Research Progress Report

Research Committee

Western Weed Control Conference

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PREFACE

This report has been prepared in advance of the 1958 meeting of the Western Weed Control Conference as a supplement to the conference proceedings. It consists of summary type reports of current research results submitted by workers throughout the conference area.

This Research Progress Report is particularly to be recommended for its timeliness. These results of research were assembled in time to be available at the annual conference meeting. This was accomplished by the timely combined efforts of those reproducing the copy as well as personell of the research committee.

During the short period of preparation it was not possible for authors and editors to consult. Questions of clarity and content requiring consultation between authors and editors, therefore, remain unresolved. Time has permitted only the correction of the more obvious errors. Undoubtably not all of these were corrected.

The individual reports were assembled by ten project chairmen. Each chairman being responsible for a specific project as designated previously by the research committee. The individual reports are listed by subject under each project title. An author indix and list of herbicide names and designations are also included.

This report should serve a useful purpose in correlating the findings of many research workers, providing new leads, and disseminating the latest information to the membership of the conference and others.

I appreciate the cooperation of the Project Chairmen in making this useful workbook available. Thanks also to the many contributors for the reports you submitted.

Jesse M. Hodgson
Chairman, Research Committee
Western Weed Control Conference

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NAMES AND DESIGNATIONS OF CHEMICALS USED AS HERBICIDES

Designation accepted by WSA	Chemical name
AMS	ammonium sulfamate
amitrol . . .	3 amino-1,2,4-triazole-formerly ATA
BCPC	sec-butyl N-(3-chlorophenyl carbamate)
BDM	borate-2,4-D mixtures [c]
BMM	borate-monuron mixtures[c]
CBDM	chlorate-borate-diuron mixtures[c]
CBFM	chlorate-borate-fenuron mixtures[c]
CBM	chlorate-borate mixtures[c]
CBMM	chlorate-borate-monuron mixtures[c]
CDAA	2-chloro-N, N-diallyacetamide
CDEA	2-chloro-N,N-diethylacetamide
CDT	2-chloro-4,6-bis (diethylamino)-s-triazine
CEPC	2-chloroethyl N-(3-chlorophenyl) carbamate
CIPC	isopropyl-N-(3-chlorophenyl) carbamate
CPPC	2-(1-chloropropyl) N-(3-chlorophenyl) carbamate
dalapon . . .	2-2 dichloropropionic acid
DCB	orthodichlorobenzene
DCU	dichloral urea
dichlone . . .	2,3-dichloro-4-napthoquinone
DIPA	P,P-dibutyl-N,N-diisopropylphosphinic amide
diuron . . .	3 (3,4-dichlorophenyl)-1,1-dimethylurea
DMA	disodium monomethylarsonate
DMTT	3,5-dimethyltetrahydro-1,3-5,2H thiadiazine-2-thione
DNC	3,5-dinitro o cresol
DNAP	4,6-dinitro o secondary amylphenol
DNBP	4,6-dinitro o secondary butylphenol
EBEP	ethyl bis (2-ethylhexyl) phospinate
endothal . . .	3,6-endoxohexahydrophthallic acid
EPTC	ethyl N, N-di-n-propylthiolcarbamate
erbon	2-(2,4,5-trichlorophenoxy) ethyl 2,2-dichloropropinate
EXD	ethyl xanthogen disulfide
fenuron . . .	3-phenyl-1, 1-dimethylurea
4-CPA	4-chlorophenoxyacetic acid
4-(4-CPB) . . .	4-(4-chlorophenoxy) butyric acid
4-(MCPB) . . .	4-(2-methyl-4-chlorophenoxy) butyric acid
4-(3,4-DB) . . .	4-(3,4-dichlorophenoxy) butyric acid
4-(2,4,5-TB) . .	4-(2,4,5-trichlorophenoxy) butyric acid
4-(2,4-DB) . . .	4-(2,4-dichloropenoxy) butyric acid

[c] These abbreviations are used to designate mixtures used as soil sterilants. The writer should indicate in a footnote the percentage composition of the product. For example: sodium chlorate 40%, sodium metaborate 57% and monuron 1%.

Designation accepted by WSA	Chemical name
HCA	hexachloroacetone
IPC	isopropyl N-phenylcarbamate
IPX	isopropyl xanthic acid
KOCN	potassium cyanate
MAA	monomethylarsonic acid
MCPA	2-methyl-4-chlorophenoxacetic acid
MCPES	2-methyl-4-chlorophenoxyethyl sulfate
MH	maleic hydrazide
monuron . . .	3-phenyl-1,1-dimethylurea
neburon . . .	1-N-butyl-3-(3,4-dichlorophenyl)-1-methylurea
NPA	N-1-napthylphthalamic acid
OCH	octochlorocyclohexenone
PBA	polychlorobenzoic acid
PCP	pentachlorophenol
PMA	phenylmercuric acetate
sesone . . .	sodium 2,4-dichlorophenoxyethyl sulfate
silvex . . .	2-(2,4,5-trichlorophenoxy) propionic acid
simazin . . .	2-chloro-4,6-bis (ethylamino)-s-triazine
SMDC	sodium methyldithiocarbamate
TCA	trichloroacetic acid
TCB	trichlorobenzene
3,4-DA . . .	3,4-dichlorophenoxyacetic acid
2-(4-CPP) . . .	2-(4-chlorophenoxy) propionic acid
2,4-D . . .	2,4-dichlorophenoxyacetic acid
2,4-DEB . . .	2,4-dichlorophenoxyethyl benzoate
2,4,5-T . . .	2,4,5-trichlorophenoxyacetic acid
2,4,5-TES . . .	2,4,5-trichlorophenoxyethyl sulfate
2-(MCPP) . . .	2-(2-methyl-4-chloropheroxy) propionic acid
2,3,5,6-TBA . .	.2,3,5,6-tetrachlorobenzoic acid
2-(2,4-DP) . . .	2-(2,4-dichlorophenoxy) propionic acid
2,2,3-TPA . . .	2,2,3-trichloropropionic acid
2,3,6-TBA . . .	2,3,6-trichlorobenzoic acid

PROJECT 1. PERENNIAL HERBACEOUS WEEDS

W. R. Furtick - Project Chairman

SUMMARY

A total of 27 reports were obtained from 13 investigators in eight states including California, Washington, Idaho, Montana, Colorado, Nevada, Wyoming, and Oregon. These reports are summarized by weed species.

Broad-Leaved Perennial Weeds

Canada Thistle (Circium arvense). Tests in Idaho with ATA applied during the spring of 1956 showed 80 to 90 percent root kill with four pounds active ingredient per acre when evaluated in October of that year. This treatment, observed in 1957, gave an 88 percent reduction in stand. The two pound rate was much less effective, showing a 46 percent stand increase in 1957. However, in the untreated check, thistle stand had increased by one thousand percent. Reapplication of these treatments in 1957 gave approximately 90 percent topkill with little or no regrowth. Root damage extended to a depth of 24 inches in the soil at the high rate of application, with injury most extensive in the lateral roots. 2,4-D and 2,4,5-T treatments were used as comparisons in these tests. Although 2,4-D was superior to 2,4,5-T, neither was effective in reducing thistle stands.

ATA at four pounds active ingredient per acre gave 80 to 94 percent reduction in Canada thistle stand according to reports from Oregon. Two pounds was almost as effective. One pound per acre reduced thistle stand by 50 percent. Applications to thistle six to eight inches in height gave as good results as bud stage treatments.

Both Oregon and Idaho report ineffective control of thistle with ATA-2,4-D combinations. Apparent antagonism was observed with this combination whether applied singly or combined in the spray solution.

Tests were conducted in Oregon utilizing pre-plant treatments of ATA for Canada thistle control. In these tests ATA was applied at two and four pounds active ingredient per acre to thistle six to eight inches in height. No soil toxicity to beans, corn, Sudan grass, and barley could be observed when planted at one, two, and three week intervals following ATA application. Due to the lack of complete thistle emergence before treatment, control was somewhat ineffective. Only 60 to 70 percent stand reduction resulted.

In Idaho, plowing thistle twelve days after treatment with ATA gave added control. Earlier plowing was less effective.

Results from Wyoming show that recovery of Canada thistle following treatment with 2,4-D or ATA is better under irrigated conditions.

Effective control of Canada thistle with the chlorinated benzoic acid herbicides at rates of ten to twenty pounds per acre was reported from Colorado. The 2,3,6-TBA gave 90 to 95 percent control while the polychlorobenzoic acid gave 70 to 75 percent control at equal rates. ATA gave only sixty percent control at rates up to 16 pounds active ingredient per acre. 2,4-D at two and four pounds per acre gave control equal to ATA in these tests.

Morning Glory (Convolvulus arvensis). Effective control of morning glory was obtained with fall applications of sodium chlorate, erbon, 2,4-D amine, and chlorinated benzoic acids, according to reports from Colorado. Poorer results were observed with monuron, chlorea, ureabor, and DB granular. Rates required for control were 480 pounds per acre and above for sodium chlorate, 80 pounds and above for erbon, and 20 pounds and above for 2,4-D and the chlorobenzoic acids. In these tests, 2,3,6-TBA and polychlorinated benzoic acid appeared to be equal for the control of morning glory. With foliage applications, the 2,3,6-TBA was superior at rates of five to twenty pounds per acre. The chlorobenzoic acid containing principally 2,3,5- and 2,3,6-TBA - was more effective than the polychlorinated benzoic acid. Results showed considerable more latitude in time of application with the chlorobenzoic acids when compared to 2,4-D.

The United States Bureau of Reclamation in Ephrata, Washington, reports one hundred percent topkill of morning glory sprayed with two pounds of 2,4-D early in the growing season. Seed was set on the plants which were sprayed later in the season. Examination of the morning glory sprayed in this project six weeks after the fall rains had started showed no sign of recovery; however, the roots were budding six to eight inches below the soil surface.

Russian Knapweed (Centaurea picris). Tests were conducted at two locations in Colorado comparing fall applications of soil sterilants on Russian knapweed. The first area was an abandoned field with a western slope. The second location was on a railroad embankment with an eastern slope, a situation which in previous experience had been found unfavorable for satisfactory chemical control. The chlorinated benzoic acids at rates above 20 pounds per acre gave approximately 100 percent control of Russian knapweed and appeared to be less affected by the more difficult terrain of the railroad embankment. Chlorea at 1280 pounds per acre gave 100 percent and 75 percent control at locations one and two respectively. DB granular at rates above 640 pounds per acre, 2,4-D amine, and erbon at rates above 80 pounds per acre gave 100 percent control at the first location but were rather ineffective on the railroad embankment.

Foliage applications of ATA, polychlorobenzoic acids, and 2,4-D on Russian knapweed were also conducted in Colorado. The results show no control with ATA even at eight pounds active ingredient per acre. 2,4-D appeared to be one of the most effective treatments with up to 90 percent control at four pounds per acre. The trichlorobenzoic acids at rates of ten to twenty pounds per acre gave 90 to 100 percent control of knapweed. 2,3,6-TBA gave better control than the other chlorinated benzoic acids.

Leafy Spurge (Euphorbia esula). Results from Colorado show ATA to be highly effective for the control of this perennial weed. Rates of four, eight, and sixteen pounds active ingredient per acre gave 80, 80, and 85 percent control respectively. The chlorobenzoic acid herbicides were also highly effective as foliage applications at rates of ten to twenty pounds per acre. The 2,3,6-TBA was superior. 2,4-D at two and four pounds per acre was rather ineffective. Combinations of ATA with 2,3,6-TBA or 2,4-D did not provide the control obtained with the same amount of ATA used alone.

Similar results on leafy spurge were reported from Montana where ATA was applied in 1955 and 1956 in comparison to 2,4-D. In these tests, five pounds of ATA was as effective as ten pounds. Best control was obtained where ATA or 2,4-D was reapplied in 1956 to plots treated with five pounds ATA in 1955. 2,4-D was not effective when used alone. Associated grasses were injured by two ATA treatments but were much more vigorous whenever the stand of leafy spurge had been reduced by 50 percent or more.

Whitetop (Cardaria draba). Reports from Colorado show ATA to be more effective than the chlorobenzoic acids or 2,4-D for the control of whitetop. ATA at rates of four, eight, and sixteen pounds per acre gave 65, 80, and 70 percent control respectively. However, the plants were too mature for best control with 2,4-D, and results were less than desirable. There was no advantage in combining ATA with 2,4-D for controlling this weed.

In Wyoming, 2,4-D at four pounds per acre with a wetting agent gave 90 percent reduction in a whitetop stand. For complete control of whitetop, 20 pounds of 2,4-D or ten pounds of ATA were required.

Perennial Ground Cherry (Physalis subglabrata). Tests were conducted in Idaho comparing 2,4-D and other growth regulating herbicides with ATA for the control of perennial ground cherry. The most effective treatment was ATA at eight pounds active ingredient per acre which reduced the stand 98 percent. 2,4,5-T and 2,4,5-T propionic at two and four pounds per acre were also quite effective, reducing the stand of perennial ground cherry by approximately 90 percent. 2,4-D was the least effective chemical used in these tests.

The ability of perennial ground cherry to initiate buds on roots from several depths in the soil was also studied in Idaho. All the roots from the various soil depths initiated buds and shoots; however, the shallower roots budded earlier and had a higher percentage of shoots.

Blue Flag (Iris missouriensis). In Nevada, 2,4-D at two and four pounds per acre applied post bloom was highly effective for controlling blue flag in pasture areas. Dalapon at ten pounds per acre also provided excellent control but severely thinned the perennial grasses with a resulting increase in sedges and broadleaf weeds. The effect of these treatments on clover could not be determined. The clover had virtually disappeared from all plots due to the grass competition when the area was protected from grazing.

Mouse-ear Povertyweed (Iva axillaris). Spring applications of 2,4-D amine or ester gave good control of this perennial weed according to reports from

Colorado. Ninety percent control was obtained with one application of two or four pounds per acre. ATA and the polychlorobenzoic acids did not give satisfactory control. The 2,3,6-TBA, however, was highly effective, giving 90 and 100 percent control at ten pounds and twenty pounds per acre respectively.

Perennial Grasses

Bermuda Grass (Cynodon dactylon). A comparison of dalapon with ATA for the control of Bermuda grass was conducted in California. Control obtained from single treatments of both dalapon and ATA were generally satisfactory at rates above six pounds. ATA and dalapon gave equal results at comparable dosages. Equal or better results were obtained from a single application of a given amount of chemical than from multiple applications amounting to the same total dosage.

Tests in California with aromatic weed oils show that the element of control is more a function of duration of the program rather than the number of treatments. However, the timing is important in securing maximum effectiveness from a given number of oil sprayings. A total of six treatments with aromatic oil at one week intervals gave only a 24 percent control of Bermuda grass when compared to 81 percent control for the same number of treatments when spaced at two week intervals. Four treatments spaced at three week intervals provided 72 percent control.

Foxtail Barley (Hordeum jubatum). In Nevada, mowing foxtail barley when heads appeared and again approximately one month later prevented heading of foxtail in pastures and appeared to be a good method of controlling encroachment of this weed. Tests in 1957 showed that rotational grazing could accomplish the same result when the pastures were heavily stocked during the critical periods mentioned in the previous test. Light stocking and continuous grazing did not provide as good control.

Studies conducted in Nevada on high water table lands show that the establishment of suitable competing pasture plants coupled with proper fertilization can be a practical method of eliminating foxtail from such pastures.

Invasion of Herbaceous Perennial Weeds and Cost of Prevention of Their Spread

The Bureau of Reclamation, Columbia Basin Project, reports little movement of Russian knapweed, wild morning glory, and whitetop to new irrigated areas from infested land inundated as part of an equalizing reservoir. In the inundated area, weeds were sprayed by aircraft and ground rig with 2,4-D two or three times a year until the reservoir was filled. Although studies have shown that seed viability is not lost by immersion in water for several years, these perennial weeds have not been observed to encroach on the new farm land irrigated from this project. Some movement of weeds has occurred a few yards from old farmland infestations where soil had been moved in excavation of canals. Preventing spread of perennial weeds can be done quite economically if areas are carefully watched and new patches eradicated.

Preplant treatments with 3-amino-1,2,4-triazole for Canada thistle (Circium arvense) control on cropland. Chilcote, D. O. and Furtick, W. R. To study preplant treatments with ATA for Canada thistle control, an experiment was established in an area solidly infested with this weed. The area had been spring plowed, worked into a seed bed, and the thistle allowed to reach a height of 6 to 8 inches. At this stage treatments of ATA at two and four pounds active ingredient per acre were compared with untreated plots. Each plot was subdivided into three smaller plots which were worked up at one, two, and three week intervals following application and planted to corn, beans, barley, and sudan grass. No crop injury from ATA was observed at any of the planting intervals. The first planting grew better due to the better soil moisture.

The thistle control was determined by counting live thistle stems within a 6' x 6' quadrat placed in the center of each plot. From 60% to 70% stand reduction resulted from ATA treatments at two and four pounds per acre respectively. Untreated plots showed no reduction in stand. Although the thistle stand was considerably reduced, the results were less than satisfactory. This can be attributed to the fact that thistle emergence continued after treatment so that only part of the latent thistle stand was treated. Fall plowing with ATA treatments prior to working in the spring might eliminate this problem. (Contribution of the Oregon State College Experiment Station, Corvallis, Oregon).

Control of Canada thistle (Circium arvense) with 3-amino-1,2,4-triazole. Chilcote, D. O. and Furtick, W. R. Several experiments were initiated in 1956 evaluating 3-amino-1,2,4-triazole (ATA) for the control of Canada thistle. These trials were conducted at various locations in western Oregon comparing ATA at rates of 1, 2, and 4 pounds active ingredient per acre with similar rates of 2,4-D. In addition, combinations of ATA and 2,4-D were studied. Applications were made at the early bud to early bloom stage. The results were evaluated the following year. In determining the control from various treatments, 6' x 6' quadrats were placed in the center of each plot and the number of live thistle stems in this area were counted.

Stem counts in the 2,4-D areas showed little or no reduction in the number of stems over that of the untreated checks, which indicates it is only a temporary control measure. With ATA, 80 to 94 percent stand reduction was obtained with one application of 4 pounds active ingredient per acre. Surviving thistle plants were severely stunted and chlorotic. The two pound rate was somewhat less effective. Applications of ATA as low as one pound active ingredient per acre gave approximately 50 percent reduction in stand. Combinations of ATA with 2,4-D at one and two pounds of each material gave quick foliage necrosis, but final control was quite unsatisfactory.

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A separate trial was conducted to evaluate the response of Canada thistle to ATA when sprayed at different stages of growth. ATA was applied at rates of two and four pounds active ingredient per acre. Applications at the 8 to 10 inch stage were compared with bud stage treatments. Results showed that control was equally good at either stage. (Contribution of the Oregon State College Experiment Station, Corvallis, Oregon).

Spring versus fall applications of heavy rates of 2,4-D and ATA for Canada thistle control. Alley, H. P. Extensive experiments were established during 1957 to study fall versus spring applications of heavy rates of 2,4-D (20-40 lb/A), ATA (amino triazole 8 lb/A), and the effect of irrigation versus non-irrigation upon residual and activity of the chemicals. Duplicate 25 ft. x 50 ft. plots were treated June 20 with the heavy rates of 2,4-D (20 lb/A and 40 lb/A) and the ATA (8 lb/A) plots treated three weeks later. Fall applications were made on August 20. One replicate of each treatment was irrigated on July 9 and July 25. Evaluation cannot be made the same year the chemical applications are made. However, there are indications that the Canada thistle plants were recovering and making more rapid regrowth in the irrigated plots. (Wyoming Agricultural Experiment Station).

Results of foliage treatments of Canada thistle (Cirsium arvensis) with amino triazole, three formulations of chlorinated benzoic acid, two 2,4-D formulations, and three combination applications. Thornton, Bruce J. This test was located in North Central Colorado in a sparse, non-irrigated pasture. The thistle stand was uniformly heavy with vigorous plants, 4 to 4½ feet tall, in pre-bloom stage. Soil moisture was good. The applications were made on June 1, 1956. Materials used, rates of application, and results, as determined one year later, are presented below.

Herbicide	Gal. H_2O Acre	Gal. Oil Acre	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct.
Amino triazole	40		4	60%	8	50%	16	60%
TBA 1281-S 1/	40		5	65%	10	90%	20	95%
TBA 1281-AN 2/		20	5	40%	10	80%	20	85%
PBA m103 3/	40		5	20%	10	70%	20	75%
2,4-D B. ester					2	65%	4	70%
2,4-D Amine					2	55%	4	55%
ATA - TBA	40				2		5-5	85%
ATA - 2,4-D B.ester							5-2	6[illegible]%
TBA - 2,4-D B.ester							5-2	75%

Note: Rates of herbicides basis active ingredients.
1/Predominantly 2,3,6-trichlorobenzoic acid, aqueous type. 2/Same, oil type.
3/Polychlorobenzoic acid, principally 2,5-di, 2,3,5-tri, 2,3,4,5-tetra, and 2,3,5,6-tetra.

In this test the benzoics appear more effective against Canada thistle than amino triazole (ATA), with 2,4-D formulations appearing equally effect-

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ive with the triazole. In other tests amino triazole and the 2,3,6-benzoics have appeared about equally effective with both being more effective than 2,4-D. Some benefit appears to result from combining TBA with ATA, and ATA with 2,4-D on the basis of the amount of material required, but combining ATA with 2,4-D indicates but little if any benefit. (Colorado Agricultural Experiment Station).

The effect of several herbicides and subsequent plowing on the control of Canada thistle. Erickson, Lambert C. Herbicide treatments applied to Canada thistle in June of 1955 showed the following results in June of 1956:

Material or mixture, active ingredient per Acre	% change in stand density
2,4-D amine 4 lbs.	-30
MCPA amine 4 lbs.	- 2
MCPA amine 4 lbs. plus ATA 3 lbs.	+10
MCPA amine 8 lbs. plus ATA 3 lbs.	-31
ATA 3 lbs.	-52

A slightly revised study June 1956 to July 1957 gave the following results:

Material or mixtures, active ingredient per Acre	% reduction in stand
1.5 lbs. 2,4-D amine plus 0.5 lb. ATA applied 3 days later	-13
2 lbs. ATA	-18
2 lbs. 2,4-D amine plus 1 lb. ATA applied 3 days later	-32
4 lbs. (4 to 1 ratio MCPA to ATA)	-33
4 lbs. ATA	-68
4 lbs. 2,4-D amine	-32
6 lbs. ATA	-66
4 lbs. 2,4-D amine plus 2 lbs. ATA applied 3 days later	-35

The results from both these studies show that there is no merit in combining ATA with other herbicides. In fact there is evidence of antagonism in these mixtures whether applied singly or combined.

A further study on the influence of plowing at intervals after treating gave the following results:

Average reduction from all above treatments, plowed 5 days later-10%
Average reductions from all above treatments, plowed 7 days later-39%
Average reductions from all above treatments, plowed 12 days later-43%

These results indicate that Canada thistle should not be plowed earlier than 12 days following the chemical application. (Idaho Agricultural Experiment Station.)

The effects of ATA, 2,4-D, and 2,4,5-T on root decomposition and regrowth of Canada thistle. Schaeffer, Ralph J. and Lambert C. Erickson. All treatments were applied to a relatively uniform stand of Canada thistles on non-cropped, but sporadically irrigated land.

Amino triazole (ATA) applied at 2 and 4 pounds active ingredient in July of 1956 produced detrimental effects on all the prevailing top growth. Root studies conducted in October indicated only minor injury to roots treated at 2 pounds, but the 4 pound rate produced root kills of 80 to 90%. This apparent translocation extended into both the lateral and vertical roots. Regrowth readings in June 1957 showed that the checks had increased approximately ten fold. There was an increased stand of 46% in the 2 lb., per acre treatment while the 4 pound rate gave a decrease of 88%.

Duplicate re-treatments were made in July 1957. In October these gave top kills of 85% with 2% regrowth, and 90% topkill with no regrowth respectively. Root damage was more extensive in the lateral than in the vertical roots. At the high rate damage extended to a depth of 18 to 24 inches.

2,4-D was applied at 2,4,8, and 80 pounds per acre in 1956. In October many vertical and lateral roots were dead. No laterals were killed at the lower rate. Regrowth readings in June 1957 revealed the following: The 2, 4, and 8 pound rates gave increases of 85, 221, and 272 respectively; 80 pounds reduced the stand 13%.

2,4,5-T was the least effective of the three chemicals. The 1957 stand counts were: 528, 779, 739, and 6% respectively from the 2,4,8, and 80 pound rates respectively.

All data must be compared to the 1000% increase in the check plots. (Idaho Agricultural Experiment Station).

Results of foliage treatments of field bindweed (Convolvulus arvensis) with chlorinated benzoic acid and 2,4-D formulations. Thornton, Bruce J. This test was located in the Arkansas Valley on an undisturbed area. Growth was heavy and vigorous, but much too far along to be considered suitable for effective treatment with 2,4-D, being long past the bloom stage. Amino triazole was not included as previous tests had indicated its ineffectiveness on bindweed as a foliage treatment. The applications were made on August 10, 1956. Materials used, rates of application, and results, as determined one year later, are presented on the following page.

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Herbicide	Gal. H_2O Acre	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct.
TBA 1281-S 1/	80	5	80%	10	95%	15	100%	20	100%
PBA M177 2/	80	5	20%	10	70%	15	80%	20	95%
PBA M103 3/	80	5	10%	10	10%	15	20%	20	60%
2,4-D B.ester	80					2	0%	4	0%
2,4-D Amine	80					2	20%	4	20%

Note: Rate of herbicides basis active ingredient.
1/ Predominantly 2,3,6-trichlorobenzoic acid.
2/ Polychlorobenzoic acid, principally 2,3,5- and 2,3,6-tri.
3/ Polychlorobenzoic acid, principally 2,5-di, 2,3,5-tri, 2,3,4,5-tetra, and 2,3,5,6-tetra.

Previous tests had indicated the effectiveness of the benzoics, especially the 2,3,6-trichloro, as a foliage treatment on bindweed when applied at an earlier stage. The above results indicate the possibility of considerable more latitude as to time of application as compared to 2,4-D formulations. (Colorado Agricultural Experiment Station).

Results of soil treatments of field bindweed (Convolvulus arvensis) with sodium chlorate, Karmex W. Ureabor, Chlorea, DB Granular, amine salt 2,4-D, two benzoic formulations, and Baron. Thornton, Bruce J. This test was located in the Arkansas Valley on an undisturbed area. The stand was uniformly heavy. The applications were made on November 9, 1956. Materials used, rates of application, and results, as determined one year later, are presented below.

Herbicide	Gal. H O Acre	Lbs Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct
Sodium chlorate	320					480	90%	960	70%
Karmex W 1/	80					80	40%	160	20%
Chlorea 2/	640					640	30%	1280	60%
Ureabor 3/	480					480	40%	960	30%
DB Granular 4/	dry					640	30%	1280	60%
2,4-D Amine	80					80	70%	160	100%
TBA 1281-S 5/	160	20	90%	40	99%	80	99%	160	100%
PBA M103 6/	160	20	60%	40	90%	80	100%	160	100%
Baron 7/	160	40	10%	80	80%	160	80%	320	100%

Note: Rates of herbicides based on active ingredients.
1/Monuron. 2/Mixture of borate, sodium chlorate, and monuron. 3/Mixture of borate and monuron. 4/ Polychlorobenzoic acid, principally 2,5-di, 2,3,5-tri, 2,3,4,5-tetra, and 2,3,5,6-tetra. 5/Predominantly 2,3,6-trichlorobenzoic acid. 6/Polychlorobenzoic acid, principally 2,5-di, 2,3,5-tre, 2,3,4,5-tetra, and 2,3,5,6-tetra. 7/Erbon.

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Although the original stand appeared uniform, the greater growth reductions by some of the lighter applications as compared to heavier applications of the same materials indicate the possibility of less vigorous original stands, or possibly a soil or some other factor. Russian thistle was quite heavy on the DB Granular and 2,4-D amine plots, with practically no annual growth on the other plots in the test. (Colorado Agricultural Experiment Station).

2,4-D for Morning Glory control. Verling, Francis P. Chemical control of Morning Glory (Convolvulus Arvensis) through the use of 2,4-D Amine.

During the 1957 growing season 191 acres of Morning Glory were boom sprayed with 2# of 2,4-D in 35 gallon of water per acre. Application was started in the early bloom stage on the 6th of June. Virtually 100% top growth kill was achieved; however, seed was set on the plants sprayed toward the end of the program completed on the 20th of June.

In a check of the area the second week of November, 6 weeks after fall rains started, the top growth showed no sign of recovery; however, an examination of the roots showed budding 6 to 8 inches below the surface. The area will again be sprayed next year. (U.S. Bureau of Reclamation, Ephrata, Washington).

Results of soil treatments of Russian knapweed (Centaurea picris) with Chlorea, DB Granular, amine salt 2,4-D, two benzoic formulations, and Baron, involving two separate tests. Thornton, Bruce J. Test I was located on the Western Slope in an abandoned field that had not been disturbed for several years. The stand was heavy. The applications were made on November 14, 1956. Test II was located on the Eastern Slope and on the sides of a railroad embankment, a situation which in previous experiences had been found unfavorable to satisfactory chemical control results, either foliage or soil type. Stand was uniformly heavy. Applications were made on December 4, 1956. Materials used, rates of application, and results are given in the following table.

Herbicide	Test	Gal. H_2O Acre	Lbs Herb. Acre	% Re- duct.	Lbs. Herb Acre	% Re- duct.	Lbs. Herb Acre	% Re- duct.	Lbs. Herb. Acre	% Re- duct.
Chlorea 1/	I	640			320	20%	640	30%	1280	75%
	II	640			320	40%	640	60%	1280	100%
DB Granular 2/	I	dry			640	90%	960	100%	1280	99%
	II	dry			640	10%	960	10%	1280	20%
2,4-D Amine	I	160			80	100%	120	100%	160	100%
	II	160			80	0%	120	25%	160	70%
TBA 1281-S 3/	I	160	20	100%	40	100%	80	100%	160	100%
	II	160	20	90%	40	100%	80	100%	160	100%

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Herbicide	Test	Gal. H_2O Acre	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct.
PBA M103 4/	I	160	20	50%	40	100%	80	100%	160	100%
	II	160			40	60%			160	95%
Baron 5/	I	160	40	80%	80	90%	160	100%	320	100%
	II	160	40	20%	80	40%	160	90%	320	90%

Note: Rates of herbicide based on active ingredients.
1/ Mixture of borate, sodium chlorate, and monuron. 2/Mixture of borate and 2,4-D. 3/Predominantly 2,3,6-trichlorobenzoic acid. 4/ Polychlorobenzoic acid, principally 2,5-di, 2,3,5-tri, 2,3,4,5-tetra, and 2,3,5,6-tetra. 5/Erbon.

In general, the benzoics appeared to be less effected by the more difficult terrain afforded by the steep railroad embankment than the other materials, with the exception of the Chlorea which showed to an advantage, indicating terrain may not have been the only factor involved. (Colorado Agricultural Experiment Station).

Results of foliage treatments of Russian knapweed (Centaurea picris) with amino triazole, chlorinated benzoic acid and 2,4-D formulations. Thornton, Bruce J. This test was located in the San Luis Valley at the margin of a field, the upper half of each plot next to the fence being unplowed and the lower half having been plowed and planted to grain in the spring. No difference was noted in the results on the resulting two types of growth. The stand was heavy, plants vigorous, 15 to 30 inches tall, and in late bud to early bloom stage. The applications were made on July 25, 1956. Materials used, rates of application, and results, as determined one year later, are presented below.

Herbicide	Gal. H_2O Acre	Gal. Oil Acre	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct.
Amino triazole	80		2	0%	4	0%	6	0%	8	0%
TBA 1281-S 1/	80		5	65%	10	98%	15	95%	20	98%
TBA 1281-S	40		5	--	10	40%	15	95%	20	95%
TBA 1281-AN 2/		40	5	35%	10	85%	15	98%	20	100%
PBA M103 3/	80		5	10%	10	10%	15	70%	20	90%
PBA M177 4/	80		5	70%	10	30%	15	40%	20	80%
ACP LV 129 5/	80						2	60%	4	90%
2,4-D B.ester	80						2	60%	4	80%

Note: Rates of herbicides basis active ingredients.
1/Predominantly 2,3,6-trichlorobenzoic acid, aqueous type. 2/Same, oil type. 3/Polychlorobenzoic acid, principally 2,5-di, 2,3,5-tri, 2,3,4,5-tetra, and 2,3,5,6-tetra. 4/ Polychlorobenzoic acid, principally 2,3,5- and 2,3,6-tri. 5/Butoxy ethanol ester.

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The results are somewhat in variance with those of similar tests in that M177 generally has been somewhat more effective than M103, which was attributed to the presence of 2,3,6-tri. Repeat applications were made as warranted by regrowth. (Colorado Agricultural Experiment Station).

Results of foliage treatments of leafy spurge (Euphorbia esula) with amino triazole, chlorinated benzoic and 2,4-D formulations, and three combination applications. Thornton, Bruce J. This test was located in North Central Colorado on an undisturbed area. The stand was uniformly heavy, plants vigorous, 15 to 20 inches tall, and in bloom stage. Soil moisture was good. The applications were made on May 31, 1956. Materials used, rates of applications, and results, as determined one year later, are presented below.

Herbicide	Gal. H_2O Acre	Gal. Oil Acre	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct	Lbs. Herb. Acre	% Re-duct.
Amino triazole	40		4	80%	8	80%	16	85%
TBA 1281-S 1/	40		5	45%	10	85%	20	95%
TBA 1281-AN 2/		20	5	20%	10	80%	20	80%
PBA M103 3/	40		5	15%	10	40%	20	90%
2,4-D B.ester	40				2	15%	4	10%
2,4-D Amine	40				2	35%	4	20%
ATA -TBA	40						5-5	75%
ATA - B.ester	40						5-2	75%
TBA - B.ester	40						5-2	35%

Note: Rates of herbicides basis active ingredients.
1/Predominantly 2,3,6-trichlorobenzoic acid, aqueous type. 2/Same, oil type. 3/Polychlorobenzoic acid, principally 2,5-di, 2,3,5-tri, 2,3,4,5-tetra, and 2,3,5,6-tetra.

At the highest rates used not a great deal of difference is evidenced in the effectiveness of the amino triazole and the three benzoics. At the lowest rates used the amino triazole is definitely more effective, with the benzoics showing progressively less effectiveness in the order in which they appear in the table. Repeat applications were made as warranted by regrowth. (Colorado Agricultural Experiment Station).

Control of leafy spurge with ATA and 2,4-D, 1957. Baker, Laurence O. In June 1955, 3 amino-1,2,4-triazole (ATA) was applied to leafy spurge at rates of 5 and 10 pounds per acre on triplicated square rod plots. 2,4-D was used at a 3 pound rate as a supplement to certain ATA treatments. In June 1956, half of each plot was retreated. Observations made on regrowth in 1957 showed that all ATA rates had reduced the stand of leafy spurge by at least 65 percent from the original treatment. Two annual 10 pound ATA treatments provided no better control of spurge than half that rate but did

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injure associated grasses more. Two annual treatments were more effective than one. ATA in 1955 followed by 2,4-D the next year was as effective as when ATA was followed by ATA. Chlorotic growth was observed in 1957 on plots treated with ATA in 1955 with no additional treatments.

Treatments with 2,4-D only were considerably less effective, at the rates used, than when ATA was used in conjunction with 2,4-D. Results from certain treatments in this test follow. No explanation is available for the large regrowth on the treatment with ATA at 10 pounds followed by 2,4-D. Most of this difference occurred in one replication.

1955		1956		Average percent
Chemical	Rate	Chemical	Rate	regrowth 1957
ATA	5	ATA	5	12
ATA	5	untreated		33
ATA	10	ATA	10	12
ATA	10	untreated		20
ATA	5	2,4-D	3	12
ATA	10	2,4-D	3	25
2,4-D	3	2,4-D	3	80
2,4-D	1½	2,4-D	1½	100
Check	--	-----		100

Even where grass was injured by two ATA treatments it was much more vigorous when ever the stand of leafy spurge had been reduced by 50 percent or more. Final elimination of the remaining spurge plants should be much easier with increased grass competition. (Montana Agricultural Experiment Station, Bozeman, Montana).

Results of foliage treatments of whitetop (Cardaria draba) with 3 amino-1,2,4-triazole, chlorinated benzoic acid and 2,4-D formulations, and combinations. Thornton, Bruce J. This test was located in North Central Colorado on an undisturbed area. The stand was uniformly heavy, plants vigorous, 12 to 18 inches high, in bloom. Soil moisture good. The applications were made on May 30, 1956. Materials used, rates of application, and results, as determined one year later, are presented below.

Herbicide	Gal. H_2O Acre	Gal. Oil Acre	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct.
Amino triazole	40		4	65%	8	80%	16	70%
TBA 1281-S 1/	40		5	0%	10	20%	20	70%
TBA 1281-AN 2/		20	5	0%	10	10%	20	40%
PBA M103 3/	40		5	0%	10	25%	20	50%
2,4-D B.ester	40				2	50%	4	15%
2,4-D Amine	40				2	70%	4	30%
ATA - TBA	40						4-5	65%

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Herbicide	Gal. H_2O Acre	Gal. Oil Acre	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct.
ATA - B.ester 2,4-D	40						4-2	50%
TBA - B.ester 2,4-D	40						5-2	25%

Note: Rates of herbicides basis active ingredients.
1/ Predominantly 2,3,6-trichlorobenzoic acid, aqueous type. 2/Same, oil type. 3/Polychlorobenzoic acid, principally 2,5-di, 2,3,5-tri, 2,3,4,5-tetra, and 2,3,5,6-tetra.

In this test amino triazole appears generally more effective than the benzoics or the 2,4-D formulations, with results as a whole being unsatisfactory. No particular benefit resulted from any of the combinations used. The marked ineffectiveness of the 2,4-D formulations would appear to indicate that the plants were too far advanced for best results, at least with respect to 2,4-D. (Colorado Agricultural Experiment Station).

The effect of several chemicals on White top. Alley, H. P. Duplicate ½ sq. rod plots of White top (Cardaria draba) were treated June 8, 1956 with various chemicals and rates as presented in attached table. All chemicals were applied with a knapsack sprayer in a total volume of 40 gal. water per acre. Weed counts were made before chemical application and again one year following application. Counts were made by locating three sq. ft. quadrats diagonally across each plot. The addition of a wetting agent increased the effectiveness of both the 2,4-D ester and 2,4-D amine applications. Four pounds of the ester or amine at 4 lb/A plus wetting agent gave a 90 percent reduction in White top stand. For complete control 20 lb/A of the 2,4-D amine or 10 lb/A of the ATA (amino triazole) was required. The powder formulation of ATA was considerably better than the liquid ATA (ATA 889) at equivalent rates. All other chemicals used in the experiment were ineffective in reducing the stand of White top. (Wyoming Agricultural Experiment Station)

Chemical 1/	Rate/Acre	Percentage Control Rep. I	Rep. II	Av.
2,4-D Ester	10	100	97	98.5
"	20	93	100	96.5
"	2	33	0	16.5
"	4	92	35	63.5
" & wet	2	97	0	48.5
" & wet	4	92	88	90.0
2,4-D Amine	10	90	100	95.0
"	20	100	100	100.0
"	40	100	100	100.0
"	60	100	100	100.0
"	2	0	0	0.0
"	4	56	0	28.0
" & wet	2	0	0	0.0

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Chemical [1]	Rate/Acre	Percentage Control Rep. I	Rep. II	Av.
2,4-D Amine & wet	4	93	86	89.5
ATA	1	0	0	0.0
"	5	77	80	78.5
"	10	100	100	100.0
4 (MCPB)	2	0	0	0.0
	4	0	0	0.0
4(2,4-DB)	2	0	15	7.5
	4	0	0	0.0
ACP-M-103-A	2	0	20	10.0
	4	0	0	0.0
ACP-M-177	2	0	0	0.0
	4	0	0	0.0
ACP-889	5	68	55	61.5
	10	100	80	90.0

[1] 2,4-D ester-propylene glycal butyl ether ester
2,4-D Amine-Alkalamine salts (of the Ethonal & Isopropomal series)
ATA-3-amino-1,2,4 triazole
4(MCPB)-4-(2-methyl-4 chlorophenoxy) butyric acid
4(2,4-DB)-4-(2-4-dichlorophenoxy) butyric acid
ACP-M-103-A-trichlorobenzoic and tetrachlorobenzoic acid and isomers of these
ACP-M-177-80 percent of 2,3,6-trichlorobenzoic acid
ACP-889-2 lb/gal liquid 3-amino-1,2,4-triazole
ATA-MCP-

Effects of four herbicides on the control of perennial ground cherry, Physalis subglabrata. Schaeffer, Ralph J. and Erickson, Lambert C. Perennial ground cherry is estimated to infest about 14,000 acres in Idaho, and further, it is estimated that about half of this acreage has been infested since the advent of 2,4-D. This study is in progress on idle farmland which is irrigated intermittently but inadequately. The original herbicide treatments were applied in June 1956. Root damage data were taken in October 1956, and regrowth data were taken in June 1957. The so called 2,4-D, top kill data were obtained 6 weeks after the 1957 treatments were applied. These were made at the original rates.

2,4-D Amine was the least effective chemical used on perennial ground cherry, resulting in stand reductions of 16, 40, 30 and 70% respectively from the 2, 4, 8 and 80 pound per acre rates. Root injury did not exceed 10" in depth on any 2,4-D treatment.

2,4,5-T gave the greatest overall stand reductions: These were 83, 96, 94, and 94% respectively for the 2, 4, 8 and 80 lb. per acre rates. Top kill from similar 1957 treatment ranged from 90 to 95% regardless of rate. The two lower rates gave the greater root damage. The 2 lb. rate produced severe root decomposition down to 24". Decomposition at the 4 lb. rate progressed down to 14". The 8 and 80 lb. rates produced severe injury down to 18", Complete root decomposition was common to a depth of 12" at 8 lb. rate and 7 inches at the 80 lb. rate.

2,4,5-TP-Stand reductions were even greater than from 2,4,5-T. Reduction in stand amounted to 94% at the 2 lb. rate, and 95% and 97% respectively for the 8 and 80 lb. rate. Top kill from the 1957 treatment was only 10% for the 2 and 4 lb. per acre rates, and 85% for the 8 lb. rate. Only one plant could be found on the three plots again treated at the 80 lb. per acre rate. Comparatively, root damage was less extensive and less severe. Root damage was observed only down to the 10" level on the 2,4 and 8 lb. per acre plots, with damage to only 3" at the 80 lb. per acre rate.

Amino Triazole-The greatest stand reduction resulting from any of the herbicides and rates tested was obtained by 8 lbs. per acre of amino triazole. This resulted in a reduction of 98% and a 92% reduction at the 4 lb. rate. Top kill from the 1957 treatments were only 5 to 10% at either rate. Root damage was only slight and reached no deeper than 10", with no complete root kill anticipated. (Idaho Agricultural Experiment Station)

<u>The ability of perennial ground cherry roots to initiate buds from root segments taken at twelve soil depths.</u> Schaeffer, Ralph J. and Erickson, Lambert C. This study was to determine the ability of perennial ground cherry roots to initiate buds from several soil depths, or distances from the crown. Root samples were taken on October 12, 1957, to a depth of 36 inches. These were cut into 3 inch segments and planted in flats in the greenhouse on October 14, 1957. Eleven to thirty-five segments were collected from each depth with each depth group placed in separate flats. Emergence readings were begun one month after planting. No attempt was made to count the number of shoot buds at the time of the planting. Some flats have produced more shoots than the original number of root segments planted. Two months after planting there was a marked difference in plant vigor, with the segments from the upper levels being the most advanced. The first blooms were initiated seven weeks after planting, and first appeared on the plants originating from the root segments taken at the three inch depth. The percentage of shoots arising from the respective root segment depths are as follows:

3"	96%	15"	73%	27"	60%
6"	116%	18"	63%	30"	63%
9"	73%	21"	41%	33"	64%
12"	89%	24"	84%	36"	62%

This study indicates that perennial ground cherry roots are capable of initiating buds and shoots from roots at all depths of soil studied in this experiment.

The use of competing species and fertilizer practice for controlling foxtail barley (Hordeum jubatum) on high watertable lands. Cords, H.P. The permanent watertable in the area selected for this study fluctuates between three and four feet below the surface. However, because of current and past irrigation practice, the watertable level rises almost to the surface after each irrigation and only slowly falls to the equilibrium level. This condition, coupled with past grazing practice, had allowed foxtail barley to become the dominant species with scattered plants of other weeds such as curly dock and of perennial bunch grasses and strawberry clover. The plot area was plowed in the fall of 1956. Five grasses and three legumes were seeded in pure stands, each by three seeding methods. This report will be concerned with the effectiveness of the various species in suppressing foxtail under two fertility levels--low available nitrogen and moderately high available nitrogen. The native levels of phosphate and potash were both high. The soil is non-saline and moderately alkaline.

In those grass plots with adequate stands, nitrogen fertilization resulted in lower foxtail infestation. In addition, fertilizer treatment produced more forage at an approximate cost of $10.00 per additional ton. This relationship held true for both the June and September cuttings. This finding is contrary to result obtained in the greenhouse the previous winter and reported in the 1957 Research Progress Report. Nitrogen treatment, as expected, had no effect on the legumes.

At the time of the June cutting, the alfalfa plots had the lowest per cent foxtail, followed by tall wheatgrass and tall fescue. However, high watertable conditions later in the summer resulted in severe thinning of the alfalfa stands and a resulting increase of foxtail. At the time of the fall cutting tall fescue was by far the best species for suppressing foxtail. Orchardgrass and tall wheatgrass followed next, and alfalfa was among the poorer competitors.

The preliminary results of this study indicate that establishment of suitable species coupled with proper fertilizer practice are practical methods of converting high watertable pastures of this sort from foxtail patches into profitable producers of forage.. (Nevada Agricultural Experiment Station.)

Mowing and pasturing for control of foxtail barley (Hordeum jubatum). Cords, H. P. Previous results have shown that two mowings--the first at the time the first heads appear and the second approximately a month later-have almost entirely prevented heading of the foxtail. In the spring of 1957 an experiment was designed to find whether the same results could be obtained by pasturing. A nine-acre area heavily infested with foxtail was divided into four pastures, two of which were lightly stocked and grazed continuously, and two of which were heavily stocked during the critical periods mentioned above. Evaluation was made by counting the number of foxtail spikes in a 9.6 square foot frame. Twenty-three of these counts were made in each of the pastures in July and again in October. In July, the number of heads on the pastures grazed rotationally was about 8 per cent of those on the pastures grazed continuously. After this evaluation, all pastures were mowed. Only a relatively few heads were found on any of the pastures in October. This study will be continued to determine the long-time effect of these practices. (Nevada Agricultural Experiment Station).

Chemical control of blue flag (Iris missouriensis). Cords, H.P. In the spring of 1956 an experiment was begun involving six chemicals each at three rates and applied at each of three dates. The area selected for the study was in a wet pasture. The vegetation was a mixture consisting of perennial grasses, 30-50 per cent, sedges (Carex spp.) 5-15 per cent, perennial clovers, 5-25 per cent, perennial broadleaf weeds (dandelion, plantain and dock) 5-10 per cent, and blue flag, 10-40 per cent. The area was protected from grazing during the course of the experiment. The dates were selected on the basis of phenological stage of the blue flag and were early vegetative stage, bud stage and just post-bloom. The vegetative stage application was not made until the spring of 1957. All plots were evaluated just before spraying and again twelve months later by means of visual extimates of three independent observers. Results of the bud and post-bloom stage applications are given below.

Percent reduction of Iris
as influenced by various chemical treatments

	Time of Application	
Chemical Treatment	Bud Stage	After Bloom
Dalapon, 10 lb./Acre	96	99
Dalapon, 20 lb./Acre	99	100
Dalapon, 40 lb./Acre	98	100
ATA, 4 lb./Acre	27	51
ATA, 8 lb./Acre	21	12
ATA, 16 lb./Acre	9*	16
2,4-D, 1 lb./Acre	45	59
2,4-D, 2 lb./Acre	63	80
2,4-D, 4 lb./Acre	77	98
2,4,5-T, 1 lb./Acre	35	26
2,4,5-T, 2 lb./Acre	40	31
2,4,5-T, 4 lb./Acre	72	66
2-(2,4,5-TP), 1 lb./ Acre	57	6*
2-(2,4,5-TP), 2 lb./Acre	33	34
2-(2,4,5-TP), 4 lb./Acre	62	43
Monuron, 10 lb./Acre	31*	11
Monuron, 20 lb./ Acre	3*	55*
Monuron, 40 lb./Acre	20	5
Check, no treatment	1.7	

*Increase

The dalapon treatments, while effective against the blue flag, were undesirable in that the perennial grasses were severely thinned with a resulting increase in the sedges and perennial broadleaf weeds. Four pounds per acre of 2,4-D applied post-bloom appeared to be the most effective treatment when all factors were taken into consideration. The effect of treatment on the clovers could not be determined, since the clovers virtually disappeared in all plots, probably as a result of competition from the grasses due to protection from grazing. (Nevada Agricultural Experiment Station).

Results of foliage treatments of mouse-ear povertyweed (Iva axillaris) with amino triazole, chlorinated benzoic acid and 2,4-D formulations. Thornton, Bruce J. This test was located in the San Luis Valley on an undisturbed area. The stand was uniform, fairly heavy, plants vigorous, 12 to 16 inches tall, lower flowers forming seed. Soil moisture good. The applications were made on July 30, 1956. Materials used, rates of application, and results, as determined one year later, are presented below.

Herbicide	Gal. H_2O Acre	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct.	Lbs. Herb. Acre	% Re-duct.
Amino triazole	80	2	50%	4	70%	6	50%	8	50%
TBA 1281-S 1/	80	5	70%	10	90%	15	100%	20	100%
PBA M103 2/	80	5	10%	10	50%	15	60%	20	60%
PBA M177 3/	80	5	10%	10	40%	15	60%	20	60%
2,4-D B.ester	80	5				2	90%	4	90%
2,4-D Amine						2	90%	4	90%

Note: Rates of herbicides basis active ingredients.

1/Predominantly 2,3,6-trichlorobenzoic acid. 2/Polychlorobenzoic acid, principally 2,5-di, 2,3,5-tri, 2,3,4,5-tetra, and 2,3,5,6-tetra. 3/Polychlorbenzoic acid, principally 2,3,5- and 2,3,6-tri.

In this test the amino triazole and the polychlorobenzoics are definitely inferior to the 2,3,6-trichlorobenzoic, but little difference is evident in the comparative effectiveness of the two polychlorobenzoic formulations. The 2,4-D formulations are second only to the 2,3,6-trichlorobenzoics in effectiveness. (Colorado Agricultural Experiment Station)

An evaluation of several programs of treatment with dalapon and ATA for the control of bermudagrass. Day, Boysie E., Russell, Robert C., and McCarty, C. Dean. A series of tests were conducted in the summer of 1957 to compare the effectiveness of dalapon and ATA on the control of bermudagrass at several rates and under several programs of treatment. Tests were conducted in a dense and uniform stand of bermudagrass under sprinkler irrigation.

Objectives of the experiment were (1) to determine the effectiveness of single treatments of dalapon at rates of 3,6, and 12 pounds per acre. (2) to compare single applications of dalapon with split applications applied at several different treatment intervals. (3) to determine the effectiveness of single treatments of ATA at rates of 6 and 12 pounds per acre. (4) to compare single applications of ATA with split applications applied at different treatment intervals. Materials were applied at a standard volume of 100 gallons per acre. A commercial wetting agent, X77, was used at the rate of 6 ounces per 100 gallons of spray in each of the dalapon treatments. All programs of treatment were scheduled to terminate on the same date, August 30, 1957. Visual estimates of percent control were made for each treatment by several independent observers weekly for eleven weeks following the last treatment in each treatment series.

A schedule of treatment and data for the eleven-week observations are given in table I. Weed control obtained from single treatments of both dalapon and ATA was generally satisfactory at all rates above six pounds. ATA gave about equal results to those obtained by dalapon at comparable dosages. Evidence does not indicate any particular value of split application over a lump treatment of the same total amount of chemical. Equal or better results were obtained from a single treatment of a given amount than from multiple applications amounting to the same total dose. (Univ. of Calif. Citrus Experiment Station, Riverside, Calif., and Univ. of Calif. Agricultural Extension Service).

Table I
The control of bermudagrass eleven weeks after treatment obtained by Dalapon and AtA at several rates of treatment in single or split applications

Herbicide	Rate per treatment (lbs/A)	No. of treatments	Spacing of (weeks)	Total rate of treatment (lbs/A)	Weed Control (%)
Dalapon	3	1	-	3	55
"	6	1	-	6	82
"	9	1	-	9	86
"	12	1	-	12	90
"	3	2	1	6	93
"	3	3	1	9	94
"	3	2	2	6	88
"	3	3	2	9	91
"	3	2	4	6	78
"	3	3	4	9	83
"	3	2	8	6	86
"	6	2	1	12	92
"	6	2	2	12	97
"	6	2	3	12	70
"	6	2	4	11	92
"	6	2	6	12	85
"	6	2	8	12	79
"	6	2	10	12	89
ATA	6	1	-	6	86
"	12	1	-	12	93
"	6	2	3	12	87
"	6	2	6	12	90
"	6	2	9	12	91

Invasion of harbaceous perennial weeds. Suggs, Delbert D. Water was first delivered to lands almost free of herbaceons perennial weeds. Between the dam and the land to be irrigated lay 4,000 acres of farmed land infested with noxious weeds principally white top, Cardaria draba, Russian knapweed, Centaurea repens, and wild monring glory, Convolvulus arvense. These weedy lands were to be inundated as a part of the Equalizing Reservoir. The weeds were sprayed by aircraft and ground rig with 2,4-D, two or three times a year until the reservoir was filled. Studies by Vic Bruns, ARS, Prosser, Washington Experiment Station have shown that seed viability is not lost by immersion in water for several years. During the seven years since the first delivery of water to the canals, we have had no reports of new infestations of white top, Russian knapweed, or morning glory on laterals or on farms. Movements of Russian knapweed have occurred a few yards from old farmland infestations where soil has been moved in excavation of channels. These observations raise the questions of how much downstream infestation may be expected along a waterway from seeds transported by the water, on the surface and below the surface. (Bureau of Reclamation, Columbia Basin Project, Washington).

Cost of prevention of spread of dalmation toadflax and goatweed. Suggs, Delbert D. Isolated infestations of dalmation toadflax, Linaria dalmatica and goatweed, Hypericum perforatum were marked and sterilized by Grant County Extension Weed Specialist and Bureau personnel on dry range land in central Washington, in 1954. Patches were at least two years old. During the three succeeding years, 20 to 40 new patches or individual plants per year were treated and the tops clipped. Individual plants were found as far as 30 miles from the original patches. Dalmation toadflax had been cultivared by some persons as a perennial "snapdragon". With the advent of irrigation, seedlings appeared along waterways and borrow ditches several hundred feet away from the home gardens. Because the patches were small, total cost for materials did not exceed $15 or $20 per year, plus labor and transportation at $20 to $30 per year. By cooperation of persons and agencies concerned, we believe we can prevent the damage caused by these weeds at a very low cost. Both weeds, though well adapted to dry range conditions, appear to be highly competitive on irrigated farms. Each is resistant to normal applications of 2,4-D. Each makes tiny, heavy seed easily transported by any media except wind. Although the irrigation project is constantly being freshly exposed to movements of these seed on the irrigated farm land from other areas, we hope to keep these two weeds "eradicated" at a nominal cost. To date, the annual cost has been less than that required to remove barnyard grass from one acre of beets or beans. (Bureau of Reclamation. Columbia Basin Project, Washington.)

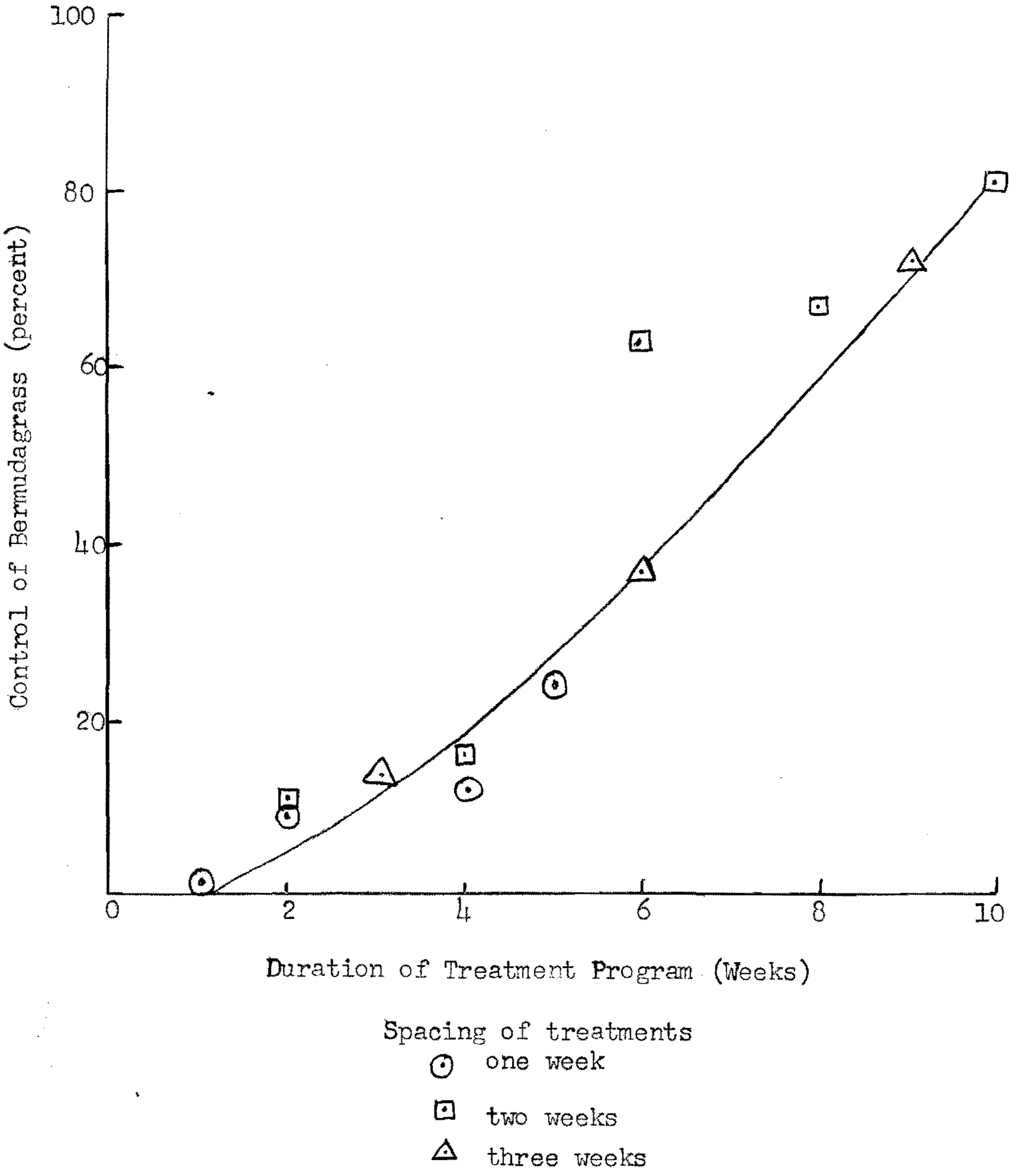
The effect of number and frequency of treatments with aromatic weed oil on the control of bermudagrass. Day, Boysie E., Russell, Robert C., and McCarty, C. Dean. Tests of twelve programs of treatment with weed oil were made on a dense stand of bermudagrass in a sprinkler-irrigated lemon orchard. Plots 5 feet wide and 13 feet long were established in the tree aisles using a randomized block design with each treatment replicated eight times. Aromatic weed oil was applied at a standard rate of 100 gallons per acre in each treatment or retreatment. Treatment programs were scheduled to terminate on the same date, August 30, 1957. Thus environmental factors were uniform for all treatment programs during the rating period.

Thirteen programs of treatment, amounting to 104 plots were compared. Programs consisted of two to six applications at one-week intervals, two to six applications at two-week intervals, and two to four applications at three week intervals. Thus treatments varied in number from two to six in programs varying in duration from two to ten weeks. Evaluation of each program was made on the basis of independent visual estimates of percent control by several observers at weekly intervals following the final treatment in each treatment program.

Rating data for the observations made eleven weeks after final treatment are shown in figure 1. A total of six treatments spaced at one week intervals produced only a 24 percent control of bermudagrass as compared to 81 percent control for the same number of treatments at two week spacing. Four treatments spaced at three week intervals provided 72 percent control. Thus the ultimate control obtained was more a function of the duration of the programs rather than the number of treatments. It is evident that careful timing of retreatments is an important factor in securing maximum effectiveness from a given number of oil sprayings. (Univ. of Calif., Citrus Experiment Station, Riverside, Calif., and Univ. of Calif. Agricultural Extension Service.)

Figure 1

The effect of number and frequency of treatments with aromatic weed oil on the control of bermudagrass.



PROJECT 2. HERBACEOUS RANGE WEEDS

M. Hironaka -- Project Chairman

SUMMARY

Sixteen reports were contributed by fifteen authors from six states. The reports pertain to the following species: medusa-head rye (Elymus caput-medusae), halogeton (Halogeton glomeratus), Klamath weed (Hypericum perforatum), diffuse knapweed (Centaurea diffusa), niggerhead (Rudbeckia occidentalis), California false hellebore (Veratrum californicum), cinquefoil (Potentilla spp.), tall larkspur (Delphenium occidentalis), and eight noxious native forbs that are found on high elevation ranges.

Introduced Range Invaders

Species in this category were introduced, unintentionally in most cases, and have become established in large quantities on our ranges. In nearly all cases the environment was made favorable for their establishment by mismanagement of the native species. Some of the introduced are poisonous; others are noxious because of their poor forage qualities.

Medusa-head rye. Encouraging results on the reduction of medusa-head with the use of herbicides are reported from California and Idaho. This control is temporary but it does indicate the possibility of replacement with native or desirable introduced species during the "control" period. Papers on the ecological aspects deal with response to fertilizer and its relationship to soil moisture, root development, and on the phenological behavior of medusa-head when grown during the various months of the year.

Halogeton. Research on this poisonous species centers around the use of pre-emergence herbicides, competition between crested wheat and halogeton, and a physiological study dealing with the relationship of sodium chloride accumulation and oxalate formation in halogeton plants grown in salt solutions of different concentrations.

Klamath weed. The tremendous success of biological control of Klamath weed is reported from California. The introduced Chrysolina gemellata beetle has been largely responsible for the reduction of this weed to less than one per cent of its former occurrence. The area once occupied by Klamath weed now support desirable forage species.

This is the first time such a high degree of control has been attained on an introduced range weed. It certainly is encouraging news to those working on other introduced species.

Diffuse knapweed. A recent newcomer to the rank of range weed in Idaho is diffuse knapweed. Preliminary evaluation of herbicides for the control of this species is presented.

Native Species

Species in this category may be found in small amounts on ranges that are in the good condition class. It is when they become excessively abundant that a weed problem arises. Most of the species are non-toxic, but some are poisonous.

Non-toxic. The species reported in this group are found on forest ranges. Evaluations of herbicides on the control of niggerhead, California false hellebore, cinquefoil, and eight other perennial forbs are presented.

Poisonous. More cattle have been lost because of poisoning by tall larkspur than any other species on forest ranges. Attempts to control this species date back many years, with little success. Two papers are presented on the results of herbicide evaluation for the control of tall larkspur in Montana.

The reports of the individual contributors have been arranged according to the above categories.

CONTRIBUTORS REPORTS

Introduced Range Invaders

The effects of rate and date of dalapon application on control of medusa-head rye, Elymus caput-medusae. Morton, Howard L., Torell, Paul J., and Haas, Robert H. An experiment was initiated in Washington County, Idaho, during the spring of 1956 to determine the minimum rate of dalapon application necessary to control medusa-head rye at different stages of growth. Treatments of 1.0, 2.0, and 4.0 pounds dalapon per acre were applied on April 27, May 31, and June 26, 1956; the dates corresponding to the two-leaf, late boot, and dough stages of growth, respectively. All treatments were applied in water equivalent to 40 gallons per acre with a power sprayer.

An initial evaluation for medusa-head kill and seed production was made during the fall of 1956. Since there were apparent treatment differences in the second year following dalapon application, an evaluation for medusa-head control was made in 1957, although there was no chemical retreatment on these plots. All plots were evaluated for per cent medusa-head ground cover in both 1956 and 1957. The ground cover data were subsequently converted to per cent medusa-head control.

The following table shows the per cent medusa-head control obtained in 1956 and 1957 from three rates of dalapon applied at three dates in 1956:

	1 lb./A		2 lbs./A		4 lbs./A	
Date of Application	1956	1957	1956	1957	1956	1957
April 27	47	7	90	46	97	42
May 31	10	19	22	16	50	40
June 26	0	37	0	8	0	27

The treatments applied on April 27 were considerable more effective in killing medusa-head than treatments applied on May 31 and June 26, 1956. Although the 1.0 pound rate applied on April 27 was only partially effective, the treatment reduced the medusa-head competition and permitted the establishment and growth of many broad-leaved annual weeds particularly annual sunflower, Helianthus annuus, in 1956. Although approximately the same percentage control was obtained from the 4.0 pound per acre treatment applied on May 31, the broad-leaved annuals were not evident on this treatment. The results from this study indicate that early spring treatment of medusa-head with dalapon is necessary if good control is to be obtained, and that higher rates will not substitute for an early date of treatment.

Although there was some apparent reduction in medusa-head during 1957 on plots treated in June of 1956, the reductions do not necessarily correspond to the control obtained in the 1956 growing season. This suggests that there was some carry-over effect to 1957 from the 1956 dalapon treatments. It is not known whether this carry-over effect is from residual herbicide, reduction in seed available, or from weakened seedling vigor. (Idaho Agricultural Experiment Station and Crops Research Division, ARS, USDA, cooperating.

Control of medusa head (Elymus caput-medusae L.) by several preemergence herbicides and competition with resident and reseeded species. Major, J., McKell, C. M., and Kay, B. L. EPTC, CDAA, CIPC, Simazin, Dalapon, and Monuron were applied in the fall at three geometrically increasing rates from one-half to eight pounds per acre on valley rangeland dominated by medusa head. The dry vegetation had been burned August 16 to concentrate seeds at the soil surface. Rates of application for Monuron and Simazin started at $\frac{1}{2}$ lb/A. for Dalapon at 1, and for the EPTC, CDAA, and CIPC at 2. Herbicide blocks were replicated four times. The EPTC, Simazin and pelleted CIPC were applied on dry soil September 20-23, the other herbicides a week later in water at the beginning of a heavy rainstorm. After 4.35 inches of rain, rose clover (Trifolium hirtum) and Harding grass (Phalaris tuberose var. stenoptera) were band seeded at about 8 lbs/A of each with 200 lbs/A of 16-20-0 fertilizer. A second, similar seeding followed three weeks later, after two inches more rain. Our objective was to set back the medusa head at least temporarily so desirable resident, and especially the reseeded, species could occupy the site and ultimately exclude medusa head.

Vegetation composition has been estimated by the point-step method, cover has been estimated, and stocked quadrat (four inches square) data have been taken on the reseeded species in the rows.

EPTC, CIPC, and Simazin have already (January) given outstanding control of resident grasses, including medusa head. The Simazin has eliminated most other vegetation as well. The EPTC and CIPC plots now have really excellent bur clover (Medicago Lisfida) stands from resident seed. Plots treated with the other chemicals differ little from the checks.

The seeded species, according to an analysis of variance and Duncan's multiple range test, show no significant differences in survival to date between chemicals. The stands are good to excellent, but variable. (Botany Dept., University of California; Crops Research Division, ARS, USDA; and Field Stations, University of California, Davis).

Relations of medusa head (Elymus caput-medusae L.) to fertilization, Dalapon, and soil moisture. Major, J. and McKell, C. M. NH_4NO_3 at 150 lbs/A of N alone and with P at 100 lbs/A as treble superphosphate gave very great yield responses on a medusa head infested range on an Olcott soil, a planosol or solonetz, in Solano Co., California. Dalapon was applied at 4½ lbs/A on unfertilized vegetation early in spring. Gypsum blocks had been installed at 6, 12, 20 and 36 inches to record soil moisture.

Both weedy and desirable forage plants responded to the N and especially to N + P. In April medusa head was more abundant on the fertilized plots than on the unfertilized, but in June it was less abundant. An explanation is evident in the soil moisture records. Moisture depletion was rather uniform on all plots between storms in late winter, although the N and N + P plots were producing much more herbage than the others. When temperatures rose in March and April, the more abundant vegetation on the N and N + P fertilized plots used soil moisture faster and to greater depths than did the unfertilized vegetation. The soil moisture on the N and N + P plots had essentially reached the permanent wilting point by the latter part of April. Later rains which did occur in this "unusual" year could not be used by the dry herbage, but did produce additional plant growth on the plots not fertilized. Here the vegetation had not run out of moisture and was still green and functioning. Medusa head was one of the principal plants to benefit from this additional late spring moisture. It was benefited only on those plots with a rather sparse plant cover, natural to this infertile soil, where the medusa head had not been ultimately reduced in density to a very few plants per square meter by competition from the fertilized filaree (Erodium botrys) and grasses (Bromus mollis, Avena fatua, resident Lolium multiflorum, Hordeum hystrix, etc.). The few medusa head plants left on the Dalapon-treated sites responded more to the late rains than the relatively few, already mature medusa head plants on the heavy N-fertilized plots. Dalapon eliminated most of the grasses, leaving greatly increased amounts of filaree and especially Hypochoeris glabra. These, with the medusa head plants left unkilled by the herbicide, used up the available soil moisture.

In another locality on hill range we have found that grazing tends to preserve enough soil moisture to mature a dense medusa head stand, wheras the resident ungrazed annuals can rob the medusa head of most of the water it needs before it is phenologically ready to use it. Fertilized vegetation is even more effective in using up soil water than the untreated range. (Dept. of Botany, University of California and Crops Research Division, ARS, USDA, Davis, California).

Relative rate of root development of medusa-head and cheatgrass. Hironaka, M. and Tisdale, E. W. The purpose of this study was to determine whether the root system of medusa and cheatgrass differ sufficiently to explain the replacement of cheatgrass by medusa.

Because the technique used in this study has not been reported in print to the authors' knowledge, a brief description seems warranted. One-inch diameter tubes made of nylon cloth material were filled with soil obtained by the use of an orchard type soil sampler. The soil was replaced in the tubes in the reverse order of extraction. The length of the tubes that were to be recovered during the winter months were two feet or shorter and those recovered during April, May, and June were three feet in length. Each tube was "planted" in the field and seeded with either medusa or cheatgrass. The plot area was straw mulched to lessen the effects of frost. After fall germination and emergence had occurred the seedlings were thinned to one per tube. Four replicationsof each species were examined monthly from mid-December to mid-June. Roots were recovered from the tubes by use of a jet stream of water. Length measurements were taken from root tip to seed and from leaf tip or panicle to seed as the plant was stretched out on a flat surface.

The relative length of the roots of the two species for the seven months are presented in Table 1. Length of root was very similar in the 2 species from mid-December to mid-March. The aerial portion of both species changed very little from December to March, while root length increased significantly during this period. No root growth took place during the coldest period (mid-January to mid-February) when the maximum-minimum temperatures under litter were 37 and 19 degrees F. respectively. The root branching development of the two species was similar.

The significance of the difference in root length in the spring is uncertain because of the earlier maturity of cheatgrass and the extremely favorable spring experienced in 1957. This study does indicate that medusa-head may have a slight advantage over cheatgrass for soil moisture, however. This study is being continued, with the addition of 2 perennial grasses.

Table 1. Average root and aerial lengths of medusa-head rye and cheatgrass from mid-December to mid-June (av. of four measurements.)

Date of Recovery	Root Length (in.)		Aerial Length (in.)	
	Medusa	Cheat	Medusa	Cheat
Dec. 12	13.2	13.5	3.2	2.7
Jan. 12	16.2	16.1	3.1	2.6
Feb. 12	18.4	16.5	3.1	2.8
Mar. 14	25.3	25.4	3.1	2.2
Apr. 13	36.4	32.4	4.4(a)	4.9(a)
May 22	37.6	32.5	8.7(b)	11.6(c)
June 9	38.2	31.9	15.8(c)	15.0(d)

a. 3-4 blades b. early boot stage c. pre-anthesis d. dough stage

(Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow, Idaho).

Responses of medusa head (Elymus caput-medusae L.) to different planting dates. Major, J. Plantings were made monthly from August 1956, to March 1957, and have been kept in the greenhouse at supposedly optimum moisture conditions.

None of these plants stooled out, so in January one-half the plants (duplicate plantings had been made) were moved outside but still watered. The outside plants became normal in appearance. Only the outside plants seeded between August and November produced normal seed crops. The December plantings produced a few flowering culms. The January to March seedings have not flowered to date and are still green. The plants which flowered than dried up, except for the August and December seedings, which are still partially green.

The greenhouse plants have never flowered, except for the September and October plants, which had one-fifth to one-tenth the normal number of flowering culms. The number of seeds per culm was normal, however. The flowering plants dried; the others are still green.

Evidently medusa head requires cold treatments after germination for normal completion of its life cycle. Seemingly the short days of autumn also provide a necessary stimulus.

The natural distribution of medusa head confirms that this is not a plant of subtropical, maritime climatic regions. Medusa head does best in continental climates, as is now becoming evident both from its American distribution and its Eurasiatic, where the plant is found in the less maritime parts of the Mediterranean area, and eastwards clear into Kirghizia and the border of Mongolia. The bulk of its distribution is Asiatic and so are the reports of its weedy nature. (Botany Dept., University of California, Davis, California).

An evaluation of certain chloro phenoxy herbicides for pre-emergence control of Halogeton glomeratus. Haas, Robert H., Morton, Howard L., and Torell, Paul J. Certain herbicides have displayed encouraging possibilities for controlling halogeton, when applied as a pre-emergence treatment to the weed. This report covers one of three studies conducted in 1956 to evaluate the performance of a number of herbicides for pre-emergence control of halogeton.

This study evaluated ten chloro phenoxy compounds in a randomized block, split-plot design of three replications. Each material was applied at rates of 2.0 and 4.0 pounds acid equivalent per acre in water at 15 gallons per acre. All treatments were made on November 11, 1956, and they were evaluated on October 10, 1957. The results of the evaluation are included in the following table:

Average per cent of ground covered by halogeton on plots treated with certain phenoxy compounds applied as a pre-emergence application.

Herbicide	Rate per acre 2 lbs.	4 lbs.
2, 4-D	35.7	10.3
2,4,5-T	35.7	5.3
MCPA	23.7	7.7
4-CPA	52.3	43.0
2-(2,4-DP)	23.7	3.7
Silvex	2.0	0.3
4-(2,4-DB)*	20.0	14.3
4-(MCPB)	17.7	7.7
4-(2,4-DB)**	8.7	4.0
2,4-D Amide	9.7	4.0

* Iso-octyl ester
**Butoxy-ethoxy-propanol ester

Precipitation during the spring of 1957 was considerably above normal. This may have been a contributing factor in the generally poor control afforded by the various phenoxy materials tested. However, under the prevailing conditions of this experiment, only silvex provided a practical degree of halogeton control. This material has been outstanding as a pre-emergence herbicide on halogeton in other tests, and it will be investigated further for this purpose. (Crops Research Division, ARS, USDA, and Idaho Agricultural Experiment Station, cooperating).

An evaluation of three substituted urea compounds for pre-emergence control of halogeton. Haas, Robert H., Morton, Howard L., and Torell, Paul J. Diuron, neburon, and DMU were evaluated for pre-emergence control of halogeton at rates of 2.0, 4.0, and 8.0 pounds per acre active ingredient. The experiment was of a randomized block, split-plot design with three replications. The whole plots included rates, while materials were assigned to the subplots. All materials were applied on November 28, 1956, in a spray volume of 100 gallons per acre. The evaluation of per cent ground covered by halogeton was made on October 28, 1957.

The resultant data converted to per cent control are included in the following table:

Material	Rate per acre in pounds 2	4	8
Diuron	70.1	99.3	100.0
DMU	37.4	98.0	99.8
Neburon	19.1	80.5	96.9

As has been true in other studies, diuron continued to be the outstanding urea material for pre-emergence control of halogeton. DMU provided good control at 4.0 and 8.0 pounds, while neburon provided a creditable performance at the 8.0 rate only. (Crops Research Division, ARS, USDA, and Idaho Agricultural Experiment Station, cooperating).

Range seedings to control halogeton in Nevada. Tueller, Paul T. During the field seasons of 1952, 1953 and 1954 a number of permanent plots were established on ranges seeded to crested wheatgrass in northeastern Nevada. Permanently located stakes are the centers of concentric 9.6 sq. ft. and 100 sq. ft. plots. In the 9.6 sq. ft. plots the number of plants of each species was counted and recorded. In the 100 sq. ft. plots the per cent crown density was recorded. These plots were read during the 1955 and 1957 field seasons.

An increase in both numbers and density of crested wheatgrass was found on the better sites with an accompanying reduction of halogeton. On poor and overgrazed sites crested wheatgrass has remained relatively stable with an occasional reduction in number or density while halogeton densities and numbers have increased. Also these data show wide yearly variations in halogeton, and less strikingly in crested wheatgrass.

Frequency of halogeton and crested wheatgrass was taken on these same seedings in 1955 and 1957. A four-square-foot steel frame subdivided into 4 one square foot parts was dropped systematically along transects from permanent starting points. The frequency of occurrence was recorded for all plants. A figure of 4 indicates occurrence in all 4 subdivisions, while zero would indicate the complete absence of the particular species in question.

Frequency of occurrence of crested wheat grass & halogeton in 2 years on 8 areas seeded by the Bureau of Land Management in northeastern Nevada in 1952

BLM	Crested wheatgrass		Halogeton		No.
Project	1955	1957	1955	1957	Plots
Brush Creek	0.96	1.54	2.33	1.96	75
Hubbard	0.60	1.17	3.57	3.07	275
San Jacinto	0.92	1.80	0.81	0.31	175
Strode	0.64	0.77	0	0	75
Bell Canyon	0.22	1.26	3.42	2.96	50
Agee	0.22	0.22	1.78	2.30	250
Mike Spring	1.35	1.84	0.35	0.52	75
Independence	1.22	2.49	1.92	0.87	275

Seven out of 8 areas showed an increase in frequency of crested wheatgrass while 5 out of 8 showed a decrease of Halogeton. A poor shadscale-greasewood site (Agee project) shows an increase in Halogeton and no change in frequency of crested wheatgrass.

A good sagebrush site that has been overgrazed (Mike Spring project) shows an increase in both halogeton and crested wheatgrass. On most of the better sites the frequency of halogeton was reduced to one half and the frequency of crested wheatgrass was doubled. (University of Nevada Agricultural Experiment Station and the Soil and Moisture Division, B. L. M.)

Sodium accumulation and oxalate formation in Halogeton glomeratus. Williams, M. Coburn Halogeton has become one of the most serious of the poisonous weeds infesting the western portions of the United States. The most publicized losses occurred in the sheep industry during the late 1940's and early 1950's. Since then death losses have been low because sheep men no longer graze their flocks where halogeton constitutes an excessive portion of the range vegetation.

In addition to death losses, this weed causes severe economic loss by reducing the number of acres of land which can be safely utilized by livestock. This plant also accumulates great quantities of sodium, the release of which by the decaying plants has been noted to leave a layer of black alkali on the soil surface and thus contribute to the deterioration of the soil.

Physiological studies were begun at Utah State University during 1957 to study the relation of sodium chloride to growth, oxalate formation, and sodium accumulation by halogeton. Seedlings were germinated in petri dishes, then trasnplanted to flats containing a 1:1 mixture of desert soil and vermiculite. After a few days the plants were placed in 2 gallon earthenware jars containing Hoagland's nutrient solution. The plants were grown for two weeks after which the solution was replaced and sodium chloride added to the solution in concentrations ranging from 0.0001 M to 0.1 M. The plants were grown in the above solution for 2 weeks, then measured for growth and analysed quantitatively for oxalates.

The presence of salt in the solution had no effect on normal growth of the aerial portions of the plant. In fact, percent gains in length of the central stem and bottom lateral were slightly higher in plants receiving salt. Gains were considerably increased when plants were grown in the 0.0001 M. solution. Root growth in the 0.1 M solution was slightly depressed.

Oxalate content of the leaves ranged from 15.6 percent in the controls to 30 percent in leaves of plants grown in a 0.1 M solution. Total oxalate content of plants grown in nutrient solution having 4 p.p.m. sodium as impurities is 18.5 percent. The sodium content of 1.44 percent is a result of the initial growth in soil, the impurities in the water, and the original sodium in the seed. Leaves from a plant harvested from the desert in late October had a total oxalate content of 32.25 percent and a sodium content of 12.4 percent.

These studies will be expanded during 1958 to study effects resulting from completely sodium free media to concentrations of 1.0 M sodium chloride. Plant material will be tested to determine toxicity when decreasing percentages of the toxic element occur as sodium oxalate. (Crops Research Division, ARS, USDA, and Utah Agricultural Experiment Station).

A ten-year study of vegetational changes associated with control of Klamath weed (Hypericum perforatum) by imported beetles. Huffaker, C.B.

and Kennett, C. E. Klamath weed, Hypericum perforatum L., prior to 1949, was estimated to infest 2 1/3 million acres in Northern California alone. The failure or unfeasibility of other solutions prompted the late H.S. Smith to initiate biological control. In 1947, a ten-year study was started on the effect on this weed of imported beetles, primarily Chrysolina gemellata (Rossi).

The data obtained show a major improvement in range condition. Control was effective to a degree not even hoped for by enthusiasts. This weed now exists at a level less than one per cent of its former serious occurrence in this state. There was concurrent marked increase in perennial grasses, chiefly the highly desirable climax oatgrass, Danthonia californica, in Humboldt County; and there and elsewhere, the winter annuals--grasses, legumes and forbs--of fair to good forage value claimed a major portion of the space opened up by decline of the pernicious weed. The principal species of forage value were Danthonia californica, Bromus hordeaceus (=mollis), and Erodium spp., in Humboldt County and the latter two plus Lotus spp., in Shasta and Placer Counties.

The increase of other weeds following decline of Klamath weed was not serious, in many instances there being no increase at all. The principal weedy species in Humboldt County were dogtail, Cynosurus echinatus, and hawkbit, Hypochoeris glabra, while broncho grass, Bromus rigidus, was the predominant weed in Shasta and Placer Counties. In Humboldt County, both dogtail and hawkbit are extensive in certain areas but they do not displace or dominate the oatgrass, Danthonia californica, which was the dominant single plant species over a study area of 10 miles from the original beetle release site.

Certainly, abuse by improper grazing will increase the chances that noxious species will come in. Successful chemical methods of control, no less than biological, are subject to the same unfounded fear that if we control a given noxious weed we may get a worse one in its place! (Department of Biological Control, University of California, Berkeley).

An evaluation of certain herbicides for the control of diffuse knapweed, Centaurea diffusa Lam. Haas, Robert H. and Torell, Paul J. Diffuse knapweed has caused some concern as a weed on the sagebrush-grass ranges in the Fairfield area of Camas County, Idaho. A study was initiated on June 14, 1957, to gain a preliminary evaluation of herbicides that might be useful for controlling this weed. The study included six herbicides at three rates: namely, 2,3,6-TBA, an alkanol amine of 2,4-D, low volatile esters of 2,4-D, 2,4,5-T, silvex, and 4-(2,4-DB) at 1.0, 2.0, and 4.0 pounds acid equivalent per acre for all materials. All herbicides were applied at 40 gallons per acre. The experimental design was a split-plot randomized block of three replications.

An evaluation of the control provided by the various herbicides was made on September 26, 1957. At that time, no fall precipitation had occurred, and the soil was too dry to support any regrowth of the current years rosette or vegetative growth. Consequently, since diffuse knapweek appears to behave as a biennial, only the control of the upright or fruiting plants for 1957 was read. The final evaluation will be accomplished in the spring of 1958.

The information provided by this study to date indicates that of the herbicides tested, only the amine of 2,4-D and the ester of 2,4-D gave satisfactory control of diffuse knapweed. This was evidenced by 92, 94, and 96 per cent control for the 1.0, 2.0, and 4.0 pound rates respectively of amine 2,4-D; the respective control for the ester of 2,4-D was 96, 97, and 100 per cent. With the exception of 94 per cent control for the 4.0 pound rate of 2,4,5-T and 90 per cent control for the 4.0 pound rate of silvex all other herbicides and rates provided substantially less than 90 per cent control.

Although the treatments were made at an early bud stage of growth, the average height of the fruiting plants was 23 inches, and they were beginning to become slightly hardened and harsh. Subsequent observations indicated that an earlier spraying date might give more effective control of diffuse knapweed. (Crops Research Division, ARS, USDA, and Idaho Agricultural Experiment Station, cooperating).

Native Species

A comparison of several herbicides in controlling niggerhead (Rudbeckia occidentalis). Klomp, Gerard J. Observations were continued and additional data were collected to determine the relative phytotoxicity of several herbicides compared with 2,4-D when used on niggerhead (Rudbeckia occidentalis). Previous studies have indicated that 2,4-D at 2 pounds per acre is effective in controlling niggerhead growing on high elevation ranges (6,000 feet) in eastern Oregon. In this study a series of 1/160-acre plots were replicated 4 times by blocks with a check plot in each block. Percentage control was determined by comparison of sprayed plot with check.

When observed one month after spraying niggerhead on plots sprayed with 2 pounds per acre 2,4-D and with a mixture consisting of 2/3 2,4-D plus 1/3 2,4,5-T at 2 pounds per acre appeared to be most damaged. Plots sprayed with ATA at 2 pounds per acre and 4 pounds per acre showed evidence of chlorosis and browning. Plots sprayed with 4-(MCPB) at 2 pounds per acre and 4 pounds per acre and with 4-(2,4-DB) at 2 pounds per acre and 4 pounds per acre showed little injury to niggerhead at this time.

Observations made on these plots made one year after spraying indicate that ATA at the 2 pounds per acre and 4 pounds per acre rates are both more effective for niggerhead control than 2,4-D at 2 pounds per acre. The mixture of 2,4-D plus 2,4,5-T was less effective than 2,4-D. The results of the treatments all of which were applied in water at the rate of 50 gallons per acre are shown on the following page.

Compound	Rate	Average percent kill
2,4-D	2 lbs/A	74
ATA	4 lbs/A	98
ATA	2 lbs/A	93
2,4-D plus 2,4,5-T	2 lbs/A	49
4-(2,4-DB)	4 lbs/A	48
4-(2,4-DB)	2 lbs/A	11
4-(MCPB)	4 lbs/A	34
4-(MCPB)	2 lbs/A	9

(Crops Research Research Division, ARS, USDA, La Grande, Oregon).

California falsehellebore (*Veratrum californicum*) and cinquefoil (*Potentilla* spp.) and their control by 2,4-D and ATA. Klomp, Gerard J. Frequent invaders on many wet meadow sites in the timber type are California falsehellebore (*Veratrum californicum*) and cinquefoil (*Potentilla* spp.). Because the forage potential on these wet sites is so great, any weed which reduces the volume of desirable forage species such as grasses, is important to the livestock operators using such ranges.

In a study to determine the herbicidal properties of 2,4-D and ATA against California falsehellebore and cinquefoil, replicated 1/20 acre plots were established on an area heavily infested with the two weeds. 2,4-D (isopropyl and butyl esters mixed) at 3 pounds per acre and ATA at 3 pounds per acre were sprayed in water at 50 gallons per acre with a boom spray at 50 psi.

Observations 14 months after spraying indicated the following control:

	ATA (3 lbs/A)	2,4-D (3 lbs/A)
California falsehellebore	65%	95%
Cinquefoil	45%	85%

(Crops Research Division, ARS, USDA, LaGrande, Oregon)

A comparison of several herbicides in controlling weeds in high elevation pastures. Klomp, Gerard J. To determine the comparative effectiveness of several herbicides currently being tested for weed control, a study was established in an open park in the lodgepole pine-fir type. Undesirable perennial weedy species include: western yarrow (*Archillea lanulosa*), cinquefoil (*Potentilla* spp.), penstemon (*Penstemon* spp.), aster (*Aster* spp.), carrotleaf leptotaenia (*Leptotaenia multifida*), low larkspar (*Delphinium bicolor*), arrowhead butterweed (*Senecio triangularis*), bistort (*Polygonium* spp.), and lupine (*Lupinus* spp.).

Interspersed with the weeds are palatable grasses and sedges. Although these are sparse, observations will be made to collect information on their reaction to the spraying and to note the rate of increase and occupancy of the site.

The study was made in three blocks with treatments and checks randomized within the blocks. Plots were 1/40 acre in size. Herbicides were applied in water at 50 gpa. Spraying was done in the spring (July at this elevation-6,000 feet).

Herbicides and rates applied were:

2,4-D	2 lbs/A
2,4-D	4 lbs/A
2,4-D (2/3) plus 2,4,5-T (1/3)	2 lbs/A
2,4-D (2/3) plus 2,4,5-T (1/3)	4 lbs/A
ATA	2 lbs/A
ATA	4 lbs/A
4-(MCPB)	2 lbs/A
4-(MCPB)	4 lbs/A
4-(2,4-DB)	2 lbs/A
4-(2,4-DB)	4 lbs/A

Of the herbicides tried, the mixture of 2,4-D (2/3) plus 2,4,5-T (1/3) at 4 pounds per acre was most effective against more species. This was followed by 2,4-D at 4 pounds per acre; 2,4-D (2/3) plus 2,4,5-T (1/3)at 2 pounds per acre; and 2,4-D at 2 pounds per acre, in that order. Next were ATA and 4-(MCPB) with 4-(2,4-DB) lease effective against all species.

Resistance of weed species tested to all herbicides from most susceptible to most resistant is: cinqufoil, carrotleaf leptotaenia, bistort, arrowhead butterweed, lupine, aster, penstemon, and larkspur. (Crops Research Division, ARS, USDA, La Grande, Oregon)

Control of tall larkspur (Delphinium occidentalis) with herbicides. Baker, Laurence O. Tall larkspur has proved very difficult to control when treated with 2,4-D and/or 2,4,5-T at a pre-bud stage of growth. In 1956 one-half square rod plots were treated in triplicate with 2,4,5-T and a 1 to 1 mixture of 2,4,5-T and 2,4-D at 3 and 6 pounds per acre at two different stages of larkspur growth. On the first date larkspur plants were all under six inches in height. The second set of treatments were made three weeks later at which time some larkspur plants were budding. Results as obtained in June 1957 are on the following page:

Treatment	Rate in lbs per acre	Av. number of larkspur plants May 1956	Av. number of larkspur plants June 1957
1st Application date			
2,4-D--2,4,5-T	3	13	5
	6	15	0
2,4,5-T	3	19	0
	6	14	0
Check		14	11
2nd application date			
2,4-D--2,4,5-T	3	13	5
	6	12	7
2,4,5-T	3	16	10
	6	15	4
	9	17	7

(Contributed by Montana Agricultural Experiment Station, Bozeman, Montana).

Tall larkspur (Delphinium occidentalis) control with soil sterilants. Baker, Laurence O. Individual plants of tall larkspur were treated June 18, 1956 with D B Granular, XPI-7 (U.S. Borax and Chemcical Corporation product containing 2,4,5-T and boron trioxide) and concentrated borascu on square rod plots in triplicate. Rates of 2.72 and 5.4 pounds per square rod were used, however only individual plants were treated. It was assumed that 40 plants per square rod represented a complete infestation. Accordingly 30.8 and 61.7 grams were applied to each plant. When less than 40 plants were found the total rate was, of course, reduced. Results follow:

Treatment	Rate/plant	Av. number of larkspur plants June 1956	Av. number of larkspur plants June 1957
D B Granular	30.8 grams	25	2
	61.7 grams	23	6
XPI-7	30.8 grams	22	5
	61.7 grams	21	6
Concentrated borascu	61.7 grams	23	4
Check		24	27

It is believed that the plants not killed were not treated. Lower rates would probably be as effective. (Contributed by Montana Agricultural Experiment Station, Bozeman, Montana).

PROJECT 3. UNDESIRABLE WOODY PLANTS

D. N. Hyder, Project Chairman

SUMMARY

Fourteen abstracts were submitted on the control of undesirable woody plants. The authors are commended for interesting experiments which are contributing valuable information.

Brush control problems involved in reforestation have received considerable attention in Oregon. Douglas-fir was more resistant to 2,4-D and 2,4,5-T than were ponderosa and sugar pine. All three species were injured more by 2,4-D than by 2,4,5-T. It appears that Douglas-fir might be released from competition by these pines on areas where this is the most valuable timber species. Screening trials on canyon live oak, greenleaf manzanita, golden evergreenchinkapin, deerbrush ceanothus, snowbrush ceanothus, and Saskatoon serviceberry indicate that 4-(2,4-DB) and Ammate X are moderately effective on these resistant species. Controlled burning following aerial applications of herbicides on dense brush fields did not give sufficient brush control to allow reforestation. Resprouting of the brush was common and burning stimulated germination of large quantities of dormant brush seed. Follow-up applications of herbicides are planned.

In screening trials on coastal salmonberry, spruce seedlings, and hemlock seedlings rather good salmonberry selectivity was obtained with foliage applications of 2,4,5-T PGBE. The chemical spot treatment of salmonberry by basal applications of a 1 to 1 mixture of 2,4-D and 2,4,5-T gave good kills. Three trees were planted in each spot following treatment. Although this does not provide full stocking of trees, large areas in need of reforestation could be treated at a minimum cost, and it is anticipated that the established trees would eventually shade out the remaining brush.

Chemical eradication of ribes for the control of white pine blister rust is vitally important. Considerable attention is now directed to methods which will permit a longer season for chemical treatments. Promising results were obtained in late season foliage applications of 2,4,5-T by scarifying the crowns of Ribes lacustre. A 3-pointed prong attached to the nozzle head enabled the operator to scarify and spray simultaneously.

Foliage applications of herbicides on salt cedar sprouts were not very successful without retreatment. However, basal applications of 2,4-D and 2,4,5-T gave excellent control whether treated in fall dormant, spring dormant, or full leaf stage of growth. Ecological studies of salt cedar in Wyoming are yielding interesting and valuable information.

A new development in insect control of gorse is reported from California. The gorse seed weevil was released in selected areas and destroyed 99 percent of the seed. This is not immediately impressive because the weevil does not kill the plants. However, a great part of the battle will be won when the plants can no longer spread to other valuable areas.

- Fenuron and monuron pellets gave complete kills of chamise and brush seedlings with dosages of 32 lbs/A. Dosages of 16 lbs/A killed most of the plants. The two herbicides were about equal in effectiveness on the brush species, but monuron was more harmful to annual grasses.

In Wyoming 2,4-D butyl ester and 2,4-D PGBE at 2 lbs/A gave excellent control of low growing sagebrush. Subsequent ecological studies on the treated areas will evaluate the importance of sagebrush control on these sites which have relatively low productive potential.

CONTRIBUTORS REPORTS

Effect of Herbicides on conifer reproduction. Gratkowski, H. Vigorous natural reproduction of Douglas-fir, sugar pine, and ponderosa pine in southwest Oregon was sprayed with $\frac{1}{2}$ a.h.g. solutions of low volatile esters of 2,4-D and 2,4,5-T during 1956. When treated the trees averaged about 5-6 feet in height. Treatments were applied during the period of active growth in midsummer and repeated in early fall after height growth had ended and buds were set. The chemicals were applied in three different carriers: (1) water, (2) water plus spreader-sticker, and (3) a 5 percent diesel oil emulsion. Extent of damage from these treatments was determined by examination in October, 1957.

Early fall foliage sprays of 2,4-D and 2,4,5-T were far less damaging than midsummer sprays on all three species in southwestern Oregon. Douglas-fir proved much more resistant than ponderosa pine and sugar pine. Both pines were severely damaged by the midsummer sprays. All three species were injured more by 2,4-D than by 2,4,5-T. During both seasons, damage to the conifers was greatest when the herbicides were applied in the diesel oil emulsion.

The results of this test indicate that chemical release of Douglas-fir reproduction from brush competition may be possible in southwestern Oregon. On the other hand, chemical release of ponderosa pine and sugar pine reproduction without damaging the trees is questionable. Even on Douglas-fir, the herbicides should be applied in a water solution, and the use of oil in the carrier should be avoided. (Pacific Northwest Forest and Range Experiment Station, Forest Service, USDA).

Screening tests of herbicides on brush species in southwest Oregon. Gratkowski, H. Screening tests of chemicals were continued in an effort to find more effective herbicides for use on brush species in southwest Oregon. In earlier tests (Res. Prog. Rpt., 1957) low volatile esters of 2,4-D and 2,4,5-T were most effective. However, several brush species showed various degrees of resistance to these herbicides.

During 1956, three herbicides were tested on canyon live oak, greenleaf manzanita, golden evergreenchinkapin, deerbrush Ceanothus, Saskatoon serviceberry, and snowbrush Ceanothus. The herbicides were Ammate X, the dimethyl amine of 4-(2,4-DB), and a polychlorinated benzoic acid. All chemicals were applied as foliage sprays to drip point.

At the end of the growing season in 1957, only two of the tests showed promise. A 4 a.h.g. solution of 4-(2,4-DB) in water killed 50 percent of the greenleaf manzanita shrubs on which it was applied. And a 40 pound per hundred gallon solution of Ammate X in a diesel oil emulsion killed 45 percent of the snowbrush Ceanothus plants which were sprayed with the mixture. A complete top kill was obtained on the remaining plants of both species.

The degree of control obtained with these herbicides surpassed that obtained with other chemicals in the earlier tests (Res. Prog. Rpt. 1957). (Pacific Northwest Forest and Range Experiment Station, Forest Service, USDA).

<u>Brushfield reclamation trial on forest land in southwestern Oregon.</u> Gratkowski, H. A single aerial application of herbicides followed by a prescribed burn in brushfields in the Siskiyou Uplands does not control the brush to a degree which will allow reforestation. Follow-up treatments are necessary before the area can be planted or seeded.

A cooperative test combining chemical sprays and burning has been in progress for two years on the Siskiyou National Forest, where brushfields covering 100 acres were sprayed from a fixed-wing plane in July, 1955. The treatments included: (light) 3 pounds of 2,4-D per acre, (medium) 2 pounds each of 2,4-D and 2,4,5-T per acre, and (strong) 4 pounds each of 2,4-D and 2,4,5-T per acre. The chemicals were low volatile esters applied in a diesel oil emulsion at a rate of $7\frac{1}{2}$ gallons of spray per acre.

At the end of the next summer, the degree of control was similar on all three areas. Of three major species, a good top kill was obtained on greenleaf manzanita and some dieback occurred on chinkapin and canyon live oak. Thirty percent of the greenleaf manzanita plants were killed in the light treatment, 15 percent in the medium, and none in the strong treatment. All species were resprouting vigorously.

About 80 acres of the chemically-treated brush in the light and medium treatments was burned in September, 1956. The prescribed burn removed the almost impenetrable mass of dead brush and killed the new sprouts.

This combination of a chemical spray and burning did not reduce the number of brush plants per acre enough to allow reforestation. One year after burning, the burned areas contained an average of about 10,000 sprouting shrubs per acre. The unburned chemically-treated area contained a similar number. A sample of undamaged green brushfields in the vicinity revealed a normal density of about 12,000 shrubs per acre.

Table 1. Number of sprouting shrubs per acre in burned and unbrunt brushfields in the Siskiyou Uplands

Brushfield condition		Sprouting shrubs per acre
Spray treatments	Burned	
None	No	12,125[1/]
None	Yes	13,500
Light	Yes	11,300
Medium	Yes	8,900
Strong	No	10,125

1/Living plants per acre

A second application of herbicides is planned during 1958 to determine the effect of aerial sprays on the sprouts. (Pacific Northwest Forest and Range Experiment Station, Forest Service, USDA).

Effect of burning on brush seeds stored in the soil. Gratkowski, H. Burning the remnants of chemically-sprayed evergreen brush in southwest Oregon brushfields stimulates germination of large quantities of dormant brush seed stored in the soil. The competition of brush developing from this source could be sufficient to endanger survival of conifer plantations established in the burned areas.

In July, 1955, three brushfields totalling 100 acres on the Siskiyou National Forest were sprayed with herbicides from a fixed-wing plane. Species composition consisted of Greenleaf Manzanita, Canyon Live Oak, Mountain Whitehorn Ceanothus, and Golden Evergreenchinkapin, with almost a dozen other species of lesser importance. More than 80 acres of the chemically-killed brush in two of the brushfields was burned in late September, 1956, and a half acre patch of untreated green brush was burned at the same time. One of the sprayed brushfields was left as a check.

Sampling one year after burning showed that the burned areas contained an average of more than 10,000 new brush seedlings per acre. Only a very few seedlings were found on the sprayed area which had not been burned and under untreated green brush in the vicinity of the aerial project. The brush seedlings found on the burned areas were mostly Mountain Whitethorn Ceanothus (87 percent) and Greenleaf Manzanita (12 percent). The remainder were Hoary Manzanita and Buckbrush Ceanothus (less than 1 percent combined). (Pacific Northwest Forest and Range Experiment Station, Forest Service, USDA).

Chemical screening trials on coastal salmonberry and spruce and hemlock seedlings. Krygier, James T. A chemical screening study was established on the Cascade Head Experimental Forest, Otis, Oregon, in 1955 to test effectiveness of foliage applications to control salmonberry (Rubus spectabilis). Objectives were to:

1. Screen 18 chemicals at concentrations of 2 and 4 lbs. ahg on salmonberry.
2. Test 2 chemicals for effectiveness in adverse weather conditions.
3. Test 3 formulations of 1 chemical for June to September seasonal response.
4. Duplicate objectives 1 and 2 on seedlings of western hemlock (Tsuga heterophylla) and Sitka spruce (Picea sitchensis).

Chemicals tested were 2,36-TBA (a mixture of several isomers) ATA, and various formulations of 2,4,5-T, 2-(2,4,5-TP), and 2,4-D+2,4,5-T, including propylene glycol butyl ether esters, butoxy ethanol esters, amines, and solubilized acids. Each treatment was applied to a plot of 10 tagged salmonberry plants or tree seedlings. The entire study required more than 300 such plots including 3 replications of each treatment.

Results after 2 growing seasons showed that 10 of the 36 treatments on salmonberry caused better than 90 percent defoliation. The 3 top ranking chemicals with respect to percent defoliation were the propylene glycol butyl ether esters of 2-(2,4,5-TP) (2 and 4 lbs. ahg), and 2,4,5-T esters (4 lbs. ahg) and amino triazole (4 lbs ahg). At the end of the third season effectiveness was reduced to about 60 percent defoliation for the same top three treatments. A few other treatments maintained defoliation rates of 40 per cent or better, but generally most others were either too inconsistent or ineffective to be considered useful in controlling salmonberry by foliage applications.

The results of tests made in wet weather were encouraging even though limited to only 2 herbicides. Treatments applied during the week of July 25 to August 1, 1955 showed 98 percent defoliation for applications in both wet and dry weather for ATA + 2,4-D + 2,4,5-T (at 2 lbs. each). A similar test with 4 lbs. ahg of 2,4,5-T caused 84 percent defoliation in wet and only 42 percent in dry weather. Technique in wet weather spraying varied slightly from conventional methods by directing the spray to undersides of leaves and on stems.

The effect of season of treatment on results favored the June applications over those of September. There was no difference in season reaction of formulations.

Spruce and hemlock seedlings were fairly resistant to esters of propylene glycol butyl ether, while butoxy compounds occasionally caused severe defoliation. The best chemical from the standpoint of lack of injury to seedlings was 2,4,5-T PGBE ester (at either the 2 or 4 lbs. ahg). This same chemical ranked second in the salmonberry foliage treatment, thereby demonstrating a high degree of selectivity. (U. S. Forest Service, Pacific Northwest Forest and Range Experiment Station).

Chemical spot treatments to reforest brush areas. Madison, Robert W. Reforestation of brush patches is being accomplished on the Cascade Head Experimental Forest near Otis, Oregon by treating brush in small circular plots or narrow strips, then planting trees in the treated areas. The brush, mostly salmonberry (Rubus spectabilis), can be controlled by basal treatment; but treating large areas is expensive because of myriad stems per acre. Treating 100-150 spots per acre, however, cost only $18.29 for labor and chemicals. Following treatment, three trees were planted in each spot to insure survival of at least one per spot. Selected three-year-old trees were used to provide a good head start on the brush. From the forestry standpoint, this method does not provide full stocking of trees, but it does get the area reforested and the trees should eventually shade out the remaining brush.

Treated spots should have a radius about 1.5 times the average brush height. Strips should be twice as wide as the brush height. An effective basal treatment for salmonberry is 2,4-D + 2,4,5-T (1 to 1 mixture) in diesel oil at a concentration of 16 lbs. ahg. The lower one-fifth of the stems were sprayed and care was taken to wet the root collars. This treatment gave 84 percent defoliation during the first growing season even though some plants were missed and no chemical applied. Some sprouting occurred on untreated plants and from plants on the plot perimeter. Even so, it appeared obvious that most planted trees would be free to grow for two to three years and by that time might keep ahead of the brush. (U. S. Forest Service, Pacific Northwest Forest and Range Experiment Station).

Herbicide tests on ribes continue in California. Quick, C.R. In July 1955, 27 foliage-spray tests, and in August, 19 tests were applied to vigorous old Ribes roezli Regel. (Sierra Nevada gooseberry) on Spring Gap Burn near Longbarn, Stanislaus National Forest, in an attempt to find a treatment for extending the effective foliage-spray season. Standard and experimental formulations of 2,4-D, MCPA, 2,4,5-T, 2-(2,4-DP), and 2-(2,4,5-TP) were compared in varied concentrations, but no improved late-season spray treatment was found. Similar tests made on old decadent gooseberries on Morreville Ridge, southern Plumas National Forest, gave about the same results. On this more northerly area, standard brush-killers (mixed 2,4-D and 2,4,5-T) were somewhat more effective in late season than 2,4-D or the experimental materials tested.

Further tests of aminotriazole, alone and in mixture with various phenoxy herbicides, were made on R. roezli. These formulations and mixtures were again found of little value for ribes control work.

Old decadent gooseberries on a blister rust control area on Morreville Ridge were sprayed in 1954 by operations crews. Gooseberry resprouts on this area were treated experimentally in 1955 by a variety of methods and formulations. Sprouts sprayed in June were very satisfactorily killed with 2,4-D sodium salt and with a brush-killer mixture of 2,4-D and 2,4,5-T esters. In

August, when the seasonal growth had slowed down, the sodium salt of 2,4-D was much less effective than the brush-killer ester formulation.

In 1956, the few scattered resprouts on this same area of retreatment were killed with small dry pellets of industrial clay impregnated with the volatile methyl ester of 2,4-D. About a rounding tablespoonful of the pellets was scattered on the ground close to each point from which gooseberry sprouts arose. Similar retreatment with 2,4-D pellets, of young resprouts after chemical treatment on an area near Stover Mountain, Lassen National Forest, also resulted in a satisfactory clean-up of the area. Numerous small low-growing gooseberry seedlings on several small plots of the 2,4-D pellets at rates of 0.3 to 1.2 pounds AE per square rod.

Basal stem treatment of gooseberry bushes with ester formulations of 2,4-D and 2,4,5-T diluted with oil has commonly resulted in high kills. To retest this generalization, appropriate formulations were diluted with a weed-killing oil having a considerable content of aromatics and applied in July to old R. roezli on cutover near Stover Mountain. Test formulations in the oil contained (1) the isopropyl ester of 2,4-D, (2) the isooctyl ester of 2,4-D, and (3) the mixed butoxyethanol esters of 2,4-D and 2,4,5-T. Perfect kill resulted from all treatments with a concentration of 0.1 pound AE per gallon--and from all treatments with three higher concentrations as well.

The search for cheaper and more reliable chemical methods for eradicating ribes continues. The greatest current needs are for materials and methods to extend the effective season for use of dilute-aqueous foliage sprays. (California Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture, Berkeley, California).

Improvements in foliage spray methods for ribes eradication in the western white pine region. Moss, Virgil D. Tests were made to increase the effectiveness of 2,4,5-T foliage spray in late season by scarifying the crowns of Ribes lacustre. Habitat and plant structure make this species less susceptible than others to foliage treatment. Leaves are small, both surfaces glabrous, the upper commonly glossy. Stems are long, ascending, and of layering habit. Crowns are thick barked, often multiple, and grow usually from underneath rock and forest debris. Aqueous spray containing 1,800 p.p.m. 2,4,5-T is effective until seasonal growth of plants mature in late August. Late August until the first killing frost, 5 percent oil emulsion of 2,100 p.p.m. 2,4,5-T kills an average of 97 percent of 3-year and older R. lacustre. After the first killing frost, the effectiveness of foliage spray treatment drops to an average kill of 91 percent for a 10 percent oil emulsion of 2,100 p.p.m. 2,4,5-T. These dosages of herbicide and proportions of oil (stove) in late season emulsion sprays are not injurious to conifer seedlings of high value (i.e., western white pine, western redcedar, Engelmann spruce, and Douglas-fir).

Several pairs of tenth-acre plots were treated by foliage spray methods after killing frosts in September and October, 1956. A 10 percent oil emulsion containing 2,100 p.p.m. 2,4,5-T was applied by portable power sprayer at an average volume of 32 gallons per plot. Plots contained an average of 550 R. lacustre per acre. In one plot of each pair of plots, crowns of the ribes were scarified as a supplementary treatment in the foliage spray method (i.e., generous drenching of crowns and wetting aerial portions of plants until dripping). A 3-pointed prong attached to the Friend Pecan gun nozzle head enabled the operator to scarify and drench crowns simultaneously. Crowns were jabbed 2 to 5 times with the prong to scarify bark. In scarifying crowns, 5 to 10 percent more R. lacustre were killed than by not scarifying crowns. From 98 to 100 percent of the ribes were killed by scarifying crowns, and 90 to 93 percent by not scarifying crowns in applying a 10 percent oil emulsion containing 2,100 p.p.m. 2,4,5-T to the crowns and aerial portions of all plants. (Contribution of the Division of Blister Rust Control, Development and Improvement Unit, U. S. Forest Service, Spokane, Washington).

Chemical control of salt cedar (Tamarix pentandra). Arle, H. Fred, Bowser, C. W., and McRae, G. N. In a previous experiment it was indicated that best salt cedar control was obtained as the rates of 2,4-D and 2,4,5-T acid were increased. During the spring of 1956, old growth salt cedar was mechanically destroyed by bull-dozer operations and burned about a month later. The area was then divided into 100 quarter-acre plots which were separated by 12-foot access lanes.

Initial applications were made on various plots during October 1956 on regrowth which was 4 months old and a second series was started during May 1957 when regrowth was 11 months old. Several plots were treated during February 1956 while salt cedar was dormant. The experiment compared four chlorophenoxyacetic acid compounds and one chlorophenoxy propionic acid formulation. The compounds tested and rates of application were: 2,4-D + 2,4,5-T, and 2-(2,4,5-TP) ester. These were applied at the rate of 4 lb/A during October 1956 and at rates of 3, 4, and 5 lb/A in May 1957. Application of 2,4,5-T ester and 2,4-D ester and amine formulations at the rate of 4 lb/A were made on each application date.

Poor results were obtained from the initial treatments of October 1956, with highest kills from applications of 2-(2,4,5-TP). A comparison of this chemical applied at 4 lb/A showed only 30 percent control for the October applications and 70 percent from May treatments. However, when the former were retreated at the original rate, control was increased to 94 percent.

The results of single applications of 2,4-D + 2,4,5-T and 2-(2,4,5-TP) were improved at increased rates of application. The 2,4-D + 2,4,5-T formulation applied at rates of 2, 4, and 5 lb/A gave 45, 50, and 65 percent control, and for the same rates of 2-(2,4,5-TP) 62, 70, and 82 percent control was obtained.

When these compounds were applied in an oil carrier during salt dedar dormancy, control was very poor. 2-(2,4,5-TP) was most effective; however, only 15 percentof the stand was killed by the initial application of 4 lb/A. Surviving plants showed no injurious symptoms during the following growing season. (Contributed by the Crops Protection Research Branch, ARS, USDA and the U. S. Bureau of Reclamation, USDI).

Chemical control of salt cedar (Tamarix pentandra). Timmons, F. L., and Weldon, L. W. Basal spray treatments with the butoxyethanol ester of 2,4-D at concentrations of 2 and 8 percent in diesel oil were tested on mature salt cedar at three stages of growth: full leaf, June 25, 1956; fall dormant, November 10, 1957; and spring dormant, April 10, 1957. The treatments were replicated three times on plots 1x2 rods along 5-mile Creek near Riverton, Wyoming. The treatments were applied to the basal 15 inches of the plants with a knapsack sprayer equipped with a single-nozzle wand-type boom. Sufficient spray material was applied to wet all salt cedar shoots to the point of runoff.

Observations made June 25, 1957, showed an average plant kill of 100 percent for the full leaf stage, 99 percent for the fall dormant stage, and 96 to 98 percent for the spring dormant stage. Only 18 of 223 plants survived and these had only a few weak shoots from the bottom 18 inches of the trunk or occasionally from the tip of a single branch.

In another experiment four different chemicals or mixtures, including (1) the butoxyethanol ester of 2,4-D, (2) the butoxyethanol ester of 2,4,5-T, (3) a 1 to 1 mixture of (1) and (2), and (4) a 2 to 1 mixture of (1) and (2), were compared at concentrations of 2 and 8 percent in applications made at the full leaf stage June 25, 1956. All of these treatments gave 100 percent kills of salt cedar plants. The basal spray applications of so-called low volatile ester formulations of phenoxy herbicides made June 25 resulted in complete defoliation of salt cedar on check plots within the experimental area and for 1 to 3 rods into the adjoining area on the east and north borders. Apparently considerable volatilization of the chemicals was caused by high maximum temperatures of nearly 100° F which prevailed at the time and immediately after the treatments were applied. The effect was severe enough to kill 39 to 40 salt cedar plants on three check plots and probably obscured any differences in effectiveness that might exist between different herbicides or concentrations. Obviously, additional tests at lower concentrations will be necessary to determine differences between the effectiveness of the different herbicides and the minimum concentration of each required to kill salt cedar. Also, it may be necessary to avoid making experimental applications in midsummer when high temperatures may cause excessive volatility of phenoxy herbicides. On the other hand such volatility might be advantageous in producing uniform kills from commercial control applications where there is no hazard of damage to nearby sensitive crops from volatilized fumes. (Contributed by the Crops Research Division, ARS, USDA, and the Wyoming Agricultural Experiment Station, cooperating).

Ecological studies of salt cedar. Timmons, F. L., and Weldon, L. W. Salt cedar (Tamarix pentandra) which has been an increasingly serious problem along irrigation canals and natural streams, on river flood plains, and around reservoirs in southwestern states has recently developed seemingly aggressive infestations in northeastern Oregon, north central Wyoming, western Nebraska, and western Kansas. An ecological study was initiated on 5-mile Creek near Riverton, Wyoming, early in 1956 in cooperation with the Bureau of Reclamation and will be continued at least five years. Objectives of the study are to determine the present extent of salt cedar infestations along 5-mile Creek and eventually along the entire Wind River and Bighorn River systems, to determine the rate and methods of spread, the production and viability of seed, the rate of growth of seedlings and different ages of salt cedar under northern Wyoming conditions, and the factors which may determine whether salt cedar will become a serious weed problem along the Bighorn River and perhaps the entire Missouri River system as it has on most river systems in Southwestern United States.

Eight study quadrats, 1x2 to 2x3 rods, were permanently located in April 1956 on salt cedar stands of different ages and densities at strategic locations along 5-mile Creek. Three additional study quadrats were established in May 1957. The plots were placed in areas with salt cedar of various ages ranging from seedlings only $\frac{1}{2}$ to 2 inches tall to mature plants 6 to 10 feet tall. Different densities of stand were selected and in several instances the plots were located entirely or partially on non-infested areas to afford opportunity to study later spread of salt cedar.

Original data on number of salt cedar plants per plot, average height and range in height and other pertinent growth factors were recorded and both color and black and white pictures were taken early in 1956. For detailed ecological studies of individual salt cedar plants, 26 plants or small clusters of plants of various ages from seedlings to mature plants were selected in the study quadrats and permanently marked with metal tags. New observations are being made and pictures taken in early spring of each subsequent year until the study is completed.

Observations and measurements made during 1956 and 1957 revealed some interesting information. Mature salt cedar seed was produced in abundance in both years. The seed is extremely small and can be counted and worked with as individual seeds only under a dissecting microscope or other high power magnification. Each seed is equipped for transportation by wind with a tuft of hairs. Limited germination studies indicated that the seed matured along 5-mile Creek in Wyoming had high viability soon after maturity but lost the viability within a few months. Many new infestations of salt cedar seedlings only $\frac{1}{2}$ to 2 inches in height were observed in the spring of both 1956 and 1957. Some of these were 1 to 2 miles from other salt cedar plants indicating that the seed can be carried in large quantities for considerable distances by wind or water.

A moist, almost saturated soil at or just above a stable waterline appears to be necessary during the seedling establishment period in midsummer. Topgrowth of seedlings is extremely slow the first season, rarely reaching a height of more than ½ to 1 inch, but is rapid thereafter. During the second season seedlings only ½ to 1 inch tall in early spring grew to a maximum height of three feet with an average height of one foot by September.

Salt cedar appears to be spreading rapidly along 5-mile Creek and other streams in the Bighorn and Wind River Basin areas of Wyoming with new infestations appearing every year and existing infestations increasing in density and size. At present salt cedar is serving a useful function of controlling erosion along 5-mile Creek. Further studies will be necessary to determine whether the plant will become a serious problem by clogging streams, creating flood hazards, and wasting large quantities of water as it does in the Southwest. (Contributed by the Crops Research Division, ARS, USDA, and Wyoming Agricultural Experiment Station, cooperating.).

A progress report on the gorse seed weevil (*Apion ulicis*). Holloway, J. K. Releases of the Gorse seed weevil were made in California in 1953, 1954, and 1956. The first year 95 adults were liberated and the second year 168 adults were divided between two localities, 84 in San Mateo County and the remaining were used to supplement the previous years release in Medocino County. The last release in California from imported material was 500 adults in Marin County. In 1956, 1,800 adults were sent to Oregon for release in the Bandon area.

Recoveries have been made in California and Oregon.

At the earliest release site in Mendocino County there has been a large build-up and in the immediate release site 99 per cent of the seed have been destroyed during the past two years.

Seed destruction alone does not promise much in the way of immediate control. However, the weevils could retard the spread of the weed from many of the inaccessible areas where control or eradication would be difficult. (USDA, ARS and the University of California Agricultural Experiment Station Cooperating.).

Control of chamise with fenuron and monuron pellets. Leonard, O. A., Walker, C. F., and Street, J. E. It may be desirable to control chamise (*Adenostoma fasciculatum*) for several reasons, including range improvement, watershed improvement, and for developing fire-lanes. Establishment of grass is difficult unless the areas are first burned or otherwise cleared of brush before seeding.

A wild-fire occurred on the Cleveland National Forest in 1950. The University of California subsequently initiated some research in cooperation with the Cleveland National Forest and the experimental area designated as the Tule Springs Experimental Range. The soil has been derived from granite and is of a moderately porous sandy loam type.

The site upon which the present experiments were conducted was seeded to grass (including Hardinggrass) by broadcast seeding. A poor stand of grass was obtained initially and this deteriorated appreciably, due to an increase in competition by brush.

Monuron and fenuron pellets (containing 25% active ingredients) were broadcast with a PCB Spreader (chest type) at the rates of 8, 16, 32, and 64 lb/A. Due to a high population of kangaroo rats and other rodents which might pick up the pellets, some poison bran was distributed over and around the plot area. The pellets were applied in November before the winter rains had started.

The plots were viewed in April, with no effects on the brush being apparent at that time.

One year after treatment the effects of the treatments were noted again. Chamise and brush seedlings were all killed with dosages of 32 lb/A of either monuron or fenuron pellets, and most of these plants were killed with the 16 lb/A treatment. Considerable effect occurred with the 8 lb/A application. Sprouting manzanita (Arctostaphyllos glandulosa) and scrub oak (Quercus dumosa) were not killed, but showed symptoms. Several years must elapse before the effect on these plants will be known.

Fenuron and monuron appeared to be about equal in their effect on brush in these tests, but fenuron appeared to be considerably less injurious on annual grass. There was insufficient Hardinggrass present on the chamise plot area to draw conclusions on the relative injury caused by fenuron and monuron; however, Hardinggrass did not appear to be injured with 16 pounds of monuron pellets applied on some other plots on the same range, but were killed with 64 pounds of the pellets. (University of California, Davis).

Chemical control of low growing sagebrush. Alley, H. P. Applications of 2,4-D butyl and proplene glycol butyl ether esters at 2 lb/A with and without wetting agents were made in 1957. A typical site (annual precipitation 12 in.) of the low growing type of Big sagebrush (Artemdsia tridentata) was selected. Approximately 100 acres was divided into 100 ft. and 200 ft. wide spray strips with 50 ft., 100 ft. and 200 ft. buffer strips between the chemical treated plots. Surveys show an average of 64 sagebrush plants per sq. rod with an average diameter of 10.8 and an average height of 7.7 in. The area selected shows a ground cover of 25 percent sagebrush, 14 percent grass species, 8 percent forbs and 52 percent bare area. This is a striking comparison to areas where 3 to 4 fold grass production has resulted from controlling the sagebrush.

No differences could be detected in the percentage sagebrush control. Both the butyl and low volatile esters gave 90 to 100 percent control.

The area is to be studied from the standpoint of vegetative production and the effect of various width buffer strips on snow cover within the sprayed areas. (Wyoming Agricultural Experiment Station).

PROJECT 4. ANNUAL WEEDS IN CEREALS AND FORAGE CROPS

W. Orvid Lee, Project Chairman

SUMMARY

Eight reports were received from five states. Of the eight reports, five were concerned with weed control in cereals, one with weed control in legumes, and two with control of crabgrass in turf.

Cereals. In work conducted in Montana, Baker found that a combination treatment of 4 lb. of fenuron, 10 lb. of dalapon, and 1 lb. 2,4-D applied in May with an additional treatment of 1 lb. of 2,4-D in July gave season long weed control on stubble land. Other treatments compared in the test were less effective. He also found that moisture in the chemical fallow plots was higher than on plots fallowed in the conventional manner. Observations on injury to wheat from various chemical applications made in 1956 are also reported.

In another test Baker reported that TCB, simazin, CDAA, and EPTC were applied to the soil and worked in as a spring application for control of wild oats. TCB, simazin, and EPTC showed good to excellent control of wild oats but severely injured a number of crop plants seeded about ten days after treatment. Where the treated soil was moved to the greenhouse in September and seeded to crop plants, only simazin caused injury. Wild oats again emerged in the greenhouse but EPTC prevented their development past the coleoptile stage.

In Idaho, Erickson found that 2-(2,4,5-TP) and MCPA were somewhat more effective than 2,4-D and 4-(MCPB) in controlling spurry in oats. Pre-emergence applications were much more effective than post emergence treatments. Much of the effectiveness of these herbicides appeared to be due to residual toxicity in the soil.

In work conducted by Chilcote and Furtick in Oregon, it was found that ATA shows promise for the selective removal of Canada thistle and other perennial weeds from oats. ATA at rates to 4 lb. per acre showed only slight reductions in the yield of oats and did not cause injury to the viability of the other oats or to the plants developing from such seed.

Chilcote and Furtick also report that in Western Oregon, pre-emergence applications of diuron to winter cereals at rates to 3 lb/A have given excellent control of annual weeds without injury or reductions in the yields of the cereals.

Legumes. McRae, Arle, and Hamilton report that in Arizona, diuron did not reduce the yield of hay from African alfalfa when treatments were made in February even though the plants were not dormant. When treatments were made in March and April yield reductions did occur. In another test they

found that alfalfa varieties differ in their tolerance to diuron. Reductions in yields of the first crop hay after treatment ranged from 20 to 49 percent for the different varieties. Later hay crops equaled the checks or were only slightly lower.

Turf. As reported by Hamilton in 1956, diuron continued in 1957 to be the best chemical for control of crabgrass in Bermudagrass lawns in Arizona. Pre-emergence applications at rates of 1 1/4 to 2 1/2 lb/A. were most effective and gave season long control of crabgrass. In other tests he found that the liquid formulation of diuron was about twice as effective as the wettable powder formulation in controlling crabgrass.

Fults summarizes the effectiveness of several commercial compounds for control of green bristle grass and crabgrass in turf in Colorado. Each compound was tested as both pre and post-emergence treatments at rates less than, equal to, and greater than those recommended by the manufacturers.

CONTRIBUTORS REPORTS

The control of weeds in summer fallow with herbicides, 1957. Baker, Laurence O. Chemicals were applied to stubble land on May 4th for the purpose of summer fallowing. Plots were 8 x 16 feet and treatments were triplicated. False flax (Camelina sativa), prickly lettuce (Lactuca scariola), rough pigweed (Amaranthus retroflexus), fanweed (Thalaspi arvensis), Lithospermum arvense, downy brome grass (Bromus tectorum) and volunteer grain were the principal weeds present. Prickly lettuce and pigweed had not germinated. The others were just emerged or were in the process of germinating at the time of treatment. Fenuron at 4 pounds per acre with 2,4-D isopropyl ester at 1 pound and dalapon at 10 pounds, plus 1 pound of 2,4-D isopropyl ester as an initial treatment, and 1 pound 2,4-D applied July 16th, were the only treatments that gave satisfactory season-long control. Fenuron at 3 pounds and Dalapon at 5 and 8 pounds per acre did not control all the grassy weeds. Two 2 pound treatments of ATA, and two treatments using Chipman's PA561 at $1\frac{1}{2}$ and 3 gallons per acre were necessary to weeds on these plots. The PA561 at $1\frac{1}{2}$ gallon did a somewhat better job than ATA at 2 pounds. Three gallons were slightly more effective than $1\frac{1}{2}$ gallons, but probably not worth the extra cost. 2,3,6-TBA at 3 and 4 pounds did not give complete control but was considered satisfactory from the standpoint of weed control. BCPC at 16 pounds controlled grassy weeds and 2,4-D used in the same treatment controlled broadleaf weeds with two 1 pound treatments being made. Tris-(2,4-dichlorophenoxyethyl) (3y9) phosphite at 4 pounds per acre effectively controlled all weeds for the balance of the season when applied June 5th after previously cultivating the plots.

Soil moisture samples taken September 16th from the five best chemical treatments, before seeding winter wheat, contained an average of 16.3 percent moisture to the four foot depth. Conventional cultivated fallow contained

15.0 percent moisture. The difference occurred principally in the first foot.

Winter wheat seeded on these plots germinated more rapidly and produced a more uniform stand than when seeded on regular cultivated fallow.

Spring wheat seeded on an area chemically fallowed in 1956 produced yields that were comparable to the degree of weed control obtained in 1956, except for residual effect obtained from a 4 pound rate of fenuron, and 20 pounds of erbon applied in May 1956, and polychlorobenzoic acid at 3 pounds applied in June 1956. Fenuron reduced the stand of grain, erbon thinned the stand and produced some deformed spikes. The polychlorobenzoic acids reduced the height and caused considerable deformity to culms and spikes. Formulations containing the 2,3,6 isomer as well as other isomers were used. No measureable differences between formulations were obtained. Yields were reduced in all cases where residual effect was noted. Fenuron at 3 pounds applied in May 1956 and at 3 and 4 pounds applied the previous fall produced no injury. Erbon also showed no residual effect at rates of 10 and 15 pounds applied in the spring and up to 20 pounds applied in September 1955.

In another test where around 3 inches of supplemental water was used, the sodium salt of 2,3,6-TBA applied July 10, 1956 caused considerable injury to spring wheat seeded in 1957. The stand was reduced and culms and spikes deformed by a 4 pound rate. Four pounds applied a month earlier and 2 pounds applied the same time produced very little injury. (Contributed by Montana Agricultural Experiment Station, Bozeman, Montana).

Wild oat control with chemicals, 1957. Baker, Laurence O. Several chemicals were applied to soil containing wild oat seed that shattered onto the soil in 1956. The soil was fall plowed in 1956, and spring cultivated in 1957. Treatments were applied May 13th and the area was double disced immediately. May 23 and June 3rd, corn, flax, mustard, peas, oats, barley and wheat were seeded across each plot. The area was irrigated by sprinkling with approximately one inch of water in late June. Treatments and results follow:

Treatment	Rate in lb/acre	Percent wild oats control	Control of other weeds
Tetrachlorobenzene	10	75	Seteria viridis and Erodium
Tetrachlorobenzene	20	95	cicutarium uncontrolled by either rate
Simazin	2	99	Good control of both Seteria
	4	100	and Erodium
CDAA	3	0	Little control of any weed
	6	0	by either rate
EPTC	5	95	Good control of both weeds
(ethyl-N, N-di-n-	10	98	at all rates
propylthiolcarbamate)	15	99	
Check			No control

Peas showed no injury except to simazin and to EPTC at the higher rates. Corn was injured only by tetrachlorobenzene. The cereals were killed by simazin and severely injured by tetrachlorobenzene and EPTC. Flax and mustard showed some tolerance to tetrachlorobenzene and the lower rates of EPTC. Weed competition on the check, the CDAA treated plots, and to a lesser extent on tetrachlorobenzene plots, injured all crop growth.

Soil taken from these plots and placed in the greenhouse in September produced a normal growth of flax and cereal on all except those treated with simazin. Plants were unable to survive even the 2 pound rate of simazin.

In another area where no supplemental water was available, similar treatments were applied June 14th and immediately disced in. The area had been cultivated once prior to treatment. All treatments reduced the stand of wild oats that was produced during the summer below the untreated stand. EPTC at 5 and 10 pounds, tetrachlorobenzene at 30 pounds and simazin at 2 and 4 pounds were most effective with the wild oat stands being reduced from 90 to 95 percent as compared to the untreated check. CDAA at 6 and 12 pounds and tetrachlorobenzene at 10 pounds were less effective. Tetrachlorobenzene at 20 pounds was more effective than 10, but less than the 30 pound rate.

Soil samples taken from these plots and placed in the greenhouse had wild oats emerge from all treatments indicating viable seed. However, the soil treated with EPTC at 10 pounds did not permit wild oats to grow beyond the coleoptile stage. Cereals seeded in these soil samples were injured by both rates of EPTC and simazin. Both wild and tame oats showed greater injury in the simazin treated soil than wheat or barley. (Montana Agricultural Experiment Station, Bozeman, Montana).

<u>Effects of pre- and post emergence herbicide treatments for the control of spurry in oats.</u> Erickson, Lambert C. Pre and post emergence treatments were applied simultaneously on a split plot design on adjacent fields; the post emergence being applied on the field planted one week earlier. The stand data are based on the percentage of surface soil covered by spurry, (*Spergula arvensis*). All plots were replicated three times and 3 samples were taken in each 8 x 40 foot plot. Spurry stand data were taken each 2 weeks from treating to harvest. These data revealed that the area of soil covered by spurry increased steadily as the season advanced. The data given are only those obtained from the pre harvest samples.

Table. The effects 10 herbicide treatments for the control of spurry growing in oats.

Material and rate/A.			% stand of spurry	
			Pre-emergence	Post emergence
2-(2,4,5-TP)	LV. ester	2 lb.	1.1	5.3
"	Amine	2 "	1.6	14.0
"	LV. ester	1 "	2.6	10.6
"	Amine	1 "	3.3	28.3
MCPA	Amine	2 "	4.0	13.3
4-(MCPB)	"	2 "	7.0	38.3
2,4-D	"	2 "	8.6	32.6
MCPA	"	1 "	9.3	19.6
2,4-D	"	1 "	11.3	42.3
4-(MCPB)	"	1 "	12.0	40.3
Checks			11.0	47.1

The greater efficiency of 2-(2,4,5-TP) and MCPA was not due only to greater toxicity but more so to their longer lasting residual effects. Thereby the later emerging seedlings were killed. In spurry control residual toxicity is of greater importance than initial toxicity.

Combinations were used containing 2,4-D amine with each of the other materials. These were applied in combinations of $\frac{1}{2}$ and 1 pound of each per acre. The results indicated that such combinations had no particular merit in obtaining greater toxicity to spurry at lower rates or costs. (Idaho Agricultural Experiment Station).

<u>The influence of 3-amino-1,2,4-triazole on growth, yield, and germination of spring oats.</u> Chilcote, D. O. and Furtick, W. R. Reports indicating tolerance of oats to ATA pointed to possible selective control of perennial weeds in this crop. To investigate the effect of ATA, Victory spring oats were treated with 1, 2, and 4# active ingredient of ATA at the 8-10" stage, boot stage, and headed stage of growth.

Following applications of ATA the oat plants displayed a chlorotic striping which was transitory and disappeared in one to two weeks. No reduction in height or growth was observed.

Annual weeds such as lambsquarter and dog fennel were controlled with ATA applications at the 8-10" stage of growth but were not satisfactorily controlled at the later stages.

Only slight reductions in yield resulted from ATA treatments, with no apparent differences between rates or growth stages treated.

Greenhouse tests showed no effect of ATA treatments on germination and growth of the oat seed from the treated plots.

Of interest was the response of spring barley, a contaminant of the oat seed planted for this experiment. ATA treatments at the 8-10" stage of the oats completely killed the barley plants. Treatments at the boot stage and headed were progressively less injurious to the barley with little yield reduction resulting from headed stage applications. Greenhouse tests, however, showed germination percentages of 0 to 30 percent for seed from treated plots. The plants produced were chlorotic and stunted. This was particularly true for headed stage treatments.

Further work appears justified to determine the feasibility of producing oats at the same time perennial weeds such as Canada thistle are treated with ATA. (Contribution of the Oregon State College Experiment Station, Corvallis, Oregon).

Selective annual weed control in cereal crops with Karmex diuron. Chilcote, C. O. and Furtick, W. R. Weed problems in cereal crops are not completely solved with 2,4-D. Grass pecies and certain tolerant broadleaf weeds present problems in the production of cereals, particularly in areas of western Oregon. With the development of short-strawed cereal varieties, these weed problems will become more acute.

For these reasons tests have been conducted to find an effective control measure. Diuron applied pre-emergence following planting of winter cereals has controlled most types of annual weeds selectively in these crops. Rates of one, two, and three pounds product per acre have not reduced yield. Some stand reduction has occurred with three pound per acre rates, but no yield reduction resulted. Tests on several different varieties of wheat indicate no varietal differences in tolerance to this treatment.

One limitation of diuron is the tolerance of vetch, a predominant winter annual weed in western Oregon. This weed is very sensitive to 2,4-D.

These tests were all conducted on a silty clay loam soil at one location. More extensive tests are in progress to determine the value of this treatment. (Contribution of the Oregon State College Experiment Station, Corvallis, Oregon).

Effects of diuron on alfalfa yield. McRae, G. N., Arle, H. F. and Hamilton, K. C. Weed infestations increase when the growth of alfalfa is slow or when the stand "thins out." In Arizona annual grassy weeds are a serious problem in established alfalfa during the summer and annual broadleaved weeds predominate during the winter. Use of diuron to control weeds in alfalfa in the Pacific Northwest has created farmer interest in its use to control annual weeds in alfalfa in Arizona. Tests were continued in 1957 at Mesa to determine if diuron could be used in irrigated alfalfa.

Diuron has been reported to have less effect on alfalfa if applied while the alfalfa is dormant. Southern alfalfa varieties usually are not dormant during our mild winters; however, their growth is relatively slow. To determine if the time of application influenced the susceptibility of alfalfa to diuron, applications at the rate of 2 lb/A were made to the soil (Laveen clay loam) after the first (2/13), second (3/25) and third (4/30) cuttings of African alfalfa. Yield data were obtained from 5 cuttings during 1957.

Diuron chlorosis was not evident on the regrowth following any of the treatments. Regrowth following each cutting appeared normal with no evident reduction in stand or vigor. The application of diuron in February did not reduce the yield of African alfalfa. Applications of diuron in March and April reduced total hay yield 10 percent.

Both southern and northern varieties of alfalfa are grown in Arizona. The southern varieties are grown for hay and pasture; the northern varieties for seed production. A second test was conducted to determine if alfalfa varieties differ in their susceptibility to diuron applied to the soil. On March 25, after the second cutting, diuron was applied at rates of 1.5 and 3.0 lb/A to the following varieties: Ranger, Lahontan, Chilean and African.

The yield data from this experiment indicated that alfalfa varieties differed in their susceptibility to soil applications of diuron. The yield of the first cutting after treatment of all varieties was reduced 49% by the 3 lb/A application and 21% by the 1.5 lb/A application. Ranger and Lahontan, northern varieties, recovered their vigor more rapidly than Chilean or African, southern varieties. After the first cutting, the hay yields of Ranger, Lahontan and African on plots treated with the lower rates of diuron equaled the yields of the untreated checks. Their total yields for five cuttings equaled those of the checks while the total yield of Chilean was reduced 21%. The total yield on plots treated with the higher rate of diuron was reduced as follows: Ranger, 20%, Lahontan, 23%, African, 36%, and Chilean, 49%.

The results of these and other tests indicated that the susceptibility of alfalfa to soil application of diuron may be related to the physiological activity of the plant when diuron is applied and possibly to the inherent resistance of the variety to be treated. (Crops Protection Research Branch, ARS, USDA, and the Arizona Agricultural Experiment Station, Cooperating).

Urea herbicides for crabgrass control in Bermuda grass turf. Hamilton, K. C. Study of the use of urea herbicides for controlling crabgrass (Digitaria sanguinalis and D. ischaemum) continued in 1957. The experimental area and plot setup was as described in the 1956 research progress report. Treatments this year included diuron applied at six rates (1-1/4 to 2-1/2 lb/A) in March and at 2 lb/A each month (March to August). The percent of ground covered by crabgrass, Bermuda grass and other plants was estimated at biweekly intervals during the growing season.

The following table contains data on the effects of several treatments on crabgrass.

Herbicide	Treatment Rate lb/A	Date Applied	Percent of ground covered by crabgrass in: May	June	July	August
Check-untreated			2	7	14	16
monuron	2	3/7/57	* 0	1	5	5
neburon	4	"	* 0	1	2	3
diuron	$1\frac{1}{4}$	"	* 0	0	0	Trace
diuron	2	"	* 0	0	0	0
diuron	$2\frac{1}{2}$	"	* 0	0	0	0
diuron	2	4/5/57	* 0	0	0	0
diuron	2	6/5/57	1	* 0	0	0
diuron	2	7/2/57	1	8	* 0	0
diuron	2	8/3/57	1	3	9	* 0
diuron	2	3/29/56	0	1	3	3

*Indicates the approximate time of application.

Pre-emergence applications of diuron gave the most satisfactory control of crabgrass. Control for the entire season was obtained with applications of $1\frac{1}{4}$ to $2\frac{1}{2}$ lb/A of diuron in March. Monuron and neburon applied in March controlled crabgrass only until June.

In this test postemergence applications of diuron destroyed established crabgrass and gave complete control for the remainder of the season. Post-emergence applications appear less satisfactory than pre-emergence applications because: (1) temporary chlorosis of Bermudagrass foliage is more severe; and (2) more time is required to cover bare spots when crabgrass is destroyed with mid-summer applications of diuron.

The last treatment listed in the table is diuron applied in March, 1956. During 1956 crabgrass control was complete. These plots were not treated in 1957 and re-establishment of crabgrass was observed. The effects of treatment in 1956 were evident in 1957 and little crabgrass grew on these plots.

In other tests, the wettable powder and liquid formulations of diuron were evaluated for postemergence control of crabgrass. The liquid formulation was at least twice as effective as the wettable powder when used to control established crabgrass. (Arizona Agricultural Experiment Station).

Relative herbicidal values of several crabgrass herbicides. Fults, Jess L. Some 40 different crabgrass herbicides have been tested in one way or the other at this station during the period May 1954 to October 1957. Tests have been of three kinds, i.e., greenhouse tests in flats, plot tests on turf located on the University campus, and demonstrations on home owners lawns in Fort Collins, Colorado. Some of the most critical comparative phytotoxic data, later supported by outdoor plot tests, were secured from the greenhouse tests. Both pre-emergence and post-emergence tests were run. Rates of application used were less than, equal to, and more than those suggested by manufacturers. Data were obtained on relative toxicities by making plant counts, height measurements, and estimates of leaf damage. Based on these data percent of kill and survival were obtained.

These data would indicate that under the conditions of these tests:

(1) PAX (lead arsenate, etc.) @ 50 lbs/1000 ft^2 is completely phytotoxic to green bristle grass, crabgrass and Kentucky bluegrass seedlings when used either pre-emergence or post-emergence.
(2) SODAR (disodium monomethyl hexahydrate or DSMA) @ 12 oz/1300 ft^2 has very little herbicidal effect when used pre-emergence. Used post-emergence it is an excellent herbicide for green bristle grass and crabgrass seedlings, and is only mildly toxic to Kentucky bluegrass seedlings.
(3) PMA (phenylmercuric acetate) @ 2 oz/1000 ft^2 used pre-emergence is a fair herbicide for crabgrass, poor for green birstle grass and very poor for Kentucky bluegrass; used post-emergence, it is an excellent herbicide for crabgrass, very good for green bristle grass and moderately injures Kentucky bluegrass seedlings.
(4) Green Velvet (agricultural grade chlordane, etc.) @ 15 lbs/1000 ft^2 is an excellent selective herbicide for crabgrass used pre-emergence; it is poor to fair for use post-emergence; it has little effect on green bristle grass and severely injures bluegrass seedlings both pre- and post-emergence.
(5) KOCN @ 20 lbs/1000 ft^2 used pre-emergence, has little or no herbicidal value against crabgrass or green bristle grass and moderately injures bluegrass seedlings; used post-emergence, it is an excellent herbicide for crabgrass, green bristle grass and bluegrass seedlings.
(6) Alanap 1-F @ 18 lbs/1000 ft^2, used pre-emergence or post-emergence, is a comparatively poor herbicide against either crabgrass or green bristle grass; it is very herbicidal against bluegrass seedlings used pre-emergence and moderately herbicidal post-emergence. (Colorado State University, Colorado Agricultural Experiment Station.).

The chemical control of annual weeds and seedling alfalfa in established alfalfa seed field. Weldon, L. W. and Timmons, F. L. Four chemicals were applied prior to initiation of alfalfa and weed growth in the spring of 1957 on established alfalfa near Riverton, Wyoming. Two indentical experiments were conducted, one on a light sandy loam soil and the other on a sandy clay loam soil. Treatments included were: 3-(3,4-dichlorophenyl)-1, 1-dimethylurea (diuron) at 1,2 and 3 lb/A, 3-(3,4-dichlorophenyl)-1-methyl-1-n-butylurea (neburon) at 2,4, and 6 lb/A, ethyl-N, N-di-n-propylthiocarbamate (EPTC) at 5 and 10 lb/A, and 2- chloroallyl diethyldithiocarbamate (CDEC) at 5 and 10 lb/A. Application at a total volume of 80 gal/A were made with a constant pressure knapsack sprayer equipped with a 4-nozzle boom. Little precipitation occurred for a two-week period following application; however, an appreciable amount was received within a month. The most prevalent weed species present were Setaria sp., Kochia, and Russian thistle, (Salsola kali.).

EPTC and CDEC were completely ineffective under the conditions of these experiments. Most of the chemical probably volatilized before any precipitation occurred to move it into the soil. Diuron at 2 or 3 lb/A gave 99 percent weed control on the heavy soil, but controlled only 83 percent on the lighter soil. The same treatments controlled 90 percent of the volunteer alfalfa seedlings, a necessary feature for certification requirements. The 6 lb rate of neburon was necessary for 95 percent weed control. Neburon treatment did not control the alfalfa seedlings. Alfalfa seed yields and the viability of the alfalfa seed were not affected by any of these treatments. (Contributed by the Crops Research Division, ARS, USDA, and the Wyoming Agricultural Experiment Station, cooperating.).

The chemical control of annual weeds in established red clover seed fields. Weldon, L. W. and Timmons, F. L. Four chemicals were applied prior to initiation of red clover and weed growth in April 1957 on established red clover near Powell, Wyoming. The test site was located on a gravelly sandy clay loam soil. A total of 10 inches of rainfall fell during the six-week period following treatment. Applications were made with a constant pressure knapsack sprayer equipped with a 4-nozzle boom at a total volume of 80 gal/A. The weed population that developed during the summer consisted primarily of marestail, Erigeron canadensis, prickly lettuce, Lactuca scariola, Setaria sp., redroot pigweed, Amaranthus retroflexus, and lambsquarters, Chenopodium album. Treatments included were 3-(3,4-dichlorophenyl)-1, 1-dimethylurea (diuron) at 1, 2, and 3 lb/A, 3-(3,4,-dichlorophenyl)-1-methyl-1-n-butylurea (neburon) at 2, 4, and 6 lb/A, ethyl-N, N-di-n-propylthiocarbamate (EPTC) at 5 and 10 lb/A, and 2-chloroallyl diethyl-dithiocarbamate (CDEC) at 5 and 10 lb/A.

Diuron at all rates almost completely eliminated red clover as well as as the weeds, while EPTC and CDEC were completely ineffective. Neburon gave excellent control of all weeds and red clover seedlings without reducing red clover seed yields or seed viability. The 4-lb rate of neburon gave 96 percent weed control. The 2-lb rate was slightly less effective while the 6-lb rate did not give significantly better results than that obtained with 4 lb/A. (Crops Research Division, ARS, USDA, and the Wyoming Agricultural Experiment Station, cooperating.).

The chemical control of annual weeds in seedling alfalfa. Weldon, L. W., Timmons, F. L. and Gale, A. F. Alfalfa for seed production in Wyoming is usually grown in rows and established without the aid of a nurse crop. The seedling alfalfa offers little competition to the crop of weeds that usually develops. Farmers are able to cultivate between the rows but due to the size and vigor of the alfalfa seedling a 6-inch strip over the row cannot be cultivated.

An experiment was conducted on alfalfa planted in 28-inch rows and overseeded with weed seed of which wild mustard, Brassica kaber, Kochia, Kochia scoparia, marsh elder, Iva xanthifolia, redroot pigweed, Amaranthus retroflexus, and Setaria sp. were the predominant species. Five chemicals were applied pre-emergent to alfalfa and weeds on May 7, 1957, at Laramie, Wyoming, on a sandy clay loam soil. Precipitation received, a trace on each of the three days following application and an inch within a two-week period after treatment, proved sufficient to move the chemicals into the soil. Treatments were made in 80 gal/A of total spray solution with a constant pressure knapsack sprayer equipped with a four-nozzle boom. All treatments were replicated four times. Treatments included were 2-chloroallyl diethyldithiocarbamate (CDEC) at 5 and 10 lb/A, 2-chloro-N, N-diallylacetamide (CDAA) at 5 and 10 lb/A, ethyl-N, N-di-n-propylthiolcarbamate (EPTC) at 2.5, 5, and 10 lb/A, 3-(3,4-dichlorophenyl)-1-methyl-1-n-butylurea (neburon) at 4, 6, and 8 lb/A, and 3,4-dimethylbenzylphenol (3,4-DMB) at 4 and 8 lb/A.

Weed counts showed that CDEC at 10 lb/A, EPTC at 10 lb/A, and neburon at 4, 6, and 8 lb/A gave significant reduction in broadleaved weeds. EPTC at 10 lb/A and neburon at 6 and 8 lb/A were the only treatments giving a reduction in the grass stand. Near the end of the growing season when maximum growth was obtained 12 feet of 6-inch wide row was clipped, the weeds separated from the alfalfa, and green weight of weeds and of alfalfa recorded. Neburon at all rates was the only material which gave significantly less weeds and more alfalfa. The 8-lb rate of neburon gave the best results as the plots were weed-free and production of seedling alfalfa forage was increased 5 times over the untreated check.

Post-emergent treatments were made June 17 when the weeds and alfalfa were about 3 inches high. All treatments were replicated 3 times. The butyl ester of 4-(2,4-dichlorophenoxy) butyric acid [4-(2,4-DB)] at 1 and 2 lb/A was compared with the amine formulation of 4-(2,4-DB) at 1 and 2 lb/A alone and in combination with 4 lb/A of sodium salt of 2,2-dichloropropionic acid (dalapon). Twelve feet of row was clipped, the grassy weeds, broadleaved weeds, and alfalfa separated and weighed. 4-(2,4-DB) amine at 2 lb/A controlled 99 percent of the broadleaved weeds and gave a 185 percent increase in forage production of seedling alfalfa, while 1 lb/A gave only 83 percent control of broadleaved weeds. The addition of the 4 lb/A of dalapon to 2 lb of 4-(2,4-DB) gave the same broadleaf control and completely eliminated the grass. The butyl ester of 4-(2,4-DB) gave 71 and 90 percent weed control for the 1- and 2-lb rates, respectively. When the butyl ester was compared to the amine formulation, weed control was not as good and alfalfa forage production was not increased over that of the untreated check.

The effect of adding 1/8 lb/A of 2,4-D, 2-(2,4-DP), 2-(2,4,5-TP), and nonionic emulsifier to 2 lb/A of 2-(2,4-DB) amine was also tested. There was no advantage in these additions since the 2 lb/A rate of 4-(2,4-DB) was found to give sufficient control. When added to the 1-lb rate of 4-(2,4-DB), control was somewhat increased but did not approach that of 4-(2,4-DB) amine at the 2-lb rate of application without additives. (Contributed by the Crops Research Division, ARS, USDA, and the Wyoming Agricultural Experiment Station, cooperating).

PROJECT 5. WEEDS IN FRUITS, VEGETABLES, AND ROW CROPS

Floyd M. Ashton, Project Chairman

SUMMARY

Avocado. Monuron showed promise as a selective herbicide for weed control in mature avocado tree. ATA, simazin, and baron were tested for tolerance against year-old avocado seedlings. All three herbicides tested caused damage at the maximum rate tested; the selective use of simazin in young avocado trees seems possible.

Corn. Simazin, BCPC, and DNBP (alkanolamine salt) were the best of the nine herbicides tested for control of *Erodium cicutarium*, *Seteria viridis*, *Echinochola crusgalli*, and *Amaranthus retroflexus* in corn at emergence with no damage to the corn.

Simazin and CDAA showed considerable promise as a pre-emergence herbicides in corn. Indications are that simazin will require more moisture for "Activation" than CDAA. No serious residue problem has been observed with simazin at rates which have generally been required for adequate weed control.

Cotton. Various chemical and cultural practices were compared for the control of *Echinochloa* spp. in cotton. The use of one directed application of selective weed oil and five flame cultivations gave the best weed control and the highest yield of seed cotton.

Pre-plant applications of diuron had no effect on the date of cotton maturity, yield, or fiber properties. Cotton yield on untreated checks was reduced by annual grasses.

Young cotton plants are severely stunted or killed if sprayed directly with dalapon while spot treating for Johnson grass control. Although as much as 30 per cent of the cotton plants were killed by dalapon, the yield, fiber properties, or boll components of the treated plots were not significantly different from that of the untreated checks. This was because the growth of lateral branches on the untreated plants, adjacent to dead plants, were stimulated.

Diuron was extensively tested in field trials for weed control in cotton with a wide range of soil types. The method appeared to hold considerable promise of substantial savings to growers.

The effect on the following crop, small grain, when substituted ureas were used for weed control in cotton was investigated. The residues caused severe foliage chlorosis and reduced stands but grain yields were not reduced.

Onions. Alanap-3, diuron, monuron, 3Y9, CDEC, and EPTC were tested as pre-transplant soil treatments two days before transplanting onions. All herbicides except CDEC caused significant reductions in yield and grade.

Oranges. Monuron, diruon, simazin, ATA, and EPTC caused slight or no damage to mature Washington navel orange trees at rates up to 32 pounds per acre; dalapon damage was erratic.

Potatoes. DNBP, diuron, MCPA, and 2,4-D pre-emergence applications to potatoes grown for seed production caused no carry over damage to sprouts or plants the following season when tubers from the treated plots were used as seed.

Sorghum. Monuron, diuron, and simazin post-emergence applications to sorghum caused slight to serious injury, depending on rate of application. Diuron appeared to be more selective than monuron. All varieties were not affected to the same degree.

Sugar Beets. Granular EPTC incorporated into the soil controlled *Setaria viridis* and *Echinochloa crusgalli* in sugar beets. The depth of incorporation was an important factor in the extent of damage to sugar beets. Emulsifiable EPTC incorporated into the soil reduced sugar beet stands in sandy soil but to a lesser degree in clay soils. Weed control of grasses was satisfactory but this was not true for the broad-leaf weeds.

CONTRIBUTORS REPORTS

Tolerance of mature avocado trees to monuron herbicide. McCarty, C. D., Day, B.E., and Russell, R. C. Objectives: To determine the tolerance of mature avocado trees to monuron and the evaluation of monuron as a selective herbicide for use in avocado orchards. Methods: Monuron was applied to year-old seedling avocados in the greenhouse at rates of 2½ to 10 pounds per acre. Field trials were begun in 1955. An area of 400 sq. ft. was treated around each avocado tree. Treatment extended up to the base of the trunk of the tree. An 80% active formulation was used in all field trials. Results: Greenhouse tests indicated that monuron could be successfully used for the control of weeds in avocado orchards. Field trials of single applications of 3, 6, and 9 pounds of monuron irrigated into the soil under normal sprinkler irrigation practices produced no symptoms of injury on avocado trees. Rates of 6, 12, and 18 pounds applied in November of 1955 and repeated on a yearly basis have produced no symptoms to date. Tests at rates of 10, 20, 30, 40, and 50 pounds per acre were established in December of 1956 on Hass, Anaheim, and Rincon varieties, along with seedling avocados. No injury has appeared to date on Hass, Anaheim, or Rincon. Rates of 20 pounds per acre have caused slight leaf symptoms on 6-year-old seedling trees. (University of California Agricultural Extension Service and Citrus Experiment Station. Riverside, California.)

Tolerance of year-old avocado seedlings to amino triazole, simazin, and baron. McCarty, C. D., and Day, B. E. Year-old avocado seedlings grown in 1-gallon cans were tested for their tolerance to amino triazole, simazin, and baron. All tests were run in triplicate. Results of these tests are on the following page:

(1) Amino triazole: Rates used--1, 2, 3, 4, 8, 16, 32, and 64 pounds per acre. ATA symptoms began to appear at the 8-pound-per-acre rate and above one week after application of the herbicide. The injury reached its peak 2 months after application. Although no plants died, no plant treated at rates of 16 pounds per acre or above successfully recovered. No symptoms appeared at the 1, 2, and 3-pound rates. Plants treated at 4 and 8 pounds per acre developed initial symptoms but recovered.

(2) Simazin: Rates used--20, 40, 80, and 120 pounds per acre. Considerable chlorosis and yellowing occurred at the 120-pound rate. Slight symptoms have appeared at the 80-pound rate. No symptoms have appeared to date on plants treated at 20 and 40-pound rates.

(3) Baron: Rates used--4, 8, and 16 pounds per acre. Trees treated at the 16-pound rate were killed. Severe injury occurred at the 8-pound rate from which the trees only partially recovered. Trees treated at 4 pounds did not develop symptoms although their rate of growth was retarded when compared with control plants. (University of California Agricultural Extension Service and Citrus Experiment Station. Riverside, California).

Weed control in field corn, 1957. Baker, Laurence O. June 6, 1957 several cehmicals were applied to field corn. The corn was about 25 percent emerged with the tallest coleoptiles about 1 inch above ground. All chemicals were applied in a total volume of 35 gallons per acre. The main weeds were *Erodium cicutarium*, *Seteria viridis*, *Echinochloa crusgalli*, and *Amaranthus retroflexus*. The area was irrigated twice during the summer. Plots receiving no weed control were severely dwarfed by weed competition.

Simazin at 4 pounds per acre provided the best weed control and did not injure the corn. The alkanolamine salt of DNBP at 5 pounds and BCPC at 12 pounds gave almost as good weed control and also caused no corn injury. Treatments and their effects on weeds and corn follow. Ratings ranging from 0 to 10 are used with the 0 representing no injury to corn and no weed control.

Treatment	Rate per acre	Weed Control	Corn Injury	Treatment	Rate per acre	Weed Control	Corn Injury
dimethyl amine salt of 2,4-D	1 lb	4	0	2,3,6-TBA	2 lbs	7	1
	2 lbs	5	0		4 lbs	9	5.5
Simazin	1 lb	7	0	2,4-D acetamide	1 lb	5	0
	2 lbs	7	0		2 lbs	5	0
	4 lbs	10	0	BCPC	12 lbs	9	0
3Y9 liquid (tris-(2,4-dichlorophenoxethyl) phosphite)	4 lbs	6	0	EPTC	10 lbs	8	0
	6 lbs	6	1	Alkanolamine salt of DNBP	5 lbs	9	0
3Y9 on #2 vermiculite	4 lbs	9	2.5	BCPC 3Y9	12+6 lbs	9	1
	6 lbs	7	4	check (untreated)		0	7

(Montana Agricultural Experiment Station, Bozeman, Montana)

New herbicides for weed control in field corn. Chilcote, D. O. and Furtick, W. R. Two new compounds, Simazin and Randox T, show considerable promise for weed control in field corn. These herbicides have demonstrated a wide range of effectiveness on weed species and a long residual life in the soil from tests conducted at various locations in Oregon. Results indicate that Simazin will require more moisture for activation than is true of Randox T.

In these tests pre-emergence applications of Simazin up to 6 pounds active ingredient per acre did not lower silage or grain yield of corn. Rates of 1 to 2 pounds active ingredient per acre have generally been required for adequate weed control.

Randox T has been effective as a pre-emergence treatment at 4 to 6 pounds per acre. No reduction in silage or grain yield resulted at these rates.

A residue problem has been encountered when sensitive crops such as spring barley are planted following corn treated with Simazin. However, at rates below 3 pounds active ingredient per acre, no serious residue problem has been observed. (Contribution of the Oregon State College Experiment Station, Corvallis, Oregon).

Tolerance of mature Washington navel orange trees to monuron, diruon, simazin, amino triazole, dalapon, and EPTC. Day, B. E., McCarty, C. D., and Russell, R. C. Objective: To determine the tolerance of Washington navel orange trees to various herbicides in the establishment of a selective weed control program in citrus orchards. Methods: Monuron and diuron were applied on an 80% active basis. All other herbicides were applied on an active basis. 400 sq. ft. were treated around each tree. Treatment extended up to the base of the trunk of the tree. All treatments were replicated 4 times. All herbicides were tested at rates of 8, 16, 24, and 32 pounds per acre. Application of the herbicides was made in November of 1956 and January and March of 1957. Results:

(1) Monuron: Washington navel oranges showed no symptoms of injury at rates of 8, 16, and 24 pounds per acre. No symptoms of injury appeared on trees treated at 32 pounds per acre although there may have been a tendency for the setting of a light crop of fruit.

(2) Diuron: No symptoms of injury appeared on trees treated with diuron.

(3) Amino triazole: ATA produced only minor symptoms at rates up to 32 pounds per acre. Injury consisted of a few bleached leaves on inside sucker growth and an occassional bleached leaf on the tree skirt possibly caused by spray drift.

(4) Simazin: At the rates tested, simazin has caused no injury from applications made in January, 1957.

(5) Dalapon: The response of the trees to dalapon was erratic. In some instances 8 pounds per acre have caused 5 to 20 per cent leaf drop and 95 per cent fruit drop. In other cases, rates of 24 pounds per acre caused only minor leaf burn. Injury at the 32-pound-per-acre rate usually consists of 95 to 100 per cent defoliation and die-back of branches up to ½ inch in diameter. The bushy regrowth which appeared on trees treated at the 32-pound rate soon developed typical injury symptoms.

(6) EPTC: No injury symptoms appeared from EPTC at the rates tested. (University of California Citrus Experiment Station and Agricultural Extension Service. Riverside, California.).

Screening of newer herbicides for use with transplant onions. Barnard, E. E. Two month old Y41 onion plants were transplanted into four replicated and randomized plots two days after treatments had been made to the soil. The pretransplant soil treatments were alanap-3 at 2, 4, & 6 lbs/acre, diuron at 1, 2, & 3 lbs/acre, monuron at 1, 2, & 3 lbs/acre, 3Y9 at 2 & 4 lbs/acre, CDEC at 4 and 8 lbs/acre, and EPTC at 4 & 8 lbs/acre. They were applied in water at the rate of 50 gallons per acre. All weeds not controlled by the herbicides were suppressed mechanically and the plots were sprinkler irrigated as needed. The crop was mature when harvested as dry onions.

Stands were seriously reduced by 2 lbs. and 3 lbs. of both monuron and diuron as well as by 4 lbs. of 3Y9. The number of bulbs meeting the U.S. NO. 1 grade were seriously reduced by the same treatments as well as by all alanap-3 treatments and the 8 lb. treatment of EPTC. The full story of the injury caused by the herbicides is shown by the weight of the crop produced. All treatments caused significant or highly significant reductions from the check in both total weight and weight of U. S. No. 1 grade onions with the exception of the CDEC treatments. All CDEC treated plots approximated the check in all measured characteristics; total weight, total number, weight of No. 1's and Number of No. 1's. It appears from this test that of the materials tested only CDEC is worthy of further trial. (Contribution of the Montana Agricultural Experiment Station.).

Various chemical and cultural practices in cotton for watergrass control. Wilkerson, J. A., Miller, J. H. and Carter, L. M. Various chemical and cultural practices were compared for the control of watergrass (*Echinochloa* spp.) in cotton. Prior to cotton planting the area was seeded with watergrass at the rate of 100 pounds per acre. Seed bed preparation and cotton planting were conventional for the region. The main plot weed control treatments were as follows: (1) diuron [3-(3,4-dichlorophenyl)-1, 1-dimethylurea] at the rate of one pound per acre was applied pre-emergence and again at early lay-by (June 25) and no weed control practices were used; (2) diuron at the rate of one pound per acre was applied pre-emergence, and five flame cultivations were made beginning when the cotton plants were 8 inches tall; (3) ten flame cultivations were made beginning when the cotton plants were 4 inches tall; (4) one directed application of selective weed oil at the rate of five gallons per acre (20 gal/A in treated band) was applied when the cotton was two to three inches tall, and five flame cultivations were made beginning when the cotton was 8 inches tall; and (5) beginning at emergence, the plots were cultivated with a rotary hoe three times at weekly intervals until the cotton was four inches tall when sweep cultivation was initiated and continued until a total of four sweep cultivations had been completed.

Subplots were established in that one-half of each treatment was hoed June 10 except Number 3 which was hoed May 27.

Table 1 shows the effect of the various treatments on weed control, yield of seed cotton and quality of cotton lint. Treatment 4 gave better weed control than any other treatment. Treatments 1, 2, and 3 were not different from each other but gave better weed control than 5. The first pick seed cotton yields showed that a significant difference between treatments was obtained among all treatments. The order of ascending yield was 5, 3, 1, 2, and 4. The total yield data show the same general trend. Examination of cotton grades showed no appreciable differences among treatments 2, 3, and 4. However, cotton grades were materially reduced in treatments 1 and 5.

In the subplots weed control for hoed plots was superior to nonhoed plots in each case except treatment 4. Yield of seed cotton from hoed plots was greater than from nonhoed for treatments 1, 3, and 5; no difference was found for treatment 2, and the nonhoed plots produced more in treatment 4. Among hoed plots, no difference in either weed control or yield of seed cotton could be shown. Among nonhoed plots, weed control in treatment 4 was far superior to any other treatment. Treatment 2, 3, and 1 were not different from each other but gave better weed control than treatment 5. The yield data from the nonhoed plots showed a significant difference among all treatments. The order of ascending yield was the same as for main plots. Among hoed plots, grades were rather uniform and no reductions due to grass encountered. In the nonhoed plots, treatment 4 was the only one in which cotton grades were equal to that of the hoed plots. Reduced grades due to grass were found in all other nonhoed plots. Reductions were as follows: Treatment 3 - 25% of the samples were reduced one grade; treatment 2 - all samples were reduced 1 grade; treatment 5 - all samples were reduced, but 50% were reduced 2 grades; treatment 1 - all samples were also reduced, however, 75% were lowered 2 grades. (Contribution of Botany Department, University of California, Davis and Crops Research Division, and Agricultural Engineering Research Division, ARS, USDA).

Table 1. The effect of various chemical and cultural practices on cotton and watergrass. Shafter, Calif.-1957.

Treatment	Weed rating 1/ 12/3/57		Yield (lbs) of Seed Cotton/.02 A. first picking		total picking		Grades 2/		Value/cwt lint 3/	
	Nonhoed	hoed	nonhoed	hoed	nonhoed	hoed	nonhoed	hoed	nonhoed	hoed
1	4.4	9.6	68.5	80.5	76.1	88.3	1 LM*,3SGO**	4SLM	23.30	29.75
X̄	7.0		74.5		82.2				26.53	
2	5.0	9.9	77.5	78.3	85.9	87.3	3SLM*,1 LM*	2SLM+ 2SLM	27.91	30.59
X̄	7.5		77.9		86.6				29.25	
3	4.6	9.9	61.0	80.8	67.9	89.4	3SLM, 1 SLM*	LM, 1SLM+ 2 SLM	29.50	31.01
X̄	7.2		70.9		78.6				30.26	
4	9.3	9.8	84.8	80.0	93.9	86.9	3SLM+, 1SLM	LM, 3SLM	31.01	30.59
X̄	9.6		82.4		90.4				30.80	
5	0.5	9.0	53.5	77.5	59.8	84.6	2LM*, 1LM** 1 SGO**	1 SLM+,	24.70	30.17
X̄	4.8		65.5		72.2				27.44	
Subplot X̄	4.7	9.7	69.1	79.4	76.7	87.3				
Treat. LSD .05	0.9		3.3		5.2					
.01	1.2		4.6		7.3					
Subplot LSD .05	0.6		3.5		3.6					
.01	0.8		4.8		5.0					
Interaction LSD .05	1.2		7.7		8.1					
.01	1.7		10.7		11.2					
Interaction LSD .05	1.2		6.4		7.8					
.01	1.7		8.9		10.8 (Subplots among treatments)					

1/0 = no control; 10 = perfect control
2/Each asterick indicates a reduction of 1 grade due to grass. LM = low midling, SLM = strict low middling, SGO = strict good ordinary
3/Best estimation of value based on grades

Weed control in cotton with diruon. Gould, W. L. A study was made to determine the effectiveness of diuron in controlling annual grasses and annual morning glory when applied as a lay-by treatment in cotton on a field scale basis, and to compare the cost of chemical weed control to standard cultural practices.

Diuron was applied on a field scale basis as a lay-by treatment in cotton on several farms in the Lower Rio Grande Valley of New Mexico. Application time varied from June 28 to July 25; and in all cases, the fields were clean tilled prior to application of herbicide. The fields were irrigated immediately after chemical application so as to completely saturate the beds. Diuron was applied at the rate of one pound per acre active material at the earliest treatment, and 0.80 pounds per acre on the later treatments. Chemical applications were made by a custom sprayer. Soil types varied widely from a sandy loam to clay. Abundant rainfall during late July and August made ideal conditions for the infestation of annual grasses as sprangletop (Leptochloa filiformis), stinkgrass (Eragrostis sp.), cupgrass (Eriochloa gracilis), and barnyard grass (Echinochloa crusgalli). Annual morning glory (Ipoemea sp.) was present in most of the fields. Weed counts were made in several of the fields where untreated areas had been left and/or where an untreated field with comparable crop history was adjoining. Grass counts, made at random through the fields by means of a 6 inch by 6 foot quadrat laid across the rows at comparable locations in the field, are presented in Table 1. Annual morning glory counts were made along the row in 40 inch by 20 foot plots at six random locations in the fields. The counts indicated that diuron was 60-70 percent effective in controlling annual morning glory emergence. Plants found in the treated portion of the fields were small and did not set flowers.

The cost of the chemical treatment varied from \$6.50 to \$7.50 per acre. Fields not chemically treated were cultivated one to three times after the date of application of diuron on the treated fields. The cost of cultivating is approximately \$1.00 per acre per cultivation. Hoeing costs varied from \$6.00 to \$50.00 per acre, the average cost being around \$12.00 per acre.

Table 1. Comparison of total grass count in six-6" X 6' quadrats in untreated and diuron treated cotton fields.

Farm No.	No. of grass plants	
	Non-treated	treated
1	156	1
2	10*	3
3	560	8
4	196	1
5	129	6
6	429	2
7	251	0

*This field had been hoed regularly from lay-by until time of count.

(New Mexico State Agricultural Experiment Station contribution).

The effect of pre-planting applications of diuron for weed control in Upland cotton. Arle, H. F., Hamilton, K. C., and McRae, G. N. Prior research in Arizona into the persistance of urea herbicides indicated that a pre-planting application of diuron controlled annual weeds in Upland cotton. In 1957, diuron was applied at rates of 2 and 3 pounds per acre before pre-irrigation or prior to final seedbed preparation; 22 and 7 days before cotton planting, respectively. Soil on the experimental area was a Laveen clay loam. On April 4, Acala-44 cotton was planted in moist soil covered by a shallow mulch of dry soil.

Emergence and seedling development of the cotton was normal. Within a few days after the first irrigation (May 28) the leaves of cotton on treated plots developed diuron chlorosis. The higher rate of diuron applied prior to seedbed preparation caused the most severe chlorosis. Even those plants that developed severe chlorosis regained normal color within 2 to 3 weeks. After recovering from this temporary chlorosis, the treated cotton appeared to make normal growth.

The following table contains the data (by picking dates) on the yield of seed cotton.

Diuron applied	Pounds of seed cotton per plot			
	Picking			
Before pre-irrigation	First	Second	Third	Total
2 lb/A	15.5	8.9	8.4	32.8
3 lb/A	15.9	9.8	8.8	34.4
Before final seedbed preparation				
2 lb/A	15.6	8.9	7.9	32.4
3 lb/A	14.8	10.2	8.8	33.8
Check-untreated and uncultivated	10.3	12.6	4.6	27.5

Preplant applications of diuron had no effect on the date of cotton maturity, yield, or fiber properties. Cotton yield on the untreated checks was reduced by the rank growth of annual grasses.

Although the treated plots were not cultivated during the growing season, the control of annual grasses was very satisfactory. Grass control was most complete where the higher rate of diuron was applied. There was no evident difference in weed control between the two dates of application. Of the two annual grasses present, Panicum fasciculatum was more susceptible to diuron than Echinochloa colonum. After each irrigation numerous grass seedlings would emerge on the treated plots, appear to develop normally for several days, then develop diuron symptoms and die. (Crops Protection Research Branch, ARS, USDA, and the Arizona Agricultural Experiment Station, cooperating.).

Effects of dalapon applied to Upland cotton. Hamilton, K. C., Arle, H. F., and McRae, G. N. The use of spot applications of dalapon in cotton to control Johnson grass necessitated research into the effects of dalapon on cotton.

Young cotton plants are severely stunted or killed if sprayed directly while controlling Johnson grass. Tests were continued in 1957 to determine the effects on cotton of spot treating different portions of a cotton plant population. At Tempe, 2 to 3-foot sections of each row, equivalent to 10, 20 and 30 percent of the Acala-44 cotton plants, were sprayed directly simulating spot treatments. Applications were made prior to the first irrigation (May 23, cotton 6-8 inches high) using a solution of 1 pound of dalapon in 5 gallons of water. At Marana, using similar application methods, 10, 15, 20, 25 and 30 percent of the Acala-44-WR cotton plants were spot treated with dalapon prior to the first irrigation (May 13, cotton 3-5 inches high). All treated cotton died within 7 to 14 days.

Data showing the effect on yield of seed cotton of spot treating various portions of the total cotton plant population are summarized in the following table.

Percent of cotton stand killed with dalapon	Yield of seed cotton expressed as percent of the untreated checks	
	Tempe	Marana
10	87	97
15	--	93
20	92	94
25	--	95
30	99	92
0	100	100
Calculated yield of checks in lb/A	2646	2840

Although as much as 30 percent of the cotton plants were killed by spot applications of dalapon, the yield of treated plots was not significantly different from that of the untreated checks. Growth of lateral branches on the untreated plants, adjacent to dead plants, was stimulated and bare spots covered over. Spot applications of dalapon did not affect cotton fiber properties (length, strength and fineness) or boll components (boll weight, seeds per boll, percent lint, lint index, etc.).

When dalapon is applied as a spot treatment in cotton some spray will drift to adjacent cotton plants. Two tests were conducted in 1957 to determine the effects of low rates of dalapon applied, simulating spray drift, to young cotton. Dalapon at rates of 1/8 to 2 lb/A was applied directly over the entire row prior to the first irrigation. Low rates of dalapon applied simulating spray drift did not reduce cotton stands, slow plant development, or cause malformed leaves.

Date showing the effect on yield of seed cotton of low rates of dalapon applied to young cotton are summarized in the following table.

Rate of dalapon in lb/A	Yield of seed cotton expressed as percent of the untreated checks	
	Tempe	Marana
1/8	113	101
1/4	---	97
1/2	111	109
1	---	100
2	108	104
0	100	100
Calculated yield of checks in lb/A.	2248	2910

Application of dalapon at rates equal to, and greater than, those resulting from spray drift did not reduce cotton yields. Direct application of low rates of dalapon to young cotton did not affect fiber properties or boll components. (Crops Protection Research Branch, ARS, USDA, and the Arizona Agricultural Experiment Station, cooperating.).

Effect on small grains of urea herbicides applied in the previous cotton crop. Hamilton, E. C., Arle, H. F., and McRae, G. N. A major consideration when using urea herbicides for weed control in cotton is that small grains planted the following winter may be injured by herbicide residues in the soil. Tests were continued in 1957 to determine some of the factors which influences the persistence of urea herbicides in irrigated soils.

One test was conducted at Mesa on a Laveen clay loam soil. Diuron had been applied at cotton layby in July, 1956 at rates of 0, 3/4, 1, 1¼, 1½, and 2 lb/A. After cotton harvest in December, the land was prepared for small grains. Half of each replication was worked with a moldboard plow; half with a disk plow. The land was pre-irrigated. Arivat barley, Palestine oats, and Awned Onas wheat, one drill width of each, were planted the length of each plot. The grain was planted in moist soil covered by a shallow mulch of dry soil.

Emergence and seedling development of small grains was normal until the first irrigation, February 28. Within a few days small grain foliage developed diuron chlorosis on plots which had been treated with the higher rates of diuron. Chlorosis was most severe on the disked plots. Barley developed the most severe chlorosis; oats, the least. Except for slightly reduced stands on the plots treated with 2 lb/A of diuron, by mid-April all small grains appeared to have recovered from the effects of diuron residues.

Small grains were harvested in June. There was no significant difference in the response of the three small grains to the various treatments. The data on total yield of small grains (by methods of seedbed preparation and rates of diuron) is given in the following table.

Rate of diuron Lb/A applied in 1956	Total yield of small grains (1957) Expressed as percent of untreated check	
	Seedbed disk plowed	Moldboard plowed
3/4	110	95
1	103	104
1¼	98	107
1½	100	107
2	93	106
0	100	100
Calculated yield of check	1851 lb/A	2251 lb/A

The yield data indicated a significant interaction between the method of seedbed preparation and rates of diuron. Although diuron residues caused severe foliage chlorosis and reduced the stands of small grains, yields of grains were not reduced.

In a second test at Mesa, monuron and diuron (2 lb/A) were applied at cotton layby. Alternate replications were worked with moldboard and disk plows, then planted to barley, wheat and oats as in the first test. Following the first irrigation diuron residues produced more severe chlorosis than monuron residues. Chlorosis was most severe where the seedbed was disked. Diuron residues also reduced small grain stands. By mid-April, all small grains appeared developing normally on the treated plots. Yield data indicated no difference in grain yields between the untreated checks and plots treated with monuron or diuron. (Crops Protection Branch, ARS, USDA, and The Arizona Agricultural Experiment Station, cooperating.).

<u>Effects on Upland cotton of chlorophenoxy herbicides applied to the soil.</u> Hamilton, K. C., McRae, G. N. and Arle, H. F. Cotton is very susceptible to foliage applications of 2,4-D and many related compounds. When chlorophenoxy herbicides are applied to the soil much higher rates are required to affect cotton. Tests were continued in 1957 to determine the effects of soil applications of chlorophenoxy herbicides on the yield, fiber properties and disease resistance of Upland cotton.

In a test at Eloy (silt loam soil) an alkanolamine of 2,4-D at rates of 1, 2, and 4 lb/A was applied to the soil prior to the pre-irrigation on March 13. Acala-44 cotton was planted April 16 in moist soil covered by a shallow mulch of dry soil. Application of 2,4-D before the pre-irrigation did not affect seedling emergence. During May and June, cotton seedlings developed extremely malformed leaves on plots treated with 2 and 4 lb/A of 2,4-D. After mid-July the new foliage produced by cotton on treated plots appeared normal. Total yield of seed cotton was not affected by 2,4-D applied before the pre-irrigation.

In another test at Eloy, alkanolamines of 2,4-D and MCPA at rates of 1/5, ½ and 2 lb/A were applied (April 16) directly over cotton seed at planting. A 2 inch band of soil behind the packer wheel of the planter was sprayed. Covering disks then throw 2-3 inches of soil over the sprayed band of soil and seed. The higher rate of both 2,4-D and MCPA delayed seedling emergence, reduced cotton stands by 90 percent, and caused severe leaf malformation. The 1/5 lb/A application had somewhat less effect on cotton, reducing the stand only 30 percent and causing moderate leaf distortion. After June, new foliage produced by plants growing on treated plots appeared normal. Only the high rates of 2,4-D and MCPA caused a significant reduction, 15%, in the yield of seed cotton.

The tests at Eloy were in a field where Verticillium Wilt has been a serious problem. Cotton plants were examined to determine if preplanting and planting application of chlorophenoxy herbicides affected the susceptibility of cotton to this disease. In this test, soil applications of 2,4-D and MCPA did not reduce the amount of Verticillium Wilt in cotton.

In a test at Mesa (clam loam soil) chlorophenoxy herbicides were injected 1½ inches into the soil 6-8 inches to each side of the drill row prior to the first irrigation. Treatments included: 1.5 and 3 lb/A of a triethylamine of 2,4,5-T and a diethanolamine of MCPA: 1, 1½ and 2 lb/A of an alkanolamine and a butoxyethanol ester of 2,4-D; and 4 lb/A of a butoxyethanol ester of 4-CPA. The herbicides were injected May 20 when the Acala-44 cotton was 6-8 inches high. Cotton on plots treated with 2,4-D and MCPA developed malformed leaves after the first irrigation. The amount of malformation was proportional to the amount of herbicide applied. The amine of 2,4-D caused more malformation than the ester. Cotton on plots treated with 4-CPA did not develop malformed leaves until after the second irrigation. Applications of MCPA and the higher rates of 2,4-D reduced the yield of seed cotton 11-25%.

In a test at Tempe (clay loam soil) the treatments were 1½ and 3 lb/A of an amine of 2-(2,4-DP) and 2-(2,4,5-TP) and an ester of 2-(MCPP) and 3 lb/A of an ester of 4-(2,4-DB). Acala-44 cotton was 6 inches high when herbicides were injected in the soil May 8 prior to the first irrigation. After the irrigation the cotton on plots treated with 4-(2,4-DB) became stunted and developed malformed leaves. The chlorophenoxypropionics caused no malformation. Yield of seed cotton was reduced 10-20% by applications of 2-(2,4-DP) and the 3 lb/A application of 2-(MCPP) and 4-(2,4-DB).

In these tests cotton fiber properties were not affected by any soil application of herbicides. (Arizona Agricultural Experiment Station and the Crops Protection Research Branch, ARS, USDA, cooperating).

Pre-emergence herbicides on Russet Burbank potatoes raised for seed production. Ames, G. D. It is not known whether many herbicides applied as a pre-emergence control of annual weeds might cause leaf-crinkling or necrosis which would interfere with disease readings of the crop for the purpose of foundation or certified seed.

Potatoes were planted June 10, 1956, and sprayed June 28, only three days before emergence.

Materials included DNBP at 1½ lb/A, diuron at 3/4 lb/A, 2,4-D at 2 lb/A, MCPA at 2 lb/A and a no-treatment check. Observations were made on the plant throughout that summer with no visible leaf effects except where some of the shoots had emerged at the time of spraying or too soon thereafter on the 2,4-D plots. A later test showed extensive damage when 3 lb/A of 2,4-D was applied. It may be quite conceivable that damage could occur at 2 lb/A also under different conditions.

Tubers from the treated plants were then stored in a cellar over winter, checked for normal sprouting and replanted in 1957. Plants were not then retreated in 1957. No abnormal results were noted in either sprouting or the plants throughout the season. Further tests will be conducted. (Tetonia Branch Experiment Station, University of Idaho).

Tolerance of sorghum to post-emergence applications of herbicides. Arle, H. F., Hamilton, K. C., and McRae, G. N. Tests were continued in 1957 to determine the tolerance of sorghum to post-emergence applications of herbicides. In a test at Mesa, Hegari sorghum was grown on a Laveen clay loam soil. Prior to the first irrigation (July 16, sorghum 4-7 inches high) diuron was applied to the soil at rates of 1 and 1.5 lb/A. Prior to the second irrigation (July 30, sorghum 18 inches high) diuron at rates of 1, 1.5, and 2.5 lb/A and 2 lb/A of simazin were applied to the soil.

Applications of diuron before the first irrigation caused a slight, temporary stunting of the sorghum. During August sorghum growth and development appeared normal on all plots treated with diuron. Application of simazin retarded the rate of growth of sorghum during July and early August; however, after mid-August growth appeared normal. Application of 2 lb/A of simazin and 2.5 lb/A of diuron caused a significantly reduced--31%--grain yield of sorghum.

A second test was conducted at Mesa to determine if sorghum varieties differ in their susceptibility to post-emergence applications of urea herbicides. Prior to the second irrigation (July 30, sorghum 16-20 inches high) diuron at rates of 1.5 and 2 lb/A and 1.5 lb/A of monuron were applied in four sorghum varieties: Hegari, Asgrow 610, Double Dwarf Yellow Sooner, and Double Dwarf 38.

Application of monuron caused all varieties to become more severely stunted. Initially Hegari became more chlorotic and stunted than the other varieties. At maturity, Hegari and Double Dwarf 38 appeared least affected by monuron while the height and head size of Asgrow 610 were greatly reduced.

The data on grain yield indicated no difference in the tolerance of the four varieties to soil applications of urea herbicides. Applications of monuron and the higher rate of diuron reduced the average yields of all varieties, 38 and 22 percent, respectively. Double Dwarf Yellow Sooner was the only variety whose grain yield was significantly reduced by the application of 1.5 lb/A of diuron. (Crops Protection Research Branch, ARS, USDA, and the Arizona Agricultural Experiment Station, cooperating.).

Preliminary screening trials with EPTC vermiculite for weed control in sugar beets. Alley, H. P. and Fabricius, L. J. The 1 percent EPTC (Ethyl N, N, - di n propylthiolcarbamate) vermiculite formulation was tested for sugar beet weed control in 1957. Three rates and two depths of application was used. EPTC was applied as 100, 200, and 400 lbs/A actual material and incorporated into the soil at depths of 1.5 and 3.0 inches. The vermiculite was applied with a fertilizer spreader and incorporated to the desired depths with the Howery Berg tiller units. One row of sugar beets and one row of grasses (*Setaria viridis*) and (*Echinochloa crusgalli*) were planted in each of the two replicated 75 foot plots. Percentage beet stand was determined by actual count of emerged seedlings. Percentage grass control was determined by clipped weight measurement.

The 200 lb/A rate of application appeared to be the best treatment. The 400 lb/A application gave outstanding grass control but reduced the sugar beet stand considerably. Although there appeared to be differences in depths of incorporation, statistical differences could not be measured.

Chemical	lbs actual per acre	Depth Inc.	Percentage grass control	Percentage beet stand
EPTC	100	1.5"	54.3	87.1
EPTC	100	3.0"	46.5	83.4
EPTC	200	1.5"	95.6	95.1
EPTC	200	3.0"	91.9	72.1
EPTC	400	1.5"	96.6	74.2
EPTC	400	3.0"	97.5	59.2
Check	0	0	0	100.0

(Wyoming Agricultural Experiment Station).

Screening of liquid EPTC for weed control in sugar beets. Alley, H. P., and Fabricius, L. J. Preliminary studies were conducted in 1957 to evaluate liquid EPTC (Ethyl N, N, - di n propylthiolcarbamate) for weed control in sugar beets. Tests were curtailed by the limited amount of chemical available.

Experiments were established on clay and sandy soils. The chemical was applied in 6 in. bands at rates of 2.5 lb/A and 5.0 lb/A and incorporated into the soil at 1.5 and 3 inch depths. Sugar beet stand was determined before thinning operations. Percentage weed control determined by clipped weight measurements.

Considerable differences in the activity of EPTC was shown in the two soils used. Sugar beet stand was reduced considerably in the sandy soils. Reduction in stand was not as critical in clay soils. Clipping weights showed better than 90 percent control of grassy weeds at both rates of chemical application. The chemical controlled less than 50 percent of the broad-leaved weeds common to the sugar beet fields.

Greenhouse studies are being conducted to further study the effect of moisture, temperature, and soil type, upon the activity of EPTC. (Wyoming Agricultural Experiment Station).

PROJECT 6. AQUATIC WEEDS, SUBMERSED AND EMERGENT

T. R. Bartley, Project Chairman

SUMMARY

Four abstracts regarding control of aquatic weeds were received from one contributor. Three of the reports describe methods and comparative costs of controlling submersed aquatic weeds, and the other one pertains to ditchbank weed control.

On the Columbia Basin Project in Washington, the cost of controlling algae in irrigation channels with copper sulfate was \$0.08 per cubic foot per second of flow per mile of channel length, and the cost for control of rooted aquatic weeds with aromatic solvents was \$1.84 for the same flow and distance. The cost of chaining a channel of 100 cfs of flow is estimated at \$4.00 per mile, or twice the cost of both copper sulfate and aromatic sol- fate and aromatic solvent treatments.

Also, on the Columbia Basin Project, copper sulfate was applied periodically as a low concentration slug treatment to control algae so that it would not mat with pondweeds and clog trashracks before pumps. This method was successful in reducing the clogging problem to less than 20 percent of the 1956 stoppages.

On a certain irrigation canal on the Columbia Basin Project, several species of aquatic weeds have been controlled by periodic applications of copper sulfate during the period from 1955-1957 in conjunction with the voluntary establishment of water plantain at the outset of this period. Applications of copper sulfate and stands of water plantain in separate canals did not maintain control.

Observations made on volunteer stands of creeping bent and water bent grasses along irrigation canals on the Columbia Basin Project indicate that they offer good competition for waterline weeds on small laterals. Both grasses seem to be hardy on this project and they spread rapidly.

In Wyoming, applications of 2,4-D in May and July, 1956, at the rate of 80 lb/A, plus a spot treatment in 1957, have completely eliminated water sedge (Carex Aquatilis). Four repeated spray applications of ATA (3-amino-1,2,4-triazole) totaling 50 lb/A over a 3-year period (1955-1957) eliminated 99 percent of the Carex. Dalapon (sodium salt of 2,2-dichloropropionic acid) was compared with ATA treatments of the same dates at rates totaling 60 and 120 lb/A but the control during 1955 and 1956 was much less satisfactory than the 2,4-D and ATA treatments. Repeated applications of DNBP-fortified diesel oil gave adequate seasonal control and reduced the stand of Carex 88 percent. Repeated burnings gave fair control but little reduction in stand. Repeated applications of three soil sterilants, erbon, monuron, and Ureabor gave only fair control. An extensive new experiment testing 19 different treatments and several herbicides for control of Carex was initiated in 1957.

The results of a 3-year study in Wyoming for methods of controlling miscellaneous weeds growing along irrigation ditchbanks indicate that adequate control would require two treatments each year of dalapon, ATA, DNBP-fortified diesel oil, or propane burning, or one treatment of CDT each year for an indefinite period. An extensive new experiment was initiated in 1957 testing 33 different treatments and several herbicides for control of this type of weed growth. The abstracts concerning salt cedar are on pages 46 and 47 only, and were not repeated under this project.

CONTRIBUTORS REPORTS

Cost of control of submersed aquatic weeds and algae. Suggs, Delbert D. The cost of algae control using one-third pound per cubic foot per second, at bi-weekly intervals, at five mile spacings, six times during the irrigation season, was $0.08 per cubic foot per second of flow per mile of channel length. The cost of control of rooted submersed aquatic weeds with seven to ten gallons of aromatic solvent per cubic foot per second of flow was $1.84 per cubic foot per second per mile. Flows of 5 to 2000 c.f.s. were treated with copper sulfate. Flows of 5 to 300 c.f.s. were treated with aromatic solvent. Application to the larger flow was accomplished without interruption of water delivery by first increasing the flow then decreasing it to 100 c.f.s. for the treatment period. On 100 c.f.s. channels, we estimate the cost of chaining at $4 per c.f.s. per mile, or twice the cost of both copper sulfate and aromatic solvent treatments. (Bureau of Reclamation, Columbia Basin Project, Washington.).

Control of submersed aquatic weeds by water plantain and copper sulfate. Suggs, Delbert D. Control of submersed aquatic weeds (Potamogeton pulsillus, P. pectinatus, Zanichellia pallustris, Ranunculus trichophyllus, and Chara vulgaris) has occurred from 1955 through 1957, though the irrigation canal was chained in 1954 to regain capacity. During the 1955-57 period copper sulfate was applied at approximately one-third pound per cubic foot per second of flow at bi-weekly intervals at stations two miles apart. This period of three years coincided with the voluntary establishment of Alisma gramineum var. geyeri, water plantain. No other treatment or chaining has been required to maintain the capacity of the canal. Each of the species have survived, and made seed, yet growth has been low. Treatments of other channels with copper sulfate alone has killed algae. Some reduction in stem length was observed of the rooted aquatic weeds, but at least one application of aromatic solvent was required to maintain the capacity of the channels. Another channel, in which water plantain and the pondweeds were present, was left untreated to observe the competitive effect of the water plantain. By midsummer, it was necessary to apply copper sulfate to control filamentous algae. In December, 1957, water plantain seed and crowns were planted near the ends of four waterways in an attempt to duplicate the weed control obtained in the original channel. (Bureau of Reclamation, Columbia Basin Project, Washington.

Control of algae with copper sulfate as a low concentration slug treatment. Suggs, Delbert D. Control of algae in a large canal (2,000 cubic feet per second flow) was attempted to alleviate matting with pondweeds. Detached masses were clogging trash racks before pumps. Copper sulfate was applied at bi-weekly intervals, at rates of one-third pound per cubic foot per second of flow, every five miles. In concrete lined sections crystals to one inch in diameter were dumped in the bottom of the canal. In earth lined sections 50 pound bags of the crystals were suspended beneath the water surface. Solution time for the bags was approximately $1\frac{1}{2}$ hours. Each application downstream was made to coincide with the arrival of the slug from upstream, as calculated and as indicated by surface floats. Applications were begun June 4 and ended August 27, 1957. Algae (species of Spirogyra and Cladophera) were killed within four days. The clogging problem was reduced to less than 20 percent of the 1956 stoppages. Pondweeds (Potamogeton pulsillus, P. pectinatus and Zannichellia pallustris) became detached as in 1956, but made few seed and caused little clogging of trash racks. Invasion into new reaches of the canal was less than in previous years. Algae was controlled in laterals subtending the canal for distances of four to six miles. (Bureau of Reclamation, Columbia Basin Project, Washington.).

Bent grasses as competition to waterline weeds on irrigation channels. Suggs, Delbert D. Observations were made of volunteer stands of two bent grasses. Agrostis palustris creeping bent, and Agrostis semiverticillata water bent, in hope of finding more suitable vegetation to compete with weeds on waterlines. A one-year old stand of water bent was observed in 1956 and 1957. An increase in area of approximately ten times occurred. Low temperatures of -20°F occurred during the period. Seed production was high. Competition to barnyard grass, Echinochloa crusgalli, was completely exclusive. Creeping bent was discovered in 1957 on a small channel. It had spread rapidly after a trial chaining of the channel. Seed production was low, but seeds are available from commercial channels. Both the grasses appear to be hardy on this project, and offer the best competition we have seen on small laterals. We believe they merit further study. We will seed small trial areas in 1958, where weediness in crops will not be a factor. (Bureau of Reclamation, Columbia Basin Project, Washington.).

The control of water sedge growing along irrigation channels. Timmons, F. L., Weldon, L. W., and Gale, A. F., ARS, CRD. An experiment on which a preliminary report was made in the 1957 WWCC Research Progress Report was continued through 1957 with retreatments and observations of results.

Repeated spray applications of 2,4-D (2,4-dichlorophenoxyacetic acid) applied at 80 lb/A May 24 and July 18, 1956, plus a spot treatment May 22, 1957, completely eliminated water sedge (Carex aquatilis). The sedge was replaced naturally with a desirable dense turf of Kentucky bluegrass. Four repeated spray applications of ATA (3-amino-1,2,4-triazole) July 12, 1955, May 24 and July 18, 1956, and June 5, 1957, at rates of 20, 10, 10, and

10 lb/A totaling 50 lb/A (ai), eliminated 99 percent of the Carex. ATA at lighter rates of 10, 5, 5, and 5 lb/A on the same dates, totaling 25/A, eliminated 87 percent of the Carex in two years. Dalapon (sodium salt of 2,2-dichloropropionic acid) was compared with ATA in treatments on the same dates at two series of rates: 20, 10, 20, 10 lb/A and 40, 20, 40, and 20 lb/A, totaling 60 and 120 lb/A, respectively. Dalapon eventually eliminated 88 percent of the Carex at both rates, but the control during 1955 and 1956 was much less satisfactory than from the 2,4-D and ATA treatments. Both dalapon and ATA permitted invasion of broadleaved weeds as the stand of Carex was reduced, and Kentucky bluegrass was killed out. All ATA and dalapon plots were sprayed with 2,4-D at 2 lb/A once in 1956 and once in 1957 for control of broadleaved weeds. This was not necessary on plots receiving heavy rates of 2,4-D.

Five repeated spray applications of DNBP-fortified No. 2 diesel oil at 120 gpa on July 12, 1955, May 24 and July 7, 1956, and June 5 and July 9, 1957, totaling 600 gpa, gave adequate seasonal control of vegetation and eventually reduced the stand of Carex 88 percent. Five repeated burnings with a propane weed burner on the same dates gave only fair seasonal control of vegetation and reduced the stand of Carex only 23 percent in two years.

Three repeated applications of erbon (2-(2,4,5-trichlorophenoxy) ethyl 2,2-dichloropropionate) at two different rates of 80 and 160 lb/A on May 25 and July 18, 1956, and May 22, 1957, totaling 240 and 480 lb/A, respectively, gave only fair control of Carex in 1956 and early in 1957 but eventually reduced the stand 93 to 98 percent. Two repeated applications of monuron (3-(p-chlorophenyl)-1, 1-dimethylurea) at 40 and 80 lb/A October 21, 1955, and May 22, 1957, totaling 80 and 160 lb/A, gave only fair control of Carex on the ditchbanks above the waterline and little control at and below the waterline. Two repeated applications of Ureabor (mixture of borates and 4 percent monuron) at rates of 432 and 864 lb/A on October 21, 1955, and May 22, 1957, totaling 864 and 1728 lb/A, gave similar results to those from monuron.

An extensive new experiment testing 19 different treatments for control of Carex along a continuously flowing irrigation canal was initiated in the spring of 1957. Preliminary observations made August 8, 1957, showed that single applications of 2,4-D (amine) at 40 and 80 lb/A, of erbon at 80 and 160 lb/A, and of DB Granular (mixture of borates and 7.5 percent 2,4-D) at 533 lb/A made May 15, 1957, had given 87 to 94 percent topkill of Carex, with the 2,4-D treatments having a slight advantage.

Single applications of ATA at rates of 10 and 20 lb/A on June 6 gave final topkills of 67 and 93 percent as compared to 95 to 97 percent topkills for two repeated applications of ATA at 5 and 10 lb/A on June 6 and July 9. Two repeated applications of dalapon at 20 lb/A on June 6 and July 9 or three applications on June 6, June 21, and July 9 gave 98 to 100 percent topkill of Carex.

Three repeated treatments of DNBP-fortified diesel oil at 120 gpa on June 6, June 21, and July 9 gave a final topkill of 83 percent as compared to 75 percent topkill from two repeated spray treatments made June 6 and July 9. Three repeated burnings with a propane burner on June 6, June 21, and July 9 gave 56 percent control of Carex topgrowth as compared to 49 percent control from two burnings June 6 and July 9.

No attempt was made to determine results after retreatments of ATA, dalapon, DNBP-fortified diesel oil, and burning made August 8 and/or September 5. This experiment will be continued in 1958 with observations of results and retreatments as scheduled or necessary for complete elimination of the Carex. (Contributed by the Crops Research Division, ARS, USDA and Wyoming Agricultural Experiment Station, cooperating).

The control of miscellaneous weeds growing along small irrigation ditchbanks. Timmons, F. L., Weldon, L. W., and Gale, A. F. An experiment on which a preliminary report was made in the 1957 WWCC Research Progress Report was continued in 1957 with retreatments and observations of results. Seven chemical treatments and one burning treatment were replicated twice on plots $8\frac{1}{2}$ x 33 feet located end to end across a small irrigation ditch in which the flow of water was being obstructed by miscellaneous annual and perennial vegetation consisting mostly of barnyard grass, bromegrass, foxtail grass, pigweed and smart-weed.

Initial treatments of sodium salt of 2,2-dichloropropionic acid (dalapon) at rates of 20 and 40 lb/A in June 1955, followed by four retreatments at the same rates or half these rates and totaling 60 and 120 lb/A, respectively, during the 3-year period 1955-57, maintained satisfactory control of weeds. Initial applications of 3-amino-1,2,4-triazole (ATA) at 10 and 20 lb/A, followed by four retreatments at the same rates or half these rates and totaling 35 and 70 lb/A during the 3-year period, gave excellent weed control and were slightly more effective than dalapon. The lighter rates of both dalapon and ATA were nearly as effective as the heavier rates. Four repeated applications of 2-chloro-4, 6-bis (diethylamino)-s-triazine (CDT) at 20 lb/A June 16 and August 25, 1955, and at 10 lb/A May 25, 1956, and July 9, 1957, totaling 70 lb/A, gave results about equal to those from dalapon. It was necessary to supplement all dalapon, ATA, and CDT treatments with one application of 2,4-D at 2 lb/A May 25, 1956, and July 9, 1957, for control of broadleaved weeds.

Seven repeated spray applications of DNBP-fortified diesel oil at 120 gpa, totaling 840 gpa during the 3-year period, maintained good control of vegetation about equal to that from repeated dalapon treatments supplemented with 2,4-D. Seven repeated propane burning treatments gave fair to good control of vegetation during 1955 to 1957 but were definitely less effective than ATA, dalapon, or fortified diesel oil, especially in 1957.

Results of this-3-year study indicate that adequate control of obstructive vegetation in small irrigation ditches would require two treatments each year of dalapon, ATA, DNBP-fortified diesel oil, or propane burning or one treatment of CDT each year for an indefinite period.

An extensive new experiment was initiated in the spring of 1957 testing 33 different treatments for the control of miscellaneous weeds in small ditches. Treatments were replicated three times on plots 0.5 x 1 rod. The experiment is testing two substituted chloro-urea compounds and two commercial mixtures of a substituted urea with sodium chlorate and/or borates each at three different rates, two triazine compounds and erbon, each at two rates and two other soil sterilant compounds or mixtures at one or two rates. Dalapon and ATA are tested each at two rates alone and at one in combination with 2,4-D at 2 lb/A. DNBP-fortified fuel oil and propane-burning are being tested each at 3-, 6-, and 8-week intervals during the growing season.

Abundant rainfall during spring and summer made conditions favorable to effective weed control by the less soluble compounds. Observations of results made periodically during the season to September 4, 1957, showed good to excellent weed control by all treatments except the 6- and 8-week intervals of burning and of spraying with DNBP-fortified fuel oil, and the lightest rates of CDT, dalapon alone, erbon (2-(2,4,5-trichlorophenoxy) ethyl 2,2-dichloropropionate), and the two mixtures of urea, chlorate, and/or borates. The best weed control throughout the season was with the compounds least soluble in water, namely, diuron (3-(3,4-dichlorophenyl)-1, 1-dimethylurea) and simazin (2-chloro-4, 6-bis-(ethylamino)-5-triazine), Perhaps this was due to the unusually heavy rainfall in 1957 and the location of the plots on rather porous sandy loam soil.

This experiment will be continued through 1958 with observations of results and retreatments as scheduled or as necessary to maintain adequate control of weeds. (Contributed by the Crops Research Division, ARS, USDA, and Wyoming Agricultural Experiment Station, cooperating.).

Ecological studies of salt cedar. Timmons, F. L., and Weldon, L. W., ARS, USDA. Salt cedar (Tamarix pentandra) which has been an increasingly serious problem along irrigation canals and natural streams, or river flood plains, and around reservoirs in southwestern states has recently developed seemingly aggressive infestations in northeastern Oregon, north central Wyoming, western Nebraska, and western Kansas. An ecological study was initiated on 5-mile Creek near Riverton, Wyoming, early in 1956 in cooperation with the Bureau of Reclamation and will be continued at least five years. Objectives of the study are to determine the present extent of salt cedar infestations along 5-mile Creek and eventually along the entire Wind River and Bighorn River systems, to determine the rate and methods of spread, the production and viability of seed, the rate of growth of seedlings and different ages of salt cedar plants, the life history and phenological development of salt cedar under northern Wyoming conditions, and the factors which may determine whether salt cedar will become a serious weed problem along the Bighorn River and perhaps the entire Missouri River system as it has on most river systems in Southwestern United States. (This abstract is given in full with another one by Timmons and Weldon on chemical control of salt cedar on pages 46 & 47).

PROJECT 7. CHEMICAL AND PHYSIOLOGICAL STUDIES

Virgil H. Freed, Project Chairman

SUMMARY

A total of 12 reports were received this year representing an increase of three over last year. This, perhaps, indicates a growing awareness of the importance of chemical and physiological studies to weed control. These reports come from four different states and are presented by 16 different workers.

The scope of the investigations represented by these reports is broad. However, interest in the soil-herbicide relation continues high as does also the interest in absorption and translocation of herbicides.

Absorption and Translocation of Herbicides

The fine work in Arizona on absorption of the 2,4,5-T by mesquite has been continued in a study of formulation as a factor in absorption and contact toxicity. Hull found significantly greater reponse from controlled absorption than uncontrolled. This finding should lead to more promising formulations.

Sheets at California found a marked increase in herbicidal activity of ATA to grasses upon addition of surfactants. Here is another proof of the important role of surfactants on the activity of herbicides.

The group at California, Yamaguchi, Clor and Crafts, are continuing to unravel the mystery of translocation of herbicides in plants. Using the autoradiographic technique, they compared the translocation of 2,4-D, ATA, and urea in plants as well as the movement of S^{35} labelled EPTC in a wide variety of crop and weed plants. Their finding of relatively low mobility of 2,4-D under adverse growing conditions should be useful in explaining some of the variable field results with this material.

Soil-Herbicide Relationships

Schaeffer and Erickson of Idaho have studied the persistence of four herbicides at four varying regions of the soil after one year. Even up to 80 pounds per acre the chlorophenoxy alkyl acids showed but little persistence in the surface six inches of the soil.

The factors influencing the behavior of EPTC in the soil was studied by Sheets. He found wide differences in initial activity in different soil types with the greatest toxicity found in sandy loam soil. Persistence did not correlate with soil type although the disappearance rate varied from one soil to another. His finding that microorganisms may contribute significantly to loss of EPTC toxicity in the soil is of great importance to field workers.

The Oregon group have investigated physical properties and reactions of EPTC that may also contribute some understanding of the behavior of this interesting herbicide.

Day and Hendrixson have contributed a most interesting report on the influence of temperature on the breakdown of ATA in soil. They interpret a slower breakdown at a high and a lower temperature as due to the effect on soil microorganisms whose temperature optimum lies between 20°C and 30°C.

Preliminary studies on the behavior of simazin in the soil were carried out in Oregon. Relatively strong adsorption by soil colloids and slow leaching was found for simazin.

Soil Plant Relationships

The relation of soil and its characteristics on germination and growth of crops and weeds was studied by Bovey and Walker at Idaho. High salt content and high pH in Parma soil and mixture made from it with Lewiston soil prevented germination and growth. A mixture of two mormally productive soils gave a depression of growth for up to 8 weeks. The higher germination in soils as compared to germination in growth chambers lead the authors to suggest the presence of some stimulatory chemical or biological agent.

Physiological Effects of Herbicides

Muzik and Lawrence in studying the effect of 2,4-D and drying on nitrogen metabolism in bean roots obtained significant results. While 2,4-D causes marked changes, even greater changes are the result of drying. They suggest that these changes are characteristic of the death of the plant and are not specific to 2,4-D.

A study of the uptake of radioactivity from pre-emergence applications of C^{14} labelled endothal by sugar beets showed that there was a very low level of residue at the end of 59 days. It was demonstrated that the chemical is broken down and the metabolites incorporated into plant constituents.

CONTRIBUTORS REPORTS

Contact toxicity and absorption rate of 2,4,5-T as influenced by interaction of formulation and carrier. Hull, Herbert M. Methods of maintaining an herbicide in contact with the leaf surface for extended periods of time have been considered by several investigators. Perhaps most desirable would be an herbicide mixture, or an adjuvant thereto, which would maintain such contact while at the same time controlling absorption rate so that contact injury to the leaf phloem would be minimized.

In order to evaluate contact injury and absorption rate in four-week-old mesquite seedlings (Prosopis juliflora var. velutina), various mixtures of 2,4,5-T were applied to only the basal leaf of seedlings which were at the four-leaf stage. Four basic formulations of 2,4,5-T including emulsified free acid, triethylamine salt, sodium salt, and butoxyethanol ester were used at 1000 ppmw acid equivalent. Each of these was carried in 10 percent (v/v) aqueous emulsions of nontoxic oil, diesel oil, latex suspension, polybutene, or water only for a total of 20 combinations. An anionic surfactant was used in all combinations at 0.8 percent. At hourly intervals after treatment, and later at decreasing intervals, the development of apical epinasty was measured over an eight day period.

Perhaps most striking of the various treatments was the combination of the ester with the latex emulsion carrier. Twenty-four hours after treatment average epinasitc curvature in this group was not greatly different from the other combinations. A great increase in curvature appeared between the 24th and 72nd hour. Seventy-two hours after treatment, the ester-latex group had an average curvature of 59.3 degrees, whereas the average range for the other ester combinations was 7.5 to 15.8 degrees. The only other combination that approached the above curvature was the amine carried in water (38.9 degrees) and in a latex emulsion (44.5 degrees). After 72 hours, all curvatures slowly decreased. Of further interest was the small amount of contact injury noted on the leaves treated with the latex emulsion, less than any of the other carriers, including water only.

In order to evaluate the ester-latex combination on field mesquite, an experiment was installed in July, 1957. Trees were sprayed with the butoxyethanol ester of 2,4,5-T at concentrations ranging from 125 to 8000 ppmw acid equivalent, both with and without the addition of five percent latex suspension. All mixtures contained one percent of a nonionic surfactant. The percentage of foliage remaining green in October, 1957 was not greatly different between the plus-latex groups and the minus-latex groups, with the exception of the 2000 ppmw concentration. Here, only 23 ± 6.3 percent of the foliage remained green in the plus-latex group and 61 ± 6.6 percent remained green in the minus-latex group.

These experiments suggest that the addition of latex under certain conditions may maintain 2,4,5-T in contact with the leaf surface and control absorption for extended periods of time. (Crops Research Division, Agricultural Research Service, USDA, Box 5735, Tucson, Arizona).

The effect of surfactants on the activity of ATA. Sheets, T. J. The effect of surfactants on the herbicidal acitivity of 3-amino-1,2,4-triazole (ATA) was evaluated by comparing the herbicidal activity of two formulated products. One formulation contained a surfactant and the other did not. The two products were applied as foliage sprays at rates corresponding to 1.0 to 2.0 pounds per acre to young barnyard grass (Echinochloa crusgalli (L) Beauv.) which was growing in No. $2\frac{1}{2}$ metal cans. The experimental design was a randomized block with 4 replications. The test was conducted in the greenhouse.

The ATA with surfactant reduced the fresh weights of barnyard grass whereas ATA without surfactant was ineffective at corresponding rates (Table 1). There was no difference in the response of kidney beans to the two formulations.

Table 1. The response of barnyard grass to ATA with and without surfactant.

Formulation of ATA	Application rate lb/A (active ATA)	Fresh weights % of control
ATA without surfactant	1.0	98
" " "	2.0	100
ATA with surfactant	1.0	84
" " "	2.0	73
LSD at the 5 percent level		7
LSD at the 1 percent level		10

In another test a surfactant was essential for maximum activity of technical ATA (88.5 percent) on seedling barley (Hordeum vulgare L). Vatsol OT at 0.025 percent by volume increased the effect of technical ATA on seedling barley; 0.05 percent Vatsol was required to increase the effect of technical ATA to that of the formulation of ATA containing a surfactant. Additional Vatsol did not improve the activity of the ATA. No contact injury was observed at 0.1 percent Vatsol. (Crops Research Division, ARS, USDA, and the California Agricultural Experiment Station, cooperating.).

Comparative studies on herbicide transport. Yamaguchi, S., Clor, M.A., and Crafts, A.S. Comparative studies on herbicide transport have been continued with the autoradiographic method. Translocation of foliar applied 2,4-D-1-C^{14} movement in a mineral nutrient series showed a large movement from the treated leaf to branch tips and to roots in very vigorously growing plants. On the other hand, autoradiographs of its movement in stunted plants showed an unexpectedly small amount of the herbicide translocated, a mere trace moving into the roots. ATA, unlike 2,4-D, translocated readily under a wide range of growth conditions in zebrina.

2,4-D, ATA, and urea movement were compared in cotton plants growing in Hoagland's solution. The chemicals were applied to leaves. Autoradiographs showed that the accumulation of 2,4-D in the roots was much slower than of ATA and urea.

An earlier experiment with pot-bound and stunted zebrina plants showed strong movement of urea and ATA to the tips of branches, but a very limited movement of 2,4-D to these regions. Another experiment was conducted using stunted zebrina plants. In this instance the roots were spread out on filter paper saturated with tap water. 2,4-D, ATA, and urea were applied singly and in combinations. In combinations including 2,4-D, the 2,4-D was applied first and the other chemicals were applied the following day to the same leaf.

Autoradiographs of ATA and urea treatments showed dark images of the roots and branch tips. Combinations of these produced images more intense than either used alone. 2,4-D showed very light images. Combinations of 2,4-D with ATA and urea produced autoradiographs which showed essentially a distribution pattern characteristic of 2,4-D. However, there was evidence that some ATA and urea translocated to branch tips and roots.

Sulfur-35-labeled EPTC (ethyl N, N-di-n-propylthiolcarbamate) was supplied our department by Stauffer Chemical Co. Translocation tests by the autoradiographic method indicated absorption and ready translocation from 2½ microcuries foliar applications of either vapor or solution. However, the amount translocated appeared to be much less than 10% of the amount applied. More than 50% diffused through the leaf and out from the lower surface where it was adsorbed on activated carbon pads. Relatively high mobility and free redistribution in the plants were indicated. The test plants included red kidney bean, corn, sugar beet, wild morning glory, alfalfa, barley, lima bean, barnyard grass and Jimson weed. The autoradiographs did not show any differences of distribution or accumulation which might relate to varying susceptibility of these plants to EPTC. (Botany Department, University of California, Davis).

The persistence of four herbicides in Greenleaf soil. Schaeffer, Ralph J. and Erickson, Lambert C. A biological study was made to determine the presence of 2,4-D, 2,4,5-T, and 2,4,5-TP, in Greenleaf soil at rates of 2, 4, 8, and 80 pounds per acre, and amino triazole at 4 and 8 pounds per acre. The plots were treated in July, 1956, and soil samples were taken in June, 1957. The soil samples were taken at six inch intervals to a depth of 24 inches. Composite soil samples were made up from three plot replications, placed in six-inch pots, and planted to tomatoes on July 12, 1957. The tomato was selected as the test plant because of its high susceptibility to epinasty, and other morphological symptoms indicating chemical injury or response. Tomato germination ranged from 52% to 100% in 18 days. The tomato seed had an official germination of 85%. The check planting germinated 87%. The germination from each material and rate is shown in the table on the following page.

Material	Rate per acre	Percentage germination 0 to 6"	6 to 12"	12 to 18"	18 to 24"	Average
2,4-D	2 lbs.	76%	64%	72%	64%	69%
	4 lbs.	92%	80%	80%	80%	83%
	8 lbs.	84%	96%	64%	88%	83%
	80 lbs.	84%	92%	72%	88%	84%
2,4,5-T	2 lbs.	68%	84%	80%	92%	81%
	4 lbs.	88%	80%	80%	80%	82%
	8 lbs.	100%	80%	80%	80%	85%
	80 lbs.	52%	88%	64%	76%	70%
2,4,5-TP	2 lbs.	88%	80%	84%	84%	84%
	4 lbs.	72%	0%*	0%*	56%	32%
	8 lbs.	76%	80%	76%	80%	78%
	80 lbs.	80%	56%	68%	56%	65%
Amino triazole	4 lbs.	100%	80%	52%	60%	73%
	8 lbs.	76%	64%	80%	60%	70%
Check		80%	100%	84%	84%	87%

* It may be possible that the 2,4,5-TP had moved throughout the upper 18 inch depth, and not beyond this point, also that the material had been decomposed in the upper six inches. This left a layer sufficiently toxic to destroy germination of tomato seeds planted in soil from the 6 to 12 and the 12 to 18 inch depths.

Growth of the plants in 18 days averaged 3.25 inches for the soils taken to a depth of six inches, and 1.25 inches for the soils taken to a depth of 24 inches. This constant difference in the rate of plant growth is attributed to the differences in soil fertility at the different soil depths and not to any presence of herbicides. (Idaho Agricultural Experiment Station.).

Factors influencing the herbicidal activity of EPTC. Sheets, T. J. The influence of soil type and time on the herbicidal activity of ethyl N, N-di-n-propylthiolcarbamate (EPTC) were studied under greenhouse conditions. Each of 7 soil types was treated at concentrations of 0.31, 0.62, 1.25, 2.5, 5.0, 10, 20, 40, 80, and 160 ppmw of oven dry soil. The cultures consisted of 500 grams of treated soil contained in No. 2 metal cans. Alternate monthly crops of oats were used as a measure of toxicity. The experimental design was a randomized split-block with 3 replications.

The initial phytotoxicity of EPTC was greatest in a sandy loam soil and least in a clay soil. Data of the first cropping indicated that there was a direct relation between the 50 percent effective dose and clay and organic matter contents of the soils. In the two extreme soil types a 6.5 fold difference in concentration of EPTC was required to produce the same injury to oats.

The herbicidal activity of EPTC disappeared much more rapidly in some of the soils than in others. There appeared to be no simmple relationship between rate of inactivation and soil type.

Autoclaving the soil prior to treatment greatly prolonged the toxicity period of EPTC. Loss of EPTC from autoclaved soil was about 1/3 as rapid as from non-autoclaved soil. Although EPTC is quite volatile, these data suggest that soil microorganisms may contribute significantly to the loss of EPTC toxicity when the herbicide is incorporated into the soil. (Crops Research Division, ARS, USDA, and the California Agricultural Experiment Station, cooperating.).

Physical properties of S-ethyl-di-n-propyl thiol carbamate. Freed, V. H., Montgomery, M., and Traegde, S.C. The new herbicide, S-ethyl-di-n-propyl thiol carbamate (EPTC), has received considerable attention as a selective pre-emergent herbicide. Variability of results under different conditions led to the suspicion that the physical properties of the compound might play an important role. The vapor pressure (as an index of volatility), water solubility and the nature of the adsorptive forces of this molecule were felt to be important. Certain of the properties of this compound have been presented by the manufacturer in a brochure.

The following properties and reactions were all determined by conventional chemical means under controlled conditions.

Vapor pressure	
234.0°C (boiling point)	759.00 mm Hg
167.5°C	96.00 " "
60.0°C	1.00 " "
25.0°C	0.15 " "
Latent heat of vaporization	
solubility (H_2O)	14,500 cal/mol
20°C	375 ppm
28°C	402 ppm
Latent heat of solution	1,500 cal/mol
25°C	0.21 $mg/cm^2/hr$

Preliminary studies of adsorption of EPTC by soil using the vapor train technique indicate rather weak sorptive forces as compared to other herbicides. Moreover, the adsorbed chemical may be replaced by water vapor suggesting a somewhat competitive adsorption site.

Observations indicated that EPTC hydrolyzed on standing in water. This process was followed at two different temperatures, namely 20°C and 30°C. This reaction was found to obey first order kinetics yielding a reaction constant of 2.8×10^{-4} at 20°C and 4.25×10^{-4} at 30°C. The energy of activation for this process is 7,500 calories/mole. On the basis of this information and the reaction products that have been isolated, the following is suggested as the hydrolysis reaction.

$$\begin{matrix} C_3H_7 \\ C_3H_7 \end{matrix} \Big\rangle N\text{-}C\text{-}S\text{-}C_2H_5 + HOH \longrightarrow \text{Intermediates}$$

$$\longrightarrow (C_3H_7)_2\,NH \quad CO_2\uparrow + HSC_2H_5$$

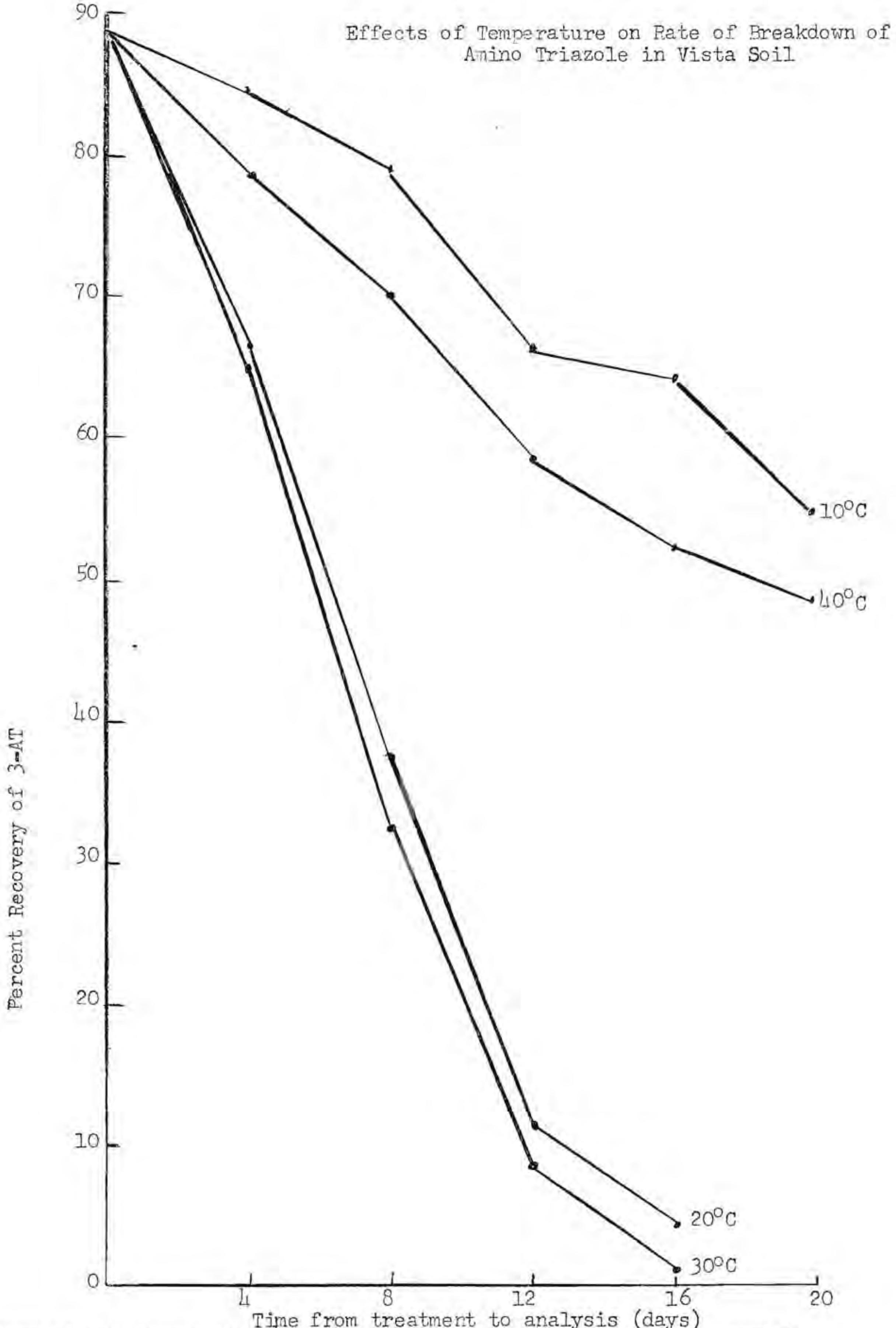
(Agricultural Chemistry Dept., Oregon Agricultural Experiment Station).

The effect of temperature on rate of breakdown of amino triazole in soil. Day, Boysie E. and Hendrixson, R. Ted. Experiments were conducted to determine the effects of temperature on the rate of breakdown of amino triazole in soil. Soil samples originally containing known amounts of ATA were stored at four temperatures and analyzed periodically for residual ATA.

To 100 gm. samples of air-dry virgin Vista sandy loam, 25 mg. of ATA solution containing 20 mg. of actual material was applied to four replicates for each scheduled analysis. These were in four temperature groups as follows: 10°C, 20°C, 30°C, and 40°C. Moisture was constantly maintained close to field capacity by periodic weighing and addition of water. At four-day intervals, replicate samples from each temperature group were analyzed for ATA by a modification of the method of Sund, (Journal of Agricultural and Food Chemistry, 4: (1) 57-60, January, 1956).

The data are given in the accompanying figure, each point on the graph representing the average of four replicate analyses.

About 90 percent of the ATA was recoverable after addition to the soil. It is evident that ATA was rapidly broken down in the soil at intermediate temperatures, declining to a low level within about ten days. Breakdown was much slower at both the high and low temperatures. Decomposition of ATA appears to be due to the action of soil microorgamisms having a temperature optimum in the range of 20°C to 30°C. (University of California, Citrus Experiment Station, Riverside, California).



(University of California Citrus Experiment Station, Riverside, California)

Some aspects of the behavior of simazin in soil. Montgomery, M., Freed, V. H., and Fang, S. C. The new herbicide 2-chloro 4,6 bis (ethylamino) s-triazine (Simazin) is of considerable interest not only because of its effectiveness in controlling many plants but also because of its long residual life in the soil. The long residual life cannot be accounted for solely on the basis of the chemical's low solubility in water.

In the course of investigation with simazin, a study of its adsorption by soil was undertaken. A sandy soil known to be a relatively poor adsorber was used. A twenty-five milliliter aliquot of varying concentrations of simazin ranging from .4 saturated to saturated (5 ppm) was added to ten grams of soil. After equilibrium was established between the adsorbed simazin and simazin in solution, an aliquot of the supernatant solution was taken and the amount of simazin remaining was determined. The following table presents the information obtained.

Concentration of simazin solution (ppm)				
Original	5.35	4.28	3.21	2.14
After adsorption	2.98	2.60	1.81	1.17

As can be seen from the data, nearly half of the simazin was removed from solution by adsorption. A comparison with CMU (3(p-chlorophenyl)-1, 1-dimethyl urea) and ATA (3-amino-1,2,4-triazole), two herbicides which are known to be fairly strongly adsorbed, shows that simazin is the most strongly adsorbed. On the same soil the percentage of CMU adsorbed from a saturated solution is about 7% while for ATA the percent adsorption from a saturated solution is going to be less than 1%.

In a leaching study of simazin, C^{14} labelled material was used. An amount corresponding to 21 pounds per acre was applied to a column of sandy loam soil and leached with 12" of water applied over a 24 hour period. It was found that this amount of water removed only 3.3% of the simazin from the surface 0.125". Of the radioactivity leached, 13.5% was found in the 4th inch, 18% in the 3rd inch from the top, 20.1% in the second and 58.3% in the top inch. This clearly indicates the relatively slow leaching of appreciable quantities of simazin. (Agricultural Chemistry Department, Oregon Agricultural Experiment Station).

The influence of edaphic factors on the performance of weed and crop plants. Bovey, R. W. and Walker, J. G. The objective of this study was to determine if certain crops and weed plants can be associated with a particular soil type or reactions (acid-neutral-alkaline). In this study data were catagorized to indicate the influence of soil type on: (1) germination, (2) survival, (3) rate of growth, (4) flower initiation, and (5) seed initiation or plant maturity.

The soils were obtained from areas as nearly virgin as possible. They were taken at different locations in Idaho, and are described as follows: (1) Helmer silt loam, an acid soil developed under high rainfall conditions near Bovill. (2) Macvoy, a very fine sandy loam, neutral, soil, developed under moderately light rainfall conditions near Lewiston. (3) An unnamed saline-alkali loam developed under light rainfall conditions and poor drainage near Parma. (4) Athena silt loam, a slightly acid soil developed under moderate rainfall conditions near Moscow.

Each basic soil type, Helmer, Macvoy, unnamed Parma, and Athena were analyzed to determine: pH (electrode method); salts (electrical conductivity); base exchange capacity; quantitative analysis for nitrogen (Kjeldahl method); phosphorous (bicarbonate method); potassium (flame photometer); air-water permeability ratio; hydraulic conductivity; mechanical analysis (hydrometer method); and moisture equivalent (centrifuge method). The results obtained from the soil analysis are presented in Table 1.

The respective soils including two mixtures i.e., $\frac{1}{2}$ Parma-Macvoy and $\frac{1}{2}$ Helmer-Macvoy, were placed 6 inches deep in 3 ft. by 10 ft. greenhouse benches. Twenty species were planted, including wild oats, medusa-head rye, downy brome, barnyard grass, marida oats, rough pigweed, lambsquarter, five-hooked bassia, Pennsylvania smartweed, corn cockle, spurry, shepherds purse, rape, dodder, gromwell, burnet, marsh elder, tarweed, dog fennel, and safflower.

To determine the germination potential of the twenty species, four replications of each containing fifty seeds were germinated between blotters in a Minnesota germination chamber. An infra-red heat treatment for one-half minute reaching a maximum temperature of 160° F., was given to all seeds in the study in anticipation of breaking dormancy in certain species.

The following results were obtained: (1) Two benches, those containing the Parma, and the $\frac{1}{2}$ Parma-Lewiston mixture, were so high in salt content and pH (see table) that no germination or growth of any kind resulted, and the $\frac{1}{2}$ Helmer-Macvoy mixture gave a depressive effect on plant growth for a period of 8 weeks (foreign to either soil in itself). (2) germinations were higher in all the remaining soils than those obtained in the germination chamber. This suggests that chemical substances and/or biological activity in soil stimulates germination; (3) the slightly acid, Athena soil, was most favorable for germination. (4) Most species grew best on the Athena except spurry and Pennsylvania smartweed which distinctly preferred the most acid soils; also, dog fennel and barnyard grass showed tolerance to the acid soil. (5) the remaining species showed a wide tolerance to soil types, indicating that if distribution limitations exist they are due to other factors; (6) promotion of flower and seed initiation are most directly influenced by light and heat. (Idaho Agricultural Experiment Station).

Table 1.

	Helmer Silt Loam	Macvoy Very Fine Sandy Loam	Un-Named (Parma) Saline Alkali Loam	Athena Silt Loam
pH	5.8	7.45	9.8	6.4
Electrical Conductivity	0.20	0.75	48.00	0.45
PPM Salt	140	525	33,600	315
Quantitative Analyses				
% Nitrogen (Kjeldahl Method)	0.215	0.085	0.049	0.170
P_2O_5 Lbs/Acre (Bicarbonate Method)	284	128	183	137
Potassium Lbs/Acre	644	1338	1995	952
Exchange Capacity in m. e./100 gms.	50.78	28.16	19.58	41.57
Physical Analysis				
Air-Water Permeability Ratio	1.9	3.4	69.4	5.05
Hydraulic Conductivity cm/sec	.000572	.000508	.000018	.000215
Mechanical Analysis (Hydrometer Method)	Silt Loam	Sandy Loam	Loam	Silt Loam
Moisture Equivalent (Centrifuge Method) % H_2O	38.40	16.67	19.09	27.92
Average plant growth in cm.	28.26	26.88	None	36.18

Amino-acid metabolism in bean roots as affected by drying and 2,4-D. Muzik, T. J. and Lawrence, J. M. Bean plants, (*Phaseolus vulgaris* L.) var. Black Valentine were sprayed with 2,4-D at the rates of 1 lb., 2 lb., and 4 lb. per acre. Control plants were either (1) untreated and allowed to grow naturally or (2) uprooted and laid on the greenhouse bench. The plants were treated at three weeks of age and the roots harvested at 1, 4, 11 and 18 days after treatment for study of the nitrogen fractions. Both the protein nitrogen, the free amino nitrogen and the individual free amino acids decreased much more rapidly in the roots of the 2,4-D treated plants than in the control plants growing without treatment. The change was however, as much or more striking in the roots of the uprooted plants, suggesting that the change is characteristic of damage or death and is not specific to 2,4-D. The pattern of individual amino acid changes did not vary between groups. (Washington Agricultural Experiment Station).

The absorption of C^{14} from radioendothal by sugar beets. Freed, V. H., Fang, S. C. and Traegde, S. C. The uptake of C^{14} of radioendothal by sugar beets was studied using pre-emergence applications of 4 and 13.7 pounds per acre. The final harvest was made after 59 days, and after drying, samples were taken for radiochemical analyses and solvent extraction.

Radiochemical analyses revealed an average of 0.20 and 0.22 ppm C^{14} calculated as endothal for the 4 and 13.7 pound rates respectively. Solvent partitioning of the radioactivity showed, however, that only 18.2% of this activity could be solvent extracted. Since the extraction also removed plant metabolites in which $C^{14}O_2$ had been incorporated, it is apparent that little or no endothal remained in the beets at harvest. (Agricultural Chemistry Dept., Oregon Agricultural Experiment Station).

Colorimetric determination of microgram quantities of simazin. Montgomery, M. and Freed, V. H. Preliminary investigations indicate that microgram quantities of simazin (2-chloro-4,6-bis-ethylamino-s-triazine) can be determined using pyridine in a scheme of color development. It appears that the triazine containing a ring chlorine forms a pyridinium salt with pyridine, which upon addition of base apparently undergoes ring opening yielding an intensely colored Schiff base.

Reagents:

5n Sodium Hydroxide
50% v/v pyridine in water, saturated with glycine

Procedure:

Five milliliters of solution containing 2.5-25 micrograms of simazin is placed in a ten milliliter volumetric flask. Two milliliters of pyridine reagent is added and the open flask is heated in a water bath at 85-90°C for a period of one hour. The flask is cooled and two milliliters of 5n sodium hydroxide solution is added. Distilled water is used to bring the flask to volume. The color intensity is determined at 440 Mu two minutes after the addition of sodium hydroxide. The time of reading after the addition of base is important in that the color fades with time.

The intensity of color is markedly reduced by the presence of excess acetone and probably will be reduced in a like manner by other organic solvents. It was found that 1.7% acetone did not alter the intensity whereas 5% caused a reduction of about 20%. This allowable concentration of acetone permits the preparation of a more concentrated standard solution from which dilutions for a standard curve can be made. The direct preparation of a standard solution in water alone is difficult owing to the extremely low solubility of simazin (5 ppm). (Agricultural Chemistry Dept., Oregon Agricultural Experiment Station).

PROJECT 8. RESEARCH TECHNIQUES

Thomas J. Sheets, Project Chairman

CONTRIBUTORS REPORTS

A simplified logarithmic dilution sprayer. Day, B. E. and Russell, R. C. Hartley et al. (British Weed Conference, 1956) reported on the design and use of variable-dosage spray equipment for experimental work. This equipment sprays at constant volume while diluting the active ingredient of the spray mixture exponentially. Water or other diluent is pumped into an enclosed vessel containing a rapidly-agitated concentrate of the spray mixture expelling the increasingly dilute mixture to the nozzles.

We have constructed and tested a logarithmic sprayer that is simpler, less bulky and more flexible in use than the equipment described by Hartley. We have combined the pump, spray container and agitator in one unit. A centrifugal pump mounted directly on the shaft of a light-weight gasoline engine serves these three purposes. The case of the pump serves as the concentrate chamber. The intake of the pump is connected through a check valve to a tank containing the diluent and the discharge is connected through a quick-opening valve to the nozzles. The pump impeller serves both to pressurize the discharge and rapidly mix the incoming diluent with the spray mixture. Pressure is controlled by an adjustable bypass regulator connected from the discharge to intake. The completed unit weighs 35 pounds and is compact and portable.

The rate of dilution was calibrated by the colorimetric analysis of dye solutions collected in vials by means of a turntable rotating at constant speed beneath the nozzle. Calibration data verify that the spray dilution is exponential and that the rate of dilution within limits of experimental error, is the same as the theoretical rate.

The dilution curve obtained in equipment of this type is determined by the volume of the concentrate chamber (790 ml. in our equipment.). According to the following function:

$$\log C_v = \log C_o - \frac{v}{r} \log e$$

Where:

C_v = Concentration of spray after flow of volume v.
C_o = Initial concentration (at v = o).
e = Napierian base, 2.7183 (log e = 0.43429).
r = Volume of concentrate chamber.

With concentration (C_V) expressed in percent of original (C_o = 100 percent) and volumes expressed in liters the function for our spray equipment becomes:

$$\log C_V = 2 - .4343 \frac{v}{.79}$$

or approximately:

$$\log C_V = 2 - .55v$$

Both field and laboratory tests show that this theoretical relationship is in fact a true expression of the dilution curves obtained with the equipment (see figure 1)*. The spray mixture becomes diluted to 50 percent of the original upon discharge of 0.547 liters (0.693r). Ten-fold dilution is reached at 1.82 liters (2.30r). When spraying 100 gpa dosage is halved upon coverage of 63 sq. ft. and reduced to one-tenth upon spraying 209 sq. ft. Thus at 100 gpa the dosage varies ten-fold along a test plot 5 ft. wide and 42 feet long. (University of California, Citrus Experiment Station, Riverside, California).

*page 99

Evaluating weed control by means of point transects. Corkins, Jack P. and Day, B. E. One of the major problems in herbicide research is obtaining valid quantitative weed control data. The most widely used method, visual estimates, is only roughly qualitative. The point transect method provides a means of rapidly measuring an important competitive factor of weed populations, percent ground cover.

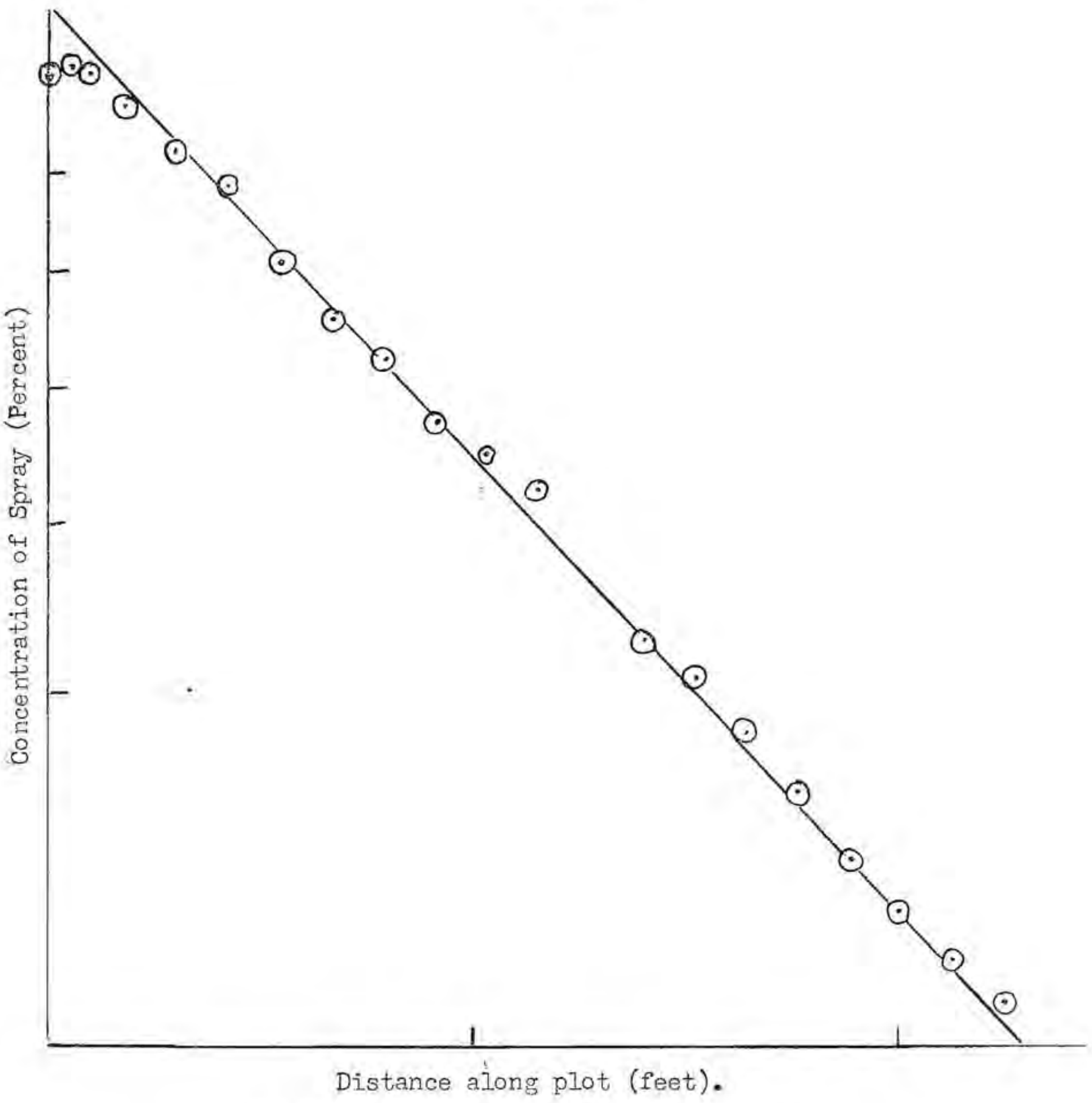
The principle of the point transect is to transect the plot with a series of lines such as tightly stretched string. These transecting lines are provided with points at regular intervals, such as knots in the string, twelve inches apart. If an above-ground portion of a plant touches the point or a vertical line running through the point, the point is then counted. For example: 100 such points are laid out at random in the plot. Weed A is found to touch 50 of these points. Then weed A covers 50% of the ground in the plot with a statistical confidence interval* on the 5% level of 40% to 60%.

Several methods of locating points have been employed. A wire grid has been used in certain turf studies. The intersections of the wires serve as points. A more convenient device consists of a comb-like arrangement of vertically placed stiff wires distributed along a horizontal bar which, in turn, is provided with a supporting base. The tines of the comb projecting downward into the vegetation provide points at the tips of the tines. Individual weed species counts are aided by a keyboard operated counter fixed to the base of this device.

An optical method of locating points has been employed in row crop weed control studies. This device consists of an aluminum sawhorse-like tripod, which is about four feet in height. The forward two legs are 36 inches apart

* Confidence interval for binomial distribution obtained directly from standard tables. (See p. 4 Snedecor's Fifth Edition).

Figure 1



CALIBRATION OF VARIABLE-DOSAGE SPRAYER

The line is calculated from the theoretical formula for the equipment, and the points are obtained experimentally by analysis of samples of the spray.

and arranged to fit the water furrows on each side of the row. The rear single leg is centered on the row. A series of five pairs of adjustable mirrors provide five optical points on a transect across the row under the tripod. One mirror of each pair is placed at the top of the tripod with the reflecting surface directed downward. The other mirror of each pair is placed below the top of the tripod and to the rear with the reflecting surface directed upward at the top mirror. The top mirror is provided with a circle having an arrowhead point at the front. The bottom mirror is provided with a circle. The pair of mirrors are adjusted so that the operator can look at the bottom mirror and sighting so as to superimpose the bottom mirror circle on the reflection of the top mirror circle. This optically places the arrowhead point at a fixed position on the ground.

Typical data obtained with the two devices described are shown in Tables 1, 2, 3, and 4. These two devices have been found to have the following advantages: (1) provide quantitative data with a minimum of human error; (2) less time consuming than other quantitative methods (less than five minutes per 100 points); and (3) provided data which in many cases reflects a competitive factor of the weeds rather than numbers of plants. The following disadvantages have been noted: (1) more time consuming than visual estimates: (2) does not provide a vigor measurement of plants which have been affected but not killed by herbicides, and (3) in many cases the crop interferes--particularly with the optical method.

The authors are keenly aware that this work is neither original nor conclusive. They are hopeful that this will stimulate the inherent inventive genius common to all weed control researchers; thus resulting in more practical means of accurately and quantitatively measuring herbicidal response. (Naugatuck Chemical Division of the United States Rubber Company and University of California Citrus Experiment Station).

Table 1. Comb-type point transect used in turf studies. These are 20 points per transect and 25 transects per plot. These data are compared to the averages of four visual estimates.

Transect	Check	Treatment A	Treatment B	Treatment C	Treatment D	Treatment E	Treatment F	Treatment G	Treatment H
1	20	13	16	7	9	0	1	2	14
2	20	15	9	5	14	1	4	7	13
3	20	9	14	6	14	1	5	3	16
4	20	14	16	4	11	1	4	2	17
5	20	16	13	7	14	1	0	1	17
6	20	12	15	4	16	3	1	1	9
7	20	8	15	7	17	1	2	1	18
8	20	13	12	12	19	1	1	2	11
9	20	15	9	7	19	0	6	0	13
10	20	11	12	11	14	1	1	0	15
11	20	15	11	13	19	1	0	1	19
12	20	8	16	6	11	0	6	4	10
13	20	14	14	3	17	0	2	3	18
14	20	14	13	3	20	0	2	0	6
15	20	19	12	4	16	0	0	2	15
16	20	11	12	2	16	1	0	4	13
17	20	13	10	8	18	1	7	3	15
18	20	13	9	11	20	1	3	0	6
19	20	18	10	4	13	0	1	3	7
20	20	15	8	2	18	0	5	4	16
21	20	12	13	2	10	3	0	1	10
22	20	12	12	0	9	2	7	1	13
23	20	17	15	3	11	0	0	3	15
24	20	17	14	3	16	1	3	3	16
25	20	8	15	2	19	0	0	1	16
Total	500	332	315	136	380	20	61	52	338
Percent Ground Cover	100	66.4	63.0	27.2	76.0	4.0	12.2	10.4	67.6
Average Visual Estimate	100	28	32	16	52	3	12	9	35

Table 2. Optical type point transect used in cotton studies. There are 5 points per transect and 20 transects per plot. The confidence intervals on the 5% level (C.I. 5%) are shown. Weeds are Puncture vine and Pig weed.

Replicates	Check Points	Check C.I. 5%	Treatment A Points	Treatment A C.I. 5%	Treatment B Points	Treatment B C.I. 5%	Treatment C Points	Treatment C C.I. 5%	Treatment D Points	Treatment D C. I. 5%
1	89	81-95	73	63-81	57	47-67	45	35-55	60	50-70
2	70	60-79	42	32-52	40	30-50	38	28-48	44	34-54
3	81	72-88	64	54-73	58	48-68	65	55-74	38	28-48
4	89	81-95	62	52-72	84	.75-91	26	18-36	63	53-72
5	90	82-95	76	67-84	81	72-88	84	75-91	42	32-52
6	88	80-94	87	79-93	20	13-29	60	50-70	58	48-68
Total	507		404		340		318		305	
Mean Percent Ground Cover	84.5	80-90	67.3	61-73	56.6	51-62	53.0	48-58	50.8	46-57

Table 3. Optical type point transect used in cantaloupe studies. There are 5 points per transect and 20 transects per plot. Readings were taken at 14 days and 28 days after a pre-emergence herbicide treatment. The weed is Puncture vine.

Replicates	Check 14 days	Check 28 days	Treatment A 14 days	Treatment A 28 days	Treatment B 14 days	Treatment B 28 days	Treatment C 14 days	Treatment C 28 days	Treatment D 14 days	Treatment D 28 days
1	15	75	1	11	-	-	1	10	-	-
1'	8	60	-	-	2	3	-	-	2	12
2	28	61	4	19	-	-	7	45	-	-
2'	23	75	-	-	6	12	-	-	1	8
3	30	88	4	15	-	-	8	59	-	-
3'	20	67	-	-	3	6	-	-	7	22
4	7	67	2	11	-	-	4	16	-	-
4'	17	58	-	-	4	28	-	-	2	30
Total	148	551	11	56	15	49	20	130	12	72
Mean Percent Ground Cover	18.5	68.9	2.8	14.0	3.6	12.3	5.0	32.5	3.0	18.0
Mean Percent Weed Control			84.9	79.7	80.5	82.2	73.0	52.8	83.8	73.9

Table 4. Optical type point transect verification test. Plot with triangular, rectangular, and square pieces of paper arranged at random. Twenty-five percent of the surface area covered with red paper and twenty-five percent with green. Transect counts are compared to visual estimates made independently by fifteen people. Transect counts based on 100 points.

Replicates	Visual Estimates Red	Visual Estimates Green	Point Transect Red	*C. I. 5%	Point Transect Green	C. I. 5%
1	25	30	26	18-36	20	13-29
2	37	33	23	15-32	22	14-31
3	30	30	23	15-32	26	18-36
4	25	30	19	12-28	27	19-37
5	16	24				
6	25	25				
7	50	30				
8	33	33				
9	24	16				
10	25	25				
11	20	20				
12	21	21				
13	25	25				
14	20	20				
15	20	20				
Total	396	382	91		95	
Average Percent Surface Cover	26.4	25.4	22.8		23.8	
Actual Percent Surface Cover	25	25	25		25	

*Confidence interval at the 5% level.

PROJECT 9. ECONOMIC STUDIES OF WEED PROBLEMS AND CONTROL

D. C. Myrick, Project Chairman

CONTRIBUTORS REPORTS

An ecomomic study of pinyon-juniper control in northern Arizona. Stubblefield, Thomas, Upchurch, M. L., Cotner, Melvin. Progress during the year included the collection of cost data for the primary methods of control. Historical records were collected from the land management agencies concerning control costs. Actual control work was observed. Time measurements and site classifications were compared for the dozer, cable and individual tree burning methods.

Plans have been made and a schedule prepared for obtaining ranch organization, production and cost data in the pinyon-juniper woodlands. Information will be obtained for model size ranches of the cow-calf, cow-yearling livestock types and on the yearlong and seasonal grazing types. Budgets will be prepared to show the net returns to land and the forage grazed. Net returns will aid in determining the extent the rancher can invest in range improvement yet recover his expenses. Range scientists have not determined the physical productivity and potentials for pinyon-juniper sites where the tree competition has been removed. Assuming certain levels of additional forage and livestock production, the various ranch budgets will show the extent to which costs can be incurred.

The Rocky Mountain Forest and Range Experiment Station is planning a detailed study of the ecologic and herbage yield changes following control on several important woodland sites in Northern Arizona. This and the corresponding livestock production changes are sorely needed for a complete economic study. (Arizona Agricultural Experiment Station and the Farm Economics Research Division, ARS, USDA.).

Cost of controlling Johnson grass on ditchbanks. McRae, G. N., Arle, H. F., and Hamilton, K. C. Where two or more effective methods of controlling weeds are available their relative costs should be considered. A test was conducted to determine the costs of controlling Johnson grass on an unlined ditchbank with L.P. burners, aromatic oil, and dalapon. Burning and herbicide applications were scheduled to obtain maximum control with each method in a single season.

All treatments began April 12, 1957. Burning was conducted on a two week schedule for 22 weeks. Aromatic oil and dalapon were applied when regrowth was 12-24 inches high. The combination treatment (L.P. burners plus dalapon) was burned every two weeks for 12 weeks. After mid-July, dalapon was applied whenever regrowth attained a height of 12-14 inches. (Previous research indicated a given amount of dalapon to be most effective when the initial application was made during July or August.)

The data obtained from this study is given in the following table:

Treatment	Number of Applications	Chemical cost/acre	Labor Cost	Total Cost
L. P. Burners	12	106.09	77.25	183.34
L. P. Burners	6	51.35		
plus			52.47	179.90
Dalapon	3	76.08		
Aromatic oil	7	113.45	28.56	142.01
Dalapon	4	94.48	17.35	111.81

Cost items used in the above table: Oil =20¢/gal., L. P. Burners@$4.05 /pound; Dalapon@ $1.07/pound; Labor =2 men at $1.00 per hour each.

Established Johnson grass was completely destroyed in one season using the dalapon, burning, and combination treatments. Seven applications of aromatic oils greatly reduced and weakened the stand of Johnson grass but kill was not complete.

The most expensive control method was the use of L.P. burners ($183.34 per acre). There was little difference in chemical cost of the various treatments. The high total cost of burning was due to the high labor requirement of this method. The combination of burning and dalapon cost ($179.90 per acre) slightly less than burning alone. The use of aromatic oils was intermediate in cost ($142.01 per acre). Since grass control was incomplete, the cost of a clean-up application the following year must be considered. Dalapon was the least expensive ($111.81 per acre) control method in this test. The data obtained in this test agree with cost figures of irrigation districts using these three methods to control Johnson grass.

The general appearance of the ditchbank throughout the season influences which method will be used to control Johnson grass. Regular burning resulted in a very clean ditchbank. The presence of dead grass following repeated applications of oil or dalapon caused the ditchbank to appear cluttered and shabby. Where dalapon was used, the annual broadleaved weeds that increased as the Johnson grass weakened, added to the shabby appearance. (Crops Protection Research Branch, USDA, ARS, and the Arizona Agriculture Experiment Station, Cooperating.).

PROJECT 10. VEGETATION CONTROL ON RIGHTS-OF-WAY AND INDUSTRIAL SITES

R. N. Raynor. Project Chairman

CONTRIBUTORS REPORTS

Chemical control of cheatgrass on roadsides in eastern Oregon. Kosesan, W. H. Cheatgrass (Bromus tectorum) growing along state highways in certain sections of eastern and central Oregon presents a serious fire hazard to grain fields adjacent to or near the roadsides. During summer months the dry, grassy growth provides ideal conditions for flames to spread.

Trials were designed to control cheatgrass to the point where remaining growth would present no fire hazard or to eliminate growth completely. Fall treatments were applied on November 8, 1956, and spring treatments on April 2, 1957. Materials tested included Telvar W (monuron), Simazin (2-chloro 4, 6 bis(diethyl amino)-S-triazine), ATA, and Dalapon.

Spring treatments gave high degrees of control; however, they were unable to eliminate possibility of fire danger. The remaining plant litter created a fire hazard in itself. Fall treatments using materials that prevented germination and killed young seedlings were very satisfactory.

The table below summarizes results.

Material	Rate/ Acre	Time of Application	Estimated % Control of Cheatgrass
Telvar W	3#	Fall	80
	6#	Fall	100
	9#	Fall	100
	5#	Spring	85
	10#	Spring	95
Simazin	2#	Spring	80
ATA	2#	Spring	75
	4#	Spring	90
Dalapon	5#	Spring	40
	10#	Spring	75

(Oregon State Highway Department).

Soil sterilization with various chemicals, 1957. Baker, Laurence O. In October 1955 several soil sterilant type chemicals were applied to an area where the principle vegetative cover was Kentucky bluegrass and Canada thistle. The chemicals were all applied at an equal rate on the assumption that three pounds of sodium chlorate per 100 square feet equalled three pounds of boron trioxide per 100 square feet, and that rates of 60 pounds of monuron and 120 pounds of erbon per acre were also equal to three pounds of sodium chlorate per 100 square feet.

In 1956 Canada thistle could be found surviving on all treated plots and annual weeds grew on all treatments which did not include monuron or erbon. In 1957 no perennials grew on plots treated with sodium chlorate or sodium chlorate combined with boron trioxide (polybor chlorate). Some Canada thistles were able to survive where only boron trioxide (concentrated borascu) was used. The annual weed growth was about equal under all three treatments.

Perennial weed regrowth occurred on all plots in 1957 that had been treated with chlorea, monuron, ureabor, or erbon; however, no annuals were able to survive.

While chlorea provided the best vegetation control in 1956, more Canada thistle regrowth occurred in 1957 on the chlorea treated plots than where monuron had been applied. It was also a more vigorous growth. The best vegetation control in 1957 was obtained with monuron; however, it was not complete even though it was considered satisfactory. It was only slightly more effective than chlorea. Ureabor permitted more thistles to grow than either chlorea or monuron, but thistle vigor was reduced below that for chlorea and about equal to monuron. Erbon showed little effect on Canada thistle except that when all annual competition was destroyed thistles grew more vigorously. (Montana Agricultural Experiment Station, Bozeman, Montana).

Effectiveness and residual life of certain soil sterilant materials under western Oregon conditions. Chilcote, D. O. and Furtick, W. R. During the past few years a series of trials have been conducted evaluating fall and spring applications of various soil sterilant materials for their effectiveness and residual life. These trials were conducted on waste land located near Corvallis, Oregon, which contained a variety of annual and perennial plant species. Soil types on which the experiments were conducted varied from silty loam to a heavy clay soil subject to considerable surface water during the rainy winter months of western Oregon. The soil sterilant materials evaluated in these tests are listed in the table on the following page.

Soil Sterilant Materials Tested in Western Oregon

Chemical	Rates evaluated
Monuron	10,20, 40 #/Acre
Diuron	10,20, 40 #/Acre
Arsenic trioxide	100, 200, 400, 600 #/Acre
Erbon	80, 120, 160#/Acre
Chlorea	3, 6, 9#/sq. rod
Ureabor	3, 6, 9#/sq. rod
Chlorox 40	3, 6, 8, 9, 13#/sq. rod
Polybor chlorate	3, 6, 8, 9, 13#/sq. rod
Atlacide	3, 6, 9#/sq. rod
Atlacide and 2,4-D	3, 6, 9#/sq. rod
DB granular	3, 6, 9#/sq. rod
Borascu	8, 13#/sq. rod

The results of these tests have emphasized the extremely short residual life of the chlorate and borate type materials under western Oregon conditions, even when applied in the spring. The phenyl urea herbicides have been outstanding in these tests. In general diuron has been superior to monuron even under spring applications where more than five inches of rain followed application. Of interest was the effectiveness and long residual life of chlorea and ureabor. These are combinations of monuron with chlorate and borate materials respectively. They have given excellent results, in some cases out-performing phenyl ureas used alone. Erbon has shown moderate residual control of grass species, but has proved ineffective for the control of sheep sorrel, and treated areas were rapidly reinfested with plantain and wild carrot. Arsenic compounds have been rather unsatisfactory in these tests. High rates and considerable time were required for maximum effectiveness.

These tests have served to illustrate the desirability of using either phenyl urea materials or the chlorate or borate combinations with phenyl urea herbicides for soil sterilization in western Oregon. Most satisfactory rates, which have provided from 12 to 18 months of complete vegetation control with one application, are 40 pounds per acre of diuron or monuron and from 6 to 9 pounds per square rod of chlorea or ureabor. (Oregon State College Experiment Station, Corvallis, Oregon).