unless otherwise specified in the accompanying table. Smooth brome and Kentucky blue were the main perennial grasses present. They were just beginning to head when treatments were applied. Broadleaved species present were Canada thistle, golden rod, Kochia, and field bindweed. They were in an early bud or pre-bud stage of growth when treatments were made.

Results are presented on the basis of perennial grass and Canada thistle control estimated 4 and 8 weeks after application of the listed treatments.

Control of vegetation on the Hale ditch with chemicals applied June 19, 1962

		Control in percent of untreated			
		after 4 weeks		after 8 weeks	
Chemical	lb/A	Per.grass	C.thistle	Per.grass	C.thistle
		percent	percent	percent	percent
paraquat + 2,4-D	1.5+2.5	96	100	95	100
paraquat + 2,4-D	1.5+1.5	90	97	97	93
paraquat	1.5	95	90	96	95
amitrole-T	2	80	90	88	100
dalapon + 2,4-D	10+2.5	63	97	96	100
amitrole T	4	63	85	100	100
Herb oil[a] 40 gpa + 2,4-D	2.5	47	93	50	98
dalapon + silvex	20+2.5	25	47	98	95
dalapon + silvex	1.0+1.25	33	57	70	95
Herbicidal oil 120 gpa		87	70	57	23
2,4-D	2.5	12	90	15	97
dalapon + 2,4-D	20+2.5	47	20	90	47

[a]Herbicidal oil containing 55 percent aromatics.

In general all treatments except 2,4-D alone gave fair control of both Canada thistle and perennial grasses while leaving sufficient stand of grass to prevent erosion of banks. Paraquat alone and with 2,4-D gave the most rapid topkill. Also all paraquat treatments had maintained good control of perennial grass and Canada thistle for 8 weeks. Previous experiments with paraquat alone have shown over 50 percent recovery of vegetation 10 weeks after treatment. This was not apparent in this experiment. Combinations of dalapon and 2,4-D were quite effective. However, there was a strong indication of interference of dalapon at 20 pounds per acre with 2,4-D effectiveness on Canada thistle. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, and Plant and Soil Science Department, Montana Agricultural Experiment Station, Bozeman)

5. Influence of several factors on the stability of xylene-water emulsions. Yeo, R. R. Applications of xylene to irrigation canals to control submersed aquatic weeds frequently give erratic results. Several factors may influence the effectiveness of applications. The factors are divided into several groups: plant, size and type of canal, environmental, chemical, and factors of application. Several chemical and environmental factors affecting the stability of xylene-water emulsions were studied in the laboratory: (1) type and amount of emulsifier, (2) temperature of emulsion, and (3) influence of mono- and di-valent salts.

Two anionic, 1 cationic, 2 nonionic, and 2 anionic-nonionic blended emulsifiers were tested to determine their relative stability. The anionic and cationic emulsifiers gave the least stable emulsions. The nonionic emulsifiers were intermediate and the anionic-nonionic blends gave very stable emulsions of xylene in water.

The two anionic-nonionic blended emulsifiers found to give stable emulsions were calcium dodecyl benzene sulfonate plus nonylphenol ethylene oxide condensate (Emulsifier No. 1)* and alkylarylsulfonate plus polyglycol ether (Emulsifier No. 2)*. When tested over periods of 2, 4, and 6 hours at concentrations of 1/2, 1, 2, and 3 percent in xylene, Emulsifier No. 2 gave more stable emulsions as the rate was increased. However, the stability of the Emulsifier No. 1 emulsions decreased as the rate of emulsifier was increased above 1 percent.

When the ratios of the anionic-nonionic components of Emulsifier No. 1 were varied, the stability changed. The ratio of the unchanged formulation gave the most stable emulsion.

Increasing temperature adversely affected the stability of the emulsions; however, reductions in stability were more pronounced with Emulsifier No. 1.

Water containing small amounts of sodium and calcium salts caused the emulsions to break rapidly. Separation of the emulsions containing sodium were slowed when 2 percent concentrations of each emulsifier were used.

The laboratory results with regard to effects of concentration of emulsifier in xylene and of water temperature on the stability of xylene-water emulsions with the two emulsifiers were corroborated by field experiments conducted in canals located in three states. Results of the field investigations will be reported later. (Contribution of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture in cooperation with Bureau of Reclamation, Region 6, and Montana Agricultural Experiment Station, Huntley Branch. Author now located at University of California, Davis)

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*Commercial names and sources of the emulsifiers are available from the author.

6. Dormancy in American pondweed winter buds. Frank, P. A. Underground buds of American pondweed (*Potamogeton nodosus* Poir.) are the primary source of recurring infestations of this species. When mature, the buds are in a dormant state that is normally broken either by exposure to low temperatures or simply by aging or after-ripening. This study was designed to determine the extent and duration of dormancy in these buds.

A number of greenhouse cultures of American pondweed were started and allowed to grow for 4 months. The cultures were mature at this time and the first one was harvested. An additional culture was harvested at monthly intervals for 5 more months. Twenty-five of the buds from each harvest were potted and submerged in water at each of the following temperatures: 45, 55, 65, and 75°F. The buds remained at these temperatures for 1 month and then were moved into the greenhouse. Observations were made weekly and the number of growing buds recorded. The remaining buds from each harvest were put in water and refrigerated at 40°F. After 1 week and at weekly intervals thereafter, 25 of the refrigerated buds were potted and submerged in water at greenhouse temperature. This process was continued until the buds exhibited little or no dormancy. The number of growing buds was recorded weekly. Previous experience with this species indicated that 2 stages or causes of dormancy may exist. In the first stage there is no growth of buds. In the second stage the buds elongate by internodal growth until they extend several inches above the soil line. After several leaves expand, there may be no further growth for several weeks or months. In making observations, only plants that were obviously beyond the second stage of dormancy were considered nondormant.

Buds from the first 3 harvests (4, 5, and 6 months after planting) were highly dormant. Seven weeks of refrigeration at 40°F were required to induce 80 percent of the buds of the first harvest to grow in 1 week after planting. Five and four weeks of refrigeration were required for the second and third harvests, respectively. At the time of the fourth harvest some of the large and more mature buds had emerged and were growing in the original container. Seventy-two percent of these buds grew with no refrigeration and 92 percent were no longer dormant after 1 week of refrigeration. By the time of the fifth and sixth harvests (8 and 9 months after planting), the buds showed little dormancy and growth was enhanced only slightly by refrigeration.

Of the four temperatures used in the constant temperature chambers, 75°F was the most suitable for growth of American pondweed buds. Growth was considerably retarded at 65°F and in no case did more than 1 of 25 buds grow at 55°F. No growth occurred at 45°F, however, when the potted buds were removed from the temperature chambers after 1 month, the growth of buds kept at 45°F equalled or surpassed that of the buds kept at 75°F. The 45°F temperature appeared to be low enough to satisfy some of the requirement for low temperatures to break dormancy in the buds. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture; and the Division of Research, Bureau of Reclamation, Department of Interior)

7. Soil sterilant evaluation trials for the control of submersed aquatic weeds. McHenry, W. B. The use of effective soil sterilants for the control of aquatic weeds would offer certain distinct advantages over herbicides used as water concentration treatments. This report summarizes fifteen field trials conducted from 1960 through 1962 to evaluate soil sterilants in an aquatic environment. Fenac, as the sodium salt; 2,4-D, as the butoxyethanol and isooctyl

esters; atrazine; and simazine were field tested in both preemergent and postemergent trials. Fenac, as the amide, was tested only in preemergent trials. BDM (7.5 percent 2,4-D), monuron TCA, and dichlobenil were applied only as postemergent treatments.

As indicated in the accompanying table, winter preemergent treatments were decidedly superior to applications made during the growing season when the weeds were mature. In the preemergent trials, fenac effectively prevented weed establishment at lower rates than 2,4-D, the next most effective herbicide. It is apparent that emphasis in herbicide evaluation for the control of aquatic weeds should be in preemergent testing. In every case but one where an herbicide gave effective control, the control lasted for the entire growing season. In an elodea control trial with the sodium salt of fenac, recovery or re-establishment occurred in August.

Soil types varied from decomposed granite-silt mixtures to clays, clay-loams, and in one lake a clay-humus ooze. Based on visual inspection, all the soils contained very fine particles and presumably adsorptive constituents.

Placement of the herbicide in the surface soil through adequate leaching is essential in canal treatments prior to exposure to flowing water. In one canal 8-10 inches of precipitation fell on the plots prior to canal use, and fenac, at 5 lb ae/A, resulted in 80 percent control of American pondweed; 20 lb ae/A gave 95 percent control. Fenac at 5, 10, 15, 20 lb ae/A failed in two other canal trials that received approximately 4 inches of precipitation or less before being exposed to flowing water. At one site, atrazine, simazine, and diuron applied on the berm at 3 and 4.8 lb ai/A received approximately 1 inch precipitation and resulted in from 91 to 99 percent control of general annual weeds. A fenac trial in the basin of the same canal failed to control aquatic weeds with the same precipitation prior to submergence. In another canal, an attempt was made to leach the fenac into the soil with the initial flow of canal water. The plot treatments apparently moved over one another in a downstream direction resulting in obliteration of individual plots and an over-all control of approximately 75 percent.

In reservoir and lake evaluations applications were made directly to the soil. The plots received from a trace to 4 inches precipitation before being gradually covered by impounded water. Under these conditions, weed control was effective in all trials regardless of rainfall prior to plot submergence. Both the fenac sodium salt and amide, 10, 20 lb ae/A were superior to 2,4-D, 20, 40 lb/A, under these conditions on American and waterthread pondweeds. In a lake where granular formulations of fenac amide, 10, 20 lb ae/A, and 2,4-D, 30, 60 lb ae/A, were applied through the water before plant growth, 100 percent control of American and sago pondweeds and southern naiad resulted.

Fenac applied during the winter dormant season appears to be an extremely promising aquatic soil sterilant for season-long control of many submerged aquatic weed species as well as slender spikerush and seedling cattails. It was completely ineffective on chara. Applied preemergent, 2,4-D was effective but not as consistent as fenac. BDM, monuron TCA, and dichlobenil were ineffective applied postemergent. Atrazine and simazine performance was considered inadequate in pre- and post-emergent trials. (Agricultural Extension Service, University of California, Davis)

Results of pre- or post-emergent soil sterilant applications for the control of some common aquatic weeds in California
(Evaluations based on visual estimates of control where 10 = 100% control)

			American pondweed *Potamogeton nodosus*		Leafy pondweed *P. foliosus*		Richardson pondweed *P. richardsonii*		Sago pondweed *P. pectinatus*		Waterthread pondweed *P. diversifolius*		Holly-leaved water nymph *Najas marina*		Southern naiad *Najas guadalupensis*		American elodea *Elodea canadensis*		*Myriophyllum* sp.		Chara *Chara* sp.		Slender spikerush *Eleocharis acicularis*		Cattail *Typha* sp.		Burhead *Echinodorus cordifolius*	
		lb ai/A	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
fenac	Na salt	5.0	9		10								4				3	0							10		8.5	
fenac	Na salt	7.5	7								7										0		10					
fenac	Na salt	10.0	9		9.5						9		3				9	0							10		8.5	
fenac	Na salt	15.0	9.5		10						9		5				10	0			0		10		10		5	
fenac	Na salt	20.0	9.8		10						10		6.5				10	0							10		10	
fenac	Na salt	22.5	9.9								10										0		10					
fenac	Na salt	30.0	10								10										0		10					
fenac	amide	10.0	9.3		10				10		8		2		10												7.5	
fenac	amide	20.0	9.8		9.5				10		10		2		10												9.5	
2,4-D	ester	7.5																										
2,4-D	ester	10.0		0						0						0												
2,4-D	ester	15.0																										
2,4-D	ester	20.0	4	0						0	4					1												
2,4-D	ester	30.0	10					4	10						10			0		4								
2,4-D	ester	40.0	7	0						0	7					2												
2,4-D	ester	60.0	10					9.5	10						10			0		9.5								
BDM		20.0		0						0						0												
atrazine		10.0	3		0								0													2.5		
atrazine		20.0	0		0								0													0		
simazine		10.0	0					0			0									0								
simazine		20.0	0					0			0									0								
monuron TCA		44.0						1												1								
monuron TCA		88.0						2												2								
dichlobenil		5.0																0										
dichlobenil		10.0																0										
dichlobenil		20.0																0										

8. Evaluation of herbicides applied to a ditchbottom to control sago pondweed (Potamogeton pectinatus). Hodgson, J. M. Recent reports have indicated that some chemicals such as fenac are promising for control of rooted submersed aquatic weeds. They were applied and leached into the soil during the season when water was absent from the canal. Four chemicals were applied to a canal near Bozeman, Montana in 1961 and 1962 to test this possibility further.

Three formulations of fenac were compared by fall application and fenac, endothal, dichlobenil, and 2,3,6-trichlorobenzyloxypropanol (tritac) were also applied in the spring in the same canal. Individual plots were 12 feet wide (canal width) x 35 feet long and treatments were randomized in linear arrangement with a 5 foot border between each plot. There were 3 replications. The soil was partially frozen at time of treatment but was alternately freezing and thawing for sometime after application. Precipitation, recorded at the nearest weather station (about 8 miles) was 3.74 inches from November 9, 1961 when the fall treatments were applied until May 12, 1962 when water was restored in the ditch. Rainfall was 1.81 inches from April 20, 1962 the date of spring applications until water flowed in the ditch May 12, 1962. The control of sago pondweed was estimated on all plots on July 20, 1962 after the water had been diverted from the ditch for a short time.

The fall applications of fenac at 20 lb/A showed 93, 95, and 95 percent control of sago pondweed with the sodium granular, amide, and sodium liquid formulations, respectively. At 10 lb/A, these formulations gave 95, 80, and 78 percent control respectively, indicating a definite advantage for the granular formulation at the lower rate. There was little difference in the sodium granular and liquid formulations applied in the spring. Sago pondweed was controlled about 70 percent with both formulations.

Endothal was the most effective of the spring treatments, controlling 93 and 97 percent of the sago pondweed at 20 and 50 lb/A respectively. The other spring treatments controlled the pondweed as follows for the 10 and 20 lb/A rates respectively: Casoron - 60 and 85 percent control; tritac - 33 and 77 percent control; and fenac granular - 60 and 70 percent control.

A rather uniform cover of the attached algae, chara, was noted in most plots when sago pondweed had been controlled to a high degree.

(Cooperative investigations of the Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture and the Plant and Soil Science Department, Montana Agricultural Experiment Station, Bozeman)

9. Fenac residue in irrigation water. Frank, P. A., Hodgson, R. H., and Comes, R. D. A problem arising from the use of herbicides in irrigation canals is the possibility of introducing toxic quantities of chemicals in water which may ultimately reach crop land. A study was initiated to determine the extent of contamination of water flowing in a length of canal to which an herbicide had been previously applied to the soil.

A 2300-foot length of canal in eastern Wyoming was treated in early spring with sodium salt of fenac at the rate of 20 lb ai/A. The application was made on top of 1 inch of snow but the soil was not frozen. A total of .55 inch of precipitation was received on the plot area before water was turned into the canal, 5 weeks after treatment. The plot ended at a check in the canal where the water ponded for 50 minutes. The water then spilled over the check and continued flowing downstream. Water samples were taken periodically above and below the treated plot. Three sampling periods were employed during the time when water was being ponded above the check. These were designated Plot Bottom T= 0, T= 15, and T= 30 minutes. The samples designated T= 0 minutes were obtained from the first wave of water traversing the entire length of the treated plot, while samples T= 15 minutes and T= 30 minutes were taken in the same spot 15 and 30 minutes later. As water spilled over the check, samples were taken at intervals of 0, 15, and 30 minutes; 1, 1.5, 2, 4, 8, 12, 24, and 48 hours. Three or more replicate 1-liter water samples were taken at each sampling period. The pH of all water samples was adjusted to pH 1 to 1.3 by the addition of 10 ml of concentrated HCl. Samples were kept frozen until required for analysis.

Fenac was extracted from the acidified water samples with CCl_4. The extract was purified and concentrated in several steps and the fenac converted to its methyl ester with diazomethane. The esterified fenac was then quantitatively determined by gas chromatography using a thermal detector and a detergent column.

By this procedure it was possible to determine less than 10 micrograms of fenac in a 1-liter water sample, or the equivalent of less than 10 ppb. The concentrations of fenac found in various water samples are shown in the following tabulation:

fenac concentration in irrigation water

Water Sample	Sampling time	Fenac ppm
Canal bottom	0 min	8.49
	15 min	1.77
	30 min	0.86
Flow over check	0 min	0.496
	15 min	0.196
	30 min	0.024
	60 min	0.012
	90 min	0.014
	2 hr	0.007
	4 hr	0.004
	8 hr	0.002

The first wave of water flowing over the treated plot contained approximately 8.5 ppm of fenac. The relatively high concentration dropped off rapidly and after 30 minutes amounted to 0.86 ppm. The reduction evidently was due to dilution within the ponded section of the canal, since very little water was lost at the check during the 30 minutes. After 50 minutes of ponding, the water spilled over the check and at that time contained 0.496 ppm of fenac. Again the concentration dropped rapidly and after 2 hours it was reduced to 6.5 ppb. After 8 hours it amounted to only 2 ppb.

The initial flow of water over treated canal soil picked up high concentrations of fenac. This was to be expected considering the inadequate precipitation received to leach the fenac downward from the soil surface. Additional evidence that the chemical had not been leached into the soil was provided by the failure of the treatment to give control of sago pondweed in the canal whereas a similar treatment at another location in the same canal a year earlier followed by 8.76 inches of precipitation before water was turned in gave excellent control of pondweed. However, the herbicide concentration dropped quite rapidly. It appeared that, even under these conditions of little soil incorporation, after several hours the water should be safe for use on crop lands.

(Cooperative investigations of the Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture; the Division of Research, Bureau of Reclamation, U.S. Department of Interior, and the Wyoming Agricultural Experiment Station)

10. Results of tests with herbicides for control of Anacharis occidentalis. Jester, Douglas B. Anacharis occidentalis is one of the more troublesome species of aquatic plants in shallow trout lakes in New Mexico.

Six test plots ranging from 0.1 to 4 acres were treated with 13 herbicides in 3 lakes during 1960, 61, and 62 to determine which chemicals could be used effectively to control Anacharis. Total alkalinity (31-249 ppm), total hardness (34-917 ppm), and pH (7.5-11.0) seemed to have no significant effect on results. Water temperatures ranged from 68^{o} to 78^{o}F at time of treatments in June and July. Lake elevations were 6,400 and 8,000 feet. Plants were growing rapidly and nearing the surface when treated. Treatment rates are based on pounds of total formulation or ppm ai.

Two forms of 2,4-D were used with little success. Chem-Pels 2,4-D was used at the rate of 100 lb/A on a plot containing 10% A. occidentalis along with a dense stand of Ranunculus, 3 species of Potamogeton, and Chara. Fifty to 100% kills were obtained on all species except A. occidentalis. No kill was observed on this species. Pellets of 2,4-D ester were used on a plot that contained 90% A. occidentalis. This treatment at 100 lb/A produced a 20% kill.

Three plots were treated with TBA. Twenty-five percent TBA granular was applied to a dense stand which contained 15% A. occidentalis along with Ranunculus, Potamogeton, and Chara. In this plot a 90% Anacharis mortality occurred along with 90-100% kills on the other species. Manufacture of this herbicide was discontinued, so Benzabor (8% TBA) was tested at 100 lb/A on a dense stand of A. occidentalis (10%), Potamogeton, and Chara without effect. On the basis of the kill with 25% TBA mentioned above, a treatment at the rate of 100 lb/A was made on a dense stand of 75% Anacharis and 25% Polygonum using custom prepared Trysben 200 (26% TBA) on attaclay pellets. A disappointing kill occurred on both species.

Two experimental pellets designated as 59-46 and 59-47 by Chemical Insecticide Corporation were used on 2 plots each, at the rate of 100 lb/A. The former produced kills of 0 and 50% and the latter caused 20 to 50% mortalities.

Kurosal G (silvex) at the rate of 100 lb/A produced a 20% kill, Aquathol G at 100 lb/A (approximately 2.0 ppm) produced a 20% kill, and 4% neburon at 100 lb/A produced 50% mortality on A. occidentalis in plots containing 90%, 90%, and 15% respectively of the species. Kurosal SL (6 lb/gal silvex) killed 10% of the A. occidentalis on a plot composed of half Anacharis and half Polygonum. Treatment rate was 2.0 ppm ai.

The only effective control found was the 1962 experimental formulation of endothal (5%)-silvex (5%). Eighty percent control was obtained on a 3/4-acre plot containing a dense pure stand of A. occidentalis treated at the rate of 2.0 ppm ai. A 1-acre plot containing 85% Anacharis was treated with 2.0 ppm endothal-silvex. A 90% kill occurred. (New Mexico Department of Game and Fish, State Capitol, Santa Fe)

11. Results of tests with herbicides for control of Ranunculus longirostris. Jester, Douglas B. Ranunculus longirostris is common in stands of aquatic

weeds in shallow trout lakes at elevations between 6,000 and 8,000 feet in New Mexico. It is rarely, if ever, dominant in a stand and is rarely found in pure stands on other than small shoals. However, it may constitute up to 25 percent of the vegetation in certain waters and is capable of occupying vacated habitats if not destroyed along with other weeds in an eradication program.

In order to determine chemical controls for Ranunculus, preferably with herbicides that will eradicate species occurring with it, 17 mixed-species test plots were treated with 10 herbicides during 1960, 61, and 62. Plots 0.1 and 0.2 acres in size were treated in June and July when water temperatures ranged from 70° to 76°F.

Alkalinity, total hardness, and pH were variable, but had no apparent effect on results.

Pellets and granular materials were hand broadcast and liquids were applied variously through stream spraying and dribbling into outboard propwash.

Control of Ranunculus longirostris appears to be a simple matter on the basis of these tests. Mortality of the species was 100% on 9 of the 17 test plots, with 90% kills on 2 plots, 80% kills on 1 plot, 50% on 3 plots, 25% on 1 plot. There was only 1 complete failure and that with a chemical that was 50 to 100% effective on 3 other plots.

The accompanying table shows herbicides used, rates of application (lb/A total formulation or ppm ai), percent R. longirostris in the plot, and percent kill. (New Mexico Department of Game and Fish, State Capitol, Santa Fe)

Herbicide	Rate (total formulation)	R. longirostris composition (percent)	Kill (percent)
2,4-D, Chem-Pels	100 lb/A	20	50
Chemical Insecticide	100 lb/A	20	80
exp. formulation 59-46	100 lb/A	10	100
	100 lb/A	5	90
	75 lb/A	10	25
Chemical Insecticide	100 lb/A	20	100
exp. formulation 59-47	100 lb/A	15	50
	100 lb/A	25	0
	75 lb/A	5	50
Kurosal SL	2.0 ppm*	10	100
Kurosal G	100 lb/A**	10	100
2,4-D, PGBE ester granules	100 lb/A	10	100
TBA, 25% granular	100 lb/A	15	100
4% neburon	100	15	90
Aquathol G	3.0 ppm*	15	100
	2.5 ppm*	15	100
Aquathol	3.5 ppm*	20	100

* ai.
**Approximately 2.0 ppm ai.

12. Results of tests with herbicides for control of five species of Potamogeton. Jester, Douglas B. Potamogeton is the most widespread and abundant genus of aquatic weeds in New Mexico. Thus, it constitutes the greatest weed problem

in both warm water and trout fisheries in the state.

During the warm months of 1960, 61, and 62 herbicides were applied to 56 plots (0.1 to 1.0 acre) containing various amounts of Potamogeton in dense stands of submerged plants. One pure stand was treated. Fifteen herbicides were used with several applied in as many as three concentrations.

The species included, in order of abundance, were P. pectinatus (35 plots) P. filiformis (15 plots), P. natans (4 plots), P. diversifolius (3 plots), and P. americanus (1 plot).

The eight ponds and lakes used for the tests represented a diversity of environmental situations. Elevations ranged from 4,000 to 9,000 feet; temperatures varied from 68° to 84°F. in May, June, and July; total alkalinity ranged from 31 to 249 ppm; versenate hardness varied from 34 to 917 ppm; pH ranged from 7.5 to 11.0; and at least 23 species of plants were treated. Desert, plains, and mountain waters were included. The temperature range was suitable and no significant treatment effects could be attributed to the variations in water chemistry.

In the following summary table, treatment rates are given as lb/A total formulation or ppm ai. Species composition refers to the percent of the stand composed of the individual species listed in the first column. Percent kill likewise refers to the species listed and not to total plant kill on the plot.

No synergistic effects affecting Potamogeton were noted between herbicides and other plants. Percentages were determined by visual comparison of test plots with untreated control plots.

Dates of treatment and evaluation are eliminated for purposes of brevity. Lapsed time was one to two months in all instances. Since complete eradications were not attempted, regrowth is not considered. (New Mexico Department of Game and Fish, State Capitol, Santa Fe.)

Species	Herbicide	Treatment rate	Species composition (percent)	Kill (percent)
P. pectinatus	2,4-D, Chem-Pels	100 lb/A	30	30
		75 lb/A	20	10
		50 lb/A	10	50
	59-46	100 lb/A	30	80
		100 lb/A	15	50
		100 lb/A	30	80
		100 lb/A	20	50
		100 lb/A	20	0
		75 lb/A	20	90
		75 lb/A	35	10
		50 lb/A	10	50
	59-47	100 lb/A	30	30
		100 lb/A	25	25
		100 lb/A	25	90
		100 lb/A	20	75
		100 lb/A	15	50
		75 lb/A	20	10
		75 lb/A	35	100
		50 lb/A	10	90
	Kurosal SL	2.0 ppm	25	100
		2.0 ppm	75	95

Species	Herbicide	Treatment rate	Species composition (percent)	Kill (percent)
	Kurosal G	100 lb/A	15	50
		100 lb/A	15	100
	2,4-D PGBE ester granules	100 lb/A	20	90
		100 lb/A	30	60
	TBA 25% gran.	100 lb/A	30	100
	Trysben 200	0.4 ppm	100	100
	4% neburon	100 lb/A	30	50
	Aquathol G	100 lb/A	15	50
		3.0 ppm	20	100
		2.5 ppm	30	100
	endothal	3.5 ppm	25	100
	endothal-silvex	2.0 ppm	50	100
		2.0 ppm	15	100
	Benzabor TBA	100 lb/A	45	0
P. filiformis	59-46	100 lb/A	25	100
		100 lb/A	30	50
		100 lb/A	30	50
		75 lb/A	30	50
	59-47	100 lb/A	25	10
		100 lb/A	25	90
		100 lb/A	50	100
		75 lb/A	30	100
	Kurosal SL	2.0 ppm	25	95
	Kurosal G	100 lb/A	25	75
	Esteron 99G	100 lb/A	30	100
	Aquathol G	3.0 ppm	20	100
		2.5 ppm	30	100
		2.5 ppm	20	90
	endothal	3.5 ppm	25	100
P. natans	2,4-D, Chem-Pels	100 lb/A	Trace	100
	59-46	100 lb/A	Trace	100
	59-47	100 lb/A	Trace	100
	silvex	0.5 ppm	40	100
P. diverisfolius	2,4-D, Chem-Pels	100 lb/A	Trace	100
	59-46	100 lb/A	Trace	80
	59-47	100 lb/A	Trace	100
P. americanus	endothal-silvex	2.0 ppm	50	100

13. Results of tests with herbicides for control of Chara vulgaris. Jester, Douglas B. The branched alga, Chara vulgaris, constitutes one of the greatest weed problems in New Mexico fishing waters and has proved in 1960, 61, and 62 herbicide tests to be one of the most difficult aquatic plants to control.

Waters in the state average among the highest in the United States in terms of hardness and alkalinity and, therefore, provide ideal conditions for dense stands and tall growth of Chara at all elevations and in all geographic areas. It is probable that control is made difficult because of the excellence of the environment for the species.

Thirty-five herbicide test plots used in 1960, 61, and 62 to test 14 herbicides on Chara demonstrated the difficulty involved in control with herbicides

Herbicide	Rate	% Composition	% Kill
2,4-D, Chem-Pels	100 lb/A	30	75
	75 lb/A	80	0
	50 lb/A	90	50
Chemical Insecticide Corp. 59-46	100 lb/A	30	80
	100 lb/A	25	25
	100 lb/A	5	0
	100 lb/A	80	20
	100 lb/A	10	80
	75 lb/A	80	100
	75 lb/A	10	25
	50 lb/A	90	60
Chemical Insecticide Corp. 59-47	100 lb/A	30	10
	100 lb/A	10	0
	100 lb/A	15	Unread
	100 lb/A	80	90
	75 lb/A	80	50
	75 lb/A	5	10
	50 lb/A	90	100
Kurosal SL	2.0 ppm	10	100
	1.0 ppm	100	80
Kurosal G	100 lb/A	15	100
	100 lb/A	85	25
2,4-D, PGBE ester, gran.	100 lb/A	80	90
TBA, 25%	100 lb/A	100	90
neburon, 4%	100 lb/A	30	90
Aquathol G	100 lb/A*	85	0
	3.0 ppm	20	100
	2.5 ppm	5	100
	2.5 ppm	30	75
endothal (liq.)	3.5 ppm	5	100
Pennsalt TD 191	1.5 ppm	100	25
Pennsalt TD 47	1.0 ppm	100	90
Benzabor	100 lb/A	45	0
Copper sulfate	13 lb/A	100	25
	5 lb/A	100	25

*Approximately 2.0 ppm.

is possible. Three lakes and ponds between 4,000 and 9,000 feet elevation in mountains, plains, and desert were used to cover a wide range of conditions. Total alkalinity ranged from 31 ppm to 249 ppm; total hardness was from 34 ppm to 917 ppm and pH from 7.5 to 11.0. These variations appeared to have little, if any, effect on results.

It will be noted from the table that erratic kill was obtained with certain herbicides even with a constant rate of treatment, and, in some cases, even when plots were located approximately 100 yards apart in the same lake. No reasons for this variation were determined. It will be further noted that several herbicides show promise but have been tested insufficiently to be considered as positive controls.

One phenomenon not shown in the table occurred in the 5 plots used to test Aquathol G and endothal (liquid). Three of these plots were composed of 40 to 60% Potamogeton, and 1 each of 20 and 15%, respectively. On the 3 plots containing 40% or more Potamogeton, a synergistic effect apparently occurred during kill or decay of the Potamogeton which caused 100% mortality of Chara vulgaris. On the plot containing 20% Potamogeton, a 75% kill of Chara was obtained. There was essentially no Chara mortality on the plot containing 15% Potamogeton. A Pennsalt Chemicals Corporation representative advised that this effect had occurred consistently in tests in other geographic areas, but that 50% Potamogeton was commonly required for the effect. However, in this instance, it was obtained with a 40% Potamogeton stand. (New Mexico Department of Game and Fish, State Capitol, Santa Fe)

PROJECT 7. CHEMICAL AND PHYSIOLOGICAL STUDIES

C. L. Foy, Project Chairman

SUMMARY

Again the number and range of subject matter of abstracts submitted to this section this year testify to the continuing interest of many in the application of chemical and physiological studies to weed control. As was true last year, the abstracts run the gamut, including studies on the following: (a) photodecomposition of substituted ureas and triazine derivatives by sunlight and ultraviolet light; (b) volatility losses of various 2,4-D formulations (under field conditions), barban, eight triazine derivatives, dalapon and two radio-labeled surfactants (under laboratory conditions) and finally, vapor losses of four thiolcarbamates and three esters of 2,4-D from soil as a function of vapor pressure; (c) absorption and/or translocation of C^{14}-labeled photosynthates, 2,4-D, 2,4,5-T, surfactants (Pluronic L-62, T-1947), Cl^{36}-labeled dalapon, S^{35}-labeled sodium lauryl sulfate and several fluorochromes; (d) solution additives, aids to absorption, translocation and toxicity (Pluronic L-62, T-1947, sodium lauryl sulfate dimethyl sulfoxide, a mixture of methylcellosolve, alkyl aryl sodium sulfonate and sodium acetate); (e) physical and chemical principles involved in the soil behavior of four thiolcarbamates, endothal and three triazine derivatives; (f) tolerance of wheat varieties to three triazine compounds; (g) effect of relative humidity on the herbicidal response of dalapon on Johnsongrass; and (h) infrared spectra analysis of several phenyl carbamates.

Further reports describe (i) the association of C^{14} (from 2,4-D-1-C^{14}) with a water extractable protein fraction of bindweed and (j) evidence (dinitrophenol inhibition) of a metabolic component of 2,4-D absorption in four species. An extensive study on (k) the effect of light quality and toxicity of 2,4-D upon pectic compounds in six selections of Canada thistle failed to support the theory that 2,4-D acts through the pectic substances in killing this species. A final contribution (l) dealing with the effects of dalapon on pyruvate metabolism casts further doubt upon dalapon interference with coenzyme A activity as a mechanism of herbicidal action.

It is apparent that the usefulness of fundamental chemical and physiological information toward achieving more effective weed control is beginning to receive due recognition. Considerable progress during 1962 is indicated by the 23 reports from six states reported herein.

1. Effect of sunlight on absorption spectra of substituted urea and triazine herbicides. Jordan, L. S., Day, B. E., and Clerx, W. A. Methods were developed to determine the effect of sunlight on urea and triazine $1X10^{-3}$ molar solutions in ethanol herbicides adsorbed on filter paper from strips of treated filter paper which were exposed to sunlight from 12 A.M. to 2 P.M. daily. After each exposure the absorption spectra from 200 to 300 mμ were determined and the papers placed in a light-tight box until the next day.

The greatest reduction of absorption for all four urea herbicides occurred near the peak absorption wavelength for the non-irradiated herbicide. This was near 248.5 mμ for monuron, 250.5 mμ for diuron, 252.5 mμ for neburon, and 241 mμ for fenuron. The greatest reduction occurred during the first 12 hours exposure to sunlight. The amount of reduction decreased with each successive 12 hour exposure period. The order of the greatest to lowest reductions of peak height was: neburon, fenuron, monuron, and diuron. The least change in the absorption spectra occurred at wavelengths greater than 270 mμ.

For the three triazines, the decrease of absorption was about equal during the first two 12-hour exposure periods. The decrease was less during the third and least during the fourth period. The greatest reduction occurred in the region between 215 and 230mμ. This included the maximum for the non-irradiated herbicides of 224 for simazine and atrazine and 223 for ametryne. There was less reduction at 230 mμfor simazine and atrazine and at 230 to 240 for ametryne than at the peak wavelength for the non-irradiated chemicals. The least change of adsorption occurred in the region of 250 to 260 mμ. (Department of Horticultural Science, University of California, Riverside)

2. Effect of ultraviolet light on substituted urea and triazine compounds. Jordan, L. S., Day, B. E., and Clerx, W. A. The chemicals were adsorbed on green ribbon filter paper from various concentrations in 95 percent ethanol. The absorption spectra were determined, then the saturated papers were irradiated with ultraviolet light for 18 hours and the absorption spectra determined again. Maximum absorption occurred in the region of 248.5 mμ for monuron, 250.5 mμ for diuron, 252.5 mμ for neburon, and 241 mμ for fenuron. The absorption spectrum for each chemical changed after irradiation. Decreases occurred in regions of maximum initial absorption, increases were obtained at wavelengths greater than the maximums, and decreased absorption occurred at the shorter wavelengths except for the region between 220-235mμ .

In other trials treated filter paper was irradiated for 2, 4, 8, 16, 32, 64, 128, and 1080 minutes with ultraviolet light. The paper strips were saturated with $5X10^{-3}$, $1X10^{-3}$, $5X10^{-4}$, and $1X10^{-4}$ molar solutions of the four compounds.

A rapid decrease of absorption occurred during the first 2 minutes of irradiation with the three highest concentrations of monuron and the highest concentration of fenuron. The decrease was negligible during the first two minutes with diuron, neburon, and the three lowest concentrations of fenuron. In general, for the lowest concentrations, absorption continually decreased with time. The decrease of absorption for $5X10^{-3}$ M treatments with monuron and fenuron was rapid at first, then slower and finally an increased absorption occurred between 128 and 1080 minutes. Absorption for diuron and neburon at the highest concentration decreased very little during the first two minutes. This was followed by a relatively rapid decrease and then little or no change of absorption.

The absorption spectra for simazine, atrazine, and ametryne, adsorbed on filter paper, changed upon irradiation with ultraviolet light. The absorption maximum for simazine and atrazine was at 224 mμ and for ametryne it was at 223 mμ. Simazine was irradiated for 18 hours and atrazine and ametryne for 40 hours. After irradiation, absorption decreased at wavelengths longer than the region of the maximum for the non-irradiated herbicides. Absorption increased at 200 mμ for simazine and atrazine and was about the same for ametryne after irradiation. At $1X10^{-4}$ and $5X10^{-4}$ M the absorption curves were almost flat.

Various concentrations of these herbicides were irradiated for 0, 2, 4, 8, 16, 32, 64, and 128 minutes. There was decreased absorption at the peak for each herbicide. The rate of decrease diminished as time progressed. At lowest concentrations ($1X10^{-4}$ and $5X10^{-4}$ M) there was less decrease than at $1X10^{-3}$ or greater concentrations. (Department of Horticultural Science, University of California, Riverside)

3. Photodecomposition of monuron on the soil surface. Jordan, L. S., Day, B. E., and Clerx, W. A. Methods were developed to determine the photodecomposition of herbicides on the surface of soil. Styrofoam cups were filled with virgin Vista sandy loam soil. Recrystallized monuron was sprayed onto the soil surface in one cc of ethanol. The rate of monuron was 0.1, 0.2, 0.3, 0.4, and 0.5 lb/A.

One set of cups was placed on the roof of the Horticulture building from 9-19-62 to 10-3-62. During this period the soil received 136 hours of sunlight starting from sunrise to sunset each day. During this period the average soil temperature was 77°F. The average maximum temperature was 91.5°F. and the average minimum temperature was 55°F. The average relative humidity at 8 A.M. was 75 percent and at 12 noon it was 39.4 percent. The average evaporation loss was 0.244 inches.

Another set of cups was irradiated with shortwave ultraviolet light (273.5 mμ) for 331 hours at 38° C. A third set was kept in the dark while the first two were being irradiated.

After irradiation the three sets of cups were watered with 10 cc of water to leach the herbicide into the soil. Eleven Kanota oat seeds were planted and the cultures were sub-irrigated. After 14 days the height of the plants was measured. The fresh weight and injury ratings of the plants was determined after 24 days of growth. The results are shown in the following table:

lb/A	Height cm			Weight g			Rating*		
	Dark	UV	Sun	Dark	UV	Sun	Dark	UV	Sun
0.5	12.2	14.7	12.8	0.26	0.79	0.45	6	3	3
0.4	13.5	17.6	16.5	0.70	1.26	0.94	3	0	2
0.3	15.5	18.3	17.4	0.89	1.31	1.20	2	1	1
0.2	17.1	17.8	19.5	1.10	1.35	1.56	1	-	-
0.1	18.3	18.5	19.5	1.35	1.49	1.48	-	-	-
Ck	18.9	20.3	19.3	1.47	1.66	1.46	-	-	-

*0 = no injury, 10 = death

In general, the greatest reduction in height and weight, and the greatest injury symptoms occurred with the plants growing in the soil left in the dark. The least reduction and injury occurred with plants irradiated with UV light. This indicates that the herbicide was decomposed most by the ultraviolet, next most by sunlight, and least in the dark. Further experiments are planned to compare the decomposition of herbicides on soils using different wavelengths of UV light and sunlight. (Department of Horticultural Science, University of California, Riverside)

4. Volatility of formulations of 2,4-D under field conditions. Day, B. E. Jordan, L. S., and Russell, R. C. An evaluation of the relative volatility of nine low-volatile formulations of 2,4-D under mid-summer desert temperature conditions was made in the Coachella Valley, California. Materials were applied to ten-foot square plots widely dispersed in a two acre skip-row planting of cotton. Plots were treated at rates of 4 lb/A ae at a volume of 100 gpa. Materials were applied at low pressure within a high-walled plastic enclosure under calm wind conditions, and every effort was made to minimize spray drift. Volatility was assessed on the basis of injury to cotton plants surrounding the treated plots. Four degrees of injury were recognized in rating the cotton.

In the same field at considerable distance from the treated plots, individual cotton plants were sprayed with diethyl amine 2,4-D at a series of rates ranging logarithmically from 1 to 4098 micrograms ae per plant.

Continuous records of surface air temperature and wind direction and velocity for the duration of the experiment were obtained from an official weather station located one mile from the test area. The mean maximum surface air temperature for the 84 days of the experiment was 105.7°F., the mean minimum 76.71°F. Day winds were predominantly from the SE and night winds from the NW.

All materials were applied on July 29, except the Na salt formulation which was applied a week later on July 6. Ratings were made at 42, 56, and 84 days following application. Maximum development of symptoms were recorded on August 24, fifty-six days after treatment. Herbicidal symptoms were distributed in patterns extending to the NW of the plots, indicating that volatilization occurred during the high daytime temperatures. The formulations tested are ranked in order of decreasing volatility.

1. ACP 62-202 (an emulsifiable acid formulation of 2,4-D).
2. ACP 62-75 (an emulsifiable acid formulation of 2,4-D).
3. 2,4-D acid (highly purified, unformulated).
4. Diethyl amine 2,4-D (highly purified).
5. Weedone 638 (emulsifiable acid, 1962 formulation).
6. Weedar 64 (an alkyl amine salt of 2,4-D).
7. Sodium salt of 2,4-D (highly purified, unformulated).
8. Dacamine D-2 (an oil soluble amine of 2,4-D).
9. Emulsamine E-3 (an oil soluble amine of 2,4-D).

Individually treated plants also observed on August 24 (56 days after treatment) were rated as follows:

Treatment, micrograms per plant	Injury
1 - 16	none
32 - 128	slight
256	moderate
512 - 4096	severe

The minimum treatment of 32 micrograms causing symptoms to cotton is approximately equivalent to 0.5 grams of 2,4-D per acre. (Department of Horticultural Science, University of California, Riverside)

5. Volatility of various herbicides under laboratory conditions. Foy, Chester L. and Smith, Leon W. Since several radioactively labeled compounds were to be used in subsequent studies on their penetration, translocation and metabolism in plants, it was of interest to determine their relative volatilities under normal (laboratory or greenhouse) conditions.

Droplets of each solution, C^{14}-labeled T-1947 (a nonionic surfactant), three forms of barban (C-1, carbonyl and ring-labeled), trietazine, propazine, prometone, hydroxypropazine, simazine, hydroxysimazine, ipazine, atrazine, Cl^{36}-labeled dalapon (sodium salt) and S^{35}-labeled sodium lauryl sulfate, were deposited on nickel-plated planchets under a laboratory hood fan at 23-25°C. Samples were counted continuously or at frequent intervals for 48 to 96 hours without change in geometry.

Under these conditions only trietazine and ipazine (deposited in 95% ethanol) showed a significant loss (85 and 44%, respectively) after 12 hours.

Disappearance was 99 and 94%, respectively after 48 hours. Exposure under an infra-red heat lamp (sometimes used to hasten drying of solutions in planchets) where the temperatures were 61°C and 52°C at the base of the planchet and one inch above the planchet, respectively, caused virtually complete loss of these compounds in less than two hours. Atrazine and propazine were approximately 95% gone in 16 hours; simazine, about 35% in 24 hours. Losses of prometone Sodium Lauryl sulfate, T-1947, dalapon (sodium salt) and hydroxypropazine were insignificant after 24 hours; the other compounds were not tested for volatility loss at elevated temperatures.

The results indicate the need for exercising care and guarding against loss of assumed nonvolatile compounds in critical laboratory studies. (Botany Department, University of California, Davis)

6. Vapor losses of thiolcarbamates and 2,4-D esters from soil as a function of vapor pressure. Vernetti, Jack B. and Freed, V. H. Vapor pressures and vapor losses from soil were determined for several compounds. The results, including latent heats of vaporization calculated from the Clapeyron equation, are summarized in the following table.

Vapor pressures and volatility from soil

Chemical	V.P. mm. Hg	V.P. mm. Hg	ΔH KCal/ mole	%Loss from soil 24 hrs
EPTC	1.97×10^{-2}(24°C)	6.2×10^{-2}(40°C)	14.5	22.6
t-Butyl N,N-dipropyl thiolcarbamate (R-1856)	1.11×10^{-2}(26°C)	3.54×10^{-2}(41°C)	14.4	20.6
Propyl N,N-dipropyl thiolcarbamate (R-1607)	5.41×10^{-3}(24°C)	2.00×10^{-2}(42°C)	13.5	17.2
PEBC	4.8×10^{-3}(24°C)		12.0*	11.6
Isopropyl 2,4-D	1.05×10^{-2}(25°C)	$6.40 \times (10^{-2})$(40°C)	23.9	11.2**
Butyl 2,4-D	3.92×10^{-2}(25°C)	$2.02 \times (10^{-2})$(40°C)	20.5	8.3**
Iso-octyl - 2,4-D				3.6**

* Calculated from boiling points under reduced pressure.
**Extrapolated from a two day vapor loss study.

Vapor losses were measured from Newberg sandy loam containing 6-10 ppm of the chemical.

In general it would appear from the table that vapor pressures can be used as an approximate guide to relative vapor losses in a homologous series of compounds. However, on comparing vapor pressures of PEBC, R-1856, R-1607, and butyl 2,4-D with isopropyl 2,4-D, the implication would be that a lower vapor loss should exist for the four compounds than is actually indicated on the table. Examination of the heats of vaporization yields a possible clue to this discrepancy. Isopropyl 2,4-D has a higher ΔH value, requiring more energy to vaporize; this parameter is a measure of resistance to volatilization with respect to the other four compounds.

Comparison of the heats of vaporization and vapor losses from soil between the thiolcarbamates does not give such a simple picture. The differences of ΔH vap. are smaller than would be expected for the magnitudes of variation in vapor losses. Apparently other factors such as diffusion through the soil may play an important role. (Department of Agricultural Chemistry, Oregon Agricultural Experiment Station, Corvallis)

7. Additives to dalapon sprays. Jordan, L. S., Day, B. E., and Hendrixson, R. T. Experiments were conducted to determine the possibility of increasing dalapon toxicity to grasses. Various combinations of dalapon, methyl cellulose, sodium acetate, and alkyl aryl sodium sulfonate were tested on oats grown in the laboratory. Oats were grown in styrofoam cups, with sub-irrigation until 10 cm tall. They were then sprayed with dalapon at 2,000 ppm alone or with a mixture of one or more of the additives. After 7 days the first leaf was removed and the height of the second leaf measured to serve as an index of toxicity of the spray.

None of the additives, alone, increased the toxicity of dalapon to the oats. Alkyl aryl sodium sulfonate (0.24 percent) and methyl cellulose (2.25 percent) reduced the effect of dalapon. The only dual combination tested which increased the toxicity of dalapon over that of the commercial formulation was methyl cellulose (2.25 percent) and alkyl aryl sodium sulfonate (0.40 percent). The addition of 2.25 percent methyl cellulose, 1.40 percent sodium acetate and 0.4 percent alkyl aryl sodium sulfonate significantly increased the toxicity to oat plants over all other combinations tested. The reasons for this are not well understood. Methyl cellulose probably increased and maintained the spray load on the grass foliage. The sodium sulfonate probably increased the spread and penetration of dalapon. The action of sodium acetate is not known.

Field plots were established to determine the effectiveness of a methylcellulose formulation of dalapon on bermudagrass. Plots 5 x 20 feet were established in a lemon grove. The grass was mowed and allowed to regrow to an average height of four inches. Dalapon was applied at the rate of 6, 12, and 18 lb/A with a bicycle sprayer using 100 gpa volume at 40 psi pressure. Dalapon at the rate of 6, 12, and 18 lb/A plus 10 percent methylcellulose formulation with 45 percent, 15 CPS, methylcellulose; 20 percent of 40 percent active alkyl aryl sulfonate; and 35 percent sodium acetate ("Seedcoat" obtained from Colloidal Products, Incorporated) (by weight) was applied with a knapsack sprayer using 100 gpa volume. Eight replications were used. The plots were rated weekly by three persons working independently. A rating scale of 0 to 100 was used with 0 indicating no effect and 100 indicating complete foliage kill.

Bermudagrass control by three rates of dalapon alone and combined with 10 percent methylcellulose based formulation is shown in the following table.

Ratings of bermudagrass control with dalapon and combined with 10 percent methylcellulose formulation

Material	Rate lb/A	Control (percent) at weekly intervals 1	2	3	4	5	6	8
dalapon	6	14	28	44	52	60	72	84
dalapon	12	39	58	68	76	83	91	94
dalapon	18	70	83	87	88	90	93	96
dalapon + MC	6	79	85	90	89	92	93	89
dalapon + MC	12	96	97	97	98	98	98	96
dalapon + MC	18	99	98	96	96	95	92	86

The combination of dalapon and methylcellulose affected the bermudagrass substantially more during the first five weeks after treatment. Control ratings for the eight weeks were about the same for dalapon alone and in combination with methylcellulose formulation 100A. The formulated material gave a much more uniform, as well as early, control. (Department of Horticultural Science, University of California, Riverside)

8. Translocation of photosynthate and 2,4-dichlorophenoxyacetic acid in the grape vine. Leonard, O. A. and Weaver, W. J. Current-season grape shoots were exposed to carbon-14 CO_2 before flowering, at flowering, when the fruit were one-third full size, and when the fruit were fully enlarged. After one entire shoot was treated with the labeled CO_2, one-half of the shoots were then treated with lethal quantities of 2,4-D. The treated grape shoot was collected immediately, after 3 days, after 21 days, and when the fruit were full size for autoradiography and counting (only a small portion of the shoot and fruit cluster was used for autoradiography). The rest of the grape vine was sampled for autoradiography. To check on possible translocation from the main stem into untreated current-season shoots, a berry from each cluster was sampled for autoradiography. Translocation of 2,4-D was followed by formative effects and by callus formation. Formative effects on the regrowth from the grape stumps indicated further translocation down the stem.

The main results can be summarized. Treatments made to the shoots before flowering resulted in no translocation of either 2,4-D or carbon-14 out of the treated shoots for 21 days following treatment; however, there was label in the main body of the grape shoot when the fruit were full size. The 2,4-D killed the shoots, so there was no translocation of carbon-14 out of the 2,4-D treated shoots. Further, there were no symptoms of 2,4-D on the current seasons shoots, or on the regrowth from the stumps.

When the treatments were made at flowering, translocation out of the shoots was slight in 3 days but appreciable after 21 days and when the fruit were full sized. 2,4-D symptoms were present on the regrowth from the stumps from the 21-day treatments, and from those made when the fruit were full size.

In treatments made when the fruit were one-third full size, translocation out of the treated shoots was pronounced both for carbon-14 and 2,4-D; however, 2,4-D symptoms on current-seasons shoots were rare. Regrowth from the stumps, however, showed many formative effects.

Treatments made when the fruit were full-sized showed only limited translocation from the treated shoots. No observations on the regrowth from the stumps will be possible until such regrowth occurs in 1963.

The total activity in the treated shoots and the re-distribution of this activity between the vegetative shoot and the flower or fruit cluster was followed. Shoots treated before flowering showed no significant loss of radioactivity until after a time lapse of more than 21 days; only a small percentage of the total activity migrated into the cluster. When treated at flowering, only a small loss of carbon-14 from the treated shoots occurred within the 21-day period; a greater percentage of the carbon-14 migrated from the vegetative shoot into the flower cluster. When treated when the fruit were small, about 55 percent of the total activity migrated out of the treated shoot into the main body of the grape vine, while another 15 percent migrated into the fruit clusters. Treatments made when the fruit were full size indicated that only a small percentage of the total activity migrated out of the treated shoot (perhaps 10 percent), but 30 percent migrated into the fruit and was stored there largely as sugar. (Botany Department, University of California, Davis)

9. Dimethyl sulfoxide as an absorption and translocation aid. Norris, Logan A. and Freed, V. H. Dimethyl sulfoxide (DMSO) was tested as an absorption and translocation aid for 2,4,5-T in bigleaf maple, *Acer macrophyllum*, seedlings. The triethanol amine salt of 2,4,5-T was applied in basal, injection and foliar type treatments at concentrations normally used in the field. Bigleaf maple seedlings, three to five years old, were grown in the greenhouse under a sixteen hour day for three months prior to treatment. Solutions of the triethanol amine salt of 2,4,5-T (carboxyl C^{14} labeled) were prepared in water and DMSO at 0, 20, 50 and 100 percent DMSO by volume. The concentration of 2,4,5-T and the exposure time varied with the treatment. Following exposure all trees were sectioned into the treated section, new growth, stem and roots. These sections were then dried, ground and extracted. The solutions were plated and counted in a gas flow Geiger counter. The data was corrected for self-absorption. All tests were run in duplicate.

Basal Treatment

Each tree received 25 microliters of 11,240 ppm C^{14} 2,4,5-T applied with a micro-syringe to the lower inch of the stem. After 18 days, the trees were sectioned and treated as described above.

Results expressed as a percent of the recovered counts:

	Basal treatment Percent DMSO			
Section	0	20	50	100
New growth	1.7	0	0	0
Stem	.1	1.8	0	2.0
Treated section	98.2	96.3	98.2	98.0
Roots	0	1.9	1.8	0

Injection treatment

Each tree received 100 microliters of 50,000 ppm C^{14} 2,4,5-T through a glass tube inserted in a slit in the bark. The trees were sectioned after four days and treated as before.

Results expressed as a percent of the recovered counts:

	Injection treatment Percent DMSO			
Section	0	20	50	100
New growth	9.9	5.1	3.6	5.8
Stem	.8	1.4	1.5	7.5
Treated section	75.7	91.0	94.7	86.7
Roots	13.6	2.5	.2	0

Foliar Treatment

A treatment of 50 percent DMSO and 1 percent X-77 surfactant was added to the treatment schedule. Each tree received .5 ml of 50,000 ppm C^{14} 2,4,5-T on a single leaf. Following a two week exposure period, the treated leaf was washed with alcohol and the tree sectioned and treated as before.

Results expressed as a percent of the recovered counts:

Section	Foliar treatment Percent DMSO 0	20	50	50/X-77	100
New growth	.01	.01	.03	.04	.02
Treated leaf	1.18	1.03	3.66	5.76	10.44
Stem	.06	.02	0	.04	0
Roots	.03	0	.05	.02	0
Leaf washing	98.72	98.94	96.26	94.14	89.54

It is evident from the data that DMSO is undesirable as a solvent for injection type treatments. The results of the basal treatment however, would seem to indicate that it may have some value as a basipetal translocation aid. It was noted in field tests of basal and injection treatments however, that ester and amine formulations of 2,4,5-T and 2,4,5-TP in DMSO gave poor kills of bigleaf maple. The foliar application in 100 percent DMSO shows a ten fold increase in absorption but no apparent translocation. It is not anticipated that additional translocation would occur after the two week exposure period allowed in this test. It was noted in other tests that 20, 50, and 100 percent of DMSO solutions exhibited a certain degree of phytotoxicity to maple leaves. (Department of Agricultural Chemistry, Oregon Agricultural Experiment Station, Corvallis)

10. Absorption and metabolism of C^{14} surfactant as influenced by 2,4,5-T in bean leaves. Norris, Logan A. and Freed, V. H. It has been well established that surfactants increase the uptake of herbicides. Some earlier work has indicated that some sort of a herbicide-surfactant interaction may exist. Detached fully-expanded primary leaves of Black Valentine beans, *Phaseolus vulgaris*, were used to study the uptake and metabolism of Pluronic L-62 surfactant as it is influenced by 2,4,5-T.

The following treatment solutions were used: Soln. #1 1.0 percent C^{14} Pluronic L-62; Soln. #2 500 ppm 2,4,5-T as the triethanol amine salt and 1.0 percent C^{14} Pluronic L-62.

A treatment consisted of applying 0.10 ml of a treatment solution to a leaf and placing it in a small glass chamber, with the petiole in water, for .5, 1, 8, 24, or 72 hours. The chamber was maintained in the dark at room temperature. The air entering and leaving the chamber was washed in NaOH. A flow rate of about 60 mls per minute was used. Following exposure the leaf was washed and extracted with 80 percent isopropyl alcohol. The respired CO_2, trapped in the NaOH, was plated as $BaCO_3$. The extract, leaf washing, and the carbonates were counted in a gas flow Geiger-Müller counter. The data were corrected for self absorption.

Results: Expressed as a percent of the recovered counts.

1.0 percent C^{14} Pluronic L-62

Time in hours	Percent of activity recovered in Carbonates	Leaf washing	Extract
.5	0	99.87	.13
1	0	99.84	.16
8	0	99.06	.94
24	.05	98.31	1.64
72	.08	95.39	4.53

500 ppm 2,4,5-T as the triethanol amine salt and 1.0 percent C^{14} Pluronic L-62

Time in hours	Percent of activity recovered in Carbonates	Leaf washing	Extract
.5	.02	99.89	.09
1	.01	99.89	.10
8	.21	99.74	.05
24	.28	98.86	.86
72	.68	69.95	29.37

These data indicate a marked effect of the herbicide on the uptake of the surfactant. The mode of action involved is not known. Further work is planned to study the effect of this phenomenon on the subsequent translocation of the herbicide and the surfactant.

Some preliminary results have been obtained concerning the effect of the herbicide on the metabolism of the surfactant. The above study shows that leaves treated with surfactant and herbicide liberated 0.21 percent of the absorbed activity, per mg respired CO_2, as $C^{14}O_2$ in the 72 hour treatment. Leaves treated with the surfactant alone liberated only 0.13 percent. This would seem to indicate that the addition of the herbicide resulted in a more rapid breakdown of the surfactant to CO_2.

Aliquots of the plant extract from the 72 hour treatment were placed on Whatman #1 filter paper strips. The chromatograms were developed with n-butanol, ethanol, and water (4:1:5). The strips were counted in a gas flow Geiger-Müller chromatogram scanner. Chromatograms of extract from leaves treated only with surfactant revealed three major and one minor peak. The major peaks were all about the same magnitude and appeared at R_f values of .85, .65, and .51. R_f .85 corresponds to the unaltered surfactant. The extracts from surfactant plus herbicide treated leaves showed most of the material around the location of the unaltered surfactant with minor peaks around R_f values of .50 and .63.

These results would seem to indicate that while the surfactant with herbicide is metabolized to CO_2 at a slightly faster rate, the surfactant when applied alone is being degraded or metabolized to other products at a much faster rate. The significance of this information is not fully known. Further studies are planned to investigate more intensively this herbicide-surfactant interaction. (Department of Agricultural Chemistry, Oregon Agricultural Experiment Station, Corvallis)

11. Absorption pathway of fluorochromes in the mesquite leaflet. Hull, Herbert M. Fluorescence microscopy has revealed that initial entry of certain fluorochromes into mesquite leaflets is predominantly through the trichomes. Entry of this nature is rather unexpected in view of the numerous findings with a wide variety of plants which demonstrate that most organic substances penetrate primarily through the stomata or cuticle. Studies with greenhouse plants and with foliage of field plants collected during different seasons have suggested that the relative proportions of fluorochrome entering vie the trichomes as compared to stomata and cuticle is probably a function of growth environment and leaf development. The relationship is quite complex and further study is required before it can be precisely correlated with the variables involved.

Of the various fluorochromes used, thioflavin TG and acridine orange have proven particularly useful, as has an ethanol or aqueous extract of the prickle-poppy, Argemone sp. Acridine orange is a water-soluble basic dye with a molecular weight of 302, which is the same order of magnitude as a number of the more popular phenoxy and benzoic acid herbicide formulations. Under ultraviolet irradiation it fluoresces a blue-green color with maxima at 467 and 497 mμ, but after initial absorption by the trichome it emits a brilliant yellow fluorescence. It then radiates outward from the trichome base apparently in the periclinal and anticlinal epidermal cell walls and forms red, yellow, and green rings with increasing radii, in much the manner of a circular chromatogram. The radii of the outer rings reach 100 μ or more two to three hours after treatment. Whether the change in color is due to a concentration effect, a pH effect, or to changes in the autofluorescence of certain endogenous constituents induced by the fluorochrome is not known. Future work will endeavor to answer this question and establish the effect of fluorochrome polarity or solubility, surfactant hydrophile-lipophile balance, and other factors on fluorochrome movement within the leaflet. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Tucson, Arizona)

12. Tracer studies with two radiolabeled surfactants and dalapon. Foy, Chester L. and Smith, Leon W. Gross absorption and translocation studies with dalapon-Cl^{36}, T-1947-C^{14} and sodium lauryl sulfate-S^{35} were conducted on cotton and barley. Herbicide and surfactants were applied to leaves by drop treatments, in the following combinations: (1) dalapon-Cl^{36} alone; (2) dalapon-C^{36} + T-1947; (3) dalapon-Cl^{36} + sodium lauryl sulfate; (4) T-1947-C^{14} alone; (5) sodium lauryl sulfate-S^{35} alone; (6) T-1947-C^{14} + dalapon; (7) sodium lauryl sulfate-S^{35} + dalapon; (8) untreated.

Because of low specific activities, rather large droplets (100 μl) were required; these were confined on the leaves by lanolin rings. Wetting patterns and acute toxicity were observed, and plants were harvested for autoradiography and counting 1 hour, 24 hours and 7 days after treatment. Detailed count data on all plant parts are still being analyzed. Tentatively, based on autoradiographic patterns and preliminary count data, the following conclusions seem justified:

(1) No labeled compound moved out of the treated leaf of either species within 1-2 hours.

(2) Dalapon-Cl^{36} alone was distributed into all plant parts within 24 hours.

(3) T-1947-C^{14} alone remained liquid for long periods, penetrated extremely poorly and produced no autoradiographic image outside the treated leaf even after 7 days. T-1947-C^{14} moved distally from the spot of application within the treated leaf, however.

(4) Sodium lauryl sulfate-S^{35} alone penetrated and/or dried rapidly. Initial movement was (as for T-1947-C^{14}) out toward the tip of the leaf. However, after 7 days, S^{35} (perhaps now metabolized to sulfate) was distributed throughout the plants.

(5) Nonlabeled dalapon seemingly increased T-1947-C^{14} uptake and movement, perhaps by producing acute toxicity in the region of absorption.

(6) Conversely, with sodium lauryl sulfate-S^{35} which entered rapidly alone, acute toxicity caused by adding nonlabeled dalapon had little initial effect but reduced translocation of S^{35} outside of the treated leaf.

(7) Nonlabeled sodium lauryl sulfate seemingly enhanced gross absorption and translocation of dalapon-Cl^{36} (especially in barley) whereas nonlabeled T-1947 interfered with uptake and distribution of dalapon-Cl^{36}. The latter result is somewhat anomalous in view of the fact that herbicidal action of dalapon was greatly enhanced by T-1947 in spray tests on corn. Volumes of the treatment droplet and relative concentrations of each compound in solution may have influenced the results.

(8) Although both T-1947-C^{14} and sodium lauryl sulfate-S^{35} moved out toward the tip of the leaf (eg. in cotton-forming a wedge pattern, characteristic of apoplastic movement with the transpiration stream), they apparently moved in different systems. Sodium lauryl sulfate-S^{35} (identified by chromatography as nonmetabolized after 24 hours) moved predominantly in the veins, whereas T-1947-C^{14} (presumably still intact also) was found mostly in the interveinal areas. Moreover, T-1947-C^{14} tended to accumulate in the lysigenous glands of cotton in a manner similar to several 2-chloro and 2-methoxy triazines and DCPA. (Botany Department, University of California, Davis)

13. Soil behavior of four thiolcarbamates. Vernetti, Jack B. and Freed, V. H. Previous work (1962) with EPTC demonstrated the soil behavior effects of compounds having negative heats of solution. Three other thiolcarbamates were investigated with respect to behavior in soil. Tertiary butyl N,N-dipropylthiolcarbamate (R-1856), propyl N,N-dipropylthiolcarbamate (R-1607), and PEBC all exhibited negative heats of solution. Consequently the three compounds had a greater soil adsorption and more solubility at lower temperatures. The summary of the data including EPTC is shown in Table I.

Table I

Solubility and adsorption

Chemical	Solubility ppm	Solubility ppm	ΔH soln. Cal./mole	% Adsorption 24°C	% Adsorption
EPTC	375 (25°C)	636 (3°C)	-3930	61.6	37.9 (3°C)
R-1607	109 (24°C)	162 (4°C)	-3240	68.1	54.5 (4°C)
PEBC	90 (25°C)	130 (3°C)	-2740	75.0	69.4 (3°C)
R-1856	35 (24°C)	65 (4°C)	-5060	88.6	67.1 (4°C)

Leaching experiments were carried out in eight inch soil columns with the chemical initially dispersed in the upper half inch of soil. Twelve inches of water were added to the top and the leachate collected. As expected, analysis of the effluent water showed an increase in leaching with a decrease in temperature. Results are listed in Table II.

Table II

Leaching of thiolcarbamates as influenced by temperatures

	Fraction of initial amount of chemical in column			
	EPTC	PEBC	R-1607	R-1856
Effluent Water (24°C)	0.009	Trace	0.000	0.000
Effluent Water	0.064 (3°C)	0.039 (3°C)	0.123 (4°C)	0.007 (4°C)

(Department of Agricultural Chemistry, Oregon Agricultural Experiment Station, Corvallis)

14. The adsorption of endothal by soil as a function of its availability. Freed, V. H., Montgomery, M. and Nance, R. The adsorption of endothal by soils in which it performed well and soils in which it was rather disappointing was

measured. A fairly good inverse correlation between satisfactory weed control and degree of adsorption was noted. However, it was found that one particular soil did not follow this relationship in that good weed control was obtained even though endothal was extensively adsorbed.

In attempting to explain this anomalous behavior, desorption studies were carried out with this particular soil and another in which the extent of adsorption was about the same and in which weed control with endothal was poor. Desorption studies were carried out by adsorbing endothal on soil from an aqueous solution, and then removing the supernatant solution and replacing it with water.

After an equilibration period the amount of endothal that had been desorbed into the water was determined. The results showed that the soil which gave good weed control released 75% more endothal than the soil which gave poor weed control. This behavior points out a very important consideration in assigning adsorptive indices to soils, in that the extent of adsorption alone does not give a true indication of the chemical available for weed control. (Department of Agricultural Chemistry, Oregon State University, Corvallis)

15. The effect of temperature on the uptake of simazine by wheat. Montgomery, M. and Freed, V. H. Residue studies in the greenhouse indicated wheat isn't as tolerant of simazine under these conditions as some field studies indicate. Even at low rates of application injury to the wheat was encountered. In attempting to determine the reason for this behavior, uptake studies from soil were carried out at two temperatures, 60° and 80°F., under the same light intensity. Two different treatments were made at each temperature. One involved applying 0.5 lb/A to the soil surface, while the other consisted of blending soil with sufficient simazine to give a concentration of 0.5 ppm.

Radioanalysis of the plants after 4 weeks indicated large differences in the uptake at the different temperatures. In the 0.5 lb/A treatment, 84 percent more radioactivity was found in the plants growing at 80°F. than those at 60°; with the 0.5 ppm concentration, 6 times as much radioactivity was taken up at the higher temperature. The smaller temperature differential with the 0.5 lb/A treatment was probably due to leaching of the chemical from the soil surface to the root zone since considerable moisture is required in greenhouse culture. This would make a much higher concentration of simazine in the root zone of the plants growing at 80°F.

These results would tend to explain why applications of simazine to fall wheat do not result in as serious injury of the crop as under spring treatment. Shortly after seedling development the plants are not very active due to the low winter temperatures, so little simazine would be taken up during this time. It is likely that by the time plants resume growth in the spring, a good deal of the chemical has been dissipated in the soil. (Department of Agricultural Chemistry, Oregon State University, Corvallis)

16. The movement and persistence of two triazine compounds as affected by moisture and soil types. Chamberlain, E. W. Studies were initiated in the summer of 1961 to determine the movement and persistence of atrazine and ametryne in soils collected from four winter wheat growing areas in Wyoming. These soils had been previously treated with atrazine at 1, 2, and 4 lb/A and ametryne at 1 and 2 lb/A. Atrazine had been applied both in the fall and spring and ametryne only in the spring. Soil samples were collected on 2 days during the summer of 1961 at the 0-1, 1-2, 2-3, 3-4, and 4-5 in depths. Four replications were used in this

experiment and oats were used as indicator plants. The oats were clipped and green weight used as a factor in determining the presence of the chemicals. The soil types were sandy loam, sandy clay loam, and clay loam.

Soil samples obtained from the sandy loam sites show that three months after treatment and with 8 in of precipitation both atrazine and ametryne had moved to the 3-in soil depth. Nine months after treatment atrazine had moved to the 5-in depth with 13.53 in precipitation. Treated plots received a mechanical treatment (duckfoot) prior to the second sampling date. The soil samples taken after the mechanical treatment indicated that the phytotoxicity was considerably reduced as evidenced by the greater amount of oat growth obtained at all sampling depths. Both atrazine and ametryne disappeared rapidly from sandy loam soil after the soil was disturbed by a mechanical operation. One mechanical operation was needed to reduce the toxicity of these two triazine compounds within the germination zone of the wheat seed. Atrazine provided control of both grass and broadleaved weeds for a complete summer fallow season, whereas ametryne controlled all weeds except tansy mustard (*Descurainia pinnata*).

On the clay type soil atrazine was extremely persistent and had remained in the top 2 in of soil two years after treatment in sufficient quantity to prevent all plant growth.

Additional studies were conducted in the greenhouse to determine the depth of movement of atrazine and ametryne in sandy loam soil and clay loam soil with measured amounts of precipitation. These soils were put in columns 8 in long and 5 3/8 in in diameter and compacted to approximately that of a well prepared seed-bed. The chemicals were applied at a rate equivalent to 2 lb/A in 240 gallons of water per acre with a small atomizer. Twenty-four hours after the chemicals were applied a measured amount of water, equivalent to 2 in of rainfall, was added to the top of the soil column.

The 2 in of precipitation moved entirely through the 8 in column of sandy loam soil and only to a depth of 6 in in the clay loam soil.

Results showed that both ametryne and atrazine moved to the 4 in depth in the clay loam soil. On the sandy loam soil atrazine moved to a depth of 4 in while ametryne showed phytotoxic symptoms only to a depth of 2 in. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie)

17. Study to evaluate the tolerance of several winter wheat varieties to three triazine compounds. Chamberlain, E. W. and Allen, C. P. Fourteen varieties of winter wheat were tested for tolerance to atrazine, ametryne, and 2-chloro-4(1-propenyl amino)-6(isopropyl amino)-s-triazine (G-34361). The varieties used were Rego, Cheyenne, Wichita, Nebred, Bison, Minter, CI 13543, N551147, Yogo, Warrior, Kharkof, Shoshoni, Omaha, and Concho. The 14 varieties were planted 10 seeds to a row in a metal flat and replicated three times. The chemicals were applied at an equivalent of one-twentieth (1/20) lb/A and mixed thoroughly into the top 1 in of soil before planting the wheat seeds. Two tests were used in this experiment.

Seven of the more promising varieties from the first test were selected for a second test for each chemical. Visual observations were made every seven days and individual leaf length measurements were taken at 28 days growth on both tests.

In most cases the seeds in treated flats germinated and emerged first. Also the seedlings in treated flats appeared more vigorous and were taller up to the fourteenth day, when compared to the untreated flats. After the fourteenth day, the lack of tolerance in some wheat varieties became quite apparent and some varieties almost immediately stopped growing. The soils in the treated flats seemed to dry out faster than in untreated flats. In both tests the varieties seemed to be least tolerant to ametryne, followed by atrazine, and finally by G-34361.

The varieties showing the most tolerance for atrazine were Rego, Wichita, and Shoshoni; for ametryne the most tolerant were Minter, N55147, Warrior, CI 13543, and Kharkof; and for G-34361 tolerant varieties were Wichita and CI 13543. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie)

18. Influence of relative humidity on the herbicidal response of Johnsongrass to dalapon. Foy, Chester L. and Sukartaatmadja, Karhi. In earlier studies (Prasad, Foy and Crafts--Plant Physiol. Supp. 37:xiii, 1962.), autoradiography and counting showed that the absorption and translocation of dalapon-2-C^{14} or -Cl^{36} by plants was enhanced by high relative humidity. At least two factors, rate of droplet drying and stomatal distribution and behavior, were shown experimentally to contribute to the humidity effect.

Interpretation of results from radioisotope tracer studies alone is sometimes limited because nonherbicidal dosages are most commonly used. To supplement such studies, the influence of relative humidity on the growth regulating and/or herbicidal response of Johnsongrass to dalapon was investigated.

Rhizome cuttings of uniform length and containing three nodes were grown in greenhouse flats for two weeks, then transferred to one gallon cans (2 plants each) for an additional period of four weeks before treatment. Dalapon (10 lb/100 gal), containing formulated anionic surfactant, was sprayed on the foliage by use of a compressed air-operated hand sprayer.

In preliminary experiments using a sub-lethal dosage (4 lb/40 gpa) of dalapon and bagging in polythene bags to achieve high humidity, there were only minor and temporary differences between environmental regimes. Although, initially trends toward an increased effect under high humidity were indicated by several criteria (eg. acute toxicity, inflorescence emergence, tillering, height changes), at the conclusion of the experiment (4 months after treatment), all treatments (bagged and unbagged) caused 62.5 to 75.0 percent kill of shoots but only 12.5 to 25.0 percent death of rhizomes.

A later experiment involved the use of lethal dosages of dalapon (10 lb/100 gpa) in the greenhouse and in walk-in type Minneapolis-Honeywell constant environment chambers. Conditions in the open greenhouse were 72-84°F. and 60-78 percent relative humidity; in the chamber, 83-85°F. (daytime temperature in the greenhouse) and 90-95 percent relative humidity. Light intensity was slightly lower in the chamber (800 f.c.) than in the open greenhouse (1000 f.c.) but day lengths were identical (15 hr light, 9 hr dark). Two weeks after treatment all plants in the chamber were returned to the open greenhouse. Spray droplets dried in the greenhouse within 30 minutes; in the chamber, in about two days.

Individual treatments, resulting injury symptoms, height reductions and mortality data are shown in the following tables (each entry represents 4 replications or 8 parent plants). (Botany Department, University of California, Davis)

A. Dalapon injury ratings*

Treatment	1 wk after treatment	4 wks after treatment
1. Untreated (greenhouse)	0	0
2. Treated, left in greenhouse	2	2
3. Untreated (chamber)	0	0
4. 48 hr. in chamber, treated, left in chamber	4	8
5. Treated, transferred to chamber immediately	6	8
6. Treated, transferred to chamber after 24 hr	4	7
7. Treated transferred to chamber after 48 hr	3	6

* 0 = Normal, unaffected; 10 = all foliage affected (brown or necrotic)

B. Height

Treatment		Ave. ht (cm) at treatment	Percent increase 2 wks after treatment*	Percent reduction in ht increase 2 wks after treatment
1.		61.8	81.2	
2.		55.4	7.0	92.2
3.	Same as above	60.8	51.5	17.7
4.	(A)	59.4	11.6**	86.2
5.		62.4	7.5	90.6
6.		65.5	3.2	95.8
7.		65.1	3.4	95.6

* Measured only once. Almost no further increase in height after two weeks.
** Sprayed two days after all other treatments.

C. Kill of shoots and rhizomes

Treatment		Percent of plants with complete shoot kill: after 1 month	Percent of plants with complete shoot kill: after 4 months	Total fresh wt of shoots (gm)	Kill of rhizomes (%)
1.		0	0	172	0
2.		0	62.5	36	50
3.	Same as above	0	0	150	0
4.	(A)	50	100	-	100
5.		37.5	100	-	100
6.		0	75	14	62.5
7.		0	75	23	75

19. Correlation of infra-red spectra of phenyl carbamates with herbicide activity. Vernetti, Jack B. and Freed, V. H. The infra-red spectra of twenty phenyl carbamates were examined in relation to biological activity of the compounds on oats, millets, rye grass, and brome grass. In most cases, activity could be correlated with the absorption bands found in the regions 1600-1570 cm.$^{-1}$ and 1510-1520 cm.$^{-1}$ Phenyl ring vibrations ($C \overset{=}{_{1}} C$ stretching) were assigned to both frequency ranges The 1510-1520 cm.$^{-1}$ band was found to be overlapped by a N-H banding mode (amide II) making resolution impossible between the two vibrations.

Herbicidal activity was frequently associated with compounds exhibiting bands in the 1510-1520 cm.$^{-1}$ region having 70-85 percent of the intensity of carboxyl stretching mode (amide I) extinction. Inactive carbamates were either above or below this intensity range. Substitution of a methyl group for hydrogen on the nitrogen atom resulted in a marked decrease in intensity of the band. Loss of herbicide activity of the chemical was also observed. Apparently, of the two assigned modes to the 1510-1520 cm.$^{-1}$ band the N-H band is the most dominant with respect to biological activity.

The 1570-1600 cm.$^{-1}$ ring vibration was observed to be stronger in the active as compared to the inactive carbamates. This appeared to be especially true with regard to activity of compounds toward oats. Twelve of the twenty carbamates were inactive to oats and of the inactive members, ten had weak bands in this region. The two exceptions had bands of intermediate strength.

Correlation of the amide I band with activity yielded little information. This was disappointing as possible consequences of hydrogen banding effects could not be studied. There appeared to be an indication that the active carbamates had a slightly higher frequency but not of sufficient significance to warrant a conclusion.

Investigation of other bands in the spectra did not show good correlations with activity. Limitations in equipment prevented studies of frequencies below 650 cm.$^{-1}$ The lower frequencies would produce information on skeletal vibrations of molecules possibly yielding more useful correlations. (Department of Agricultural Chemistry, Oregon Agricultural Experiment Station, Corvallis)

20. Water extractable protein and 2,4-D-1-C^{14}. Whitworth, J. W., and Anderson, W. P. Since the differential tolerance of two strains of bindweed to 2,4-D did not appear to be related to differences in absorption, penetration, and translocation of 2,4-D-1-C^{14}, methods are being developed to determine the site of action and metabolic fate of 2,4-D. Water extracts were made of the two strains of bindweed plants treated with 2,4-D-1-C^{14}, and fractions of these extracts were made by sedimentation and electrophoretic methods. The major portion of the radioactivity was found in the fraction containing nucleoprotein fragments in the size range of microsomes. This association of the radioactivity with the nucleoprotein fragments does not necessarily mean that there is bonding between the 2,4-D and the protein surfaces. The electrophoretic mobility of the fraction containing the nucleoprotein fragments corresponded to that of a similar extract from untreated plants and also to that of an aqueous solution containing only pure 2,4-D. (New Mexico State University Agricultural Experiment Station, University Park)

21. Dinitrophenol and shading effects on translocation of 2,4-D. Yamaguchi, Shogo. 2,4-D distribution in plants has been characterized by absorption and

retention of a large or major portion of the applied amount within a few inches of the points of application, whether on the foliage or to the roots. This phenomenon of absorption and retention by tissues has been thought to be a result of some energy-utilizing function. For this reason, dinitrophenol (DNP) has been used in attempts to depress this function through phosphate uncoupling and thereby to permit freer movement of 2,4-D. The plants used were cucumber, soybean, red kidney bean and barley. The results are presented as evidence for a metabolic aspect of 2,4-D absorption.

DNP at 10^{-4} M added to Hoagland's solution was effective in permitting increased upward movement of 2,4-D, labeled with carbon-14, from the roots. One-tenth micromole of labeled 2,4-D was added to 100 ml of Hoagland's solution containing the DNP. The roots also showed less absorption.

DNP added to Hoagland's solution is readily absorbed and distributed throughout the plant. Tender plants and very young plants were susceptible to leaf injury at 10^{-4} M and 5×10^{-5} was more appropriate. One-tenth micromole of labeled 2,4-D applied as a spot to the leaf of a plant pretreated for a day in such a DNP solution resulted in greatly reduced 2,4-D translocation out of the treated leaf. However, the autoradiograph of such a leaf has shown extensive apoplastic movement within the treated leaf blade, such as never observed before with 2,4-D. This pattern of apoplastic distribution of 2,4-D within the treated leaf of the red kidney bean plant was also reproduced by keeping the plant in the dark for 30 hours and again keeping the treated plant in the dark. The 2,4-D treatment times in these experiments were 1 and 4 days, and 6 hours. (Department of Botany, University of California, Davis)

22. The effect of light quality and toxicity of 2,4-D upon pectic compounds in six selections of Canada thistle (Cirsium arvense L.) Chamberlain, E. W. and Mitich, L. W. A study of the interrelationship of four light qualities (red, green, blue, and a warm-white control) and two rates of 2,4-D (2 and 4 lb/A) on the pectic compounds in six selections of Canada thistle was initiated in 1961. This study was completed in January 1963 and will be published in a Ph.D. thesis.

Ninety-six plants of each selection were used in this investigation, forty-eight for calcium pectate determinations and the remainder for pectin methylesterase analyses. Two selections were placed in the growth chambers for a 7 day acclimation period. The plants were then removed, chemically treated, and returned to the chambers for an additional 14 days. This procedure was used for all six selections. Two selections were chemically treated and placed in the chambers without undergoing the acclimation period to determine if the level of pectic compounds in the plants was altered. Plants of two selections were chemically treated and grown under normal greenhouse and field conditions to serve as a control to the chamber grown plants.

Results from this study indicate that herbicidal treatment with 2,4-D did not cause a significant difference in the amount of calcium pectate in the foliage or roots of any of the selections. However, indications were that light quality caused a highly significant difference in the amount of calcium pectate produced in the foliage of all thistle selections except 3 and 4. Significantly greater amounts of calcium pectate were produced under red and green light than blue or white in selections 1, 2, 5, and 6. In all selections, blue and warm-white light resulted in the least production of calcium pectate.

The greatest production of calcium pectate in the roots occurred under blue and white light. Only in selection 1 and 2 did a significant difference occur due to light qualities.

Calcium pectate was calculated from three arbitrary groups of pectic substances according to their solubility characteristics: namely, the water, oxalate, and acid soluble fractions. Of these three fractions comprising calcium pectate, the acid soluble extract was the least affected and the water soluble extract the most affected by light quality and 2,4-D treatment.

No significant difference attributable to 2,4-D application or light quality occurred in the amount of pectin methylesterase units (PMU) produced in the foliage or roots of the six selections. However, when comparing the selections independent of light and chemical treatment, a difference occurred between selections 1 and 2, the latter producing greater amounts of PMU in both foliage and roots.

When PMU of the foliage was determined on an alcohol insoluble solids basis (AIS), which represents the plant materials independent of moisture, selections were found to be different; 1 and 2 producing significantly greater amounts of PMU than 3 and 4.

Treatment with 2,4-D did not cause a significant difference in the level of calcium pectate or PMU in the foliage or roots of any of the thistle selections. Therefore, this study does not support the theory that 2,4-D acts through the pectic substances in killing Canada thisle plants. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie)

The percent of calcium pectate in the foliage of six selections of Canada thistle as affected by 2 rates of 2,4-D when grown under four light qualities.

Selections 1/	Treatments	Red 2/	Green	Blue	White
1	Check	.226	.267	.185	.198
1	2 lb 2,4-D	.239	.225	.175	.170
1	4 lb 2,4-D	.254	.227	.150	.165
2	Check	.290	.220	.190	.175
2	2 lb 2,4-D	.220	.211	.166	.170
2	4 lb 2,4-D	.237	.266	.180	.210
3	Check	.149	.143	.114	.131
3	2 lb 2,4-D	.079	.113	.152	.187
3	4 lb 2,4-D	.121	.190	.133	.106
4	Check	.100	.190	.158	.099
4	2 lb 2,4-D	.169	.169	.155	.129
4	4 lb 2,4-D	.132	.130	.155	.141
5	Check	.200	.193	.167	.146
5	2 lb 2,4-D	.206	.180	.161	.155
5	4 lb 2,4-D	.204	.146	.162	.176
6	Check	.219	.152	.181	.108
6	2 lb 2,4-D	.217	.193	.205	.170
6	4 lb 2,4-D	.242	.183	.203	.200

1/ All selections collected in Wyoming

2/ Percent of calcium pectate in 1 gram of alcohol insoluble solids (AIS)

23. Effects of dalapon on metabolism of pyruvate-1-C^{14} and -2-C^{14} in bean leaves. Ross, Merrill A. and Ross, Cleon. Dalapon induced injury was previously reported to cause an increase of hydrolyzable phosphate, (interpreted as high energy phosphate)[1]. This result would appear inconsistent with findings which might indicate possible interference of coenzyme A activity through inhibition of pantothenate formation[2].

Warburg measurements of oxygen uptake indicate that leaf discs from dalapon-treated leaves respire more rapidly than do leaf discs from non-treated leaves.

Leaf discs from dalapon-treated leaves and untreated leaves were incubated in Warburg flasks containing pyruvate-1-C^{14} and -2-C^{14}. In both the dalapon treated and non-treated leaf discs 75 percent of the total pyruvate -1-C^{14} recovered, was recovered as carbon dioxide, 25 percent as water soluble constituents, and almost none as the fat soluble constituents. In contrast, 23 percent of total -2-C^{14} recovered, was recovered as carbon dioxide, 76 percent as water soluble constituents and 1 percent as lipid soluble constituents. $\frac{-1\text{-}C^{14}}{-2\text{-}C^{14}}$ ratios between dalapon-treated and non-treated leaves were calculated for each fraction. These did not vary between treatments. A slight increase in pyruvate uptake occurred in the dalapon treated tissue.

From these data it would appear that coenzyme A activity was not influenced by dalapon. (Colorado Agricultural Experiment Station, Colorado State University, Fort Collins)

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[1]Ross, Merrill A. and Frank B. Salisbury. 1962. The effect of herbicides on high energy phosphate levels. Western Weed Control Conference Proceedings.

[2]Hilton et al. 1959. The pantothenate-synthesizing enzyme--a metabolic site in the herbicidal action of chlorinated aliphatic acids. Weeds 7:381-396.

HERBICIDE INDEX AND NOMENCLATURE

Chemical name	Temporary designation, code, or trademark	Common name	Page nos.
3-amino-2,5-dichlorobenzoic acid		amiben	22,26,27,30,53
3-amino-1,2,4-triazole		amitrole	2,3,18,27,59,60, 62,63,65
3-amino-1,2,4-triazole-ammonium thiocyanate	amitrole-T		2,3,7
N-(beta-O,O-diisopropyldithiophosphoryethyl)-benzenesulfonamide	R-4461		1,4,22,26
2,4-bis(ethylamino)-6-methylmercapto-s-triazine		simetryne	50
2,4-bis(isopropylamino)-6-methylmercapto-s-triazine		prometryne	7,22,26,27,37,43, 44,46,49,50,57
2,4-bis(3-methoxypropylamino)6-methylthio-s-triazine	CP-17029		44,54
borate-2,4-D mixtures	BDM		68
5-bromo-3-sec-butyl-6-methyluracil	BSBMU	bromacil	35,43,54
5-bromo-3-isopropyl-6-methyluracil	H-82	isocil	3,4,10,22,26,34,36, 44,46,54,58
sec-butyl N-(3-chlorophenyl) carbamate	BCPC		37
1-n-butyl-3-(3,4-dichlorophenyl)-1-methylurea		neburon	3,27,72,73,75,76,78,79
α-carbo-(2,4-dichlorophenoxyethoxy)ethyl-N-(3-chlorophenyl)carbamate			37
α-carbo-(2,4-dichlorophenoxyethoxy)ethyl-N-phenylcarbamate			37
t-butyl N-N-dipropyl-thiolcarbamate	R-1856		82,89
butynyl-N-(3-chlorophenyl) carbamate	BIPC		36,54
2-chloroallyl diethyldithio-carbamate	CDEC		25,27,37

Chemical name	Temporary designation, code, or trademark	Common name	Page nos.
2-(3,4-dichlorobenzylmercapto)-4,6-dimethylpyrimidine	R-3441		22
mixed 2-(X,X-dichlorobenzylthio)-4,6-dimethylpyrimidine	R-4518		22,53
2,4-dichlorophenoxyacetic acid		2,4-D	1-3,7,20,30,43,51,56-60,62,65,67,72-76,78,80,82,84,94,95
2,4-D and 2,4,5-T,oleic-1,3-propylenediamine salts	Decamine		58,81
4-(2,4-dichlorophenoxy)butyric acid	4-(2,4-DB)		7
diphenylacetonitrile		diphenatrile	37
3-(3,4-dichlorophenyl)-1,1-dimethylurea		diuron	3,4,8,9,23,24,27,30,31,37,38,43,45-51,54,68,78,79
1-(3,4-dichlorophenyl)-3-isopropyl-3-(2-propynyl)urea			44,54
_N_-(3,4-dichlorophenyl)methacrylamide	DCMA, N4556		53
3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea	Lorox	linuron	23,27,37,42-44,54
_O_-(2,4-dichlorophenyl)-_O_-methylisopropylphosphoramidothioate	DMPA		22,35-37
2,4-dichlorophenyl-4-nitrophenyl ether	FW-925		23,35,44,58
3,4-dichloropropionanilide	DPA	propanil	42
2,2-dichloropropionic acid		dalapon	3,10,30,37,39,59,62-65,78,81,83,88,92,96
1,2-dihydropyridazine-3,6-dione (maleic hydrazide)	MH		62,63
6,7-dihydrodipyrido (1,2-a:2',1'-c) pyrazidiinium salt		diquat	23,27,52
_N_-_N_-dimethyl-2,2-diphenylacetamide		diphenamid	22,23,27,37,48-50

Chemical name	Temporary designation, code, or trademark	Common name	Page nos.
2-methoxy-3,5,6-trichlorobenzoic acid, dimethylamine salt	Banvel-T		58,59
2-methyl-4-chlorophenoxyacetic acid	MCPA		7,51
4-(2-methyl-4-chlorophenoxy) butyric acid	4-(MCPB)		7
methyl 3,4-dichlorocarbanilate		swep	22,26
methyl N-(3,4-dichlorophenyl) carbamate			37
N-1-naphthylphthalamic acid	NPA		25,27
7-oxabicyclo-(2.2.1) heptane-2,3, dicarboxylic acid	Aquathol	endothal	9,22,23,25,35,37,39, 41,42,70,72,73,75,76, 78,89
pentachlorophenol	PCP		26,27,37,53
3-phenyl-1,1-dimethylurea		fenuron	3,27,78,79
3-phenyl-1,1-dimethylurea trichloroacetate	fenuronTCA		2
polychlorobenzoic acid	PBA		53
polychlorodicyclopentadiene isomers	Bandane		28,29
potassium cyanate	KOCN		27
propyl N-N-dipropylthiolcarbamate	R-1607		4,30,82,89
propyl ethyl n-butylthiolcarbamate	PEBC, R-2061		4,25,26,39,40,82,89
propynyl-N-(3-chlorophenyl) carbamate			37
sodium 2,4-dichlorophenoxyethyl sulfate		sesone	23
2,3,5,6-tetrachloroterephthalic acid, dimethyl	DCPA, DAC-893		25,27,30,35-37,44-47, 49,50,89

CODED AND OTHER HERBICIDES WITHOUT DESIGNATION OF ACTIVE INGREDIENT

CODED AND OTHER HERBICIDES WITHOUT DESIGNATION OF ACTIVE INGREDIENT

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