Research Progress Report

Research Committee
Western
Weed Control Conference

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PREFACE

The 1960 Research Progress Report has been prepared in advance for distribution at the 1960 meeting of the Western Weed Control Conference. The Western Weed Control Conference is acting as a host to Weed Society of America at these meetings. We welcome all members and guests of the Weed Society of America to their first meeting in the West, we are pleased to have you, we trust that you will have a profitable and enjoyable meeting, and return again at the duly appointed time. The members of the Western Weed Control Conference appreciate the Weed Society of America meeting in the West which enables so many more WWCC members to attend and profit from the national meeting.

These Research Progress Reports consist of abstracts and summaries of current findings of research workers throughout the conference area. This report is particularly to be recommended for its timeliness. The results are fresh from the laboratory, greenhouse, and field and were conducted for the most part during the past year. They have been assembled in time to be available at this meeting only by the whole hearted cooperation of the individual contributors and project chairmen.

Due to the limited time for preparing this report certain editorial changes were made without consultation with the authors. Such editorial changes were necessary in order to obtain uniform composition. The editor trusts that such changes will be accepted in this light.

The research committee is organized into nine projects each having a project leader. The reports from each project were assembled and a summary written by the respective project chairman.

I wish to express my sincere appreciation to the individual contributors and particularly to the project chairmen without whose efforts this publication could not have been prepared.

Floyd M. Ashton
Chairman, Research Committee
Western Weed Control Conference

University of California
Davis, California

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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 mistures 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-diallylacetamide
CDEA	2-chloro-N, N-diethylacetamide
CDEC	2-chloroallyl diethyldithiocarbamate
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) phosphinate
endothal	3, 6-endoxohexahydrophthallic acid
EPTC	ethyl N, N-di-n-propylthiolcarbamate
erbon.........	2-(2, 4, 5-trichlorophenoxy) ethyl 2, 2-dichloropropionate
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-dichlorophenoxy) 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
nebruon	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, 4, 5TP.	2-(2, 4, 5-tichlorophenoxy) 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-chlorophenoxy) 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

K. C. Hamilton, Project Chairman

SUMMARY

Fourteen reports on nine perennial weeds were received.

Quackgrass (Agropyron repens). In Oregon, quackgrass was controlled for one season by soil applications of 2 lbs/A of atrazin or 4 lbs/A of simazin; 8 lbs/A of atrazin or 16 lbs/A of simazin gave control for two seasons.

Foliage applications of amitrol T were more effective than applications of amitrol for quackgrass control.

Johnson grass (Sorghum halepense). In New Mexico, late applications of dalapon, an ester of dalapon, or a combination of dalapon and amitrol gave 80-95 percent control of Johnson grass.

Leafy spurge (Euphorbia esula). In Idaho, 2,4-D (alone and in combination with borax), 2,4,5-T, silvex, and sodium chlorate were more effective than several other herbicides in reducing the stands of leafy spurge for two seasons.

Field bindweed (Convolvulus arvensis). In Idaho, when several herbicides were applied after barley harvest for one or more years, 2,4-D, 2,4,5-T, and silvex were the most satisfactory herbicides where weed control, crop yields, and chemical costs were considered.

In Colorado, where two benzoic acid compounds and two 2,4-D formulations were applied the previous year to control bindweed, the residual effects on 14 crops were studied.

Ground cherry (Physalis subglabrata). In Idaho, high rates of several herbicides applied in the fall gave little control; 2,4-D appeared more promising than 2,4,5-T, silvex, amitrol or 2,3,6-TBA because it had less effect on the following wheat.

In foliage applications amitrol was more effective than 2,4,5-T. High soil moisture increased the effectiveness of amitrol, while applications of nitrate and phosphate fertilizers did not increase the effectiveness of the herbicides.

White horsenettle (Solanum elaeagnifolium). In Colorado, one year after treatment, the following applications reduced horsenettle stands by 70 percent or more: amitrol, 4 lbs/A; 2,3,6-TBA, 15 lbs/A; PBA, 40 lbs/A; and 2,4-D, 2 lbs/A.

Russian knapweed (Centaurea picris). In 6 tests in nonirrigated areas in Colorado control of knapweed with 2,3,6-TBA and PBA averaged 85 to 95 percent while amitrol was not effective.

Canada thistle (Cirsuim arvense). In Wyoming when several herbicides were applied at the bud stage 2,3,6-TBA and a combination of PBA and amitrol gave the best control. A surfactant increased the effectiveness of amitrol and 2,4-D.

Amitrol applied at rosette and early bloom gave better control than applications of other growth stages. Varying the volume of the carrier from 120 to 240 gallons per acre did not influence the effectiveness of amitrol.

In 11 tests in Colorado, amitrol, 2, 3, 6-TBA and PBA applications reduced thistle stands and average of 60 to 88 percent.

Poverty-weed (Franseria tomentosa). In five tests in Colorado 2, 3, 6-TBA and PBA controlled poverty-weed while amitrol reduced stands only 60-70 percent.

CONTRIBUTOR'S REPORTS

Evaluation of several chemicals for the control of Canada thistle. Alley, H. P. Square rod plots of Canada thistle (*Cirsium arvense*) were treated in the early bud-stage of growth with several chemicals. The chemicals were applied in water at 40 gpa except the 2, 4-D powder which was applied dry. Treatments were randomized and replicated three times. Stand counts were made at time of treatment and one year following treatment to determine percentage control.

Of the chemicals used 2, 3, 6-TBA, Benzac 354 (polychlorinated benzoic acid, amine salt) ACP 329 (1 lb amitrol + 4 lb. polychlorinate benzoic acid), gave outstanding control at 10 lbs active material per acre. The powder and paste formulations of 2, 4-D at 10 lbs. active/A gave only 39 and 68 percent control respectively, whereas, the same rate of 2, 4-D liquid amine and butyl ester formulations was better.

The addition of a wetting agent (X-77) to amitrol and 2, 4-D amine increased the percentage Canada thistle control when compared to plots treated without adding the wetting agent. (Wyoming Agricultural Experiment Station)

Chemical control of Canada thistle using various rates of carrier H_2O). Alley, H. P. The erratic results obtained with amitrol in the dry arid regions of the West have caused much concern. Excellent control has been reported, however, in almost all cases the chemical has been applied in large volumes of water irregardless of the chemical concentration.

This experiment was established to obtain preliminary data on the effects of volume of carrier (H_2O) and date of application. Twenty-four square rod plots were established in the spring of 1958. Applications were made on June 28, July 11, July 24 and August 11 using 120 and 240 gpa of water as the carrier for amitrol and 40 gpa water for the 2, 4-D treatment. The chemical was applied as active ingredient per acre and was duplicated on each date of application.

It was interesting to note that 8 lb/A amitrol in 120 and 240 gpa water gave complete elimination of Canada thistle on the June 11 and July 24 dates. These dates correspond to the rosette and early bloom stage of growth respectively. The July 11 (early bud) date of application was not as effective, whereas, the August 11 (hard dough) application date resulted in only 75 percent control of the thistle. At no date was heavy-rates of 2, 4-D as effective as amitrol. Visual estimates made August 14, 1959 showed the June 11 and July 24 treated plots remaining free of any Canada thistle reinvasion.

Chemical	lbs/A	gpa Carrier	Date of Application 1/	Counts 2/ 1958	Counts 2/ 1959	Percent Control	Visual Rating 3/
amitrol	8	120	6/28/58	72	0	100	excellent
amitrol	8	240	6/28/58	83	0	100	excellent
2,4-D (Amine)	40	40	6/28/58	84	33	61	fair-poor
amitrol	8	120	7/11/58	64	6	91	good
amitrol	8	240	7/11/58	58	4	93	good
2,4-D (Amine)	40	40	7/11/58	55	21	62	poor
amitrol	8	120	7/24/58	65	0	100	excellent
amitrol	8	240	7/24/58	74	0	100	excellent
2,4-D (Amine)	40	40	7/24/58	78	31	59	poor
amitrol	8	120	8/11/58	85	21	74	poor
amitrol	8	240	8/11/58	68	14	79	good
2,4-D (Amine)	40	40	8/11/58	60	36	40	poor

1/ Date of application
6/28/58 - Rosette stage (3-4 in. growth)
7/11/58 - Early bud
7/24/58 - Early bloom
8/11/58 - Hard dough

2/ Counts taken at time of chemical application and one year (June 11, 1959) following initial application. Counts taken in eight permanently located sq. ft. quadrats in each plot.

3/ Visual ratings made August 14, 1959.

More extensive tests were established in 1959. Four volumes of carrier (40, 80, 160 and 240 gpa) were used as well as six dates of application being incorporated in the trials. (Wyoming Agricultural Experiment Station)

The relative efficiency of 10 herbicides applied at high rates in fall for the control of leafy spurge. Erickson, Lambert C. This study was conducted near Donnelly, Idaho, on a coarse sandy loam soil. The initial treatments were applied on September 13, 1957. Each of the herbicides were applied at 3 rates according to the characteristics of the individual material. The following data are based on a calculated initial infestation of 100 percent density. (Idaho Agricultural Experiment Station)

Material and rate	% remaining of original stand	
	1958	1959
Check	132	106
2,4-D 16 lb./A.	39	26
" 32 "	7	5
" 64 "	2	5
2,4-D 16 lb./A. in borax complex	65	62
" 32 " " "	9	17
" 64 " " "	6	6
2,4,5-T 16 lb./A	70	64
" 32 "	9	22
" 64 "	1	1
silvex 16 lb./A.	45	60
" 32 "	10	20
" 64 "	1	5
MCPA 16 lb./A.	80	68
" 32 "	42	42
" 64 "	9	12
TBA 16 lb./A.	92	74
" 32 "	100	100
" 64 "	100	100
amitrol 16 lb./A.	50	100
" 32 "	95	53
" 64 "	40	16
monuron 40 lb./A	77	36
" 60 "	100	13
" 80 "	100	22
diuron 40 "	80	29
" 60 "	58	25
" 80 "	100	100
$NaClO_3$ 4 lb./sq. rd.	3	3
" 6 "	3	3
" 8 "	1.5	1.5
$NaClO_3$ + borax (1/4-3/4 complex) 4 lb./sq. rd.	33	33
" " 6 "	19	19
" " 8 "	22	17
Agricultural borax 4 lb./sq. rd.	59	59
6 "	48	36
8 "	57	57

Quackgrass control with atrazin and simazin. Furtick, W. R. and Chilcote, D. O. Trials were established at Corvallis, Oregon in May 1958 on a silty clay loam soil heavily infested with quackgrass, Agropyron repens. The newly prepared seedbed on the quackgrass infested land was treated with atrazin (2-chloro-4-isopropylamino-6-ethylamino-s-triazine) and simazin (2-chloro-4,6-bis (ethylamino)-s-triazine). The rates used for both materials were 2, 4, 6, 8 and 16 pounds per acre active ingredient.

The area was planted to corn and irrigated all summer by sprinkler irrigation. There was no injury to the corn at any of the different rates of application. All rates of atrazin application gave effective elimination of the quackgrass growth during the 1958 growing season. Effective elimination of quackgrass growth occurred in the simazin treated plots at rates of 4 pounds and above. The kill of the topgrowth of quackgrass was much slower in the simazin treated plots compared with atrazin.

The treated plots were held over until 1959 for further evaluation on quackgrass kill. Observations made during the spring and summer of 1959 indicated no regrowth of the quackgrass at the 8 and 16 pound rates of atrazin. There was approximately 40 percent regrowth at the 4 pound rate and 50 percent regrwoth at the 2 pound rate. The regrowth in the simazin treated plots was complete at the two and four pound rates and approximately 50 percent at the 8 pound rate. There was still a trace of quackgrass regrowth at the 16 pound rate.

The results of this trial would indicate atrazin is a promising chemical for eliminating quackgrass as a spot treatment at rates of 8 pounds active or above on land that is to be planted to corn the year following spot treatment. This material offers excellent promise as a control agent at rates of approximately 2 pounds active per acre for the suppression of quackgrass during the growing season where corn is to be produced. (Oregon Agricultural Experiment Station)

The relative effectiveness of amitrol (3-amino, 1, 2, 4 triazole) compared with amitrol plus ammonium thiocyanate. Furtick, W. R. and Phipps, F. E. Plots were established on a dense stand of quackgrass (Agropyron repens) at Corvallis, Oregon, in the spring of 1959. Amitrol was compared to amitrol plus ammonium thiocyanate at the rates of 2, 4 and 8 pounds active per acre based on amitrol. These plots were observed throughout the summer and fall of 1959. The amitrol treatments alone at all rates resulted in considerable regrowth during the fall of 1959. Only the 8 pound rate had chlorotic plants still present by September 15, 1959. There were a large number of chlorotic plants at all rates of the amitrol plus ammonium thiocyanate. At rates above two pounds per acre, nearly all plants were making limited regrowth, but all regrowth was chlorotic. Results of this trial would indicate the addition of ammonium thiocyanate to amitrol greatly increases the effectiveness of amitrol through prolonging the effects of the amitrol on the rhizome system of quackgrass. (Oregon Agricultural Experiment Station)

Herbicidal control of field bindweed (Convolvulus arvensis) and subsequent effects on crop yields. Schaeffer, Ralph J., and Erickson, Lambert C. This bindweed control study was initiated in 1956 in a dense (100%) infestation in an abandoned field. The initial treatments were applied in late summer and have thereafter been continued as after harvest treatments. The area has been cropped with barley for the past three seasons.

In addition to the materials and rates given below numerous additional treatments have been applied at the indicated intervals during the course of this study: Karmex DW at 15, 30, and 50 lb. /A., and DB Granular at 1, 2, and 3 lb. /100 sq. ft. in 1956; 2,4-D, 2,4,5-T, and silvex at 8 and 80 lb/A., amitrol at 4 and 8 lb., and simazin at 4, 8, and 12 lb. /A. in 1956 and 57; TBA at 4 and 8 lb. /A in 1957 and 58. Considering the average results on the basis of bindweed control and resulting crop yield the five most tenable treatments are given below, based upon a top combined rank of 2, a mean of 28, and a maximum materials x treatments of 54.

Treatment	Yield lb. /A	Yield Rank	Bindweed control % orig. stand	Rank	Total rank
2,4-D 8/A	4761	3	4	1	4
2,4-D 4/A	4836	2	14	9	11
2,4,5-T 4/A	4911	1	14	10	11
silvex 8/A	4374	7	14	8	15
2,4,5-T 8/A	4157	13	7	3	16
2,4-D 2/A	4072	15	8	4	19
Check	4221	10	48	25	35

Of the total 27 treatments (herbicides x rates) 10 ranked above the check in yield and 25 ranked above the check in bindweed control. The benzoic acid treatments ranked high in control in 1958, but decreased in weed control and increased in crop toxicity in 1959.

On a continuing basis 2,4-D has been the most effective herbicide when considering the three aspects--bindweed control, crop yields, and material costs. The TBA treatments applied in 1958 were almost 3 times more effective than equivalent rates of 2,4-D for bindweed control, but crop yields were lowest in the entire study. (Idaho Expt. Station)

Relative efficiency of five herbicides, applied at equivalent cost rates, for the control of perennial ground cherry (Physalis subglabrata) and subsequent crop yield. Schaeffer, Ralph J., and Erickson, Lambert C. On November 14, 1958, treatments of 2,4-D, 2,4,5-T, silvex, TBA, and amitrol were applied at three rates equivalent in cost to 50, 100, and 150 pounds of 2,4-D per acre. The treatments were applied to square rod plots in three randomized blocks. These treatments were applied to a dense ground cherry infestation in a field which had been plowed and disced following corn harvest. The field was seeded to spring wheat in 1959. When the crop matured the following average yield and weed control data were obtained.

Material	Weed stand % of checks	Control rank	Yield Bu. /A	Yield % of check	Yield rank
2,4-D	64	3	44	110	1
2,4,5-T	34	2	20	50	4
silvex	78	4	18	46	5
amitrol	89	5	33	84	3
TBA	29	1	14	36	6
Check	100	6	40	100	2

Little practical control was obtained from any herbicide at the indicated high rate fall applications. The phytotoxic effects exhibited by the ground cherry were in most instances directly proportinal to the decrease in crop yield. This was most pronounced in the benzoic acid treatments, followed by 2,4,5-T. Applications of silvex and amitrol had the least effect upon ground cherry control while both contributed to crop toxicity. The 2,4-D treatments while ranking third in weed control ranked first in crop yield and thereby indicated the greatest potential as a selective control treatment in fall applications. (Idaho Agricultural Experiment Station)

Interactions between levels of soil moisture, soil fertility, and herbicides in the control of perennial ground cherry (Physalis subglabrata). Schaeffer, Ralph J., and Erickson, Lambert C. This study was designed to determine the interacting effects of two moisture levels on single and combined herbicide and fertility levels in the control of perennial ground cherry. This was a large dense infestation in an irrigated permanent pasture. Each block was designed to include the basic fertilizer (P_2O_5 and N at 75 lbs./A), and herbicide (2,4,5-T amine, 2,4,5-T ester, and amitrol at 2 lbs. active ingredient) rates. These same materials and rates were superimposed on the initial treatments, thereby giving the initial and twice the initial rates all combinations thereof. All treatments were replicated three times. These treatments were applied September 18, 1958, and the results obtained September 1, 1959.

The following results were obtained by comparing the non-treated check with the existing stand as of September 1959. The 10 most effective treatments or combined treatments were as follows:

Rank	Material and rate	Soil moisture level
1	amitrol 2 lb./A plus 75 lbs./A of N	high
2	" 4 "	"
3	" 2 " " 2,4,5-T amine 2 lb./A	"
4	" " 2 "	"
5	" 2 " " 2,4,5-T ester " "	"
6	2,4,5-T amine 4 lbs./A	low
7	amitrol 2 lbs./A plus 75 lbs./A P_2O_5	high
8	" " " " 2,4,5-T amine	low
9	" 4 "	low
10	" 2 " " 75 lbs./A P_2O_5	low

Two factors are evident in the above compilation: (1) amitrol is more toxic than 2,4,5-T, and (2) high moisture contributes to its efficiency when applied singly or in combination with 2,4,5-T. (Idaho Agricultural Experiment Station)

Chemical control of Johnsongrass. Szabo, S. S. and Gould, W. L. This study was undertaken to determine the feasibility of late-season chemical treatment of Johnsongrass. Johnsongrass, in the late-boot to early-head stage of growth, was treated on October 8, 1958. At the time of treatment, the Johnsongrass showed good color and vigor, although the cooler tempertures had slowed its growth somewhat. The sodium salt of dalapon was applied at 30 and 15 lb/A, alone and in combination with 4.5 lb/A of amitrol. The ester formulation of dalapon was also applied at 30 and 15 lb/A. All treatments were applied to square rod plots, along an irrigation ditch, in water solution equivalent to 60 gal/A. The Johnsongrass foliage remained viable until frost occurred three weeks later. Readings on the plots were taken June 18, 1959. The results are given in the following table:

Chemical	Rate lb /A	% Control on 6/18/59
dalapon, Na salt	30	86.3
" " "	15	81.1
dalapon, NA salt + amitrol	30 + 4.5	90.0*
" " " "	15 + 4.5	90.0*
dalapon, ester	30	95.0*
" "	15	80.0
Check	00	0

* All regrowth on plots receiving these treatments was from seed. (New Mexico State Experiment Station)

<u>Residual effects of two benzoic and two 2,4-D formulations on fourteen crops on irrigated land treated for the control of field bindweed.</u> Thornton, Bruce J. Application of the herbicides was made in September, 1958, and the crops were planted the following spring with high residual effect anticipated. The test is to be continued under normal conditions of crop cultivation and irrigation to determine residual effects in subsequent years. Other herbicides are being included in the test.

Percent Reduction

Herbicide	Lbs. per Acre	Bindweed	Field corn	Sorghum	Oats	Barley	Alfalfa	Pinto beans	Castor beans	Potatoes	Sugar beets	Onions	Tomatoes	Cucumbers	Watermelons	Canatloupes
TBA	5	50	0	30	20	40	90	100	60	60	70	90	100	70	60	80
	20	90	40	80	50	70	100	100	80	80	80	80	100	100	90	100
PBA	10	40	0	30	30	50	90	100	60	60	70	90	100	70	60	80
	40	90	40	90	30	70	100	100	80	90	90	90	100	100	90	100
2,4-D amine	80	50	0	20	10	10	10	30	40	20	10	30	90	90	80	70
DBM (DB Gran.)	80	50	30	30	10	30	20	80	60	70	30	40	90	100	90	80

Note: Rates of herbicides based on active ingredient.

The fourteen crops involved in this test are commonly grown on the irrigated land in the Arkansas Valley of Colorado. The test is made possible through the cooperation of Jerre Swink, Superintendent of the Arkansas Valley Branch Station, who has assumed responsibility for the cultural practices involved. (Colorado Agricultural Experiment Station)

Comparison of effects of amitrol, 2,3,6-TBA, PBA, and Two 2,4-D formulations on white horsenettle (Solanum elaeagnifolium) as based on one test. Thornton, Bruce J. The white horsenettle involved in this test constituted a heavy infestation in a well irrigated alfalfa field in Bent county in the Arkansas Valley. The treatments were applied on May 28, 1958 and readings were taken on June 27, 1959, at which time the plots were retreated and an additional test established. All materials were applied in water at the rate of 80 gallons per acre.

The rates of application per acre, based on active ingredient, and the percent reduction of the horsenettle obtained from each rate follows:

amitrol: 2 lbs. 30%, 4 lbs. 90%, 6 lbs. 80%, 8 lbs. 90%.
2,3,6-TBA: 5 lbs. 30%, 10 lbs. 40%, 15 lbs. 70%, 20 lbs. 80%.
PBA: 10 lbs. 20%, 20 lbs. 60%, 30 lbs. 60%, 40 lbs. 70%.
2,4-D isooctyl ester: 1 lb. 40%, 2 lbs. 85%.
2,4-D amine: 1 lb. 60%, 2 lbs. 75%.

Although white horsenettle is not widespread in Colorado, we frequently find the seed in lots of agricultural seed coming into the state and are quite concerned because of the difficulty we have experienced in efforts to control the weed. (Colorado Agricultural Experiment Station)

Comparison of effects of amitrol, 2,3,6-TBA, and PBA on Russian knapweed (Centaurea picris) as based on results from six tests located in four widely separated counties. Thornton, Bruce J. The tests actually involved amitrol at 2,4,6 and 8 lbs./A, 2,3,6-TBA at 5,10,15,20, and 30 lbs./A and PBA at 10,20,30,40, and 60 lbs./A. The two representative rates are reported to conserve space, since the overall results indicate the application of rates below or above the two reported rates to be generally impractical.

Herbicide	Lbs. per Acre	Percent Reduction						
		Test I	Test II	Test III	Test IV	Test V	Test VI	Ave.
amitrol	4	0	0	0	10	10	40	10.0
	8	0	0	40	10	20	50	20.0
2,3,6-TBA	10	98	90	80	70	95	80	85.5
	20	98	95	90	85	100	95	93.8
PBA	20	90	95	70	100	70	85	85.0
	40	95	100	80	100	99	95	94.8

Note: Rates of herbicides based on active ingredient.

Three of the tests were located on non-irrigated land and three on irrigated land, but not subject to irrigation during the period of the tests. Three were on Colorado's Western Slope and three were on the Eastern side. (Colorado Agricultural Experiment Station)

Comparison of effects of amitrol, 2, 3, 6-TBA, and PBA on Canada thistle (Cirsium arvense) as based on results from eleven tests located in five widely separated counties. Thornton, Bruce J. The tests actually involved amitrol at 2, 4, 8, and 12 lbs. /A., 2, 3, 6-TBA at 5, 10, 15, and 20 lbs. /A., and PBA at 10, 20, 30, and 40 lbs. /A. The two representative rates are reported in each case, since the overall results indicate the application of rates below or above the two reported to be generally impractical.

Herbicide	Lbs. per Acre	Percent Reduction Test I	Test II	Test III	Test IV	Test V	Test VI	Test VII	Test VIII	Test IX	Test X	Test XI	Ave. Ave.
amitrol	4	60	60	80	*--	*--	35	55	85	50	*--	60	60.0
	8	50	70	75	--	--	55	85	90	50	--	60	66.9
2,3,6-TBA	10	90	75	75	50	60	75	40	70	80	40	30	62.3
TBA	20	95	75	100	90	80	80	99	99	95	80	80	88.5
PBA	20	75	--	75	50	65	60	60	70	70	70	85	68.0
	40	75	--	95	85	85	70	99	80	90	90	90	85.9

Note: Rates of Herbicides based on active ingredient. *Improper stage.

Five of these tests were conducted on irrigated grass pasture, five on irrigated farm land, and one on waste ground. Six were on Colorado's Western Slope and five were on the Eastern side. It remains apparent that Canada thistle is one of the most difficult creeping perennials to control chemically under Colorado conditions, although one of the easiest to control with cultural methods. (Colorado Agricultural Experiment Station)

Comparison of effects of amitrol, 2, 3, 6-TBA, and PBA on woolly-leaved poverty-weed (Franseria tomentosa) as based on results from four tests located in three separate counties. Thornton, Bruce J. The tests actually involved amitrol at 4, 8, 12 and 16 lbs. /A, 2, 3, 6-TBA at 5, 10, 15, and 20 lbs. /A and TBA at 10, 20, 30, and 40 lbs. /A. The two representative rates are reported in each case, since the overall results indicate the application of rates below or above the two reported to be generally impractical.

Herbicide	Lbs. per Acre	Percent Reduction Test I	Test II	Test III	Test IV	Ave.
amitrol	4	60	45	*--	80	61.7
	8	80	50	--	85	71.7
2, 3, 6-TBA	10	75	100	100	100	93.8
	20	99	100	100	100	99.8
PBA	20	95	100	100	80	93.8
	40	100	100	100	100	100.0

Note: Rates of herbicides based on active ingredient. *Improper stage.

All of these tests were conducted in the non-irrigated wheat growing sections of Eastern Colorado. All tests were in low situations common to this weed and were subject to flooding in times of heavy precipitation or run-off. (Colorado Agricultural Experiment Station)

PROJECT 2. HERBACEOUS RANGE WEEDS

Gerard J. Klomp, Project Chairman

SUMMARY

Six abstracts from three states, including three from Oregon, two from Idaho, and one from Washington, make up this section. The reports cover an interesting variety of subjects, including four grasses, three poisonous species, and two other range weeds, one of which is native and the other introduced.

Medusahead rye, cheatgrass, crested wheatgrass, and intermediate are compared on a basis of root penetration and green shoot length.

Death camas is studied in relation to time of spraying with 2,4-D and 2,4,5-T. Tall larkspur and its reaction to light applications of amitrol, 2,4-D, and PBA is reported. A warning is sounded concerning a resurgence of Hypericum on previously controlled areas.

The responses of the native niggerhead and the introduced dalmatian toadflax to a number of chemicals are reported in the last two abstracts.

CONTRIBUTORS REPORTS

Relative rate of root development of medusa-head, cheatgrass, and two species commonly used in artificial seeding. Hironaka, M. and Tisdale, E. W.

The relative rate of root penetration of medusa-head, cheatgrass, crested wheatgrass, and intermediate wheatgrass was compared from mid-December, 1957 through mid-June, 1958. The method employed was essentially the same as reported in the 1958 Research Progress Report of the Western Weed Control Conference.

Germination of the annual grasses began in mid-October and the perennial species germinated about one to two weeks later. The first recovery of roots was made on December 12, 1957 and subsequent recoveries were made at monthly intervals. The experiment was conducted near Emmett, Idaho in a medusa-head infested area. Precipitation during the October-June period was about 15 inches, nearly 5 inches above the long term average.

The average depth of root penetration is graphically presented in Fig. 1. A significant increase in root penetration of cheatgrass was not obtained during the mid-December to mid-March period because of the excessive variation encountered within months for this period. A significant increase was not found for intermediate wheatgrass for the same period. A significant difference in root penetration was not found for crested wheatgrass during the mid-December to mid-February period but was found to be significant for the mid-December to mid-March period. Medusa-head increased significantly during the mid-December to mid-January period but no significant increase could be demonstrated for the mid-January to mid-March period.

The greatest increment of root penetration for medusa-head and cheatgrass occurred during the mid-March to mid-May period, after which no additional growth was found. In fact, there was a slight decrease, but this was likely due to breakage of some roots during recovery.

Cheatgrass roots were more plentiful and were of a more fibrous nature than the roots of medusa-head. The roots of crested wheatgrass tended to branch more profusely than intermediate wheatgrass also.

There was little or no increase of green shoot length for any of the four species studied during the mid-December to mid-March period. The annual grasses grew about one inch during the following month while no additional growth was recorded for the perennial species. (Fig. 2)

The decided advantage that the two winter annuals have over the two perennial species is readily demonstrated, especially in areas where spring soil moisture is limiting. Under field conditions the perennial species usually germinate in the spring and are thus placed under a greated handicap than is shown in this study. Thus adequate control of medusa-head and/or cheatgrass is necessary to obtain successful establishment of these two perennial species. (Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow, Idaho.)

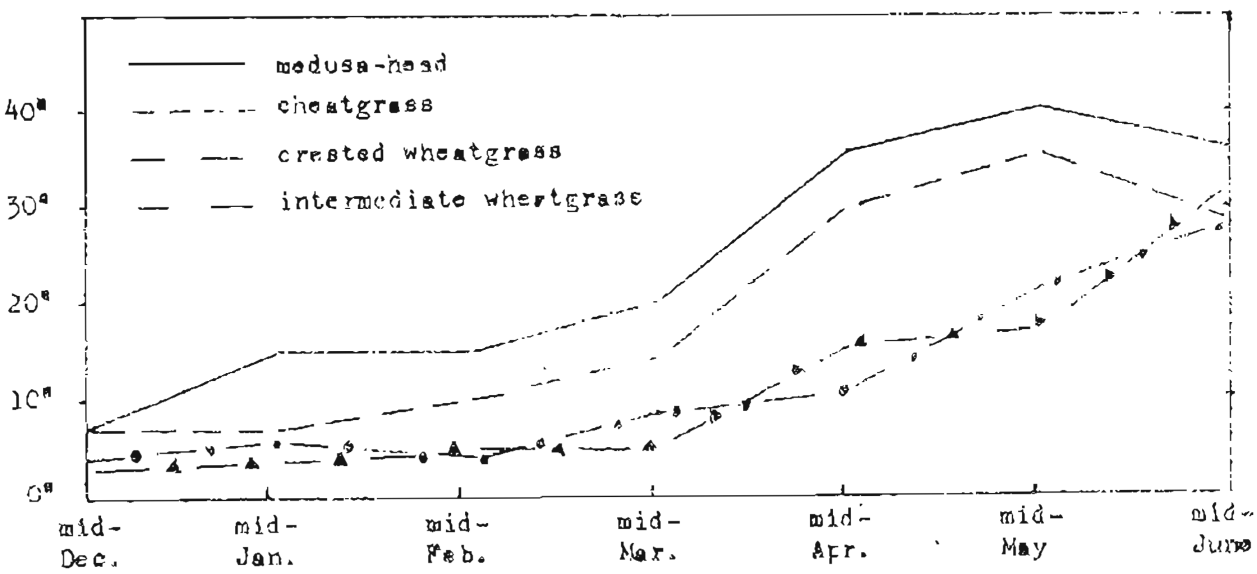


Fig. 1. Average depth of root penetration of four species from mid-December through mid-June. Germination began in October, 1957.

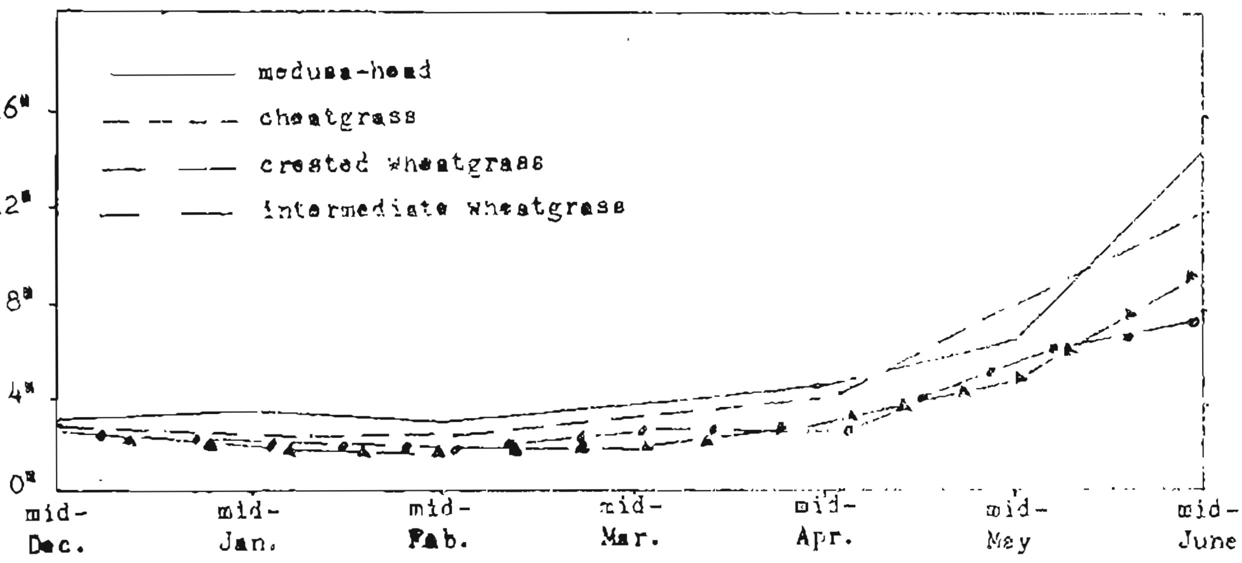


Fig. 2. Average green shoot length of four species from mid-December through mid-June. Germination began in October, 1957.

Death camas mortality from 2,4-D and 2,4,5-T treatments. Hyder, D. N. and Sneva, F. A. One-fiftieth-acre plots were established in 1958 on an area infested with death camas (Zygadenus paniculatus). Applications of 2,4-D and 2,4,5-T propylene glycol butyl ether esters, each at 1.5 and 3.0 lb/A acid equivalent emulsified in water at 10 gal/A, were made on 6 dates. The split plot experiment included 4 replications with the 6 spraying dates randomized by blocks. Herbicides and acid rates were randomized within blocks. The death camas remaining on each plot were counted April 27 and 28, 1959. Spraying dates and herbicides were sources of highly significant variation in death camas density after spraying. Acid rates and interactions did not introduce significant variation.

The highest individual-treatment plant-density-mean of 120 plants per plot was designated as 100 percent survival for computing percentage mortality. Mortality percentages by spraying dates and herbicides were as follows:

Herbicide	Death camas mortality by dates, 1958						
	4/30	5/14	6/ 2	6/13	6/23	7/ 9	Average
2,4-D	97	92	42	31	21	4	48
2,4,5-T	85	72	21	12	8	7	34

2,4-D was more effective than 2,4,5-T. The results verify reports by other investigators regarding the greater effectiveness of 2,4-D and provide new information on time of spraying. With each herbicide the time of spraying was critical.

The developmental stages of death camas growth were as follows:

4/30: 3-leaf stage, leaves about 5 inches high.
5/14: 5 or 6 leaves, flower buds seldom exposed.
6/ 2: Full flower, plants being grazed by cattle.
6/13: Pods full size, plants heavily grazed.
6/23: Pods dry, nearly all plants grazed unless protected by brush.
7/ 9: As on 6/23.

Susceptibility dropped very rapidly when flower stems were elongating. The complication of cattle grazing after June 2 prevented the evaluation of susceptibility after flower development. Prior to the 6-leaf stage of development and the appearance of flower buds the plants were highly susceptible and 1.5 lb/A of 2,4-D killed more than 90 percent of the plants. Death camas died and dried up quickly after spraying on April 30 and May 14.

Big sagebrush (Artemisia tridentata) was most susceptible on May 14, June 2, and June 13. Simultaneous control of death camas and big sagebrush resulted from applications on May 14. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and Oregon Agricultural Experiment Station, Corvallis, cooperating.)

Effects of amitrol, 2,4-D, and PBA on tall larkspur. Klomp, Gerard J. At an elevation of 5,500 feet scattered plants of tall larkspur (Delphinium barbeyii) were sprayed July 31, 1958, at which time the plants were beginning to bloom. Plot size was 1/1,000-acre with at least one tall larkspur plant per circular plot. Plot center was marked with a wooden stake to which an embossed metal label was stapled for identification. Notes were made by list and number of additional component species in each plot. Amitrol was applied at 1/2, 1, and 1-1/2 pounds per acre; 2,4-D was applied at 1-1/2, 3, and 4-1/2 pounds per acre; and PBA was applied at 2, 4, and 6 pounds per acre. Spraying was in a water solution at 50 g.p.a. All treatments were replicated three times.

The plots were checked July, 1959 and observations recorded. No tall larkspur plants were killed by any of the treatments although a few plants appeared to be stunted or slightly deformed by the heavier 2,4-D applications. Additional studies have been initiated which involve additional herbicides and heavier rates of application. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, La Grande, Oregon.)

Ecology and control of Hypericum perforatum. Tisdale, E. W. This represents a continuation of vegetation studies begun in 1951 on Hypericum-infested areas in northern Idaho. Work on the life-history of Hypericum has been largely complete and a publication issued (Tisdale, Hironaka and Pringle, 1959). The other major phase of the project, involves the changes in vegetation following release of Chrysolina and other beetles for Hypericum control. An important part of this phase involves periodic re-sampling of 20 permanent study sites representing a variety of ecological conditions in northern Idaho.

Sampling of all these sites in 1958 (not perviously reported) and several in 1959 indicated that a strong resurgence of Hypericum is occurring on many sites, especially those on which beetles were released earliest--from 1948 through 1952. These are sites in former grassland or ponderosa pine savanna in chich the beetle populations flourished. Hypericum was reduced almost to the vanishing point on most of these sites by 1955 or 1956, but is now making a decided comeback on many of them. A typical site where beetles were released in 1951 showed Hypericum populations of 106 stalks per square meter in 1952, 78 in 1953, none in 1955-58, and 14 in 1959. Chrysolina bettles are present in most cases, but during the past 2 years the populations have been insufficient to have any strong impact on the plants.

This resurgence may be due in part to favorable growing conditions for Hypericum seedling establishment in 1958. In any event, it represents a significant phase of the biological control process for this plant, and calls for more intense and probably more prolonged study than had been anticipated previously. (Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow, Idaho.)

Effects of amitrol, 2,4-D and PBA on niggerhead. Klomp, Gerard J. Because of erratic and somewhat unreliable results in attempting to control niggerhead (Rudbeckia occidentalis) with 2,4-D, further studies were undertaken, comparing 2,4-D with amitrol and PBA. On an area covered with a uniformly heavy stand of niggerhead, 1/40-acre plots were established with adequate checks and four replications of each treatment. The three herbicides were applied at 1, 2, and 3 lbs. per acre in a water solution at 50 g.p.a. Spraying was done August 1, 1958 at which time, at the elevation of 5,000 feet, the flower buds were just forming.

Observations were made in July, 1959 and estimates of percentage kill were recorded as follows:

Herbicide	Pounds per Acre	Percent Control*
amitrol	1	90
amitrol	2	98
amitrol	3	100
2,4-D	1	61
2,4-D	2	80
2,4-D	3	78
PBA	1	16
PBA	2	39
PBA	3	40

*Average of four replications.

The observations this year confirm earlier studies (reported in the 1958 Research Progress Report of the Western Weed Control Conference) that amitrol seems to give consistantly better control of niggerhead than 2,4-D and is definitely superior to PBA. Further observations will be made in 1960 to check further possible mortality. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, La Grande, Oregon.)

Studies on the control of dalmatian toadflax. Muzik, T. J., Rasmussen, L. W. and Stone, R. K. Dalmatian toadflax (Linaria dalmatica) is potentially a serious range weed in the Pacific Northwest. Of relatively recent introduction, it has spread to cover several thousand acres.

Numerous attempts have been made to control this weed. From these experiments, it appears that timing is critical for best results. In 1956, 2,4-D and 2,3,6 TBA were sprayed on four dates from early summer through fall. The data from this experiment are summarized in Table I.

Table I. Control of Dalmatian Toadflax - Percent Control in 1959

Chemical	Rate lb/A	Date of Application July 1, 1956	July 31, 1956	Sept. 5, 1956	Oct. 10, 1956
2,4-D iso-octyl ester	4	50	70	50	60
2,4-D PGBE ester	4	60	50	50	0
2,3,6-TBA	2	70	60	10	50
sodium 2,3,6-TBA	2	90	60	30	30

The sodium salt of 2,3,6 TBA sprayed on July was the only treatment which gave good control of the dalmatian toadflax. The dense growth of cheatgrass (Bromus tectorum) in the plots probably prevented seedling establishment of the toadflax. Later treatments were relatively ineffective. (Washington Agricultural Experiment Station)

PROJECT 3. UNDESIRABLE WOODY PLANTS

O. A. Leonard, Project Chairman

SUMMARY

Fewer project reports were received this year than previously, probably because of competition with the WSA meeting. Additional reports may be found in the abstracts of the Weed Society of America.

A drive will be put on for the next Research Report to secure additional information on the reaction of woody plants to herbicides, tabulated something like it was in the 1954 Research Report. Such information will be of value to all of us, both in making recommendations and in conducting research. Data will be sought on the reaction of woody plants to some of the newer herbicides, as well as those that have been in common use for a number of years.

CONTRIBUTORS REPORTS

Spraying for big sagebrush in stands of bitterbrush. Hyder, D. N. and Sneva, F. A. Spraying trials were conducted in 1958 to evaluate time of spraying, herbicides, and acid rates for obtaining selective control of big sagebrush (*Artemisia tridentata*) in stands of bitterbrush (*Purshia tridentata*). A split plot experiment was established in 4 replications with 6 spraying dates randomized by blocks. Herbicides (2,4-D and 2,4,5-T propylene glycol butyl ether esters) each at 1.5 and 3.0 lb/A emulsified in water at 10 gal/A were randomized within blocks. Individual plots were 9.9 by 88 feet. Live sagebrush and bitterbrush were counted before spraying (April 16, 1958) and after spraying (May 8, 1959) on an area 8 by 80 feet within each plot. The percentage of bitterbrush crown reduction was estimated July 16, 1959.

Spraying dates and acid rates gave highly significant variation in sagebrush mortality. Herbicides and interactions were not significant. Sagebrush mortality percentages by treatments were as follows:

Herbicide and acid rate (lb/A)		Sagebrush mortality by dates, 1958						
		4/30	5/14	6/ 2	6/13	6/23	7/ 9	Avg.
2,4-D:	1.5	69	78	68	84	62	67	71
	3.0	75	92	90	93	76	82	85
2,4,5-T:	1.5	69	90	86	78	69	62	76
	3.0	85	90	93	94	69	87	86
Average		74	88	84	87	69	74	80

Herbicides and acid rates gave highly significant variation and dates gave significant variation in bitterbrush crown reduction. Interactions were not significant. Bitterbrush crown reduction percentages by treatments were as follows:

Herbicide and acid rate (lb/A)		Bitterbrush crown reduction by dates, 1958						
		4/30	5/14	6/ 2	6/13	6/23	7/ 9	Avg.
2,4-D:	1.5	14	46	14	29	11	11	21
	3.0	24	55	52	36	19	22	35
2,4,5-T:	1.5	39	65	54	38	30	26	42
	3.0	56	59	72	78	52	42	60
Average		33	56	48	45	28	26	39

Bitterbrush was more susceptible to 2,4,5-T than to 2,4-D. Both species were most susceptible on 5/14, 6/2, and 6/13. Although individual bitterbrush were seldom killed completely, all spray applications killed the new growth and the die-back of old wood varied by spraying dates. Notes regarding plant development and herbicide effects by spraying dates were as follows:

4/30: Bitterbrush (Ptr) leaves were opening. Sprouting after spraying was slow until July, but by September regrowth-stems were about 8 inches long and the old wood was dead back about 3 inches from the top.

5/14: Ptr leaves were full size and twig growth was beginning. Spraying killed the new growth and the old wood back about 12 inches. Regrowth was slow, but was about 6 inches long in September.

6/ 2: Ptr was in late flower (full flower May 21-23) and new twigs were about 1 1/2 inches long. Spraying killed all new growth. Secondary growth was lacking in September 1958, and most plants appeared dead. Many plants were recovering in 1959.

6/13: Ptr fruit were turning pink and twigs were about 4 inches long. Plants appeared dead in September 1958, but many were recovering in 1959.

6/23: Ptr fruit was nearly ripe and new growth was about 4 inches long. The plants appeared dead in September 1958, but many were recovering in 1959.

7/ 9: Ptr fruit was ripe and twigs were about 4 inches long. The plants appeared dead in September 1958, but many were recovering in 1959.

The selective control of big sagebrush in stands of bitterbrush appears possible but not ideal. Spraying with 2,4-D ester shortly before bitterbrush flowering may give good sagebrush control, a minimum of dead wood on bitterbrush, and bitterbrush recovery in the current season. Growing conditions were good for the site in 1958. Dry growing seasons might prevent regrowth recovery after spraying and result in considerable bitterbrush kill, as experienced on a number of field trials in Oregon and Idaho. The investigation of seasonal differences may explain the erratic bitterbrush response to spraying. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and Oregon Agricultural Experiment Station, Corvallis, cooperating.)

<u>An observation on height of flight for spraying big sagebrush.</u> Hyder, D. N. A converted Navy TBM was used for spraying 1,240 A of big sagebrush (<u>Artemisia tridentata</u>) at Squaw Butte Range near Burns, Oregon on May 26 and 27, 1958. The airplane had a wing span of 54 ft. and a load capacity of 800 gal. The spray applied was a water emulsion

of 1.5 lb/A acid equivalent of 2,4-D butyl ester at 5 gal/A. On May 26 the airplane flew about 50 ft above the ground and on May 27 flew about 10 ft above. The air was calm on May 26, but the wind was blowing about 10 mph parallel with flight on May 27. A swath 125 ft wide was sprayed throughout. All swaths had been measured in advance and flagging positions had been marked by plastic strips tied to the sagebrush.

Sagebrush density and mortality were sampled in June 1959. Ten transects, each of which included ten 100 sq ft samples, were examined for each spraying day. Dead and living plants were counted and percentage mortality was calculated. There were a total of 8.0 and 7.7 sagebrush per 100 sq ft, respectively, on the areas sprayed May 26 and 27. Sagebrush mortality percentages by spraying day and transect were as follows:

Date	Spraying height	Transect number										
		1	2	3	4	5	6	7	8	9	10	Avg.
May 26	50 ft	63	69	68	30	58	62	46	42	62	52	56
May 27	10 ft	96	89	90	94	83	94	77	83	86	98	90

Air conditions were less favorable for spraying on May 27, but sagebrush mortality was higher. In addition the results were more uniform with the low flight level on May 27. The area sprayed from a height of 50 ft has a visual swath pattern with the greatest amount of sagebrush killed along the swath middle, but the area sprayed from a height of 10 ft appears uniform in swath coverage. However, wind action on May 27 resulted in incomplete kills on the leeward side of the plants. The wingtip curl dissipated in the air from a height of 50 ft, but rolled into the sagebrush from a height of 10 ft.

An average of 3.5 sagebrush per 100 sq ft remain on the area sprayed from 50 ft. Therefore the consequence of flying too high is an urgent need for respraying. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and Oregon Agricultural Experiment Station, Corvallis, cooperating.)

Soil moisture retention and snow holding capacity as affected by chemical control of big sagebrush (Artemesia tridentata Nutt.) Alley, H. P. and Sonder, L. W. With the acceptance of chemical sagebrush control as a range improvement technique, thousands of acres have been sprayed in the Western states. The scope of this practice has caused much concern among various agencies as to what affect sagebrush control has upon snow cover and moisture holding capacity of these sprayed areas.

Research conducted to help answer these questions was conducted in the Big Horn Mountains and the Red Desert. The Big Horn area, with an elevation of 8,200 feet, average annual precipitation 20 inches, was sprayed in 1953. The Red Desert, with an elevation of 7,000 feet, average annual precipitation 10 inches, was sprayed in 1957.

In the Big Horns, surveys in April 1958 and May 1959, indicate that areas with 100 percent sagebrush control hold snow longer in the spring than areas with no control. The 1958 (April) measurements on controlled areas showed an average snow depth of 23.7 inches containing 6.9 inches of water; on uncontrolled land, snow depth averaged 7.7 inches containing 2.5 inches of water. In 1959 (May) controlled areas held an average of 9.8 inches of snow with 3.4 inches of water; uncontrolled areas had 8.3 inches of snow with 2.1 inches of water.

Percentage soil moisture was determined by collecting soil samples from the surface inch and depths of 6-7, 12-13 and 18-19 inches. Bouyoucous moisture blocks were placed at 6, 12 and 18 inch depths to determine relative soil moisture. Monthly readings were taken in atmospheres tension.

The Red Desert soil moisture studies showed that, at the 18-19 inch soil depth, the controlled areas held as much as 63.8 per cent more soil moisture than the uncontrolled areas. The Big Horn experimental area showed a difference of 30.2 per cent in favor of the sprayed areas. Readings were taken during the months of June, July and August 1958 and 1959. (Wyoming Agricultural Experiment Station)

Kill of blue oak and poison oak by aircraft spraying. Leonard, O. A. and Carlson, C. E. Esters (pgbe) and amines of 2,4-D, 2,4,5-T, 2-(2,4-DP), and silvex were applied by aircraft at the rate of 2 lb. acid equivalent in 1 gallon of oil and sufficient water to make 10 gallons per acre. Amines were applied on May 10, 1955 and May 10, 1956. The esters were applied on May 10 and June 10, 1955, May 10 and June 8, 1956, and May 15, 1957. The swath widths were 35 feet, each flight strip being permanently marked. The application made in May, 1955 was 0-10 days after the leaves had become fully enlarged. Kills of blue oak (Quercus douglasii) and poison oak (Rhus diversiloba) reported in this abstract were recorded in May, 1959.

Kill of blue oak by single and repeated applications of several herbicides (pgbe esters).

When sprayed					% kill of blue oak			
5/10/55	6/10/55	5/10/56	6/8/56	5/15/57	2,4-D	2,4,5-T	2-(2,4-DP)	silvex
x					2	5	19	20
x		x			7	5	35	34
x			x		2	6	28	37
x				x	15	20	72	50
x		x		x	9	35	-	67
x			x	x	-	0	-	90
	x				2	0	2	5
	x		x		0	3	-	10

Timing of application was of utmost importance in determining kill. The applications in May were far more effective than those made in June, with one exception (a reapplication). This was when the first application was in May, the second in June, and the third in May; 90% of the blue oak were killed with silvex. The ester of 2-(2,4-DP) appeared to be slightly more effective than silvex on blue oak. Repeated applications of 2,4-D and 2,4,5-T resulted in poor kills. Amine formulations were all relatively ineffective; the best was with 2 applications of 2-(2,4-DP), with 19% of the blue oaks being killed.

The most effective treatment on poison oak was with the silvex ester applied in May for 3 years in a row. All June treatments were quite poor, as well as were all treatments with amine formulations. The poorest of the ester treatments was with 2-(2, 4-DP), where the poison oak actually appeared to have been "released" by killing the blue oak.

Kill-/[1] of poison oak by single and repeated applications of several herbicides (pgbe esters).

When sprayed					Control of poison oak			
5/10/55	6/10/55	5/10/56	6/8/56	5/15/57	2, 4-D	2, 4, 5-T	2-(2, 4-DP)	silvex
x					10	10	10	10
x		x			7	6	10	3
x			x		10	10	10	10
x				x	7	4	10	3
x		x		x	5	3	-	2
x			x	x	-	-	-	3
	x				10	10	10	10
	x		x		10	10	10	10

[1] -/ Relative kill of poison oak, with a 1 representing complete control and 10 as no control.

Some live oak (Quercus wislizenii) were killed by spraying with the ester of silvex for 3 years a row in May or for 2 years in May and 1 in June; no live oak was killed by any of the other treatments.

Digger pine (Pinus sabiniana) was not killed by any of the treatments, but it was injured most by the ester of 2, 4-D and much less by 2, 4, 5-T. Both 2-(2, 4-DP) and silvex appeared to be relatively non-injurious. (Botany Department, University of California, Davis and the California Division of Forestry, Sacramento)

<u>The use of soil sterilants for the control of salt cedar (Tamarix sp.).</u> Szabo, S. S. and Gould, W. L. The present study was initiated in July, 1958 to determine the feasibility of using various soil sterilants for salt cedar control. The chemicals used were monuron; fenuron; benzac 354, (mixture of polychlorobenzoic acids); benzac 1281, (2, 3, 6-trichlorobenzoic acid)(2, 3, 6-TBA); and Weedone 638)(an emulsifiable 2, 4-D acid.)

The treatments were applied to salt cedar regrowth on an area which had been mowed with a rotary mower. The treatments were applied in a randomized block design, replicated four times. The chemicals were applied directly to the soil. The entire treated area was inundated several months after treatment, and was under water for approximately six months.

The per cent kill, determined in October, 1959, was as follows: (1) fenuron, applied at 80, 40, 20, 10, and 5 lb/A yielded 97, 90, 88, 47, and 44 per cent kill, respectively; (2) monuron, applied at 60, 40, 20, and 10 lb/A yielded 100, 40, 47, and 49 per cent kill, respectively; (3) polychlorobenzoic acids, applied at 80, 40, 20, and 10 lb/A yielded 71, 38, 42, and 32 per cent kill, respectively. 2, 3, 6-TBA applied at 60, 40, 20, 10 and 5 lb/A yielded 70, 67, 53, and 38 per cent control, respectively; 2, 4-D emulsifiable acid, applied at 40, 20, 10, and 5 lb/A yielded less than 45 per cent kill for all rates. (New Mexico State Experiment Station)

Growth variation in Quercus turbinella and its relation to environment. Wagle, Robert F. Soil environment studies have been emphasized in the Arizona project this past year. Soil bioassays, using lettuce indicator plants, have now been completed on eight soils from chaparral areas. Chemical and mechanical assays have been completed on fifteen soils from the geographic range of chaparral.

The soils studied thus far have exhibited some of the following characteristics:

a. Soil testure in general was coarse. Gravel and rocks made up 20 to 40% of the sample weights. The sand content of most samples was above 25%. The silt content of most samples ranged between 14 and 22%. The clay content of most soils fell between 4 and 15%.

b. Chemical and bioassay results compared favorably on soil nitrogen content, but differed greatly as an index for available soil phosphate.

c. Certain vegetation soil relationships were indicated. Areas with the highest amount of grass exhibited nitrogen deficiencies, but no phosphate deficiencies - soil $_{p}$H varied from 6.7 to 8.0. Soil from shrub-covered areas showed nitrogen deficiencies in five of ten samples. In all but one soil the nitrogen deficiencies were associated with a high $CaCO_3$ content - soil $_{p}$H ranged from 6.2 to 8.0. Soil samples from woodland areas (ponderosa pine) showed no nitrogen deficiencies, but phosphate deficiencies were present in the two soils tested - soil $_{p}$H values were 6.0 and 6.7.

This soil information will form the basis for new field studies in chaparral this coming year. Macronutrient treatment of soil is a means of changing the soil environment and may be a means of changing plant composition in regard to plant species and plant density.

Herbicidal studies were conducted on two types of turbinella oak plants, old mature plants in an unburned area and plant sprouts in a burned over area. Preliminary observations indicate an 8-pound per acre treatment of fenuron affected over 90% of the plants in the unburned area and all rates of 16-pounds per acre and above (16 lb, 32 lb, and 64 lb rates) affected most sprouting plants on the burned over area. (Arizona State Agricultural Experiment Station, Tucson, Arizona)

PROJECT 4. ANNUAL WEEDS IN CEREALS AND FORAGE CROPS

D. G. Swan, Project Chairman

SUMMARY

Eight reports were received for this project. Three papers were concerned with wild oat control, one each with alfalfa, corn, corn cockle, cheatgrass, and chemical summer fallow.

Wild oat control. Carbyne, Niagara 5996, Monsanto CP 15336, and Avadex were evaluated for pre and post-emerge wild oat control. Carbyne at 1/2 lb/A did not injure wheat or barley. Higher rates were toxic to these crops. Barley showed the most resistance at the higher rates. Good wild oat control was obtained with best control when applied at the 1-3 leaf stage of wild oat growth. Niagara 5996 eliminated all crops and grassy weeds in the greenhouse. Barley showed some resistance in field tests. Monsanto CP 15336 reduced green weight of all crops and weeds except sugar beets in greenhouse tests. In field tests, without incorporation, there was no reduction in growth of wheat, oats, barley, or wild oats. Avadex, applied pre-plant, gave nearly complete wild oat control at 2 and 4 lbs/A. Barley was not injured. Spring wheat was injured at the 2 and 4 lb. rates.

Alfalfa. Treatments with 1 1/2 and 2 1/2 lb/A of diuron were applied at three winter dates. Treatments at all dates gave excellent control of mustard and sow thistle. The alfalfa hay showed chlorosis and there were yield reductions with all treatments except the low rate at the third date.

Corn. Directed layby soil treatments were made with dalapon, amitrol, and TBA. Dalapon caused stunting, leaf, flower and ear malformation. Amitrol caused yellowing and/or stunting and the TBA had no apparent effect. The dalapon treatments reduced corn yield.

Corn cockle. Treatments of 2,4-D, 2,4,5-T, MCP, TBA, and DNBP were applied at early bud stage of the corn cockle. Thirty days after treatment, all plants had completely recovered except those sprayed with MCP. This treatment gave 100 percent control.

Cheatgrass. Fall treatments of endothal monuron, TBA, IPC, and CIPC and spring treatments of endothal, and IPC were applied to merion bluegrass. Fall applied endothal at 4 lb/A was effective in controlling cheatgrass and did not lower seed yield of the merion bluegrass.

Chemical summer fallow. Rates of atrazin and atrazin plus amitrol were fall applied for control of vegetation in the fallow year. Atrazin at 2 lb/A controlled all vegetation. Atrazin at 1 lb/A plus amitrol at 1 lb/A controlled all vegetation except the spring germinated Russian thistle.

CONTRIBUTORS REPORTS

Results of pre-emergence wild oat control 1959. Alley, H. P. Greenhouse and field experiments were conducted to evaluate new herbicides for the control of wild oat (Avena fatua) and determine susceptibility of other crops. Niagra's 5996 (2,6-dichlorohenzonitrile) and Monsanto's CP 15336 (chemical identity not available) were the chemicals tested.

The greenhouse experiments consisted of two flats for each rate of chemical used. The chemical was applied to the soil surface and thoroughly incorporated into the top 1 in. Each flat was then planted to wheat, oat, barley, wild oat, sugar beets, barnyardgrass (Echinochloa crusgalli), green foxtail (Setaria viridis), and downy bromegrass (Bromus tectorum). All plants were harvested one month after chemical application. Green weight was used as the criteria for determining the toxicity of the chemical toward each individual genera.

Sugar beets was the only crop which showed any resistance to CP 15336, all other crops, and weedy grasses were drastically reduced in green weight. Wheat, barley, and oats were reduced by 70 to 100 percent by the 1, 2 and 3 lb/A rates. Barnyardgrass and green foxtail showed only moderate susceptibility. Applications of 1/2, 1, 2 and 3 lb/A 5996 resulted in complete elimination of all crops and grassy weeds used in the experiment. Setaria emerged but was killed back within three days.

In the field tests, chemical treatments were not incorporated, which could be the explanation of virtually no reduction in growth to wheat, oats, barley, and wild oat by CP 15336. Only the above mentioned crops and weedy grass was used in the field test. Barley was the only plant which showed any resistance to Niagra 5996, wheat, oats, and wild oat was reduced in green weight from 60-85 percent by 1, 2 and 3 lb/A. (Wyoming Agricultural Experiment Station)

Greenhouse and field evaluation of S-847 (carbyne) for post-emergent wild oat control. Alley, H. P. Greenhouse and field tests were conducted to evaluate S-874 (Spencer Chemical Co. product 4-chloro-2-butynyl N-(3-Chlorophenyl) carbamate) as a post-emergent wild oat control herbicide. These tests were conducted to also determine toxicity toward small grains, sugar beets and grassy weeds. Flats were planted with wheat, barley, oats, wild oat, sugar beets, barnyardgrass (Echinochloa crusgalli), green foxtail (Setaria viridis), and downy bromegrass (Bromus tectorum). Treatments were made when all species were in the two-leaf stage of growth with a small atomizer sprayer. Toxicity was determined by green weight measurements. One month following treatment the above ground growth of each planting was harvested and compared to the check (untreated) to obtain the relative toxicity.

Wheat and barley tolerated the 1/2 lb/A treatment without any reduction in green weight. This rate of application gave a reducation of 95.8 percent of the oats, 90.1 percent wild oat, 92.5 percent barnyardgrass, 75.7 percent green foxtail, and 64.8 percent downy bromegrass. Higher rates (2 and 3 lb/A) were quite toxic to all genera except barley which was tolerant and showed no reduction in green weight.

Field tests were conducted using 1/2, 1 and 2 lb/A as a post-emergent application on wheat, oat, wild oat, and barley. Plots, 4 rows wide and 50 ft. long, were planted July 30, 1959 with a small grain experimental plot planter. Treatments were duplicated and made across all plantings when the plants had obtained 2 in. growth. Plots were harvested November 2, 1959 and toxicity determined by the use of green weight measurements.

Barley was the most resistant showing no reduction in green weight at any of the rates of chemical application. The green weight of oats was reduced from 22.0 to 75.0 percent depending on the concentration, and wheat showed only moderate susceptibility, being reduced by 13.5 percent at the 2 lb/A rate. Wild oat was reduced 81.0 percent, 97.0 percent and 98.0 respectively for the 1/2, 1 and 2 lb/A rate of application. (Wyoming Agricultural Experiment Station)

Selective wild oat control in wheat and barley. Furtick, W. R. and Chilcote, D. O. Two herbicides were compared in 1958 and 1959 for selective wild oat control in spring wheat and barley. The two materials used were Carbyne (4 chloro-2-butynyl-N-(3-chlorophenyl) carbamate) and Avadex (2,3-Dichloroallyl diisopropylthiolcarbamate-cis and trans mixture). Carbyne was evaluated at the 2-3, 3-4, 4-5, leaf and the early boot stages of spring wheat and barley. Rates used were 1/2, 1, 2 and 4 pounds per acre. The only rate which did not injure both wheat and barley was 1/2 pounds per acre. Injury at the one pound rate was slight at the two early growth stages. Injury was more severe as the cereals increased in age. Wild oat control was best at the early growth stages when the wild oats were in the 1-3 leaf stage. Control decreased rapidly as the wild oat age increased. Control at the 1/2 pound rate averaged approximately 80% at the 2-3 leaf stage.

Avadex was applied prior to planting and disced into the soil at rates of 1, 2 and 4 pounds per acre. The one pound rate gave less than 50% reduction in the wild oat stand. The two and four pound rates gave nearly complete kill of the wild oats. Barley was not injured by these treatments. Spring wheat stands were reduced about 35% at the two pound rate and 70% at 4 pounds. (Oregon Agricultural Experiment Station)

Effect of diuron on alfalfa. Hamilton, K. C., Arle, H. F., and McRae, G. N. Diuron has not been recommended for use in alfalfa in the desert valleys of the Southwest. Southern alfalfa varieties are not dormant and make a limited growth during the winter. Winter applications of diuron have affected the growth of alfalfa. A test was conducted during the past year at Mesa, Arizona (Laveen clay loam soil) to determine the effect on established alfalfa of applications of diuron made on three dates during the winter.

After cutting and removing the hay of one-year-old African alfalfa diuron was applied to the soil and stubble. On November 12 and December 23 of 1958 and March 2 of 1959, diuron was applied at the rate of 1 1/2 lb and 2 1/2 lb./A. Plots were 4 x 19 feet; treatments were replicated 6 times. The yield of hay was measured in the six cuttings from December to July. These yields are summarized in the following table.

Treatment		Yield as Percent of untreated checks						
		Date of harvest						
Date	lbs./A.	12/23*	3/2*	4/7*	5/12*	6/12	7/7	Total*
11/12/58	1.5	69 b	72 bc	91abc	93ab	95	99	91ab
11/12/58	2.5	54 b	55 c	80 c	85 b	89	93	82 b
12/23/58	1.5	94a	76 b	88abc	89ab	92	95	90ab
12/23/58	2.5	94a	77 b	89abc	87ab	93	93	89ab
3/2 /59	1.5	98a	100a	87abc	87ab	93	93	92ab
3//2 /59	2.5	94a	89ab	82 bc	77 b	86	88	85 b
Check		104a	105a	99ab	100a	102	100	101a
Check		96a	95a	101a	100a	98	100	99a
Hay in yield lb./A.		841	1287	2384	2780	3762	2664	13,718

*Values with the same subscript are not significantly different.

All diuron applications gave excellent control of Sisymbrium irio and Sonchus asper. However, these applications caused a foliage chlorosis and stunted the regrowth of alfalfa. The hay yields for one or more cuttings after treatment were significantly reduced by all except the low rate of application at the third date. Applications of 2 1/2 lb./A of diuron reduced total hay yields more than the 1 1/2 lb./A. application. (Contribution by the Crops Research Division, ARS, USDA, and the Arizona Agricultural Experiment Station, cooperating.)

A study of dalapon, amitrol, and 2,3,6-TBA applied as soil directional sprays to corn. McRae, G. N., Hamilton, K. C., and Arle, H. F. Layby soil treatments applied as directional sprays were made in corn (Asgrow 102) with (dalapon) 2-2 dichloropropionic acid at 15 and 25 lb/A, (amitrol) 3 amino-1,2,4-Triazole, formerly ATA, at 8 and 16 lb/A, and (2,3,6-TBA) 2,3,5,6-Tetrachlorobenzoic acid at 3 lb/A. The treatments were applied May 5, 1959, when the corn was 20-24 inches high and replicated 6 times in a Latin square design. Plots, which were 3 rows wide and 38 feet long, were not cultivated after the herbicides were applied.

Application of dalapon at layby caused stunting, severe leaf and flower malformation and prevented normal ear formation. Application of amitrol at the 16 lb/A rate caused slight stunting. The 16 lb/A rate and the 8 lb/A rate caused temporary yellowing of corn foliage. Directed applications of 2,3,6-TBA had no apparent effect on corn. Corn yields were taken from the center row of each plot, totaling 38 feet of row. The following table shows the various treatments and ear corn yield.

Treatment Herbicide	Rate (lb/A)	Yield 1/ of ear corn (percent of untreated check) *
dalapon	15	1 a*
dalapon	25	0 a
amitrol	8	104 b
amitrol	16	92 b
2,3,6-TBA	3	104 b
Hoed check		100 b

1/ Calculated yield on untreated check 5680 lb/A

*Values with the same subscript are not significantly different.

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

Control of corn cockle. Furtick, W. R. and Chilcote, D. O. A planting of corn cockle, *Agrostemma githago*, was made on the Experiment Station at Corvallis, Oregon. The plants were treated at the early bud stage during the late spring of 1959. Treatments used were 2,4-D amine, 2,4,5-T amine, MCP amine, 2,3,6-TBA amine and an amine salt of DNBP. The treatment rates were 1 pound for each of the materials with the exception of DNBP which was used at the rate of 3 pounds per acre. All applications were made in 40 gallons of water per acre. Observations made 30 days after treatment indicated complete recovery by the plants in all treatments with the exception of MCP. This treatment gave 100 percent kill of all plants. Since corn cockle is an increasing problem in many of the grain producing areas of the West, it would appear the reports on failure of 2,4-D to control this weed were confirmed by this trial and that control may be effected by shifting to the use of MCP. (Oregon Agricultural Experiment Station)

Control of cheatgrass in grass-seed production fields. Canode, C. L., Muzik, T. J. and Robocker, W. C. Cheatgrass (*Bromus Tectorum* L.) is the most widespread and troublesome common weed in grass seed production in the Pacific Northwest. This weed not only competes with the growing plants but also matures early enough to be a source of contamination in all grass-seed crops grown in the area. The seeds of cheatgrass are impossible to separate from most commercially grown grass seeds and difficult to clean from others.

Preliminary screening trials in 1956-57 indicated that several chemicals are effective in controlling cheatgrass without apparent injury to many field grasses. The trial reported here was initiated in the fall of 1958 on Merion bluegrass grown under sprinkler irrigation near Spokane, Washington. Merion was selected because it appears to be less tolerant to chemical injury than the hay and pasture grasses and because of its widespread production in the Pacific Northwest.

The fall treatments were made on November 7, 1958, and the spring treatments on March 15, 1959. Cheatgrass was in the seedling stage of growth at the time of the fall application.

As shown in Table I, a fall application of endothal at 4 lb/A was effective in controlling cheatgrass and did not lower the seed yield of the bluegrass. Endothal at 8 lb/A in the fall resulted in a lower seed yield which was not significant. This reduced seed yield may indicate some injury to the perennial grass. IPC at 4 lb/A in the fall gave good control of the weedy grass but also had a tendency to lower seed yields of the Merion bluegrass. Rates of IPC appear to be more critical since the 8-pound rate caused severe injury to the bluegrass. The granular form of IPC severely reduced seed yields and was no more effective than the liquid form in controlling cheatgrass. CIPC in granular or liquid form caused significant losses in seed yield of the Merion bluegrass. In general, spring applications of endothal and IPC were not effective in controlling cheatgrass. (Crops Research Division, Agricultural Research Service, U. S. Dept. of Agriculture, and Washington Agricultural Experiment Station, Cooperating.)

Table I. Seed yield and control of cheatgrass in Merion bluegrass as affected by chemicals applied at different rates in the spring and fall.

Chemical[1/]	Rate	Time of Application	Cheatgrass Control*	Clean Seed*	
	lb/A		% kill	lb/A	
endothal	4	Fall	80	263	
None	0	--	0	253	
monuron	2	Fall	15	229	
monuron	1-	Fall	0	226	No sig.
IPC	4	Spring	45	220	difference
2, 3, 6-TBA	4	Fall	10	218	Duncan
endothal	4	Spring	0	204	Multiple
2, 3, 6-TBA	8	Fall	10	200	Range
IPC	4	Fall	85	200	Test
endothal	8	Fall	90	198	
CIPC	4	Fall	45	187	
endothal	8	Spring	10	173	
CIPC (Granular)**	6	Fall	85	161	
CIPC (Granular)**	6	Fall	75	156	
IPC	8	Spring	60	146	
IPC	8	Fall	95	123	
CIPC	8	Fall	80	97	
IPC (Granular)	6	Fall	90	84	
L. S. D. .05				48	

* Average of four replications with the cheatgrass control figure rounded t to the nearest 5%.

** These two materials differ only in carrier.

The use of atrazin and amitrol for chemical summer fallow. Swan, D. G. Rates of atrazin (2, chloro-4, ethylamino-6 isopropylamino-s-triazine) and atrazin plus amitrol (3 amino 1, 2, 4 triazole) were applied on December 16, 1958 for the control of vegetation in the fallow year. Treatments were made post-emerge to the volunteer wheat, cheatgrass (*Bromus tectorum*) and tarweed (*Amsinckia intermedia*). The treatments were pre-emerge to the spring germinated knotweed (*Polygonum aviculare*) and Russian thistle (*Salsola Kali* var *tenuifolia*). Data were obtained on July 8, 1959.

Atrazin at 2 lb/A gave 100 percent control of all species. At the 1 lb/A rate, the control was 70 percent for Russian thistle, 80 percent for volunteer wheat, 90 percent for cheatgrass and tarweed and complete knotweed control. Poor control was obtained at the 1/2 lb/A rate. Atrazin at 2 lb/A plus amitrol at 1 lb/A gave complete control. At the 1 plus 1 lb/A rate of the combined materials, Russian thistle control was 40 percent with 100 percent control of all other species. At the 1/2 lb atrazin plus 1 lb/A amitrol rates, 100 percent volunteer wheat and cheatgrass control was obtained with poor control of the other species. (Oregon Agricultural Experiment Station, Pendleton)

PROJECT 5. WEEDS IN HORTICULTURAL CROPS

Jerry F. Renfrow, Project Chairman

SUMMARY

Eight reports were received from nine investigators in three states. The reports are summarized below:

Beans, Kentucky Wonder. EPTC and three analogs R-1607, R-2060, and R-2061 were applied and incorporated into the soil for the control of purple nutgrass and purslane. R-1607 gave the highest percentage control, but some crop injury was noted.

Chile. Post-emergence. Eight s-triazine compounds caused injury or gave inadequate weed control on chile. Alanap-2 at 2.0 lb/A, CDEC at 12 lb/A, diuron at 1 and 1 1/2 lb/A, zytron at 10 and 20 lb/A. gave 87 to 92% weed control.

Citrus, Avocado, Olive, and Peach. Post-emergence. Seedlings of avocado, peach, and sweet orange; and cuttings of olive were screened in a greenhouse trial to determine the relative toxicity of several herbicides. The results are given in table form.

Citrus orchards. Post-emergence. Thirteen herbicides at rates of 0.3 to 5 lb/A. were screened for the control of *Oxalis cernua* in citrus orchards. Six of these materials gave complete control in this trial.

Corn, Sweet. Pre-plant and pre-emergence. EPTC was applied at 0, 3, 6, and 9 lb/A. and incorporated to a depth of six inches before planting or one inch following planting. Sweet corn was planted at one, two and four inch depths. Corn injury increased with increased rates of EPTC and with increased depth of planting.

Endive. Pre-plant. EPTC applied to a sandy loam, in seed bed condition, at 1 1/2, 3, and 6 lbs/A. satisfactorily controlled nutgrass and nightshade. Endive transplanted 7 1/2 weeks after application grew without injury from either rate of EPTC or competition from the nutgrass.

Potatoes, Irish. Pre-plant. EPTC at 3 lbs/A. applied seven days before planting and incorporated into the soil satisfactorily controlled nutgrass in Irish potatoes. The small growth of nutgrass occurring by harvest was insignificant compared to the untreated areas.

Tulips. Pre-emergence. Applications of simazin at 1, 2, and 4 lbs/A., and diuron at 3.2, 4.8, and 6.4 lbs/A. were compared to the current recommended practice of DNBP-CIPC combination for annual weed control in tulips. Simazine caused injury and yield reduction at the rate needed for good annual weed control. Diuron at 3.2 lbs/A. gave excellent weed control with no reduction in bulb yield.

CONTRIBUTORS REPORTS

Effects of EPTC and three analogs on Kentucky Wonder Beans and weed growth. Jordan, L. S., McCarty, C. D., and Day, B. E. EPTC and three analogs R-1607 (n-propyl di-n-propylthiolcarbamate), R-2060 (ethyl ethyl-n-butylthiolcarbamate), and R-2061 (propyl ethyl-n-butylthiolcarbamate) were compared with Kentucky Wonder Pole beans as the crop plant. Weed growth consisted of purple nutgrass (Cyperus rotundus) and purslane (Portulacae oleracea). All materials were applied at 3 pounds per acre to a slightly moist sandy loam soil, disced immediately to a depth of 4 inches, and planted within three days. Germination appeared normal in all plots. The foliage of bean plants growing in the R-1607 treated soil developed a slight yellow cast which was outgrown by the time the beans went on poles. No reduction in growth occurred. No symptoms were noted on plants growing in EPTC, R-2060, and R-2061 treated soils.

Weed control ratings were made 2 months after treatment. R-1607 gave 99% control of nutgrass and 95% control of purslane. R-2060 gave 50% control of both nutgrass and purslane. R-2061 gave 90% control of both nutgrass and purslane. EPTC gave 80% control of nutgrass and no control of purslane. In these tests R-1607 appeared to be the most phytotoxic. (University of California Citrus Experiment Station and University of California Agricultural Extension Service)

Screening test of herbicides on chile. Gould, W. L. and Szabo, S. S. The response of chile to eight s-triazine compounds and to five other herbicides was tested in the field. Basal directed spray treatments were applied June 19, 1959, on single row plots with a flooding type nozzle to 12"-14" chile. Alternate rows were left as borders between plots. Each treatment was applied with water carrier at the rate of 40 gpa. Treatments were randomly located and replicated twice. The treatments applied were: G-31717 (2-methoxy-4-diethylamino-6-isopropylamino-s-triazine), G-32292 (2-methoxy-4-methylamino-6-isopropylamino-s-triazine) and G-32293 (2-methoxy-4-ethylamino-6-isopropylamino-s-triazine) at 1 lb/A; G-30026 (2-chloro-4-methylamino-6-isopropylamino-s-triazine), G-30027 (2-chloro-4-ethylamino-6-isopropylamino-s-triazine), G-30031 (2-chloro-4-diethylamino-6-isopropylamino-s-triazine) and G-30044 (2-methoxy-4, 6 bis(ethylamino)-s-triazine) at 1 and 2 lb/A; G-27901 (2-chloro-4-diethylamino-6-isopropylamino-s-triazine) at 2 lb/A; NPA (N-1-naphthylphthlimide), 4 lb/A; CDEC (2-chloroallyl diethylthiocarbamate), 6 and 12 lb/A; diuron (3(3, 4-dichlorophenyl)-1, 1-dimethylurea), 1 and 1 1/2 lb/A; Zytron (0-2, 4-dichlorophenyl 0-methyl isopropylphosphoroamidothioate), 10 and 20 lb/A; and NIA-4556 (N-(3, 4-dichlorophenyl) methacrylamide at 3 and 6 lb/A.

At the rates used all the s-triazine compounds tested were injurious to the chile except G-31717, which caused moderate chlorosis within two weeks after treatment, but the chile recovered before harvest. G-31717 provided 70% weed control. None of the other treatments appeared to be toxic to the chile. As compared to the untreated checks, the following degree of weed control was obtained: NPA, 92%; CDEC, 6 and 12 lb/A, 77 and 88% respectively; diuron, 1 and 1 1/2 lb/A, 87 and 92%; Zytron, 10 and 20 lb/A, 90 and 92%; while NIA-4556 was ineffective. (New Mexico State Agricultural Experiment Station)

The tolerance of citrus, avocado, olive and peach seedlings to various herbicides. Jordan, L. S., Day, B. E., Pettitt, R. J. An herbicide screening program was conducted under greenhouse conditions to establish the relative toxicity of the chemicals tested. The objective of this work was to develop basic data to aid in field trials and to produce and record injury symptoms of the various herbicides tested.

Koethen Sweet orange and Topa Topa and Duke avocado seedlings were grown in flats and later transplanted to tin cans. Rooted Manzanello olive cuttings were also planted in cans. Peach seeds were layered in vermiculite at 40° F. until signs of sprouting appeared, at which time the viable kernels were separated from the shells and planted directly into cans. Application of herbicides was made after the plants were well established. All trials were conducted in closed containers to prevent leaching. Weighed amounts of air-dry Vista sandy loam soil was used and moisture was maintained close to 75% of field capacity by weight, using only de-ionized water. Chemicals were applied to the soil surface in water solution and concentrations based on the per cent active ingredient and applied as ppm to the dry weight of the soil without contact with the plant foliage.

Each treatment was replicated four times with one randomized replicate for each group. The four groups were determined by sorting according to size and quality so as to equalize variations in plant size and vigor. Following treatment, weekly observations were made for plant height and injury symptoms.

At the end of the 12-week trial period injury was rated and for citrus and avocados, the fresh weight of roots and tops taken. The results of these trials are summarized in table 1 for citrus and table 2 for avocados, olives and peaches. Fenuron was applied to citrus seedlings at rates of 0.125 ppm, 0.25 ppm, and 0.5 ppm and was found to cause slight injury at 0.5 but no injury at the lower rates. In previous trials, fenuron produced death of citrus at concentrations of 1 ppm and above. (University of California Citrus Experiment Station, Riverside, California)

A Comparison of the Tolerance of Citrus Seedlings to Various Herbicides

Observations 12 weeks post-treatment (Greenhouse Trials)

Table 1.

(0) - No visible injury (I) - Visible injury (D) - Plant dead

Herbicide applied	Rate at soil application in ppm.								
	0.5	1	2	4	8	16	32	64	128
Dinitro	0	0	0	0	0	I	I	I	D
endothal	0	0	0	0	0	0	0	I	I
napthoquinones[1/]									
954	0	0	0	0	0	0	0	0	0
B470	0	0	0	0	0	0	0	0	I
B562	0	I	I	I	I	I	I	I	I
Analogs of EPTC[2/]									
R-1607	0	0	0	0	0	0	I	I	I
R-2061	0	0	0	0	0	0	0	0	I

1/ Napthoquinones

954 = 2-dimethylamino-1,4-napthoquinone
B470 = 2-diethylamino-1,4-napthoquinone
B562 = 2-isopropylamino-1,4-napthoquinone

2/ Analogs of EPTC
R-1607 = n-propyl-di-n-propylthiocarbamate
R-2061 = propylethyl-n-butylthiocarbamate

A Comparison of the Tolerance of Avocado, Peach, and Manzanello Olive Seedlings to Various Herbicides.

Observation 12 weeks post-treatment (Greenhouse trials)

Table 2.

(0) - No visible injury (I) - Visible injury (D) - Plant dead

Herbicide applied	Rate of application in ppm. 0.125	0.25	0.5	1	2	4	8	16	32	64	128
Avocados:											
PBA, Benzac 103-A	I	I	I	I	I	D					
silvex, 2,4,5-TP	0	0	I	I	I	I					
2,4,5-T	0	I	I	I	I	I					
2,4-DA	0	0	0	0	I	I					
EPTC				I	I	I	I	I	I		
Olives:											
atrazin			I	I	D	D	D	D	D	D	D
trietazin			0	0	I	I	D	D	D	D	D
Peaches:											
amitrol			I	I	I	I	I	I	I	I	D
atrazin			I	I	I	D	D	D	D	D	D
propazin			I	I	I	D	D	D	D	D	D
simazin			I	I	I	I	I	I	I	D	D
trietazin			I	I	I	I	D	D	D	D	D
*dalapon			I	I	I	I	I	I	I	I	D
*TCA			0	0	I	I	I	I	I	I	I

* 5-weeks test only.

Control of Oxalis cernua in citrus orchards. Jordan, L. S., McCarty, C. D., and Day, B. E. Thirteen herbicides were screened for use to control Oxalis cernua in citrus orchards. The rate of application of each herbicide was varied from 0.3 to 5 lb/A in 100 gallons of water with a logarithmic dilution sprayer. The treatments were made when the oxalis was in full bloom. Three replications were employed.

The herbicides which completely controlled the oxalis and the average rates required are as follows: amitrol 2 lb/A, 2,4,5-T acid 2 lb/A, butoxyethanol ester of 2,4,5-T 2.4 lb/A, propyleneglycol butyl ether ester of silvex 2.5 lb/A, 2,4-D acid 3.2 lb/A, and butoxyethanol ester of 2,4-D 2.5 lb/A. The oxalis was more susceptible to these herbicides in shaded areas of the orchard than in open sunny areas.

Herbicides which did not control the oxalis at 5 lb/A or less are: butoxyethanol ester of 2-(2,4-DP), dimethyl amine salt of 4-(2,4-DB), dimethyl amine salt of 4-(MCPB), dimethyl amine salt of MCPA, 2,3,6-TBA, dimethyl amine salt of 2,3,6-TBA and PBA. (University of California Citrus Experiment Station, Riverside)

Effect of depth planting and depth of incorporation on EPTC injury to corn. Jordan, L. S., McCarty, C. D. and Purnell, D. C. A trial was established to determine the effects of the depth of corn planting and the depth of EPTC incorporation on its injury to corn. Oats were planted in the entire plot area prior to the first EPTC application. EPTC was applied at 0, 3, 6 and 9 lb/A. It was incorporated either immediately before planting to a depth of six inches with a disk or immediately after planting to a depth of one inch with a spike-tooth harrow. Sweet corn was planted at one, two and four inch depths. The Hanford fine sandy loam soil was dry when the treatments were made. The plots were sprinkler irrigated three days after treatment.

The oats, nutgrass (Cyperus esculentus) and lambsquarters (Chenopodium album) were controlled in every EPTC treated plot. The corn was injured initially by the EPTC in all plots. The injury symptoms disappeared within one month from the plots with 3 lb/A of EPTC and the one inch depth of planting. The injury to corn increased with increased rates of EPTC and with increased depth of planting. Injury was greater in the plots with one inch incorporation after planting than in the plots with six inch incorporation before planting. (University of California Citrus Experiment Station, Riverside, California)

Effects of EPTC on nutgrass, nightshade, and endive. Jordan, L. S., McCarty, C. D., and Day, B. E. EPTC was applied to a sandy loam soil in seedbed condition at rates of 1 1/2, 3, and 6 pounds per acre. Each rate was replicated four times and disced to a depth of 4" immediately after application. The herbicide was applied on March 2, weed counts were made 5 weeks later on April 6 and are given in the following table:

Nutgrass (Cyperus rotundus)

Rep	Rate lbs/A CK	1 1/2	3	6
1	66	4	0	0
2	42	3	0	0
3	70	7	1	0
4	29	8	1	0
Total	207	22	2	0

Nightshade (Solanum villosum)

Rep	Rate lbs/A CK	1 1/2	3	6
1	68	1	1	0
62	62	2	1	1
3	65	0	1	1
4	37	7	0	0
Total	232	10	3	2

Endive was transplanted into the treated area on April 23, 7 1/2 weeks after application of the herbicide. The soil was disced and furrowed and irrigated heavily at time of transplanting. No injury occurred to the endive at any rate. Harvest took place during the second and third week in June. There was no further germination of nightshade. A slight regrowth of nutgrass had occurred by harvest time but was of no economic importance. Under the conditions which occurred here, the nutgrass was suppressed for a period of time which allowed the planting, growth, and harvesting of a crop plant without competition from the nutgrass. (University of California Citrus Experiment Station and University of California Agricultural Extension Service.)

Control of nutgrass in Irish potatoes with EPTC. Shadbolt, C. Allan. Ethyl di-n-propylthiolcarbamate (EPTC) at 3 lb/A was applied to a Hanford fine sandy loam soil heavily infested with nutgrass tubers and incorporated by working twice with a spring tooth harrow. The chemical was applied in 100 gal water per acre 7 days before the potatoes, variety White Rose, were planted. Application was made to dry soil. Three replications of 12 x 100 ft were used.

During the early growth of the potatoes, the nutgrass was nearly completely controlled. The few plants that did appear were in the bottoms of the furrows. It is assumed that the chemical was not incorporated deep enough to affect these nutgrass tubers. By harvest time, some growth of the nutgrass did occur, but the infestation was insignificant compared to the untreated areas.

Growth of the potato plants throughout the season appeared completely normal. Yield of tubers were recorded from a total of 120 feet of bed from each of the treated and check plots. An average of 306 pounds of potatoes were harvested from the plots receiving 3 lb/A of EPTC, and 292 pounds from the untreated controls, indicating that the treatment had no effect upon the yield of potatoes. (University of California, Riverside)

Annual weed control in tulips with pre-emergence applications of chemical herbicides. Peabody, Dwight V., Jr. Excellent control of winter annual weeds but only partial control of summer annuals is the usual result from the presently recommended DNBP-CIPC combination of herbicides applied during the fall as a pre-emergence treatment in ornamental bulbs including tulips. From tests carried out in previous years, certain analogues of the relatively insoluble substituted-urea and triazine families of chemical compounds showed enough persistence in some soils under western Washington conditions to maintain ornamental bulb plantings free of annual weed competition the entire growing season - September to July. Objectives of last year's experiment were: (1) to determine persistence and amount of annual weed control obtained with several different herbicides (particularly diuron and simazin) in comparison to currently recommended weed control practices, and (2) to determine the effect of these pre-emergence herbicidal treatments on yield of iris, narcissus and tulips. (This report will present data from the tulip experiment only.)

This experiment was located at the Northwestern Washington Experiment Station on Puget silt-loam soil having a pH of approximately 6.0. All herbicides at the designated rates of application (see table) were applied with a small tractor-mounted plot sprayer at a pressure of 40 psi in a total volume of water equivalent to 80 gallons per acre. All pre-emergence applications were made in mid-October of 1958. The experimental design was a randomized complete block replicated 5 times. Plot size was one row 15 feet long. Equal weights of tulip bulbs of the same size (8 cm) were planted in each plot. Variety was Bartigan. All bulbs were planted in early October of 1958 in furrows 4 inches deep and then covered and hilled 4 to 5 inches high. At planting time all rows were side-dressed with a fertilizer application of 10-20-20 at the rate of 800 pounds per acre. All plots were rotovated twice (once in April, once in May) without disturbing the hills. Check plots were hoed and hand-weeded 3 times during the summer of 1959.

Weed estimates were made in late May with a 100 square grid-quadrat 12" x 50". This quadrat was dropped 4 times in each plot on the undisturbed hill. Data were recorded as total number of squares containing weeds. These data were then converted to percentages which in turn were transformed by the angular transformation for statistical analyses. Another estimate of weed control was made just prior to harvest by means of a rating system - o - no control to 10 - elimination of all weed growth. All plots were kept separate at digging time as well as when sorted shortly thereafter. Tulip bulbs were sized into two categories, salables and planting stock, and were weighed to the nearest .01 pound. Tulip bulbs of salable size were 10 cm and larger; planting stock, 9 cm and smaller.

Principal annual weed species present in order of their importance were as follows: Polygonum pennsylvanicum L., smartweed; Polygonum aviculare L., knotweed; Chenopodium album L., lambs-quarters; Stellaria media Cyrill, chickweed; Senecio vulgaris L., groundsel; and Poa annua L., annual blue grass.

From the experimental results as presented in the table, the following conclusions can be made: (1) simazin at a rate high enough to give good annual weed control results in bulb injury and reduction in yield; (2) the two granular materials tested do not give adequate annual weed control; and (3) pre-emergence treatment of diuron at 3.2 pounds active ingredient per acre resulted in excellent control of annual weed species present the entire season (approximately ten months) with no reduction in yield of salable tulip bulbs. (Northwestern Washington Experiment Station, Washington State University)

Yield of salable tulip bulbs and annual weed control estimates of 1958-1959 pre-emergence herbicide test in ornamental bulbs.

TREATMENT		YIELD[1]	ANNUAL WEED CONTROL	
Herbicide	Rate[2]	lbs/plot	Cover[3] %	Rating[4]
simazin	1.0	6.16	28.3	3.6
simazin	2.0	5.59	23.1	5.2
simazin	4.0	4.62	8.6	6.9
diuron	3.2	6.71	7.2	7.9
diuron	4.8	5.96	4.9	8.0
diuron	6.4	6.36	5.7	8.6
simazin gran.	2.0	5.21	13.5	6.0
monuron-borate granular	25.0	6.30	30.3	3.1
DNBP + CIPC	4.5+4.0	6.27	16.4	4.3
CIPC[5]	4.0	5.60	8.8	6.1
Hoed & hand-weeded[6]		5.45	34.3	9.2
	$\bar{x}$	5.839	15.18	
	$SE_{\bar{x}}$	0.513	0.28	
	CV	20%	30%	

1 Salable sizes only - 10 cm circumference and larger.
2 Rate of application expressed as pounds active ingredient per acre.
3 Estimates made May 28, 1959, with grid quadrat.
4 Rating system of 0 - no control to 10 - complete elimination of all weeds used. Estimates made July 16, 1959.
5 All plots that received this 4 lb/A rate of CIPC as a pre-emergence treatment were sprayed again in early April after emergence.
6 Hoed and hand-weeded three times during spring and summer of 1959: early May, early June, and early July.

PROJECT 6. WEEDS IN AGRONOMIC CROPS

J. A. Wilkerson, Project Chairman

SUMMARY

Although the scope of the previous year's project--Weeds in Fruits, Vegetables and Row Crops--was properly sub-divided into two sections, Horticultural and Agronomic Crops, the number of papers falling into the latter category was not seriously reduced.

This report includes 10 abstracts dealing with weed problems in 5 crops from 4 states, Arizona, California, Washington and Wyoming. Thirteen men reported timely and pertinent information and are to be commended for making their results available to such a wide group this year. Their results are summarized by crops below.

Corn. (a) Pre-emergence. Alley at Wyoming obtained outstanding results with simazin and atrazin at all rates used at two locations. In comparison, Eptam (EPTC) was equally as effective on grasses but inferior for broad-leaf weed control. (b) Pre-plan, pre-emergent and post-emergent. Hamilton and co-workers at Arizona obtained best weed control with simazin when applied pre-plant, with slight reduction in control from pre-emergence application and somewhat greater reduction when applied post-emergent to corn. (c) Alley, in post-emergence studies, used 17 chemicals or their combinations and reported outstanding control of all weeds with atrazin. Several others appear promising.

Cotton. Miller and Kempen studied the effects of soil incorporation on 20 herbicides when applied pre-emergent to cotton. They classified materials into 3 groups depending on degree of weed control and amount of cotton injury. McRae and co-workers studied the effects of monuron and diuron at different rates and stages of cotton growth. In general monuron seemed to produce more cotton injury under a given set of conditions. Also soil texture greatly influenced degree of injury.

Grass (grown for seed). Peabody compared the effects of six growth-regulating type materials on seed yield of four grass species. Yield reductions were noted only in the Creeping red fescue trials with silvex and 2,4,5-T. Type of formulation (ester) was suggested as contributing to this injury.

Peas. Anderson and Muzik compared Carbyne and atrazin at two dates for wild oat control. At the early date, carbyne gave excellent control with increased yield of peas. When applied 2 weeks later, it stunted peas and wild oats with neither being killed. Atrazin did not control wild oats.

Sugar Beets. Alley, in pre-emergence trials, compared liquid and granular materials and reported less injury with the latter. Effect of soil incorporation was also studied. Foy studied the effects of Endothal and certain thiolcarbamate herbicides when soil incorporated prior to planting. In general, EPTC and related compounds gave better control of grasses than broad-leaf weeds. R-2061 appears to be very promising. In another experiment, he compared four methods of application and found that soil incorporation greatly improved the performance of materials. Endothal and EPTC were the most promising.

CONTRIBUTORS REPORTS

Pre-emergence weed control in field corn. Alley, H. P. Chemical evaluation trials were conducted at Torrington and Wheatland, Wyoming, comparing various rates of new, as well as established herbicides for pre-emergent weed control in field corn. The corn was planted May 12, and chemical applications made May 14 at Wheatland and May 15 at Torrington. Each plot consisted of 2 corn rows, 25 ft. long and spaced 40 in. apart. The treatments were applied in water, equivalent to 40 gpa, and replicated 3 times. Good soil moisture was present at both locations. Corn, broadleaved weeds and grass stand counts were taken from a 4 in. x 10 ft. quadrate located over each corn row four weeks following chemical application.

Several of the chemicals and combination of chemicals gave good weed control without any measurable effect on corn stand. There was considerable differences between the percentage weed control between the two stations. Simazin and atrazin were outstanding at both locations. At the rate of 1, 2 and 3 lb/A these two chemicals controlled from 98 to 100 percent of both the grasses and broad-leaved weeds. EPTC treatments gave good control of grasses but was not as effective as simazin or atrazin on broadleaved weeds. Data regarding other treatments are summarized in the following table. (Wyoming Agricultural Experiment Station)

TABLE I PRE-EMERGENT WEED CONTROL IN CORN AT TORRINGTON & WHEATLAND, WYOMING

		Corn Stand Count				Broad-leaved Weeds 1/				Grasses 2/			
Chemical	Rate lb/A	Wheat-land	Torring-ton	Total	% of Check	Wheat-land	Torring-ton	Total	% of Control	Wheat-land	Torring-ton	Total	% of Cont.
2,4-D (Butyl ester)	1	84	64	148	113	153	7	160	29	116	29	145	0
2,4-D (Butyl ester)	2	79	64	143	109	68	15	83	63	34	14	48	62
2,4-D (PGBE)	1	85	64	149	114	36	18	54	76	14	15	29	77
2,4-D (PGBE)	2	77	53	130	99	37	18	55	76	10	34	44	65
2,4-D (Amine)	1	82	54	136	104	70	30	100	56	55	38	93	59
2,4-D (Amine)	2	80	60	140	107	59	31	90	60	30	28	58	54
CDAA	2	94	66	160	122	99	173	272	0	100	49	149	0
CDAA	4	92	59	151	115	55	137	192	15	95	46	141	0
CDAA	6	83	69	152	116	74	105	179	21	80	57	137	0
CDAA 2,4-D (PGBE)	2 1/2	90	70	160	122	58	35	93	59	26	53	79	37
CDAA 2,4-D (PGBE)	4 1/2	77	68	145	110	36	45	81	64	49	73	122	3
CDAA 2,4-D (PGBE)	2 1	81	67	148	113	20	25	45	80	8	21	29	77
CDAA 2,4-D (PGBE)	4 1	95	59	154	117	64	18	82	64	62	13	75	41
simazin	1	91	66	157	120	4	1	5	98	2	1	3	98
simazin	2	79	48	127	97	0	0	0	100	1	0	1	99
simazin	3	90	58	148	112	0	0	0	100	1	0	1	99
atrazin	1	85	58	143	109	2	0	2	99	1	0	1	99
atrazin	2	75	68	143	109	0	0	0	100	0	0	0	100
atrazin	4	94	58	152	116	0	0	0	100	0	0	0	100
EPTC	2	88	59	147	112	10	16	26	89	4	0	4	97
EPTC	4	78	66	144	110	12	12	24	89	4	0	4	97
DNPB	5	74	68	142	108	77	31	108	52	31	37	68	46
DNPB	7.5	79	55	134	102	37	15	52	77	50	6	56	56
DNPB	9	83	54	137	105	22	10	32	86	54	31	85	33
Fenac M-673A	1	85	59	144	110	69	32	101	55	69	28	97	23
Fenac M-673A	2	76	68	144	110	23	2	25	89	39	6	45	64
Check		70	61	131	100	107	119	226	0	36	90	126	0

1/ Kochia (*Kochia scoparia*), Lambs quarters (*Chenopolium alba*), Rough pigweed (*Amaranthus retroflexus*), Wild sunflower (*Helianthus annuus*).
Green foxtail (*Setaria viridis*), Barnyardgrass (*Echinochloa crusgalli*).

Simazin for weed control in corn. Hamilton, K. C., Arle, H. F., McRae, G. N. Under irrigated agriculture certain pre-emergence herbicides have proven more effective when applied before planting than when applied after planting. This test was conducted to determine the effects of pre-planting, pre-emergence, and post-emergence applications of simazin on corn and weeds.

Field corn was planted at Yuma, Arizona (Gila silty clay loam soil) in February and March of 1959. The treatments, , 2, 3, and 4 pounds per acre of simazin, a hoed check, and an unhoed check, were replicated 6 times in Latin squares for the three dates of application. Plots were 3 rows, 40 feet long. Plots were not cultivated after the herbicide was applied.

In pre-planting applications, simazin was applied to the soil on February 24, the area was harrowed, and corn (Asgrow 106) was planted on March 6. In pre-emergence applications the herbicide was applied to the soil on February 27 immediately after the corn was planted. In post-emergence applications the spray was applied over-the-top of corn on April 8 when the plants were 8 inches high.

On April 17 and May 18 the percent weed control was estimated on each plot. Weeds present were alfalfa, *Echinochloa colonum*, *E. crusgalli*, *Sisymbrium irio*, *Malva parviflora*, *Chenopodium murale*, *Portulaca oleracea*, and *Sonchus asper*. The averages of the estimated control for each treatment are given in the following table.

	Percent Weed Control		
	Time of Application		
Treatment	Pre-plant	Pre-emergence	Post-emergence
Check - hoed	93	93	97
Check - not hoed	0	0	0
simazin 1 lb/A.	93	74	49
simazin 2 lb/A.	97	90	75
simazin 3 lb/A.	97	96	81
simazin 4 lb/A.	98	97	90

Check - hoed	100	100	100
Check - not hoed	104	97	98
simazin 1 lb/A.	104	99	104
simazin 2 lb/A.	110	94	98
simazin 3 lb/A.	101	96	98
simazin 4 lb/A.	106	93	103
*Yield of checks in lb. /A.	6,340	7,170	7,330

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

Post-emergence weed control in field corn. Alley, H. P. Seventeen chemicals and combination of chemicals were evaluated as post-emergence weed control herbicides in field corn. Plots were established at Torrington and Wheatland, Wyoming and treatments made when the corn was in the two-leaf stage of growth. Each plot consisted of 2 corn rows, 25 ft. long with 40 in. row spacing. Each treatment was replicated three times at each location. Application was made with a bicycle wheel mounted, experimental plot sprayer applying 40 gpa as a full coverage spray. Corn, broadleaved weed and grass counts were taken from a 4 in. x 10 ft. quadrate located over each corn row, three weeks following chemical application.

Atrazin at 1 and 2 lb. active per acre controlled an average 85 to 95 percent of both grass and broadleaved weeds for both stations. Control at Torrington was virtually 100 percent, whereas control at Wheatland was not as outstanding. Both areas are predominantly a sandy soil. The Wheatland area received moisture just prior to application and the soil was wet on the surface as well as at lower soil depths, whereas, the Torrington area received .55 in. of moisture one day following treatment. Percentage control by other chemicals are listed in the attached table. (Wyoming Agricultural Experiment Station)

TABLE II POST-EMERGENT WEED CONTROL IN CORN AT TORRINGTON & WHEATLAND, WYOMING

		Corn Stand Count				Broad-Leaved Weeds 1/				Grasses 2/			
Chemical	Rate #/A	Wheat-land	Torring-ton	Total	% of Check	Wheat-land	Torring-ton	Total	% of Control	Wheat-land	Torring-ton	Total	% of Control
2,4-D (Amine)	1/2	85	59	144	98	45	18	63	66	42	20	62	62
2,4-D (Amine)	1	82	60	142	97	74	6	80	57	54	11	65	60
2,4-D (PGBE)	1/2	86	48	134	91	68	21	89	52	33	33	66	60
2,4-D (PGBE)	1	80	65	145	99	83	19	102	45	76	17	93	43
2,4-D (Butyl ester)	1/2	87	59	146	99	79	15	94	49	67	8	75	54
2,4-D (Butyl ester)	1	88	66	154	105	66	8	74	60	60	8	68	59
CDAA	2	82	59	141	96	100	147	247	0	71	7	78	52
CDAA	4	82	64	146	99	137	32	169	8	29	1	30	82
CDAA 2,4-D (PGBE)	2 1/2	70	65	135	92	67	10	77	58	35	0	35	79
CDAA 2,4-D (PGBE)	2 1	93	54	147	100	55	8	63	66	23	6	29	82
CDAA 2,4-D (PGBE)	4 1/2	92	66	158	107	87	14	101	45	36	2	38	77
CDAA 2,4-D (PGBE)	4 1	78	66	144	98	50	0	50	73	16	0	16	90
DNPB	2	77	59	136	92	17	15	32	83	33	20	53	68
DNPB	4	74	68	142	97	19	15	34	82	27	8	35	79
atrizin	1	88	59	147	100	27	1	28	85	18	3	21	87
atrizin	2	84	58	142	97	12	0	12	94	13	2	15	91
Check		86	61	147	100	99	85	184	0	64	100	164	0

1/ Kochia (*Kochia scoparia*), Lambs quarters (*Chenopodium album*)
Rough pigweed (*Amaranthus retroflexus*), Wild sunflower (*Helianthus annuus*).
2/ Green foxtail (*Setaria viridis*), Barnyardgrass (*Echinochloa crugalli*).

Evaluation of soil-incorporated pre-emergence herbicides for annual grass control in cotton. Miller, J. H. and Kempen, H. M. Surface applied pre-emergence herbicides have not provided consistent annual weed control in cotton in California. When rain occurs after planting some measure of success has been obtained, but without rain weed control is nil. This experiment was designed to test the hypothesis that soil moisture is adequate to activate certain herbicides when they are soil incorporated.

Twenty herbicides were compared for annual grass control in furrow-irrigated cotton grown on a Hesperia fine sandy loam. Cotton was planted at 2 inches and the herbicides were incorporated to a depth of 1 1/2 inches. This was accomplished simultaneously by means of specially-designed equipment that permitted seeding of cotton and weeds and spraying and incorporating of herbicides. Incorporation depth was very precise with deviations of less than 10 per cent. The herbicides were logarithmically applied in 10-inch bands using a volume of 75 gal/A. Plots were 130 feet long and the half-dosage distance was 26.8 feet. Each 2-row plot was split; both rows received identical treatment except one row received a herbicide. Thus, paired plot comparisons could be made.

At treatment (May 4) soil moisture was at field capacity and average maximum and minimum air temperatures (May 4-18) were 84.3° and 52.3° F. No rain occurred after treatment. Data were recorded before irrigation (at 16 days) and after 2 irrigations (at 60 days). The ratings were based on a scale of 0 to 10, in which 10 represented complete absence of weeds or cotton (Table 1).

Since soil incorporation involves a third demension (depth), a true expression of rates should also include the third dimension. Use of ppmv., ppmw, or pounds per acre-inch (lb/A-in.) would satisfy this requirement and permit more valid comparison of herbicides incorporated to different depths. In this study, lb/A-in. has been used since it seemed to be the most logical choice in a field study.

A list of the herbicides used and the maximum rates applied in terms of both lb/surface-acre and lb/acre-inch follows:

1. Twenty-four lb/A (16 lb/A-in.).
   a. 0-2,4-dichlorophenyl-0-methyl isopropylphosphoroamidothioate (M-1329).
2. Eighteen lb/A (12 lb/A-in.).
   a. 4,6-dinitro-0-secondary butylphenol (DNBP).
   b. N-1-naphthylphtalamic acid (NPA).
   c. 2-chloro-N,N-diethylacetamide (CDEA).
   d. 2-chloro-N,N-diallylacetamide (CDAA).
   e. 2-chloroallyl diethyldithiocarbamate (CDEC).
   f. isopropyl N-(3 chlorophenyl)carbamate (CIPC).
3. Twelve lb/A (8 lb/A-in.).
   a. ethyl-di-n-propylthiolcarbamate (EPTC).
   b. ethyl ethyl-n-butylthiolcarbamate (R-2060).
   c. propyl ethyl-n-butylthiolcarbamate (R-2061).
   d. n-propyl-di-n-propylthiolcarbamate (R-1607).
   e. 2,6-dichlorobenzonitrile (N-5996).
4. Six lb/A (4 lb/A-in.).
   a. 3-(3,4-dichlorophenyl)-1,1-dimethylurea (diuron).
   b. 3-(p-chlorophenyl)-1,1-dimethylurea (monuron).
   c. 2-chloro-4,6-bis (ethylamino)-s-triazine (simazin).
   d. 2-chloro-4-diethylamino-6-ethylamino-s-triazine (G-27901).
   e. 2-chloro-4-diethylamino-6-isopropylamino-s-triazine (G-30031).

f. 2-methoxy-4, 6-bis-(ethylamino)-s-triazine (G-30044).
g. 2-methoxy-4, 6-bis(isopropylamino)-s-triazine (G-3145).
h. 2-methoxy-4-diethylamino-6-isopropylamino-s-triazine (G-31717).

Examination of plant response data from the soil incorporation treatments revealed that the herbicides could be placed in three groups (Table 1):

1. Herbicides providing adequate weed control (_9) with negligible injury to cotton (_3).
2. Those providing good weed control (_9), but also causing moderate to severe injury to cotton (3).
3. Those showing little effect on either weeds or cotton.

Table 1. The effect of soil-incorporated herbicides on annual grass and cotton.

Herbicides	Maximum rate 1/	Range of rates 1/ providing weed control		Range of rates 1/ causing cotton injury	
		16 days	60 days	16 days	60 days
Group 1:					
CDAA	12	2-12	6-12	-	-
CDEA	12	3-12	12	-	-
CDEC	12	6-9	6-12	12	-
CIPC	12	6-12	6-12	-	-
NPA	12	9-12	-	-	-
M-1329	16	12-16	8-16	12-16	-
Group 2:					
N-5996	8	4-8	4-8	1-8	1-8
EPTC	8	4-8	4-8	1-8	2-8
R-1607	8	4-8	6-8	2-8	4-8
R-2060	8	8	-	2-8	4-8
R-2061	8	8	-	6-8	6-8
Group 3:					
diuron	4	-	4	-	4
monuron	4	-	-	-	4
simazin	4	-	4	-	4
G-31435	4	-	4	4	4
G-27901	4	-	-	-	4
G-30044	4	-	-	-	-
G-30031	4	-	-	-	-
G-31717	4	-	-	-	-
DNBP	12	-	-	-	-

1/ Rates - Expressed in lb/A-in.

(Cooperative investigations of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture and Department of Botany, University of California, Davis.)

Weed control in cotton with monuron and diuron applied during early stages of growth. McRae, G. N., Arle, H. F., and Hamilton, K. C. Early soil treatments were made in Acala 44 cotton with (diuron) 3-(3,4-dichlorophenyl)-1,1-dimethylurea and (monuron) 3-(p-chlorophenyl)-1,1-dimethylurea. The first treatments were 1.5, 2.0, 2.5 pounds per acre of monuron and 1.5, 2.0, 2.5, and 3.0 pounds per acre of diuron just before the first irrigation, May 20, 1958, when cotton was approximately 6 inches tall and had 4 to 6 true leaves. The second set of treatments at rates of 1.0, 2.0, 3.0, and 4.0 pounds per acre of monuron and diuron were applied just before the second irrigation, June 9, 1959, when cotton was approximately 15 inches tall and in the pre-bloom stage. All plots were furrowed before treatment, but were not disturbed thereafter until weed and yield data were taken.

A third group of plots was treated with 1, 1.5, and 2 pounds per acre of diuron and monuron before the first irrigation, June 6, 1959, and before the second irrigation, June 20. Growth of cotton was similar to that in the first two tests. All plots consisted of 4 rows, 40 feet in length. The treatments were applied in water, equivalent to 40 gallons per acre. Cotton yields were taken from two center rows of each plot, totaling 80 feet of row.

The soil type for the first two tests was a McClellan clay and for the last test was a sandy loam. The data from cotton grown on McClellan clay indicate that monuron applied at rates sufficient to control grass had a strong tendency to stunt and possibly to reduce the yield of seed cotton. Diuron could be used at these earlier dates with less chance of injury. Results from cotton grown on sandy loam in the Maricopa area are not available (picking date, first week in November), but all indications point to a more severe stunting of and lack of bolls on cotton treated with 1.5 and 2.0 pounds per acre of monuron. Although diuron also caused some chlorosis, it did not stunt or cause a visual reduction of bolls. From the three tests it appears that at any given rate of monuron or diuron the amounts of chlorosis and stunting are related to the clay, silt, and sand textural characteristics of that soil. The danger of extreme chlorosis and stunting with a corresponding reduction in yield is greater, when cotton on soils containing a high percentage of sand, is treated with monuron or diuron. Diuron not only is more effective in controlling early annual grasses but also has a minumum effect on the young cotton plant. (Contribution by the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and the Arizona Experiment Station, cooperating.)

Effect of growth-regulating herbicides on grass grown for seed. Peabody, Dwight V. Jr. The principal objective of this test was to determine the effect of six different growth-regulating type herbicides (see table) on the seed yield of the following grass species: (1) orchardgrass (S-143), (2) timothy (Climax), (3) creeping bent grass, (Seaside), and (4) creeping red fesque (Illahee). This experiment was located at the Northwestern Washington Experiment Station on a silt-loam soil of 6.0 pH. Prior to treatment application, inter-row spaces were rotovated to maintain soil tilth and control annual weed infestation. All treatments were applied to the established stands of grasses (planted in rows 3.5 feet apart in the spring of 1958) on May 5, 1959. At this time orchardgrass was in the boot stage of growth, creeping red fesque was "headed-out", bent grass and timothy were in "late pre-boot" growth stages. All treatments were applied with a small tractor-mounted plot sprayer in a total volume of water equivalent to 45 gallons per acre at a pressure of 40 psi. Application of each herbicide was made at only one rate - 2 pounds parent acid per acre. Experimental design was a randomized, complete block, replicated 6 times. Plot size in each variety was 3 rows each 20 feet long. At harvest time a 16-foot section of the center row in each plot was cut for seed yield determinations. After the samples had been dried, they were threshed; the seed was cleaned and weighed to the nearest gram.

Experimental results are presented in the table. There are no significant statistical differences among the yields of orchardgrass, timothy and bent grass due to herbicidal treatment. Creeping red fesque yields, however, vary enough among the treatments that large differences due to treatment effect are significant. In general it is indicated by these results that (1) both silvex and 2,4,5-T at two pounds per acre probably caused yield reductions, at least in creeping red fesque; (2) silvex seems to have a greater adverse effect on yield than 2,4,5-T; and (3) the deleterious effect of these two chemicals may be due more to formulation than to the chemical itself since these two materials were ester formulations while the other herbicides were either amines or an acid. Injury and subsequent seed yield reductions could probably be decreased if not eliminated by earlier spraying since all varieties were treated either at or near susceptible growth stages. (Northwestern Washington Experiment Station, Washington State University)

Seed yields of four grass varieties treated with six different growth-regulating herbicides.

TREATMENT		VARIETY OF GRASS			
Herbicide	Rate[1]	Orchard	Timothy	Bent	Fesque
		lb/A	lb/A	lb/A	lb/A
silvex (ester)	2	590	542	263	564
2,4,5-T (ester)	2	600	558	322	610
MCPA (amine)	2	715	577	269	825
2,4-DB (amine)	2	676	609	294	680
2,4-D (acid)	2	634	569	259	812
2,4-D (amine)	2	747	601	268	673
No chemical treatment		649	605	249	703
	$\bar{x}$	658.8	579.8	274.5	695.3
	$SE_{\bar{x}}$	37.1	24.4	19.9	56.9
	C.V.	14%	10%	18%	20%

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

Progress report on wild oat control in peas. Anderson, W. P. and Muzik, T. J. Wild oats are a major pest of peas in the Pacific Northwest. A new weed killer, carbyne (4-chloro-2-butynyl N-(3-chlorophenyl) carbamate) shows considerable promise for the control of this weed in peas and wheat.

Application of carbyne and atrazin (2-chloro-4, ethylamino-6, isopropylamino-s-triazine) were made to peas at Pullman, Washington just after emergence when the peas were 1 inch high and the wild oats in the 1-2 leaf stage and two weeks later. Two rates of each chemical were applied at each date. Individual plots were 12' x 20' and a strip 3' x 5' was harvested from each plot. Data from the first treatment are shown in Table I (average of three replications).

Table I. Pea yield and control of wild oats

Chemical	Rate lb/A	Wild Oat Control per cent kill	Pea Yield Grams
Control	0	0	118
carbyne	1	90	215
	2	95	258
atrazin	1	10	157
	2	20	158

No visible damage to the peas occurred at the first date of spraying with either chemical. Control of the wild oats was excellent with the 1 and 2 lbs. of Carbyne. Atrazin did not control the wild oats. Yield of the peas was significantly higher than the check in the Carbyne-treated plots. No significant difference was found between the 1 and 2 lb. per acre rates.

Severe stunting of peas and wild oats occurred at the second date of spraying in the Carbyne-treated plots. Neither the wild oats not the peas were killed. Atrazine had no effect. None of the yields were significantly higher than the untreated plots. (Washington Agricultural Experiment Station)

Comparison of liquid and granular herbicides for pre-emergence weed control in sugar beets. Alley, H. P. The use of selective herbicides for weed control in sugar beets is increasing. Herbicides mixed with water and applied as a spray at the time of planting sugar beets have given outstanding results under many conditions. However, under limited moisture conditions results have been erratic. The purpose of this experiment was primarily two-fold. Firstly, a dry chemical applicator was not available which could accurately meter, apply and incorporate granular herbicides satisfactorily on a six or eight inch band. The Agriculture Engineering Department, of the University of Wyoming, constructed a satisfactory metering and distributor for granular herbicides which was used for this experiment.

Secondly, granular herbicides were compared to liquid herbicides. It was thought that a granular herbicide would have better residual characteristics, therefore not be as critical under limited moisture conditions.

The experiments were conducted at Wheatland, Torrington, Powell and Worland, Wyoming. The Torrington and Wheatland soils were sandy and the Powell and Worland soil a heavy clay. Plots were four-rows wide, 150 ft. long, replicated three times at each of the four locations. All treatments were applied on a six inch band and incorporated into the top two inch of soil in front of the sugar beet weeding units. The equipment used for mixing and distributing the chemical into the top two inches consisted of a series of hooded tillage units which are power-take-off driven.

Stand counts (taken before thinning) indicate that granular herbicides were not as toxic to the sugar beets as the liquid formulations at the same rate of application. The thorough incorporation of the chemical into the top two inches of soil (something not accomplished until 1959) may have accounted for poor weed control. It may be possible to increase rates of chemical application, especially with endothal, without reducing the stand of sugar beets and increasing percentage weed control. Each location received moisture immediately after application.

Yield data is available from only one station at this time. No reduction in yield was recorded even at the rates which reduced stand count by 50 percent. (Wyoming Agricultural Experiment Station)

Table A Summary of sugar beet stand and weed control at Torrington and Wheatland, Wyoming. 1/

Chemical 2/	Rate lb/A 3/	Percentage 4/ Sugar beet stand	B. L. weeds	Grassy weeds
endothal (liquid)	1/2	81	27	40
endothal (granular)	1/2	96	16	44
endothal (liquid)	1	92	66	54
endothal (granular)	1	97	36	52
EPTC (liquid)	1/2	69	95	64
EPTC (granular)	1/2	76	98	33
EPTC (liquid)	3/4	55	99	54
EPTC (granular)	3/4	56	99	20
CDEC (liquid)	3/4	68	91	37
CDEC (granular)	3/4	65	88	32
CDEC (liquid)	1	51	95	56
CDEC (granular)	1	68	82	46

Table B Summary for Worland and Powell[5/]

Chemical[2/]	Rate lb/A[3/]	Percentage[4/] Sugar beet stand	B. L. weeds	Grassy weeds
endothal (liquid)	1	94	36	69
endothal (granular)	1	85	23	10
endothal (liquid)	1 1/2	73	7	38
endothal (granular)	1 1/2	77	16	8
EPTC (liquid)	33/4	72	38	67
EPTC (granular)	3/4	57	45	68
EPTC (liquid)	1 1/2	42	45	58
EPTC (granular)	1 1/2	57	35	58
CDEC (liquid)	1	61	41	23
CDEC (granular)	1	70	51	0
CDEC (liquid)	1 1/2	41	44	37
CDEC (granular)	1 1/2	59	83	80

1/ Soil at Torrington and Wheatland predominantly sandy.
2/ Granular herbicides: Endothal 5% EPTC 5% and CDEC 20% impregnated on ataclay.
3/ Rate of chemical per acre on a six inch band.
4/ Percentages sugar beet stand, broad-leaved and grassy weed control determined on counts as compared to the untreated check.
5/ Soil at Worland and Powell are heavy clay soil.

Logarithmic screening evaluation of endothal and certain thiolcarbamate herbicides in sugar beets. Foy, Chester L. The most promising of the soil-applied herbicides for control of weeds in sugar beets have one or more of the following limitations under western conditions: excessive leachability, rapid decomposition, high volatility (all of which shorten the duration of herbicidal activity), and excessive crop injury. New, more effective herbicides having a broader margin of selectivity are continually being sought.

Endothal, sodium salt (disodium 3, 6-endoxohexahydrophthalate), EPTC (ethyl N, N-di-n-propylthiolcarbamate), R-2060 (ethyl N-ethyl, N-n-butylthiolcarbamate), R-2061 (n-propyl N-ethyl, N-n-butylthiolcarbamate) were compared for degree and duration of control of purslane, pigweed, and oats seeded to represent annual grasses in sugar beets.

The herbicides were applied logarithmically with a bicycle-mounted sprayer, using a volume of 124 gal/A. Plots were two rows 90 ft. long and half-dosage distances were 20. 0 ft. Maximum dosage in each case was 12 lb/A and all treatments, plus checks, were replicated four times. Three to five hours after application (May 19), the herbicides were rototilled 3 in deep into the tops of low pre-formed beds. Sugar beets were planted conventionally (May 20) with little disturbance of the dry treated soil. No rain occurred between treatment and furrow sub-irrigation on June 1.

By the second irrigation (June 10), EPTC, R-2060, and R-2061 all showed equally good control of oats as low as 2 lb/A, whereas purslane and pigweed were somewhat less sensitive, requiring higher rates (3-4 lb/A) for complete control. Endothal provided only slight control of all three species even at higher rates. (Note: Several experiments have indicated that endothal is most effective when incorporated by other methods earlier in the season.) Weed counts by species and crop injury ratings were made on June 17 (28 days after planting and 16 days after irrigation). Figures in Table 1 represent actual plant counts in two 10 x 20 in quadrats centered lengthwise over the beds. EPTC, R-2060, and R-2061 were still effective as grass herbicides, down to about 2-3 lb/A. Approximately 4-6 lb/A of EPTC or R-2061 were required for satisfactory control of purslane and pigweed; R-2060 had virtually lost its effectiveness against these species.

Additional observations were made on June 25 and July 13. Both EPTC and R-2061, at 6 lb/A, continued to show excellent control of all species for 6 weeks or longer. The most obvious break in weed control occurred at 3-4 lb/A. EPTC caused severe injury inclusing reduction of beet stands above 5-6 lb/A and slight, usually temporary, injury at 3-4 lb/A. R-2061, however, produced only slight injury symptoms above 8 lb/A.

Because of its wider margin of selectivity and long lasting herbicidal activity, R-2061 shows definite promise as a soil incorporated treatment in sugar beets. (Botany Department, University of California, Davis, California)

Table 1. The response of sugar beets and annual weeds to endothal and certain thiolcarbamate herbicides incorporated into the soil prior to planting.

Chemical treatment treatment	Rate lb/A	Plant counts (10 in band x 40 in of row) Sugar beets	Oats	Broad leaved weeds
1. endothal	12	27	47	54
	6	31	26	34
	3	26	23	65
	1 1/2	34	29	48
	3/4	25	36	36
2. EPTC	12	14***1/	0	1
	6	17**	0	10
	3	23*	0	21
	1 1/2	36	2	43
	3/4	25	8	45
3. R-2060	12	20	0	26
	6	24	0	31
	3	23	1	40
	1 1/2	24	7	37
	3/4	24	14	35
4. R-2061	12	25*	0	2
	6	24	2	3
	3	23	5	16
	1 1/2	28	10	22
	3/4	26	17	34
5. Check	-	23	20	50

1/ Asterisks denote slight (*), moderate (**), or severe (***) burning of foliage, reduction in vigor, or other injury symptoms.

The comparative effectiveness of several soil-incorporated herbicides for weed control in sugar beets. Foy, Chester L. With the herbicides currently available weed control in sugar beets is best accomplished through soil application. Results under furrow irrigation, where little or no rainfall occurs after planting, have been erratic due to the difficulty of activating pre-emergence herbicides. Thus weeds may germinate as a result of subsurface moisture and emerge through treated, sometimes dry soil. In recent investigations, soil incorporation of herbicides has been stressed as a possible means of eliminating or reducing this variability.

During the 1958-1959 season seven herbicides, reported promising for selective use in sugar beets, were compared in one or more of six replicated field experiments. The tests were conducted on representative loam or clay loam sugar beet soils of California's central valley. Chemicals and rates employed were as follows: Sodium salt of endothal (3,6-endoxohexahydrophthallic acid) and EPTC (ethyl N,N-di-n-propylthiolcarbamate), 2-8 lb/A; TCA (trichloroacetic acid), 4-10 lb/A; IPC (isopropyl N-phenylcarbamate), 1 1/2-8 lb/A; CIPC (isopropyl N-(3-chlorophenyl) carbamate), 4-8 lb/A; CDAA (2-chloro-N,N-diallylacetamide) and CDEC (2-chloroallyl diethyldithiocarbamate), 3-8 lb/A; and M-15336 (Monsanto experimental), 2-4 lb/A. The herbicides were applied with a hand knapsack, bicycle type, or tractor-mounted sprayer by one of four methods: (A) pre-emergence - sprayed on the surface of the beds after planting, subsequently undisturbed; (B) pre-plant - rototilled 2-3" deep into the tops of pre-formed beds, planted in treated area with little disturbance of soil; (C) pre-plant - sprayed broadcast on flat surface during or just prior to listing and planting; (D) pre-plant - sprayed broadcast on flat surface, disked 3-4" deep, then listed and planted.

Three of the six experiments received light to medium showers between treatment and first furrow irrigation. Partial results of two representative experiments are shown in the table below:

Experiment 1. Treated Mar. 6, 0.4 in rainfall before furrow irrigation Mar. 25.

Chemcial treatment	Rate (lb/A)	Application method	Crop Injury * % stand	vigor	% Weed Control * (Apr. 9) broad leaves	grasses
endothal	2	A	100	10	51	0
		B	100	10	31	0
	4	A	100	10	69	0
		B	100	10	33	0
	8	A	92	9.5	83	60
		B	100	10	66	33
EPTC	2	A	95	10	3	0
		B	100	9.5	47	66
	4	A	98	10	16	0
		B	80	8.5	89	100
	8	A	98	9.5	31	80
		B	58	7.5	90	100

* Crop injury and weed control ratings given as percentages of their corresponding untreated checks.

Experiment 2. Treated (D) Apr. 18, (C) Apr. 20, (B) Apr. 25, and (A) Mar. 15, no rainfall before furrow irrigation Mar. 17.

Chemical treatment	Rate (lb/A)	Application method	Crop Injury* % stand	vigor**	% Weed Control* (June 1) broad leaves	grasses
endothal	3	A	100	10	0	0
		B	98	10	7	0
		C	100	10+	75	75
		D	98	10+	35	50
"	6	A	98	10	40	0
		B	98	10	33	40
		C	100	10+	80	85
		D	99	10+	76	80
EPTC	3	A	99	10+	0	0
		B	98	10+	45	60
		C	95	10++	82	85
		D	98	10+	79	85
	6	A	99	10	0	0
		B	98	10+	90	100
		C	90	10++	98	100
		D	92	10+	98	100

* Crop injury and weed control ratings given as percentages of their corresponding untreated checks.

** Crop vigor rated on a 0 to 10 basis, with a rating of 10 meaning no injury or apparent reduction in vigor. EPTC plots with increased vigor showed slight injury at earlier stages.

The following additional conclusions seem justified:

1. Endothal (6-8 lb/A) and EPTC (3-4 lb/A) were consistently most promising for the selective control of a broad spectum of annual weeds. Endothal caused no lasting injury at any rate; EPTC showed a considerably narrower margin of selectivity sometimes producing temporary injury to beets at herbicidal rates.

2. TCA showed some promise where grasses were the only weeds present. Under proper conditions IPC and CIPC provided excellent weed control but were too injurious for selevtive use in beets. None of the other herbicides were injurious to beets but all gave unsatisfactory weed control.

3. In the absence of surface moisture, all herbicides applied by method A were ineffective. When rainfall was long delayed (1-2 months) after pre-emergence application endothal still gave satisfactory weed control, whereas the effectiveness of EPTC was reduced or lost by volatilization.

4. Incorporation methods C and D were generally most satisfactory. The tabular differences are largely explainable on the basis of the non-volatility and high leachability of endothal as compared with the higher volatility and adsorptivity of EPTC. Less leachable formulations of endothal and analogs of EPTC possessing a higher degree of selectivity have shown considerable promise in recent studies. (Botany Department, University of California, Davis, California.)

PROJECT 7. AQUATIC AND DITCH BANK WEEDS

Lyle W. Weldon, Project Chairman

SUMMARY

Twelve papers were presented for publication in this section. These are broken down into five subjects, (1) the control of emergent aquatic weeds, (2) the control of submerged aquatic weeds, (3) crop tolerance to chemically-treated irrigation water, (4) bank weed control, and (5) grass suppression in road systems.

1. The control of emergent aquatic weeds

Yeo found in Montana that granular applications of the butoxyethanol ester of silvex at 20 and 40 lb/A, the iso-octyl ester of 2,4-D at 40 lb/A and simazin at 20 lb/A gave 85 percent or better control of watercress (*Nasturtium officinale* R. Br.).

Two reports were received on cattail. Yeo concluded that dalapon, amitrol and erbon were more effective in reducing regrowth of cattails when applied after the infloresence had formed. Dalapon gave superior initial regrowth suppression, but was equal to that of amitrol the year following application. There was little, if any, difference between the ester and sodium salt of dalapon or between powder or liquid formulations of amitrol. Weldon and Timmons showed that single treatments of dalapon and amitrol made about August 1 after full development of the catkins was better than split early-late treatments. They used a total of 12 lb/A of amitrol and 20 lb/A of dalapon. 2,4-D plus oil in water emulsion also gave excellent control when repeated twice in one year.

2. The control of submerged aquatic weeds

Suggs has shown that copper sulfate crystals placed in a canal at the rate of 1/3 lb/cfs will kill algae for 15 miles. Applications over a 3-year period have also given a reduction in the rooted aquatics, *Potamogeton* and *Zannechellia*.

Timmons and Weldon applied neburon and simazin at 10, 20, and 40 lb/A to the bottom of an irrigation canal in the fall after water usage and in the spring prior to turn-in of the water for the control of *Potamogeton pectinatus* L. There was no noticeable effect due to the chemicals to pondweed. They considered the experiment was conducted under optimum conditions for best activity of the chemicals.

A large cooperative experiment, 43 individual tests, was conducted by several individuals and agencies in 1959 for the control of submerged aquatic weeds. Three quaternary ammonium compounds were tested and found to be less effective than acrolein or xylol-type aromatic solvents. Acrolein gave satisfactory control of waterweeds at rates from 1 to 3.3 gal/cfs.

3. Crop tolerance to chemically-treated irrigated water

Arle and McRae showed that two irrigations of cotton by water

containing 100 ppmv did not result in adverse effects to cotton. Their concentrations of chemical were within the range of use in that area.

4. The control of bank weeds

Yeo concluded after thorough testing that bindweed (Convolvulus arvensis L.) could be controlled with 2,3,6-TBA at 10 and 15 lb/A, or with the granulated polychlorinated amine salts of benzoic acids at 15 lb/A. These treatments also gave control of other broadleaf weeds.

Boyle experimented with 10 different herbicides for the suppression of grass growing along irrigation ditchbanks. MH, Garlon, amitrol, and dalapon showed the most promise. He recommends that further experiments of this nature be conducted using MH at 4 to 6 lb/A, Garlon at 3 to 5 gal/A, amitrol at 2 to 4 lb/A, and dalapon at rates considerably under 12 lb/A.

Yeo conducted experiments in 1958 and 1959 using a 55 percent weed oil for the control of reed canary grass. The addition of FB-2 or PCP did not increase the effectiveness of the weed oil. Three applications per year at 120 gal/A gave the best control of the grass.

5. Grass suppression in road systems

Woestemeyer and Zick showed that borate or chlorate containing chemicals gave good control of Bermuda grass. They treated the grass and then surfaced the area with asphalt and rock. The application of 1/2" water prior to the laying down of asphalt greatly increased the activity of most herbicides.

Wilkerson and Kosesan experimented with MH for the inhibition of grass along roadsides in Oregon. MH at 4 to 6 lb/A gave suppression of growth for about 12 weeks with no objectionable discoloration of the grass.

CONTRIBUTORS REPORTS

Control of watercress (Nasturtium officinale R. Br.) with pre-emergent application of granular herbicides. Yeo, R. R. Several granular herbicides were applied on May 6, 1959, to a ditchbottom approximately 14 feet wide which for no less than 2 years had been uniformly infested with watercress. The treatments, replicated three times, were applied to the ditchbottom before the water level had risen and before the watercress had emerged. The herbicides included were simazin at 10 and 20 lb/A, Ureabor at 500 and 1000 lb/A, polychlorinated amine salts of benzoic acids at 15 and 20 lb/A, iso octyl ester of 2,4-D at 20 and 40 lb/A, butoxyethanol ester of silvex at 20 and 40 lb/A, and fenuron at 20 lb/A.

Results: The treatments giving an average of 85% or better control for 6 months were the butoxyethanol ester of silvex at 20 and 40 lb/A, iso octyl ester of 2,4-D at 40/A, and simazin at 20 lb/A. The polychlorinated amine salts of benzoic acids suppressed growth of the watercress for 2 months. The remaining treatments gave unsatisfactory control. (Contributed by the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and the Huntley Branch Station of the Montana Agricultural Experiment Station, cooperating)

Control of cattail (Typha latifolia L.) with applications of herbicides made before and after formation of the infloresence. Yeo, R. R. The following formulations and rates of several herbicides were compared in applications made to cattails in 1958 at two different stages of growth, (1) before and (2) after the formation of the infloresence: the sodium salt and diethylene glycol diester of dalapon at 10, 20 and 30 lb/A; liquid and powder formulations of amitrol at 5, 10 and 20 lb/A; and erbon at 20, 40 and 80 lb/A. The first applications were made as the flowering stalks were beginning to elongate, and the second after pollination was approximately 80% complete. The plots were 8 1/4' X 16 1/2' and each treatment replicated three times. A volume of 200 gpa and a pressure of 100 psi were used. Regrown cattail shoots were counted the last week in July, 8 weeks after the first applications and 5 weeks after the second application. In 1959 shoots were counted the last week in July.

Results: As shown in table 1, the 1959 shoot counts indicate that treatments made after formation of the infloresence were more effective than those made before formation. Unfortunately, in the plots treated after the formation of the infloresence the dead cattails remained standing throughout the 1958 season, whereas in those treated before the formation of infloresence the dead cattails fell over and sluffed off in the moving water.

In summing up each parent material it was noted that dalapon treatments were possibly more effective in reducing the regrowth during the year of application than amitrol. However, the amitrol treatments were approximately as effective as the dalapon treatments in 1959. Erbon appeared to be the least effective treatment.

When the over-all effectiveness of the various formulations was evaluated it appeared that the sodium salt and the diethylene glycol diester formulations differed little except at the low rate. The 10 lb/A of the sodium salt was equal to or more effective than the ester formulation. All treatments of the herbicides significantly reduced the stand of cattail shoots. (Contributed by Cooperative investigations of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and the Montana Agricultural Experiment Station)

Treatment	Rate (lb/A)	Before formation 1958 count	Before formation 1959 count	After formation 1958 count	After formation 1959 count
Sodium salt of dalapon	10	5.0	13.3	3.0	2.7
	20	2.7	3.3	2.0	2.0
	30	4.0	11.3	1.7	1.0
Ester of dalapon	10	11.7	13.0	16.7	14.0
	20	3.7	7.3	10.7	1.0
	30	0.0	1.0	2.7	2.0
amitrol, powder	5	10.7	8.3	14.0	16.0
	10	7.3	8.0	5.0	4.3
	20	3.7	7.0	1.3	1.7
amitrol, liquid	5	6.0	6.3	4.3	3.7
	10	14.3	12.3	4.3	1.3
	20	7.0	5.3	1.0	1.7
erbon	20	16.7	19.0	7.3	8.0
	40	4.7	9.7	4.7	3.3
	80	5.0	7.3	2.3	1.7
None (check)		95.0	36.7	49.7	33.7
L.S.D. at the 5% level		18.5	12.7	11.6	7.83

Chemical control of common cattail. Weldon, L. W. and Timmons, F. L., Research Agronomists, ARS. Experiments conducted by the writers in Wyoming and Utah and reported in previous issues of this Progress Report showed amitrol (3-amino-1,2,4-triazole), dalapon (sodium 2,2-dichloropropionate), and ester formulations of 2,4-D (2,4-dichlorophenoxy acetic acid) to be the most effective chemicals for control of common cattail (Typha latifolia L.). A new experiment was begun in 1958 near Midvale, Wyoming, comparing amitrol at 12 lb/A and dalapon at 20 lb/A on three different dates of application as shown in the accompanying tabulation. Diesel oil at 10 gal/A and an emulsifier at 0.4 gal/A were added to the 2,4-D spray solution. Diesel oil at 5 gal/A and an emulsifier at 0.2 gal/A were added to all dalapon solutions. Previous experiments had shown the addition of diesel oil and emulsifier to be necessary for best results with 2,4-D and dalapon on cattail.

All spray applications were made at 240 gal/A in water with a constant-pressure knapsack sprayer equipped with a single nozzle at the end of a spray wand. All treatments were replicated 3 times on plots 16 x 21 feet arranged end to end in a drain canal.

On the earliest date of treatment, June 19, the cattail was 1 to 6 feet tall, only 5 percent of the plants were heading, and the spikes were mostly in the boot or just emerged. On the second date, July 31, female catkins in untreated plots were full size. On the last date of treatment, August 29, catkins were fully mature and there was considerable yellowing of leaves from natural maturity.

All treatments resulted in good to excellent control of cattail, 2,4-D and late-season dalapon treatments gave slightly better results than the other treatments. Split, early-late season, applications of amitrol or dalapon tended to be less effective than single late-season treatments. Previous experiments showed that single early-season applications of amitrol and dalapon are much less effective than single late-season treatments. (Contribution from the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and Wyoming Agricultural Experiment Station, cooperating.)

Chemical and rate (lb/A)	Date treated in 1958	Reduction in cattail stand on July 9, 1959 (percent)
2,4-D		
6 +	June 19 +	97
6	August 29	
amitrol		
6 +	June 19 +	87
6	August 29	
12	July 31	88
12	August 29	91
dalapon		
10 +	June 19 +	77
10	August 29	
20	July 31	96
20	August 29	93
Untreated	-	0

The percent reductions in stand of cattail as determined July 9, 1959, are shown in the above tabulation.

Aquatic weed control in large canals with copper sulfate. Suggs, Delbert. Algae was controlled with copper sulfate in a canal of 5,000 cubic feet per second capacity on the Columbia Basin Project, Washington. Large crystals were placed in the canal at the rate of 1/3 pound per cubic foot per second of flow. An application was made every two weeks from May 15 to August 15, at points on the canal 10 miles apart. Single applications resulted in an algae kill for a distance of more than 15 miles. Generally represented were Cladophera, the most common genus, Spirogyra, and Ulothrix. The crystals were dumped, all at one time, onto the bottom of concrete-lined sections of the canal. In earth sections, the crystals were placed in burlap bags and suspended in the water. Solution time varied from 15 minutes or less where dumping occurred, to nearly 30 minutes where burlap bags were used. Peak concentrations varied from 0.5 parts per million to 2.0 parts per million. Variance of concentration was apparently in direct inverse proportion to the solution time.

Production of rooted submersed aquatic weeds, species of Potamogeton and Zannechellia, diminished during the three years (1957-59) of treatment. The rate of invasion of these weeds downstream also diminished. None of the growth factors observed appeared to change sufficiently to explain the reduction in yields and rate of invasion of these pondweeds. A tentative conclusion states that the low concentration of copper sulfate and short periodic contact time kept algae under control and significantly reduced the yields of pondweeds. (Columbia Basin Project, Bureau of Reclamation, Ephrata, Washington)

Effectiveness of neburon and simazin for control of sago pondweed in an irrigation canal. Timmons, F. L. and Weldon, L. W. Wettable formulations of neburon (1-n-butyl-3-(3,4-dichlorophenyl)-1-methylurea) and simazin (2-chloro-4,6-bis(ethylamino)-s-triazine) were applied to the wetted perimeter of an irrigation canal near Riverton, Wyoming, on two dates at rates of 10, 20, and 40 lb/A active ingredient. The spray applications were made with a constant-pressure knapsack sprayer with a single nozzle boom used as a wand. The first series of applications was made November 14, 1958, after the water had been turned out but when standing water 4 to 12 inches deep remained in the bottom of the canal. The second series was made April 8, 1959, when the bottom of the canal was dry and 6 weeks before water was turned into the canal.

All treated plots were 50 feet long and extended entirely across the canal between the shoulders of the two banks. Untreated sections of the canal 50 feet long were left between treated plots as border zones for determining lateral movement of the chemicals. All treatments were replicated twice, and spring- and fall-treated plots were interspersed.

Precipitation between times of treatment and turning in irrigation water on May 25, 1959, was 7.94 inches for the fall series and 3.85 inches for the spring series. The precipitation undoubtedly was sufficient to leach the chemicals into the surface soil in the bottom of the canal before water flowed through the canal on May 25.

None of the treatments caused any observable reduction in stand or growth of sago pondweed (Potamogeton pectinatus L.) during 1959. In view of the favorable conditions for leaching the chemicals into the bottom mud around pondweed roots and tubers, the results of this experiment seem to indicate that neburon and simazin as bottom treatments between irrigation seasons hold little promise of being effective for controlling pondweed. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and Wyoming Agricultural Experiment Station, cooperating.)

Evaluation of herbicides for control of submersed aquatic weeds in irrigation channels in 4 Western States. Timmons, F. L., Weldon, L. W., Yeo, R. R., Arle, H. F., Hodgson, J. M., and Bruns, V. F., Crops Research Division, Agricultural Research Service, U. S. Dept. of Agriculture, and Suggs, D. M. Bureau of Reclamation, U. S. Dept. of Interior. Xylol-type aromatic solvent, since the discovery of its effectiveness on submersed aquatic weeds in 1947, has become extensively used for controlling waterweeds in irrigation channels of the West. Since 1957 a formulation of acrolein has been tested in canals throughout the country and has shown considerable promise for control of submersed waterweeds. Laboratory tests by the Agricultural Research Service and Bureau of Reclamation at Denver in 1957 and 1958 showed that certain quaternary ammonium compounds were effective on several species of submersed aquatic weeds.

During the summer of 1959 a regional program of field testing a formulation of acrolein and three different quaternary ammonium compounds for control of sago pondweed (Potamogeton pectinatus L.) and certain other submersed aquatic weeds was carried on in Arizona, Montana, Washington, and Wyoming. The 35 individual canal tests were conducted as nearly as possible according to a uniform regional experimental plan with regard to rates of treatment, exposure time, kinds of treatment and result data obtained. Acrolein was tested at rates of 1.0 to 3.3 gal/cfs, with 2 gal/cfs as the standard rate. The quaternary ammonium compounds were applied at rates of 2 to 8 gal/cfs active ingredient, with 4 gal/cfs as the standard. Xylol-type aromatic solvent was tested at rates of 8.5 to 10 gal/cfs in comparison with the newer aquatic herbicides in four canal tests in Montana and Wyoming.

Acrolein, in 12 canals ranging from 1.5 to 12 miles long, gave satisfactory control of waterweeds for 1 to 8 miles, averaging 3.5 miles, or 86 percent of the average length of the test canals. Average topkill of sago pondweed was 94 percent of leaves and 73 percent of stems. Average sloughing out of pondweed growth was 72 percent of leaves and 56 percent of stems. On the average retreatment was necessary in 5.8 weeks.

The three quaternary ammonium compounds were considerably less effective than acrolein at the rates tested. Alkyl tolyl methyl trimethyl ammonium chloride, in 6 canals averaging 3.4 miles long, gave satisfactory control of sago pondweed for 0 to 5 miles, averaging 1.4 miles. Average topkill of pondweed was 61 percent of leaves and 41 percent of stems. Average sloughing out of pondweed growth was 48 percent of leaves and 33 percent of stems. On the average retreatment was necessary in 3.8 weeks.

N-alkyl dimethyl dimethylbenzyl ammonium chloride gave similar results in 8 canals averaging 3 miles long. Satisfactory control of waterweeds was obtained for 0 to 2.1 miles, averaging 1.0 mile. Average topkill of sago pondweed was 69 percent of leaves and 43 percent of stems. Sloughing out of pondweed growth was 48 percent of leaves and 40 percent of stems. On the average retreatment was necessary in 4.3 weeks.

The third quaternary compound, alkyl quinolinium chloride, was much less effective in 5 canals, averaging 2.2 miles long. Satisfactory control of sago pondweed was obtained for 0 to 1.75 miles, averaging only 0.6 mile. Average percentages of topkill and sloughing out of pondweed were relatively low.

Xylol, in 4 canal tests in Montana and Wyoming, was somewhat more effective than the quaternary ammonium compounds but was less effective than acrolein in similar canals in the same localities. Xylol gave satisfactory control of sago pondweed for 1.5 to 2.4 miles, averaging 1.9 miles. Average topkill of pondweed topgrowth was 85 percent of leaves and 65 percent of stems. Average sloughing out of pondweed growth was 72 percent of leaves and 63 percent of stems. On the average retreatment was necessary in 5.3 weeks. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture; Bureau of Reclamation, U. S. Department of Interior; and the Arizona, Montana, Washington, and Wyoming Agricultural Experiment Stations, cooperating. Test herbicides contributed by Rohm & Haas Company, Onyx Oil and Chemical Company, and Shell Chemical Corporation.)

<u>Cotton tolerance to applications of acrolein in irrigation water.</u> Arle, H. Fred and McRae, G. N. During 1959 an experiment was conducted to determine possible injury to cotton by acrolein in irrigation water. Acrolein was metered from a constant head vessel into the irrigation water. Concentrations of 25, 50 and 100 ppmv were maintained for 40 minutes. Approximately 3 acre-inches of water were used to flood irrigate cotton plots.

The first series of applications were made May 29 when cotton had a height of 10-12 inches and approximately 10 true leaves. There were 6 replications of each treatment. Air temperature averaged 90 degrees F. during the application period. These applications had no apparent effect.

Half of the originally treated plots were retreated at the third irrigation on July 2, when cotton was approximately 24 inches tall and blooming profusely. The temperatures averaged 104 degrees F. during the application period. Again, there were no apparent adverse effects due to treatment. Cotton yields from the first pick were as follows. (It does not appear that unharvested green bolls remaining on plants will alter the trends established by the first pick.)

There was no significant difference between cotton yields as result of acrolein treatments. The concentrations of acrolein included in this experiment were within the range used by irrigation districts for control of aquatic weeds in canals. (Contributed by the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and the Arizona Agricultural Experiment Station, cooperating.)

Treatment	Pounds of seed cotton
25 ppm. - 1 app.	4.1
50 " 1 "	4.0
100 " 1 "	3.8
25 " 2 "	3.5
50 " 2 "	2.9
100 " 2 "	4.1
Check	3.9

Control of bindweed (Convolvulus arvensis L.) on a ditchbank. Yeo, R. R. In June 1958 several herbicides were applied to a uniform stand of bindweed approximately 4 weeks after flowering was first observed. The herbicides included 2,3,6-TBA acid, and 10% granular, oil-soluble, and amine formulations of polychlorinated benzoic acids all at 10 and 15 lb/A. A 4 lb/A rate of the butoxyethanol ester of 2,4-D was also applied. The sprays, except the oil-soluble formulation, with which diesel oil was used, were applied at a volume of 100 gpa with water as the carrier. The plots were 1/2 square rod in size and replicated three times. Foliage samples equal to 10% of the treated area were harvested from each plot in July 1959.

Results: Table 1 shows the yields of bindweed foliage occurring on a ditchbank 1 year after the application of several herbicides. The 2,3,6-TBA at 10 and 15 lb/A and the granular formulation of the polychlorinated amine salts of benzoic acids at 15 lb/A were the most effective in controlling the bindweed. All treatments significantly reduced the growth of bindweed but did not give satisfactory control. Several broad-leaved weeds were found in the untreated and butoxyethanol ester of 2,4-D plots at the time the plot samples were harvested. These included fireweed, (Kochia scoparia), and wild lettuce (Lactuca sp.). However, these broad-leaved weeds were absent on the other treated plots. (Contributed by the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and Huntley Branch Station of the Montana Agricultural Experiment Station, cooperating)

Table 1. Yields of bindweed foliage occurring on a ditchbank one year following the application of several herbicides.

Symbol		Rate (lb/A)	Yield[1]	Statistical significance[2]
a	2,3,6-TBA acid	15	0.0	a
b	Polychlorinated benzoic acids[3], granular	15	0.0	a
c	2,3,6-TBA acid	10	1.0	a
d	Polychlorinated benzoic acids, granular	10	11.3	ab
e	Butoxyethanol ester of 2,4-D	4	18.7	ab
f	Polychlorinated benzoic acids, water sol.	15	19.7	ab
g	Polychlorinated benzoic acids, oil sol.	10	44.3	bc
h	Polychlorinated benzoic acids, oil sol.	15	46.3	bc
i	Polychlorinated benzoic acids, water sol.	10	71.7	c
j	Untreated		249.3	

[1] Grams of oven-dried bindweed foliage, average of three replicates
[2] Duncan's Multiple Range Test at the 5% level.
[3] Amine salts

Suppression of quackgrass, Kentucky bluegrass, and timothy on ditchbanks. Boyle, W. Dean. Ten different herbicides were applied in varying combinations and concentrations in the spring for the suppression of grasses on ditchbanks during the summer of 1959. Trials were placed on a farm head ditch which carried water 75 to 80 percent of the irrigation season (May 1 to September 30). Four of the 10 chemicals showing the most promise are reported herewith.

MH was applied at 4 lb./A. and 6 lb./A. (actual) in 100 gallons of water on May 15, 1959, when thr grass was 3" to 4" high. The 6 lb./A. rate held growth to 6" or less throughout the entire growing season and very few seed stalks were produced. Thr 4 lb./A. rate suppressed leaf growth 8" or 9" and permitted formation of more seed stalks. Residual effects will be observed in the spring of 1960 and additional trials established, including rates between 4 lb./A. and 6 lb./A.

Garlon (formulation of dalapon ester and silvex). An application of 6 gals./A. (commercial) in 100 gallons of water, April 23, 1959, when grass was 2" to 3" high, resulted in excessive suppression. All top growth appeared to be dead during May to September, inclusive; however, new growth which has appeared during October indicates that plants were not killed. The 2 gal./A. rate resulted in immediate burn down but recovery was fast, resulting in somewhat less suppression than might be desired. Intermediate rates will be tried in 1960.

Amitrol at 4 lb./A (actual) in 100 gallons of water, applied April 23, suppressed all top growth during the period, May to September 30. Some regrowth appeared during October. At 2 lb./A. adequate suppression (6" or less) was had for approximately one half of the irrigation season or until July 1.

Dalapon at 12 lbs./A or 16 lbs./A. (actual) in 100 gallons of water applied April 23 when the grass was 2" to 3" high appeared to have killed all grass during the summer; however, a small amount of regrowth appeared during October. Suppression trials in 1960 should include rates considerably less than these. (Region 1, Bureau of Reclamation, Boise, Idaho)

Suppression of reed canarygrass (Phalaris arundinacea L.) with contact herbicides. Yeo, R. R. In 1958 and 1959 several contact herbicides were applied to reed canarygrass three times during each growing season to determine which materials and rates were most effective in suppressing growth. The treatments were replicated three times. The treatments were applied to the same plots and in the same manner in 1959 as in 1958. The plots were retreated when the plants in the best plot were 12 to 18 inches tall. The herbicides used in this trial included a locally produced weed oil containing 55% aromatics applied at 80, 100 and 120 gpa, and at 100 gpa in combination with 1 and 2 lb/A of PCP; and 1,1-ethylene-2,2-dipyridylium dibromide at 2 and 4 lb/A. In 1959 two new treatments involving the equivalent of a light and a heavy burn were added. The 1,1-ethylene-2,2-dipyridylium dibromide was applied in water at a volume of 100 gpa with 1% nonionic wetting agent added. Yields were taken at the end of the growing season when the grass in the best treatment was 12 to 18 inches tall. One square yard samples were harvested in 1958 and 27.2 square feet, or 2% of the treated area, was harvested in 1959. Because the stands of grass were thinned by the different treatments height measurements were not taken.

Results: In 1958 it was necessary to make the second application 3 weeks after the first and the third 4 1/2 weeks after the second. The plots were harvested 7 weeks after the third application. In 1959 the second application was made 3 1/2 weeks after the first, and the third 6 1/2 weeks after the second. The plots were harvested 6 1/2 weeks after the third application.

The accompanying table shows the amount of grass at the end of each growing season. The table lists the yields of grass harvested from the plots each year with the most effective treatment listed first. The same letters in the statistical significance column indicate no significant difference occurs between the yields of those treatments. In 1958 the weed oil plus PCP at 100 gpa plus 1 lb/A appeared to be significantly better than when the 2 lb/A of PCP was added to the oil. Apparently the results of these two treatments are not valid because this same treatment was less effective than the 2 lb/A mixture in 1959. The weed oil treatments at 100 and 120 gpa were significantly better than at 80 gpa. All chemical treatments significantly reduced the growth of reed canarygrass.

In 1959 the weed oil at 120 gpa gave the best suppression of growth and was significantly better than the other treatments except weed oil at 100 gpa. All treatments significantly reduced the stand of reed canarygrass. (Contributed by the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and the Huntley Branch Station of the Montana Agricultural Experiment Station, cooperating)

1958			
Weed Oil plus PCP	100 gpa + 1 lb/A	.85	a
Weed Oil	120 gpa	.96	ab
Weed Oil	100 gpa	1.39	ab
1,1-ethylene-2,2-dipyridylium dibromide	2 lb/A	1.55	abc
Weed Oil plus PCP	100 gpa + 2 lb/A	1.65	bc
1,1-ethylene-2,2-dipyridylium dibromide	4 lb/A	1.69	bc
Weed Oil	80 gpa	1.84	c
No treatment	-	3.85	
1959			
Weed Oil	120 gpa	.58	a
Weed Oil	100 gpa	.90	ab
Heavy burn		1.45	b
Weed Oil	80 gpa	1.48	b
1,1-ethylene-2,2-dipyridylium dibromide	2 lb/A	1.53	b
Light burn		1.57	b
1,1-ethylene-2,2-dipyridylium dibromide	4 lb/A	1.60	bc
Weed Oil plus PCP	100 gpa + 2 lb/A	1.63	bc
Weed Oil plus PCP	100 gpa ± 1 lb/A	1.65	c
No treatment	-	4.09	

* Growth of reed canarygrass occurring at end of growing season.
**Duncan's Multiple Range Test at the 5% level.

Response of Bermuda grass to herbicides applied as prepaving treatments. Woestemeyer, V. W. and Zick, W. H. The object was to determine the effectiveness of various herbicides, when applied prior to application of an asphalt surface, in preventing subsequent emergence of the vegetation and premature breakdown of the asphalt.

The experiment was conducted on a uniformly dense stand of Bermuda grass with scattered annual broadleaf weeds on a silty clay soil in Los Angeles County.

All top growth of Bermuda grass was removed with a minimum of root disturbance and the soil packed with a self-propelled roller in a fashion similar to commercial preparation, prior to herbicide applications, on October 29 and 30, 1958. A knapsack sprayer and one gallon of water per 54-square foot plot was used for making spray applications, and dry applications were made by hand. Subsequent applications of water at two rates were made to leach the herbicides into the soil. A light asphalt surface was applied by commercial contractors October 31, 1958. Hot asphalt was sprayed from a truck-mounted spray bar at .428 gallons per square rod, followed by 28.23 pounds No. 4 crushed rock per square yard, and subsequent rolling with a power roller. This light surfacing provided a critical test for the herbicides used, as compared with a typical hot asphalt mix of two or more inches in thickness, which in itself tends to inhibit some regeneration of vegetative growth. Precipitation, following treatment, to October 12, 1959, was approximately 6 inches, most of which fell in February.

While the principal investigation was concerned with Bermuda grass control, it was noted that a few broadleaf annual weeds were present on most plots receiving either dalapon or TCA alone, and on no other plots.

Effectiveness of various herbicides and the influence of water on their performance are indicated in the table attached. (U. S. Borax Research Corporation, Anaheim, California)

TABLE I

Stand* of Bermuda grass surviving herbicide treatments (Average of three replications)

Herbicide	Lbs. per Acre	3/16" water applied 12-22-58	3/16" water applied 5-20-59	3/16" water applied 10-12-59	1/2" water applied 12-22-58	1/2" water applied 5-20-59	1/2" water applied 10-12-59
CBM1/	1740	1	1	1	1	0	0
CBM	2610	1	1	0	0	0	0
borax1/	1740	4	4	3	1	2	2
borax	2610	5	3	4	1	1	1
borax	3480	3	3	3	1	1	1
BMM1/	218	8	7	7	4	7	5
BMM	435	6	8	8	2	4	6
BMM	870	5	6	7	1	2	3
monuron	17.4	8	8	9	7	7	5
simazin	17.4	8	9	8	8	8	8
2, 3, 6-TBA	17.4	6	6	7	3	5	8
dalapon	34.8	3	3 2/	4 2/	2	2 2/	3 2/
sodium chlorate	435	2	2	2	5	1	1
sodium chlorate	653	1	1	1	5	1	1
TCA5/	100	1	3 3/	7	1	0 4/	1
sodium borate1/ TCA Complex	667	2	2	8	0	0	0
No treatment	-	8	8	7	5	8	6

* Stand ratings are 0 for no stand to 10 for solid stand.

1/ CBM disodium octaborate 73%, sodium chlorate 25%.
borax-anhydrous borax 94%.
BMM disodium tetraborate pentahydrate 63.2%, disodium tetraborate decahydrate 30.8%, monuron 4%.
sodium borate/TCA complex - boron trioxide equivalent 53%, trichloroacetic acid 15%.

2/ Annual broadleafs present on each replicate.

3/ Annual broadleafs present on one replicate.

4/ Annual broadleafs present on two replicates.

5/ Treatments with 3/16" water in duplicate; with 1/2" water are single plots.

Temporary Grass Inhibition with MH30 Along Roadsides. Wilkerson, J. A. and Kosesan, W. H. Maleic hydrazide has shown considerable promise for temporary inhibition of roadside grasses in Oregon. On the basis of results of trials conducted by the Oregon State Highway Department at Astoria during 1957 and 1958 additional experimental work was undertaken in 1959.

MH30 was applied at the Hayesville Interchange near Salem on April 10. Rates of 2, 4, and 6 pounds per acre of actual material were applied to actively growing grass approximately 3 inches in height. Species of grass and weeds present included Red creeping fescue, Highland bentgrass, common and perennial ryegrasses, velvetgrass, orchard grass, Alta fescue, buckhorn plantain, common and false dandelion, sheep sorrel, and Canada thistle. Plot size was 3600 square feet. One pound of 2,4-D amine per acre was added to control the broadleafed species. At the time of application the weather was cloudy and calm, with a temperature of 56° F. and relative humidity of 71%.

Rate	Color Effect	Height of Grasses (Average)	Miscellaneous
2#/A	No discoloration.	7-8"	Some seed heads out (fescues).
4#/A	Slight yellowing.	6"	Alta fescue-slightly more tolerant than Red fescue. Some development of red color.
6#/A	Slight to moderate yellowing	4" (no seed heads)	Velvet grass shows more red coloration than other species. MH30-2,4-D combination very effective on sheep sorrel, dock, Canada thistle.
Check		Average height estimated at 16". Range from 10-24".	Many seed heads forming in most species.

Effective suppression of growth was noticeable for a period of approximately 12 weeks at the 4 and 6-pound rates with no objectionable discoloration. Untreated areas of the Interchange required four mowings during the 12-week period. (Naugatuck Chemical Division of The United States Rubber Company and Oregon State Highway Department)

PROJECT 8. CHEMICAL AND PHYSIOLOGICAL STUDIES

V. H. Freed, Project Chairman

SUMMARY

The number of reports submitted to the chemical and physiological section this year is much reduced. Undoubtedly this has been influenced by the number of such papers offered to the national meeting.

The importance of chemical and physiological studies to weed control is of increasing importance. Such work needs to be stimulated and encouraged for the benefit of the orderly development of new weed control practices. For this reason, it is hoped that research workers in this field will give their colleagues the benefit of their findings in future progress reports.

Because of the small number of papers, it is felt that no comment on the contributions is needed other than to call attention to the excellent reports submitted from Arizona and Colorado.

CONTRIBUTORS REPORTS

The role of surfactants in foliar absorption of indol-3-acetic acid (IAA). Hughes, R. E. and Freed, V. H. The absorption of chemicals by the leaf of a plant is a problem of major importance in chemical weed control. The water carrier commonly used in application of these chemicals makes a poor contact with the cuticle; however, this deficiency may be overcome by the addition of surfactants to lower the surface tension of the solution.

IAA was the active substance used to study the role of surfactants in foliar absorption. This chemical was chosen because it is known to possess a characteristic fluorescence which allows the determination of its concentration in aqueous solution at a concentration as low as 5×10^{-3} ppm with the use of a Aminco-Bowman spectrophotofluorometer. Thirty to 50 ul of IAA solution was applied to the first primary leaf of bean plants (var. Black Valentine) and was contained in a lanolin ring of 12 millimeter diameter. All surfactants used in this study were at a concentration of 0.1% active ingredient. At various time intervals, the treated leaves were harvested and the IAA washed from the leaf and the concentration of the solution determined.

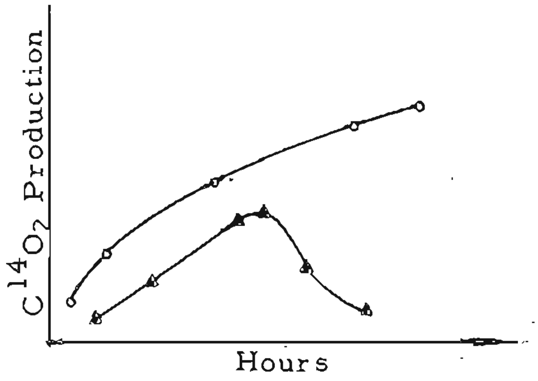
The foliar absorption pattern of IAA follows an initial phase of rapid absorption, declined markedly in rate from the fourth to the sixth day. All surfactants increased both the rate of absorption and the total amount of chemical absorbed, but the ability to promote this absorption is not directly correlated reduction in surface tension. There is an interaction between the surfactant and the species of chemical being absorbed which involves not only the ability of the surfactant to reduce surface tension, but also the chemical nature of this agent. The presence of a surfactant markedly reduces the variation in absorption as imposed by climatic conditions. It was also shown in this study that foliar absorption of IAA followed a first order rate law. (Department of Agricultural Chemistry, Oregon State College, Corvallis, Oregon)

Uptake and metabolism of amitrol in resistant and susceptible species. Kief, Mabel and Freed, V. H. The uptake and metabolism of amitrol in oat and barley plants was studied using C^{14} labeled amitrol.

Oat and barley seedlings were placed in a water solution of amitrol in an airtight system. The $C^{14}O_2$ given off by the plants was drawn off and collected as $BaC^{14}O_3$. Amounts of chemical absorbed and retained in the plant were determined by drying the seedlings, grinding to a fine powder and counting. Several experiments varying the lengths of exposure to the chemical were run to establish comparative rates of absorption and metabolism.

The experiments showed amitrol was absorbed far more rapidly by the oat plants, however a larger percentage of the absorbed material was converted to alcohol insoluble material by the barley plants.

The greater rate of $C^{14}O_2$ production by oat plants is shown on the curve. Also, apparent from the curve is a rapidly increasing rate of $C^{14}O_2$ production by the barley plants which reaches a maximum after about six hours, then falls off rapidly, probably due to increased damage to the plant system and subsequent inhibition of further metabolism of the amitrol. (Department of Agricultural Chemistry, Oregon State College, Corvallis, Oregon)



A color reaction for the determination of 4 (2, 4-DB). Kief, Mabel and Freed, V. H. A color reaction has been developed for the detection and determination of micro quantities of 2, 4-DB.

The reagent for color development in 2, 4-DB may be prepared as follows: add 0.2 ml of 35% formaldehyde to 10 ml concentrated sulfuric acid and mix well. This reagent should not be stored longer than a day or two.

Prior to color development, the sample is cleaned up and reduced to about 3 ml in volume. A drop of NaOH is added to prevent volatilization of the 2, 4-DB and the sample evaporated to dryness. Ten ml of the formalin reagent is added, the sample shaken well and allowed to stand 10 minutes to develop the color. No heating is necessary and the color is stable for about 15 minutes. The reaction produces a magenta color with 2, 4-DB which obeys Beer's law and will detect down to 5 micrograms 2, 4-DB

2,4-DB gives no color with chromatropic acid and 2,4-D no color with the formalin reagent, making it possible for these compounds to be determined in the presence of each other.

Presence of other aromatic compounds such as phenols etc. will interfere with the reaction and a suitable clean-up procedure should be adapted. (Department of Agricultural Chemistry, Oregon State College, Corvallis, Oregon)

The metabolism of atrazin by expressed juice of corn. Montgomery, Marvin and Freed, V. H. In the course of study with corn plants treated with radioactive atrazin (2-chloro-4,6-bis (ethylamino)-2-triazine) it was found that the corn plant is able to degrade the triazine ring. In an effort to determine how the corn plant detoxifies this chemical, a preliminary investigation was carried out by adding radioactive atrazin solution to sap extracted from corn seedlings. The sap was extracted from corn seedlings by grinding the seedlings with a small amount of buffer solution (0.5M sucrose, 0.1M KH_2PO_4, 0.01M EDTA and I N KOH to pH 6.8) and squeezing this pulp through cheesecloth. One ml of an aqueous atrazin solution was added to 3 ml of expressed juice. After incubation for three days, an aliquot was chromatographed with isoamyl alchol saturated with 3 M hydrochloric acid on paper which had been previously washed with this solvent. The position of the radioactive peaks was determined with a chromatograph scanner.

With the solvent isoamyl alcohol saturated with 3 M hydrochloric acid, atrazin has an R_f value of 0.88 while the hydroxy derivative of atrazin has an R_f of .62. Upon chromatography of the atrazin-sap mixture, 2 peaks were found which appear to correspond to unchanged atrazin and the hydroxy derivative. The 2 peaks had R_f values of .64 and .89. While this data is not conclusive, it strongly suggests that hydroxy atrazin is one of the first intermediates in the degradation of atrazin. (Department of Agricultural Chemistry, Oregon State College, Corvallis, Oregon)

Influence of 2,4-D on pathways of glucose utilization in bean stem tissues. Fang, S. C., Teeny, Fuad and Butts, J. S. The effect of 2,4-D on the absorption and metabolism of glucose in bean stem tissues was studied. After a two-day treatment period, the uptake of labeled glucose by bean stem tissue was the same as the control; after seven days however, there was a three-fold increase over the control. The percentage radiochemical yield of respiratory CO_2 and the glucose utilization as expressed by the ratio of synthetic function/catabolic function from either C^{14} labeled glucose were changed in 2,4-D treated stem tissues. These changes were correlated with the dosage received by the plant.

The yields of $C^{14}O_2$ from glucose-1-C^{14} and glucose-6-C^{14} in short time experiments were used to evaluate the effect of 2,4-D on the participation of the direct oxidative pathway in glucose catabolism. Treatment with various amounts of 2,4-D caused a relative increase in the amount of glucose catabolized via the glycolytic sequences.

Evidence was obtained to indicate that the synthetic pathways for cellular constituents in the stem tissue are not affected by 2,4-D. (Department of Agricultural Chemistry, Oregon State College, Corvallis, Oregon)

Biochemical aspects of the structural specificity of 2, 4-D type herbicides. Fang, S. C.; Teeny, Fuad; Theisen, Patricia; Stevens, V. L.; Bourke, John B.; and Butts, J. S. The metabolic alterations which occur in a plant cell as the result of 2, 4-D treatment are at present very poorly understood. During the past year, experiments were carried out to investigate the influence of 2, 4-D as well as its analogs (both active and inactive) on photosynthesis, ion uptake, and on the metabolism of auxins (indoleacetic acid), glucose and acetate, hoping that these data may be of value in extending the overall knowledge of selective weed control and molecular specificity. These experiments are summarized in the following:

A. Effect of 2, 4-D analogs on photosynthesis in higher plants.

Photosynthesis was measured in terms of the amount of radioactive CO_2 fixed per unit weight of leaf tissue. The results show that 2, 4-D and 2, 4, 5-T (active) depressed the photosynthesis of all plant species tested. The higher the dosage, the greater inhibition observed. 2, 4, 6-T and 2, 6-D have often been considered as wholly inactive as a plant growth regulator. However, treatment with these two chemicals in the bean plant resulted in a stimulation of the rate of photosynthesis, while treatment with 2, 4, 6-T in corn plants resulted in a slight inhibition. Pentachlorophenoxyacetic acid also is classified as an inactive analog with seemed to be inactive in the bean plant and caused a great reduction of photosynthesis in the corn plant.

B. Effect of 2, 4-D analogs on ion absorption in higher plants.

It is clearly demonstrated that both active (2, 4-D, 2, 4, 5-T) and inactive (2, 6-D, 2, 4, 6-T) phenoxyacetic acid analogs greatly depressed the uptake of radioactive sulfate and radioactive phosphate in pea and corn seedlings. In fact, the inhibitive effect of 2, 4, 6-T (inactive) was even greater than that of 2, 4-D (active). Compiling results from both pea and corn seedlings, the degree of inhibition in decreasing order on ion uptake for both sulfate and phosphate is as follows: 2, 4, 5-T 2, 4, 6-T 2, 4-D 2, 6-D. Also, the degree of inhibition caused by the same compound on sulfate absorption was always greater than that on phosphate absorption even though an equal concentration of sulfate and phosphate was used. On the other hand, neither compound showed any inhibitive effect on Ca^{45} absorption. From these experiments it is apparent that the influence of 2, 4-D on the absorption processes of the two species are markedly divergent, and are indeed complex. However, it is safe to conclude that the molecular selectivity of 2, 4-D analogs is not relative to their influence on ion absorption. In other words, the toxic action of 2, 4-D and 2, 4, 5-T in killing plants is not connected with their inhibitive influence on nutrient absorption.

C. Effect of 2, 4-D analogs on indoleacetic acid metabolism in corn root tissues.

Decarboxylative oxidation of exogenous IAA-1-C^{14} was significantly higher in corn root tissues which received prior treatment of 2, 4-D, 2, 4, 5-T or 2, 4, 6-T. 2, 4-D caused a greater increase of IAA oxidation than 2, 4, 5-T and 2, 4, 6-T. The latter two compounds were equally effective in that respect. In addition, 2, 4, 6-T (inactive) caused a conspicuous disturbance of IAA metabolism as judged from the percentage of incorporation of C^{14} derived from labeled IAA in each radioactive metabolite, while 2, 4, 5-T (active) caused no significant change under similar conditions. The results suggested that the toxic action of 2, 4-D or 2, 4, 5-T in killing plants is probably not connected with the disturbance of IAA metabolism in plant cells.

D. Effect of 2, 4-D analogs on glucose metabolism in pea root tissues.

Both active (2, 4-D, 2, 4, 5-T) and inactive (2, 6-D, 2, 4, 6-T) analogs caused a shift in both oxidative catabolism and structural incorporation of radioactive carbon either from glucose-4-C^{14}, or glucose-6-C^{14}. A decrease of C_6/C_1 ratio, obtained from the radiochemical yield of CO_2 from G-6-C^{14} and G-1-C^{14}, as caused by 2, 4-D, 2, 4, 5-T, 2, 6-D or 2, 4, 6-T treatment in pea root tissues, indicated an increase in the participation of the pentose phosphate pathway on glucose catabolism. In any case, the inactive 2, 4, 6-T caused a greater shift in the metabolism of glucose or the pathways on glucose catabolism than the physiologically active 2, 4-D.

E. Effect of 2, 4-D analogs on acetate metabolism in pea root tissues.

The results indicate that 2, 4-D, 2, 4, 5-T and 2, 4, 6-T caused a slight increase in radioactivity found in respiratory CO_2 from acetate-1-C^{14} and acetate-2-C^{14}. Also, no significant change caused by 2, 6-D treatment was noted. On the other hand, all 2, 4-D analogs (both active and inactive) caused a decrease in structural incorporation of either C-1 or C-2 carbon of acetate in pea root tissues. This information suggests that the toxic effect produced by 2, 4-D and 2, 4, 5-T is not connected with the disturbance of acetate metabolism.

The foregoing information suggests that the toxic effect produced by active phenoxyacetic acid analogs (2, 4-D, 2, 4, 5-T) is correlated with photosynthesis (the bean plant) but it is not connected with inhibitive influences or nutrient absorption, the distrubance of IAA metabolism in plant cells, the influence in glucose utilization and pathways of glucose catabolism, and the disturbance of acetate metabolism. (Department of Agricultural Chemistry, Oregon State College, Corvallis, Oregon)

PROJECT 9. RESEARCH TECHNIQUES

P. A. Frank, Project Chairman

No Reports Received