RESEARCH PROGRESS REPORT

RESEARCH COMMITTEE
WESTERN WEED
CONTROL CONFERENCE

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PREFACE

This is the 1959 Annual Research Progress Report of the Research Committee of the Western Weed Control Conference. It consists of summary type reports of current research results submitted by workers throughout the conference area.

This Research Progress Report is particularly to be recommended for its timeliness. These results of research were assembled in time to be available at the Annual Research Committee Meeting. This was accomplished by the timely combined efforts of those reproducing the copy as well as personnel of the Research Committee.

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

The individual reports were assembled by nine project chairmen. Each chairman being responsible for a specific project as designated previously by the Research Committee. The individual reports are listed by subject under each project title. An author index and list of herbicide names and designations are also included. There were no abstracts submitted under Project 9 (Economic Studies) this year.

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

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

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

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NAMES AND DESIGNATIONS OF CHEMICALS USED AS HERBICIDES

Designation accepted by WSA	Chemical name
*Acrolien	C_3H_4O
AMS	ammonium sulfamate
amitrol	3 amino-1,2,4-triazole-formerly ATA
*Atrazine	2-chloro-4-(isopropylamino)-6-(ethylamino)-s-triazine
BCPC	sec-butyl N-(3-chlorophenyl carbamate)
BDM	borate-2,4-D mixtures c/
BMM	borate-monuron mixtures c/
CBDM	chlorate-borate-diuron mixtures c/
CBFM	chlorate-borate-fenuron mixtures c/
CBM	chlorate-borate mixtures c/
CBMM	chlorate-borate-monuron mixtures c/
CDAA	2-chloro-N, N-diallylacetamide
CDEA	2-chloro-N,N-diethylacetamide
CDEC	
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-chloro-2-butynyl-N-(3-chlorophenyl) carbamate (S-847)
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%.

* not officially accepted yet

Designation accepted by WSA	Chemical name
HCA	hexachloroacetone
IPC	isopropyl N-phenylcarbamate
IPX	isopropyl xanthic acid
KOCN	potassium cyanate
MAA	monomethylarsonic acid
MCPA	2-methyl-4-chlorophenoxacetic acid
MCPES	2-methyl-4-chlorophenoxyethyl sulfate
MH	maleic hydrazide
monuron	3-phenyl-1,1-dimethylurea
neburon	1-N-butyl-3-(3,4-dichlorophenyl)-1-methylurea
NPA	N-1-napthylphthalamic acid
OCH	octochlorocyclohexenone
PBA	polychlorobenzoic acid
PCP	pentachlorophenol
PMA	phenylmercuric acetate
sesone	sodium 2,4-dichlorophenoxyethyl sulfate
silvex 2,4,5TP	2-(2,4,5-trichlorophenoxy) propionic acid
simazin	2-chloro-4,6-bis (ethylamino)-s-triazine
SMDC	sodium methyldithiocarbamate
TCA	trichloroacetic acid
TCB	trichlorobenzene
*	tetrachlorobenzene
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

* not officially accepted yet

PROJECT 1. PERENNIAL HERBACEOUS WEEDS

W. R. Furtick, Project Chairman

SUMMARY

Thirteen reports on seven perennial weeds were received from seven groups of investigators.

Field bindweed (Convolvulus arvensis). Several reports were received which indicated chloro benzoic acids, high rates of 2,4-D and DB granular were quite effective. Other materials reported included Amitrol, Monuron and SMDC.

Yellow nutgrass (Cyperus esculentus). Reports from two stations indicated EPTC was effective for control when incorporated into the soil. Amitrol and dalapon alone or in combination were of only temporary value for control.

Bermudagrass (Cynodon dactylon). Work in California indicated seasonal timing of single applications of dalapon, amitrol or weed oil had little influence on control. Fortification of weed oil with HCA was of limited advantage.

Leafy spurge (Euphorbia esula). Work in Wyoming indicated amitrol at eight pounds gave 95 percent control. High rates of 2,4-D were even better. PBA was not effective.

Wild garlic (Allium vineale). A report from Oregon on 2,3,6-TBA showed excellent control.

Quackgrass (Agropyron repense). Oregon reported EPTC soil incorporated gave excellent control.

Canada thistle (Cirsium arvense). Growth habit studies of 10 eco-types of Canada thistle in Montana showed considerable variability among the different types. Variations in root and shoot growth and seed production were found. Canada thistle reduced the yield of wheat up to 60 percent. By removing thistles by hand or with 2,4-D it was shown that most of this yield loss occurred within about 40 days after seeding the wheat.

CONTRIBUTORS REPORTS

Field trials with soil-applied TBA, 2,4-D acid, BDM, and SMDC for the control of perennial morning glory. McHenry, W. B. and Fischer, B. B. The problem of eradicating perennial morning glory (Convolvulus arvensis) has two major aspects, the eradication of the established stand and the prevention of subsequent re-establishment from seed stores in the soil.

One approach that has received considerable attention in the San Joaquin Valley is the application of 3-(p-chlorophenyl)-1,1-dimethylurea (monuron) at 40 to 50 pounds of the commercial product/A. This treatment usually satisfies both aspects of the problem quite efficiently. However, the nonselective nature of the residual action precludes cropping for several years and thus adds considerably to the cost of such a control measure.

A number of studies have been conducted in California to find other materials that will eradicate established morning glory and still allow the resumption of cropping the following year. When a satisfactory material is proven, the problem of re-establishment will be approached.

In December, 1957, the following treatments were applied: polychlorobenzoic (PBA[1]) at 20, 40, and 60 lb/A; 2,4-dichlorophenoxyacetic acid (2,4-D[2]) at 40, 80, and 120 lb/A; borate-2,4-D mixture (BDM[3]) at 534 (20 lb 2,4-D), 1,068 (40 lb 2,4-D), and 1,600 (120 lb 2,4-D) lb/A; and sodium methyldithiocarbamate (SMDC[4]) at 200, 300, and 400 lb/A.

The perimeter of each 4 square rod plot was ridged up and flooded following the herbicide applications. The SMDC was applied last to reduce vaporization loss. Soil probing 7 days later indicated an average percolation depth of 11 inches. The treatment effects were measured in July, 1958, by visual estimation using a weed control evaluation scale from 0 to 10 where 10 equals 100% kill. Two independent observations were averaged. The treatment means are grouped below in non-significant ranges at the 5% probability level.

HERBICIDE	ACRE RATE	MEAN
PBA (Benzac 103)	40 lb	10.00
PBA (Benzac 103)	60	10.00
PBA (Benzac 103)	20	9.93
BDM (DB Granular)	1,600	9.60
2,4-D Acid Paste	80	7.67
BDM (DB Granular)	534	6.83
BDM (DB Granular)	1,068	6.83
2,4-D Acid Paste	120	6.33
2,4-D Acid Paste	40	4.17
SMDC (Vapam)	200	3.00
SMDC (Vapam)	300	3.00
SMDC (Vapam)	400	1.00
Control	-0-	1.00

In general, PBA and BDM appear to have given the highest degree of eradication. The poor and erratic results of SMDC might well be attributed to vaporization loss, however, there seemed to be an inverse relationship between the degree of control and the length of time the chemical was exposed to the air prior to irrigation.

SMDC/A:	200 lb		300 lb		400 lb	
		Rating		Rating		Rating
Exposure time	95	5	73	7	97	3
in minutes:	25	4	43	2	15	0
	54	0	24	0	37	0

Injection of SMDC into the soil or metering it into the irrigation water might result in more uniform results. (University of California, Agricultural Extension Service, Davis)

1. 8% 2,3,6 tri-, 16% 2,3,5 tri-, 36% 2,3,5,6 tri-chlorobenzoic acid, and 40% other isomers.
2. 4 lb/gal as the parent acid.
3. 7.5% 2,4-dichlorophenoxyacetic acid, 39.2% boron trioxide.
4. 4 lb/gal Vapam

<u>The use of several soil sterilants for control of field bindweed</u> (*Convolvulus arvensis*). Szabo, S. S. and Gould, W. L. Square rod plots of field bindweed were treated in the late bloom stage, July 14-15, 1958, with Benzac 354, Benzac 1281, monuron, monuron + ATA, and fenuron. All treatments were applied in water solution equivalent to 40 gal/A. The degree of control was determined, 2½ months after treatment, as the percentage regrowth compared to the check plots. The results are summarized in the following table.

Chemical	Rate of Application	% Weed Control
Benzac 354	60 lb/A	100.00
	30 " "	74.29
	15 " "	0.00
Benzac 1281	20 " "	99.09
	10 " "	87.87
	5 " "	33.27
Monuron	90 " "	97.45
	60 " "	99.45
	40 " "	99.45
Monuron + ATA	40 + 2 lb/A	99.45
	20 + 2 " "	58.55
Fenuron	40 lb/A	86.36

These results must be considered as preliminary. Final results will be taken during the early part of 1959. (Contribution of the New Mexico Agricultural Experiment Station.)

<u>Chemical control of field bindweed</u>. Fabricius, Lee J. Various chemicals were applied to field bindweed (*Convolvulus arvensis*) in July of 1957. Of the chemicals tested PBA at 20 to 40 pounds acid per acre one year after treatment looked very favorable. DB granular at 40 to 60 pounds per acre also gave very good control. The amine formulation of 2,4-D at 40 pounds acid per acre induced good control, while the ester formulation at 2 to 4 pounds per acre gave good control with only a few plants not killed. ATA applied at 12 pounds acid per acre gave poor control. (Wyoming Agricultural Experiment Station)

<u>Chemical control of leafy spurge</u>. Fabricius, Lee J. Leafy spurge (*Euphorbia esula*) plots were established in June of 1957. Spurge treated with 8 pounds acid ATA per acre gave 95% control. PBA applied at 20 and 40 pounds acid per acre gave little control but showed some stunting. Excellent results were obtained with 2,4-D ester at 40 pounds acid per acre. This treatment gave 100% control. However, the following spring of 1958 this same plot was literally covered with first year seedlings which resulted in a retreatment of 4 pounds 2,4-D acid per acre. (Wyoming Agricultural Experiment Station)

Yellow nutgrass control by chemical fallow with EPTC. Kempen, Harold M. and Miller, John H. A summer fallow period, occurring after harvest of winter and early spring crops, allows the possibility of eliminating certain weeds by chemical fallow before subsequent crops are planted. An attempt was made to reduce or eliminate a uniform yellow nutgrass (Cyperus esculentus) infestation in a Delano loamy sand soil at Shafter, California.

July 10 applications of granular EPTC on 4 square rod plots were immediately incorporated by discing and compared under three water management programs in a non-replicated test. All applications were immediately followed by a flood irrigation. Water management variables included: Series A - pre-irrigated July 3, subsequent irrigations on August 1 and August 15; Series B - pre-irrigated, no subsequent irrigations; Series C - not pre-irrigated, no subsequent irrigations. All plots received a rainfall of 0.65" on Sept. 8.

Emergence of nutgrass was completely suppressed by rates above 5.0 lbs/A on Series A plots initially (July 26 and August 15), and only a limited number of plants were present by September 8. Nutgrass plants were also observed by September 8 on 7.5 and 10.0 lbs/A plots and a healthy stand was present on all Series A plots by September 30.

On Series B plots, less than 10 nutgrass plants emerged initially (July 26 and August 15) on the 5 lb/A plot, and no nutgrass emerged at the higher rates. Drought prevented further emergence, but after the 0.65" September rainfall, emergence was limited to less than 50 plants growing only on the 5.0 lb/A plot.

Nutgrass germination was prevented on both Series C plots until after the September 8 rainfall when moderate populations developed on each.

After an October 1 pre-irrigation, cotton, peas, sugar beets and barley were planted October 14 and irrigated up. Nutgrass and crop counts made October 29 are shown in Table 1. One furrow irrigation was applied December 16.

Nutgrass was controlled only on Series B plots, but crop injury also occurred. Barley and cotton emergence was prevented in spotted areas. Cotton that did emerge was severely stunted. Peas emerged, but early foliar growth was severely malformed. Sugar beets seemed to be normal but stands may have been reduced. Subsequent growth appeared normal on all crops except cotton.

Interpretation of the differences between nutgrass counts made on the irrigated and dry fallow check plots is difficult, but might be explained as follows. Since growth of yellow nutgrass is retarded during the hot summer months, few new tubers probably were produced on the irrigated plot. Yet, microfloral decomposition of the existing tubers might have been enhanced by the moist soil atmosphere. On the other hand, though no nutgrass growth occurred on the dry fallow plot, neither did any appreciable decomposition of existing nutgrass tubers occur.

On October 29, a 5 and 10 lb/A post-emergence spray was applied over crops and nutgrass and incorporated into adjoining non-replicated plots. Slight contact injury occurred on beets, barley and peas, but not on cotton or nutgrass. Peas developed malformed leaves at both rates and beets were slightly stunted by 10 lb/A but recovery appeared to be good by January 5, 1959. (Botany Department, University of California, Davis and Crops Protection Research Branch, ARS, USDA). (Cooperative investigations of the Botany Department, University of California, Davis, and Crops Research Division Agricultural Research Service, U. S. Department of Agriculture.)

Table 1. Plant counts made October 29 on nutgrass and crops following a chemical fallow treatment with EPTC.

Rate (lb/A)	Nutgrass control (plants/sq. ft.) 1/	Plants/linear foot 2/ Cotton	Barley	Peas	Beets
		Series A			
5	3.6	12.3	23.8	5.8	20.0
7.5	2.9	12.0	17.0	7.3	20.3
10	3.4	10.3	13.0	6.5	18.3
15	2.8	9.8	19.3	3.5	17.5
Avg.	3.1	11.1	18.3	5.8	19.0
		Series B			
5	0.2	9.0	17.0	6.5	14.8
7.5	0.1	6.0	14.8	5.3	6.0
10	0.4	11.0	12.8	4.8	10.5
15	0.3	9.0	11.5	6.8	18.3
Avg.	0.3	8.8	14.0	5.8	12.6
		Series C			
5	8.4	8.3	14.0	5.0	21.0
10	7.9	9.3	13.5	4.8	12.8
Avg.	8.2	8.8	13.8	4.9	16.9
Irrigated Check	1.9	10.3	19.3	3.5	25.8
Dry Fallow Check	14.8	8.1	20.1	3.6	16.5

1/ Avg. of 1 x 4 foot quadrats replicated 4 times.
2/ Avg. from one 1 x 4 foot quadrat.

The use of dalapon and amitrol for the control of nutgrass (*Cyperus esculentus*). Szabo, S. S. and Gould, W. L. Fourteen treatments of dalapon and amitrol, alone and in combination, were applied to an area heavily infested with nutgrass. The treatments of dalapon, alone, included single applications of 5 and 10 lb/A and a double application of 10 lb/A (20 lb/A total) with a two week interval between applications. The treatments of amitrol, alone, consisted of single applications of 2 and 4 lb/A and a double application of 4 lb/A (8 lb/A total). The amitrol treatments were applied in duplicate, using both the liquid and granular formulations. Mixtures of dalapon plus amitrol were applied at 10 + 4, 10 + 2, and 5 + 2 lb/A as single applications. Double applications of the mixtures containing 10 + 2 and 5 + 2 lb/A of dalapon plus amitrol were applied at an interval of two weeks.

The treatments were randomized and applied to plots 1/2 sq. rod in area. All treatments were applied in water equivalent to 40 gal/A and were replicated four times. The initial treatments were applied on July 3, 1958. The second application of the double treatments was made on July 17.

Observations made eight weeks after treatment showed: (1) all single treatments of both chemicals were ineffective in controlling nutgrass, although the 4 lb/A rate of amitrol caused slight to severe chlorosis. (2) the double applications of dalapon and amitrol and the double applications of the mixture of dalapon and amitrol at the 10 + 4 lb/A rate were equally injurious to the nutgrass. The original topgrowth was severely injured or completely killed. However, the nutgrass which emerged after treatment showed very little injury from the chemicals. Shoot counts made four months after the initial treatments indicated a 50% reduction, when compared to the untreated check plots, on the plots receiving the double applications of the treatments. This experiment indicates the need for further work involving the application of dalapon and amitrol, singly and in combination, as repeated applications at regular intervals of time. (Contribution of the New Mexico State Experiment Station)

The response of nutgrass to Eptam treatments. Gould, W. L. and Szabo, S. S. This experiment was undertaken to verify an observation in a previous experiment in which the nutgrass stand was found to be substantially less in the Eptam treated plots than in the adjoining plots. The liquid and 5 per cent granular formulations of Eptam were applied July 14 at the rates of 2.5, 5, 10, and 20 pounds per acre on 1/2 square rod plots replicated 3 times. The liquid formulation was also applied at 15 lb/A. The soil was a clay loam.

In one set of plots Eptam was applied to a vigorous growth of nutgrass which was 4-6 inches tall. Another set of plots was placed on recently disked land. The Eptam was incorporated into the top 2-4" of soil by means of a rotary tiller on 1/2 of each plot. Both sets of treatments were flood irrigated immediately after treatment.

Incorporation of the Eptam into the topsoil in the plots where Eptam was applied to the growing nutgrass decidedly increased the degree of control as compared to the non-tilled treatments. However, incorporation did not affect the response of the nutgrass where the land had been disked before treatment. The Eptam granules were more effective than the liquid formulation in inhibiting nutgrass growth, especially at the 2.5 and 5 lb/A rates of application. The following table shows the percentage nutgrass control obtained at the various rates of Eptam application.

		Percent Control		
			Land not disked	
Formulation of Eptam	Rate lb/A.	Land disked before chemical applied	Eptam Incorporated	Eptam Not incorp.
Liquid	2.5	60	27	0
	5	50	64	0
	10	86	96	50
	15	91	100	84
	20	98	97	90
Granular	2.5	64	70	65
	5	90	98	85
	10	98	98	80
	20	100	100	100

(Contribution of the New Mexico Agricultural Experiment Station)

Control of wild garlic (Allium vineale) with 2,3,6-trichlorobenzoic-acid. Furtick, W. R. and Chilcote, D. O. A dense three-year-old stand of wild garlic planted from bulblets was sprayed on March 26, 1957. At the time of application, the garlic was 6 to 10 inches tall and growing vigorously. The stand density was 8 to 10 plants per square foot. Application was made in water at a volume of 40 gallons per acre applied as a double coverage with a plot sprayer. Each treatment contained .1% wetting agent as du Pont spreader. The control was estimated May 29, 1958, as a percent of the untreated check. The average control for treatments with 2,3,6 TBA as the sodium salt, ranged from 80% reduction of garlic at 2 pounds per acre to 100% elimination of the garlic stand at 8 pounds per acre. The intermediate rate of 4 pounds per acre gave an average of 94% stand reduction. This compared with a maximum stand reduction of 30% from 8 pounds of the isopropyl ester of 2,4-D. (Oregon Agricultural Experiment Station)

Quackgrass control (Agropyron repens) with EPTC. Furtick, W. R. and Chilcote, D. O. Indications were obtained in 1957 that quackgrass might be sensitive to the herbicide EPTC. Quackgrass in plots irrigated immediately after EPTC application at the rates of 4 and 8 pounds per acre showed severe injury and partial reduction of stand during the growing season which followed. Trials were established in 1958 to evaluate the influence of soil incorporation of EPTC on quackgrass as a possible method for control. A dense stand of quackgrass was selected and treated with EPTC at the rates of 5, 10, 20, and 40 pounds per acre. The EPTC was thoroughly incorporated by double disking a few minutes after treatment. The disking was done to a depth of approximately four inches. The EPTC application was made on May 29, 1958. The amount of quackgrass left in the plots was evaluated on September 1, 1958. During the summer, the quackgrass was fertilized and irrigated to induce recovery. The reduction in quackgrass stand at the 5 pound rate of EPTC was 90%. The 10, 20, and 40 pound rates eliminated any summer growth and there was no evidence of live quackgrass. Corn and beans were planted in the plot areas as indicators for possible crop tolerance one week after treatment. The corn was not injured by the 5 pound rate of EPTC, but damage was moderate at the 10 pound rate and severe at higher rates. Snap beans were not injured by the 5, 10, and 20 pound rates, but injury was severe at 40 pounds. The plot area contained a dense stand of lambsquarter and pigweed. There was only a trace of pigweed and lambsquarter left at the 5 pound per acre rate and the weeds were completely eliminated at the higher rates. The results of this trial would indicate this treatment is promising as a control measure for quackgrass with possible uses on a selective basis. (Oregon Agricultural Experiment Station)

Control programs on bermudagrass with dalapon, amitrol, and weed oil. Day, B. E. and Russell, R. C. The objectives of these studies were two-fold: (1) to evaluate the effect of seasonal timing on single treatments of bermudagrass with dalapon, amitrol and aromatic weed oil, (2) to compare the effect of single treatments of amitrol and dalapon alone with similar treatments of each material preceded by treatments with weed oil at varying intervals of time between treatments.

Plots replicated eight times were treated in a thick uniform bermudagrass turf located in a lemon orchard in San Diego County. The grass was mowed at frequent intervals throughout the season to maintain a uniform stage of growth at each time of treatment.

Single 4 lb/A applications of dalapon and amitrol were made on June 23, July 21, August 18, and September 15. Single treatments with aromatic weed oil at 100 gpa were applied on June 23, July 21, August 4, and August 18. The plots were rated for percent control of the bermudagrass at two week intervals following treatment until regrowth became substantial.

Differences in seasonal timing on single applications of weed oil had negligible effect on the subsequent control of bermudagrass. In treatments with dalapon and amitrol, late season applications were more effective providing longer-lasting control. Mid-September treatments, however, did not follow this trend.

Separate sets of plots were treated with weed oil (100 gpa) and followed by retreatments with dalapon and amitrol, both at 6 lb/A rates, at intervals of 0, 2, 4, and 8 weeks between applications. Treatments were scheduled so that the final applications in all cases were made on the same day. Ratings based on percent control of the bermudagrass were made by visual estimate at two week intervals up to 10 weeks following the final treatments. Data from these tests are given in table 1.

Table 1. The control of bermudagrass (percent) by dalapon and amitrol preceded by treatments with aromatic weed oil at four intervals of time between treatments.

Treatment	Time between treatments (weeks)	Weeks after treatment 2	4	6	8	10
Dalapon (alone)	-	57	93	95	83	59
Oil - Dalapon	0*	92	74	44	22	9
Oil - Dalapon	2	57	50	28	10	4
Oil - Dalapon	4	48	90	88	80	63
Oil - Dalapon	8	49	94	92	78	66
Amitrol (alone)	-	55	80	68	53	35
Oil - Amitrol	0*	77	48	23	12	7
Oil - Amitrol	2	49	38	20	6	2
Oil - Amitrol	4	55	60	40	28	13
Oil - Amitrol	8	61	81	65	53	39

* Weed oil and dalapon or amitrol applied on the same day.

Applications of weed oil followed by application of dalapon and amitrol eight weeks apart gave more effective control of bermudagrass than these same treatments spaced four and two weeks apart. This combination treatment, however, was little more effective than single treatments with amitrol or dalapon alone. Successive oil and dalapon or amitrol treatments appear to have no advantage over use of dalapon or amitrol alone for control of bermudagrass. (University of California, Riverside)

Evaluation of Hexachloroacetone (HCA) for bermudagrass control. Day, B. E., Russell, R. C. HCA was tested as an herbicide for bermudagrass control in southern California during the summer of 1958. Treatments were applied to a dense uniform stand of bermudagrass turf. Testplots were replicated four times using a logarithmic dilution type sprayer. Visual ratings for injury and recovery of the grass were made at one, three, and five weeks following treatment.

Oil-soluble formulations of HCA were applied in aromatic weed oil, diesel oil, and kerosene in mixtures containing from 0.6 to 10 percent HCA (by volume) in a total volume with oil of 100 gpa. Emulsifiable HCA was applied in water at rates varying from 0.6 to 10 gallons of HCA per acre. A 2 percent mixture of HCA in diesel oil was compared with straight diesel oil applied at from 6 to 100 gpa. Data from these tests taken at one week following treatment are graphically shown in figure 1. (page 10)

For initial contact toxicity, little advantage was shown in fortifying weed oil and diesel oil since these oils were relatively toxic without additives. Later, during the stage of recovery the fortifying effect of HCA in these two oils became evident. Effective contact fortifying action with kerosene was obtained with mixtures containing from 1 to 2 percent HCA. The initial toxic effect of HCA using kerosene as a carrier was greater than HCA in a water carrier. The long-term effectiveness of HCA, however, was essentially the same for these two carriers. The combined toxicity of HCA-oil mixtures was appreciably greater than for HCA alone at rates below 5 gallons of HCA per acre. At higher rates the HCA-water mixture was about equal in effectiveness to the HCA-oil mixtures.

Comparative tests between the 2 percent mixture of HCA in diesel oil and diesel oil alone indicated that the HCA had little effect on increasing the initial toxicity of diesel oil over the range of rates tested. After five weeks recovery was, to a moderate degree, slower in the fortified oil plots.

In other tests, plots treated with emulsifiable HCA applied with the logarithmic sprayer at from 0.6 to 10 gpa were watered by sprinkler irrigation following treatment at a schedule of 0, 2, 4, 6, 8, and 11 days between treatment and irrigation. Ratings were made two weeks after treatment. Treatments followed by watering 2 to 4 days after spraying were superior in terms of initial toxicity and period of recovery to treatments immediately followed by watering and those watered over a more delayed schedule.

It is concluded from these experiments that for control of bermudagrass little is to be gained from fortification of good grades of weed oil by HCA. Oils of low phytotoxicity may be improved by admixture of HCA but this offers little improvement over use of water-emulsions of HCA. Water-HCA emulsions containing five or more percent (by vol.) HCA provided longer-lasting control of bermudagrass than weed oil. (University of California, Riverside)

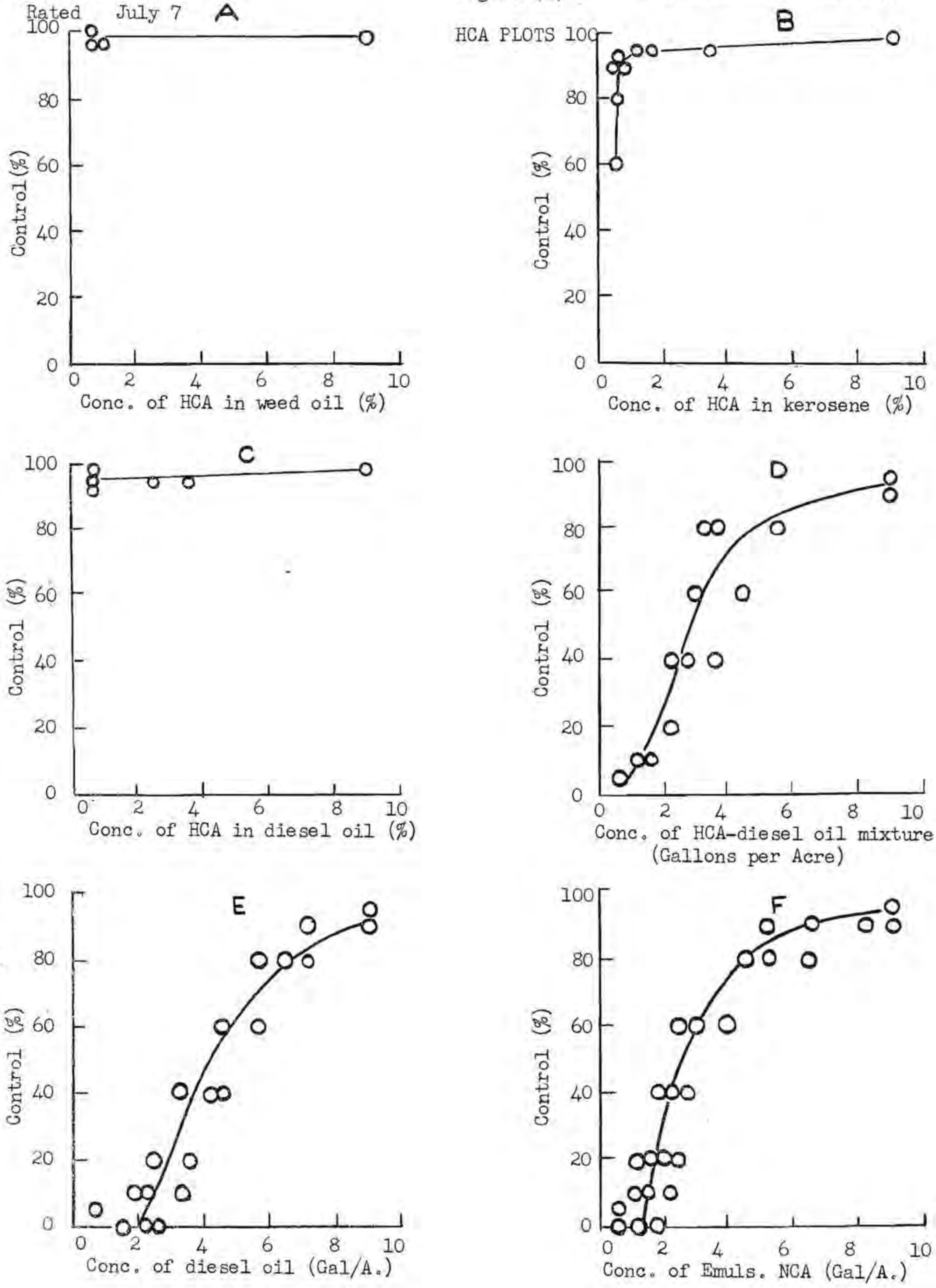
<u>Ecology and growth habits of Canada thistle ecotypes</u>. Hodgson, J. M. In 1956 root sections of ten strains or ecotypes of Canada thistle were obtained from different locations. They were planted in the center of square rod plots, and most of them have now occupied the entire plot. During the growing season of 1958, measurements and observations were made on root and shoot development and seeding characteristics.

The Laramie Wyoming, strain was one of the earliest in emergence, and shoots made growth earlier than most other strains. This strain also produced more roots per sample than any other strain. Seeds from this variety had a high germination and weighed about twice as much as the other strains. Other strains that began growth early were Gallatin Montana strains; Ada Idaho; and Fergus Montana.

Treated June 30
Rated July 7

Figure (1) One week after treatment

HCA PLOTS



The strains also varied considerably in height of shoots. The Prosser Washington strain grew the tallest and the Ada Idaho, the shortest. The average height of these two strains was 38.5 and 20.5 inches, respectively. The greatest amount of growth (average of all strains) occurred from June 13 to 23. Root samples were obtained on two dates to a depth of 21 inches. Averages of all strains showed that over 80 percent of the sample was in the layer 3 to 15 inches deep.

The seed production on so-called male plants was of particular interest since Canada thistle is reported to be a dioecious plant. Seed was collected from both male strains and germination tests proved the seed to be normal and viable. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and Montana Agricultural Experiment Station cooperating)

Effect of Canada thistle on yield of wheat. Hodgson, J. M. Data were obtained in 1955 on effect of level of Canada thistle infestation on yield of spring wheat and from 1954 to 1957 on the effect of combined treatments for control of Canada thistle. Canada thistle caused serious losses in wheat yield. Certain treatments decreased these losses.

In 1958, 2,4-D and handweeding treatments were made in spring wheat that had been seeded in a heavy infestation of Canada thistle to study further the effect of Canada thistle and certain weed control treatments on wheat yield.

When the Canada thistle (heavy infestation) was removed by hand, 14 and 29 days after wheat emerged, the wheat yields were 36.7 and 30.0 bushels per acre, respectively, compared to 15.0 bushels for the check. The yield of wheat averaged 27.8, 24.2, and 19.9 bushels per acre when 1 pound per acre of 2,4-D was applied 18, 29, and 37 days after emergence of wheat, respectively. The yield of wheat from the treatments made 27 and 29 days after seeding averaged 12.8 and 9.2 bushels per acre greater than the check.

Early treatments were important for best control of Canada thistle and highest wheat yields with either handweeding or with 1 pound per acre of 2,4-D. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and Montana Agricultural Experiment Station cooperating)

Escape of Sorghum almum. Suggs, Delbert D. Seventy acres of sorghum almum were seeded in 1957 for seed increase on six irrigated fields. Rhizomes survived the winter on each field. Attempts were made in 1958 to destroy these plants by cultivation, dry fallow, and by cropping to beans and potatoes with close cultivation. In no instance were the fields cleaned of the grass. Seedling plants occurred from them 1/2 miles downstream along runoff waterways. New plants occurred one mile away, along roads, apparently transported as seed by vehicular traffic. New plants occurred 300 to 500 feet downwind but across the slope, and across a canal, two borrow ditches and a State highway. (Bureau of Reclamation, Columbia Basin Project, Washington)

PROJECT 2. HERBACEOUS RANGE WEEDS

W. C. Robocker, Project Chairman

SUMMARY

Seven reports have been contributed for inclusion in this section. Four of the reports are from the State of Washington, two from California, and one from Colorado. Three of the reports are concerned with annual, weedy grasses.

Medusa-head rye (Elymus caput-medusae), in a check on the use of herbicides to aid in establishment of desirable species, was suppressed with least damage to the forage plants by 4 lb/A of ethyl N,N-di-n-propyl thiolcarbamate (EPTC). A study on climatic tolerances of medusa head indicated that the amount of water the plant actually needs to reach a normal maturity is about 7 to 10 inches. In the same line of investigation, cheatgrass (Bromus tectorum) in a field of intermediate wheatgrass (Agropyron intermedium) was controlled almost 100 percent by 4 lb/A of isopropyl N-phenylcarbamate (IPC) applied in late winter. There was no apparent injury to the wheatgrass.

Reports of work on two species growing on forest land indicated no control at commonly used rates of 3 amino-1,2,4-triazole (amitrol) and 2-(2,4,5-trichlorophenoxy) propionic acid (silvex or kuron) on tall larkspur (Delphinium spp.). Flat pea (Lathyrus latifolius) was controlled satisfactorily with 2,36-trichlorobenzoic acid (TBA) at 8 lb/A.

In an irrigation wasteway area where it was difficult to reseed with mechanical equipment, a technique utilizing the trampling of cattle to work into the ground seed which was spread by airplane appeared to be successful. With proper timing, this may prove to be a valuable tool for reseeding limited areas of marshy ground which would otherwise be dominated by cattails or willows.

CONTRIBUTORS REPORTS

Effects of amitrol and kuron on tall larkspur. Hervey, Donald F. Tall larkspur (Delphinium spp.) was sprayed August 9, 1957, on the Gunnison National Forest, Colorado, at an elevation of approximately 10,000 feet. Three-amino-1,2,4-triazole (amitrol) was applied at the rate of 4 pounds and 8 pounds acid equivalent per acre, and 2-(2,4,5-trichlorophenoxy) propionic acid (kuron) at the rate of 2, 4, and 6 pounds acid equivalent per acre. All applications were made at the rate of 100 gpa in water solution. At the time of application, the larkspur was in early bloom. The plots were rechecked July 23, 1958. The amitrol did not kill any of the tall larkspur plants but seriously affected most of the associated vegetation to the extent that the plots appeared practically barren except for the tall larkspur plants. Kuron did not kill tall larkspur at any of the three rates applied. However, at the rate of 6 pounds acid equivalent per acre there was a definite stunting of the tall larkspur. A second application of kuron at the rate of 2 pounds acid equivalent per acre was applied on the plot which had received the 6 pound application in 1957. This second application was made July 23, 1958. Further evaluation will be made in 1959. (Colorado Agricultural Experiment Station)

Use of herbicides as an aid in establishing desirable plants on medusa-head rye rangeland. Major, J., McKell, C. M. and Kay, B. L. The following herbicides were applied to burned-off medusa head rangeland in the fall before rains began: 2-chloro-4,6-bis(ethylamino)-s-triazine (simazin), and 3-(p-chlorophenyl)-1,1-dimethylurea (monuron) at 1/2, 1, and 2 lb/A; 2,2-dichloropropionic acid (dalapon) at 1, 2, and 4 lb/A; and ethyl N, N-di-n-propylthiolcarbamate (EPTC), pelleted isopropyl N-(3-chlorophenyl) carbamate (CIPC), and 2-chloro-N,N-diallylacetamide (CDAA) at 2, 4, and 8 lb/A. After 4.35 inches of rain, rose clover and Harding grass were band-seeded into alternate rows at a rate of 8 lb/A of each over 200 lb/A of 16-20-0 fertilizer. By January, resident grasses, including medusa head, were apparently controlled by the EPTC, CIPC, and simazin. Simazin was not selective, but EPTC and CIPC took out mostly the annual grasses and gave excellent resident bur clover (Medicago hispida) stands. By June the control of medusa head by simazin had almost vanished because of regrowth of the surviving plants, while dalapon, EPTC and CIPC gave significant control at rates at and above 2, 4, and 8 lb/A, respectively. None of the chemicals significantly hindered establishment of the seeded rose clover in this very excellent clover year. The Harding grass stand was injured by CIPC at rates above 4 lb/A and by simazin at 2 lb/A. These chemicals had been effective in reducing competition, but their residues evidently persisted to the detriment of the Harding grass. Other treatments, which were also effective in reducing competition, gave significantly better Harding grass stands than the checks. Best was 4 lb/A of EPTC, then 8 lb/A of EPTC, 1/2 and 1 lb/A of simazin, and 4 lb/A of dalapon. (Botany Dept., University of California, Davis; Crops Research Division, ARS, USDA; and Field Stations, University of California, Davis)

Expansion of infestation of Canada thistle and perennial sow thistle in one year. Suggs, Delbert D. On a fenced section on a margin of Frenchman Wasteway, a detailed survey was made of Canada thistle (Cirsium arvense) and sow thistle (Sonchus arvensis) in April and again in October 1958. The April survey reflected the initial 1957 infestations. The October survey reflected the increase in size and number of the noxious species, in competition with other species. chiefly broad-leaf, on a wet site. The vegetative cover in 1957 was 20 to 40 percent of the survey. The volume-density was approximately 0.2 acre-feet per acre. In 1958 the cover was 100 percent and the volume-density about 2.0 acre-feet per acre. The survey site consisted of a 1-acre strip above the waterline which was wet at the surface by capillary activity, but not flooded. Phosphorous and nitrogen were added as a factor in another exploratory investigation. No herbicides were applied. No grazing was permitted.

	No. of infestations			Area in square feet			Percent of total area	
Species	Apr. 15	Oct. 15	Incr. %	Apr. 15	Oct. 15	Incr. %	Apr. 15	Oct. 15
Canada thistle	7	31	440	75	2200	290	0.17	5.1
Perennial sow thistle	2	19	950	25	1200	480	.006	2.7

(Bureau of Reclamation, Columbia Basin Project, Washington)

Grass seeding by aircraft on wet right-of-way. Suggs, Delbert D. Redtop (Agrostis alba) was successfully seeded on 320 acres of the wet margin of Frenchman Wasteway in late June 1958 by fixed-wing aircraft as competition against noxious weeds and phreatophytes (cattails and willows). Seed was applied in June by modified duster equipment at the rate of 2 lb/A on wet soil which had a 20 percent vegetative cover. The soil was not disturbed except by trampling of cattle at the waterline. The stand was dense and plants were strong in October, although there was considerable livestock traffic and grazing. This method of seeding established cover on an area which was too rough or sandy for land seeding equipment and where the seed of a desirable species was heavy and flowable. (Bureau of Reclamation, Columbia Basin Project, Washington)

Herbicide treatments for controlling flat pea (Lathyrus latifolius). Kerr, H. D. and Robocker, W. C. Duplicate 10- by 20-foot plots were treated June 5, 1958, when flat pea was starting to bloom. Estimates of percentage stand reduction were made in September and are presented in the following table:

Herbicide 1/	Rate per acre	Stand reduction
	Lb	%
2,4-dichlorophenoxyacetic acid (2,4-D)	2	89
	8	94
2,4,5-trichlorophenoxyacetic acid (2,4,5-T)	2	60
	8	85
2(2,4,5-trichlorophenoxy) propionic acid (silvex)	2	90
	8	85
Sodium 2,3,6-trichlorobenzoate (2,3,6-TBA)	2	86
	8	100
3-amino-1,2,4-triazole (amitrol)	4	5
	8	22
3-(3,4-dichlorophenyl)-1,1-dimethylurea (diuron)	4	28
	8	60
1-n-butyl-3-(3,4-dichlorophenyl)-1-methyl-urea (neburon)	4	0
	8	0

1/ The chlorinated phenoxyacetic acids were propyleneglycolbutylether esters.

Wild buckwheat (Polygonum convolvulus) was controlled by 2,3,6-TBA at 8 lb/A, while Kentucky bluegrass (Poa pratensis) increased vigorously on plots given this treatment. (Crops Research Division, ARS, USDA, and the Washington Agricultural Experiment Station, cooperating.)

Control of cheatgrass (Bromus tectorum) in an established stand of intermediate wheatgrass (Agropyron intermedium). Kerr, H. D. and Robocker, W. C. Herbicide treatments were applied in February 1958 on duplicate 10- by 30-foot plots at Hooper, Washington. Cheatgrass had emerged to a uniform stand at the treatment date, but only an occasional leaf of intermediate wheatgrass was visible. In July 1958, injury to both grass species was estimated on a rating scale with 0 equalling no injury and 10 a 100 percent kill. Results were as follows: Isopropyl N-phenylcarbamate (IPC) and isopropyl N-(3-chlorophenyl) carbamate (CIPC) at 8 lb/A controlled cheatgrass with no visible injury to wheatgrass. Lower rates were less effective. Sodium 2,2-dichloropropionate (dalapon), sodium trichloroacetate (TCA), 3-amino-1,2,4-triazole (amitrol) and 3-)p-chlorophenyl)-1, 1-di-methylurea (monuron) applied at rates which controlled cheatgrass as well as the carbamates, injured the intermediate wheatgrass. (Crops Research Division, ARS, USDA, and the Washington Agricultural Experiment Station, cooperating)

Climatic tolerances of medusa-head rye (Elymus caput-medusae L.). Major, J. In an effort to more accurately circumscribe where medusa head can possibly invade and grow, some analysis was undertaken of the regional climates in places where it has invaded or grows normally. Data from northern California and adjacent Oregon (4 stations), the California Coast Ranges, Sacramento Valley, and Sierra foothills (8 stations), western Idaho (3 stations), and Eurasia from southern France and North Africa to the Ukraine and central Asia (7 stations) indicate that medusa head grows where winter frost occurs but extended periods of great cold do not. Some of these climates are almost as hot as any on earth. If potential evapotranspiration as calculated by Thornthwaite is used as a measure of the heat requirement, the lower limit for medusa head seems to be about 23-25 inches per year and the upper 37 inches. Medusa head climates are very continental, not at all maritime.

There seems to be no upper limit on the precipitation where medusa head can grow, just so very great amounts do not depress temperatures too much. Actually, medusa head can get along with 11 inches of precipitation in a coolish climate such as in Idaho, and 50 inches is not excessive if sufficiently unfavorably distributed and in a hot enough climate as in California and Greece. Precipitation is usually in winter but may show a summer peak as in the Ukraine. The range of amounts of water actually used by medusa head vegetation is rather small (10-1/2 to 22 inches) and is only 10 to 14 inches in cool areas and those with no summer rain - which medusa head does not use. This spread is further reduced if we calculate the amount of water used by vegetation subsequent to the winter low of plant activity and until summer growth is sharply cut off when soil water is exhausted. This amount of water that medusa head evidently needs to mature a "crop" is about 7 to 10 inches.

Thornthwaite assumes soils store 4 inches of water that can be used by plants. Actually medusa head in California occupies deep, heavy soils with a storage capacity of 5 to 7 inches. In other words, medusa head probably uses 2 inches more water, leaving 2 inches less for runoff, than normal vegetation. This water runoff that is in excess of plant needs and soil storage amounts to 4 inches in northern California, is variable between 6 and 24 inches in the rest of California, and is negligible in Idaho. The differences between what the vegetation can use and what it gets are less in the northern California and Idaho climates with some summer precipitation (12 to 15 inches water deficits) than in summer-dry California with up to 25 inches deficit. (Dept. of Botany, University of California, Davis)

PROJECT 3. UNDESIRABLE WOODY PLANTS

D. N. Hyder, Project Leader

SUMMARY

This project report includes 11 abstracts of current work on a variety of problems in the control of undesirable woody plants. The authors are commended for their contributions of valuable information.

In the aerial application of 2,4,5-T upon mesquite it was found that the height of flying was more critical than swath width. Increasing the height of flying to 50 feet decreased effectiveness with both normal- and inverted-emulsion sprays.

Salt cedar was controlled in Arizona by mechanical undercutting, raking, and burning at an average cost of 15 to 40 dollars/A, depending upon salt cedar density. The application of fenuron at 80 lb/A and monuron at 40 lb/A gave promising control of salt cedar in New Mexico.

The use of fire for controlling juniper is under study in Arizona. Proper timing and control of broadcast burning gave successful control in dense stands of juniper. In thin stands the trees were burned individually with a propane torch to obtain good kills at a cost less than that required for bulldozing. The spread of juniper into stands of grass was checked by burning grass residue while the juniper were small. The importance of proper control and timing is emphasized.

Mixed-brush stands in southwestern Oregon continue to present difficult control problems. Some species are readily killed with a single application of 2,4,5-T or 2,4-D, while other species yield to respraying, and still other species have continued resistance.

Studies of soil moisture, snow depth, and herbage response in Wyoming are revealing the nature of benefit derived from the control of sagebrush. Low-growing big sagebrush was readily killed with 2 lb/A of 2,4-D esters. In Oregon, 2,4-D effectiveness on big sagebrush and green rabbitbrush was not influenced by the addition of certain nutrients or gibberellin.

Prickly pear cactus in Wyoming was killed readily with benzac at 20 to 40 lb/A, but was resistant to other herbicides.

CONTRIBUTORS REPORTS

Effects of swath width and height of flying in the aerial application of 2,4,5-T to mesquite. Tschirley, Fred H. A butoxyethanol ester of 2,4,5-T in a normal and an inverted emulsion was applied to mesquite in the spring of 1958. Swath widths of 42, 60, and 90 feet were tested at heights of 0 and 50 feet above treetop level. Applications were made with a 450 hp Stearman using conventional boom and nozzle spray equipment. Rate and volume were 1/2 lb/A a.e. and 5 gpa, respectively, on all plots.

The results, based on defoliation one growing season after treatment, are shown in the table on the following page. There was no difference between the normal and the inverted emulsion; neither could a difference be demonstrated between the three swath widths. Height of flying was, however, significantly different at .01. Greater defoliation was obtained on plots sprayed at treetop level than on plots sprayed from 50 feet above treetop level.

Herbicide 1/	Swath width (feet)	Percent defoliation 0-foot height	50-foot height	Mean
Normal emulsion	42	86.0	73.0	79.5
(oil in water)	60	81.5	64.5	73.0
	90	77.5	76.5	77.0
	Mean	81.7	71.3	76.5
Inverted emulsion	42	81.0	72.0	76.5
(water in oil)	60	76.5	77.5	77.0
	90	81.0	75.0	78.0
	Mean	79.5	74.8	77.2
Combined Means		80.6	72.1	

1/ Butoxyethanol esters of 2,4,5-T furnished by Amchem Products Company.

The data suggest that swath widths greater than 42 feet can be used safely, but that the plane should be flown as close to the treetops as possible. (Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture)

Mechanical control of salt cedar. Frost, K. R. and Hamilton, K. C. A cooperative investigation into the control of salt cedar (*Tamarix pentandra*) was initiated in 1958 by the University of Arizona, Bureau of Reclamation, and Corps of Engineers. The initial study was of the salt cedar clearing operation on the Gila River by Wellton-Mohawk Irrigation and Drainage District.

The operation entailed clearing salt cedar by undercutting and bulldozing from a 55-mile by 400-foot strip. Caterpillar D8 tractors with dozer blades and 10-foot, rear-mounted, undercutting blades were used. International TD-18 tractors with rakes were used to pile the debris, which was then burned.

Field investigations began in July of 1958. Ninety-five plots 20 x 100 feet were established in or adjacent to the cleared area before clearing to study the effectiveness of the control method. Machinery was timed in various densities of salt cedar, cost records were studied, and equipment trouble was noted. The ground cover of salt cedar in plot areas varied from 25 to 70 percent, and was as high as 100 percent in small portions of the riverbed. The density of established salt cedar varied from 100 to 400 trees per acre in plot areas.

Regrowth counts were not planned until 1959 when maintenance on the channel was scheduled. However, since earthmoving was planned in 1958, regrowth of salt cedar was determined on one-third of the plots 1 to 2 months after clearing. At this time a 90 percent reduction in plant density and a 99 percent reduction in plant cover were found. Most of the regrowth occurred from crowns not cut in the clearing operation. Thirty-five percent of the plots had no salt cedar regrowth.

In small measured areas the costs for undercutting (figured at 15 dollars/tractor-hour) with different densities of salt cedar were 30, 15, 10, and 6 dollars/A, respectively, with ground-cover densities of 80 - 90, 60 - 70, 40 - 50, and 20 - 30 percent.

Between plots, the average costs for undercutting and brush raking (figured at 15 and 12 dollars/tractor-hour, respectively) with different densities of salt cedar were as follows:

Average	Cost per Acre		Approximate
Ground Cover	Undercutting	Raking	Distance
52%	$21.00		4 miles
47%	$15.00		2 miles
41%	$17.00		1 mile
36%	$17.00		1 mile
28%	$ 7.00		3 miles
44%		$11.00	4 miles
39%		$ 7.00	3 miles
36%		$ 9.00	2 miles

The cost of clearing operations ranged from 15 to 40 dollars/A, depending on salt cedar density. (Arizona Agricultural Experiment Station)

The use of soil sterilants for the control of salt cedar (*Tamarix sp.*). Szabo, S. S. and Gould. W. L. The present study was initiated 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), and weedone 638 (an emulsifiable 2,4-D acid).

The treatments were applied to sq. rod plots. The plots were established on a relatively young salt cedar area, the established plants being less than 5 years old. The treatments were applied in a randomized block design and were replicated four times. The chemicals were applied directly to the soil. The treatments were applied July 24, 1958. The degree of control was determined on November 4. The rating scale used was as follows: 0 = no effect, 10 = complete top kill with no regrowth. The results are summarized in the following table:

Chemical	Rate	Control Rating
Fenuron	80	9.0
	40	6.5
	20	8.5
	10	5.3
	5	2.8
Monuron	40	8.3
	20	3.3
	10	4.3
Benzac 354	80	3.3
	40	2.8
	20	1.8
	10	1.8

(continued)

Chemical	Rate	Control Rating
Benzac 1281	60	3.5
	40	2.8
	20	2.8
	10	3.0
	5	2.3
2,4-D	40	2.8
	20	2.5
	10	2.3
	5	2.5
Check		0.0

(Contribution of the New Mexico Agricultural Experiment Station)

Preliminary results of the effect of phenoxy and trichlorobenzoic acid herbicides on salt cedar regrowth. Gould, W. L. and Szabo, S. S. Applications of 2 and 4 lb/A of 2,4-D amine, 2,4,5-T LVE, 2,4,5-TP LVE, 2,4,5-TP invert emulsion, 4-(2,4-DB) LVE, and 4 and 8 lb/A of 2,3,6-trichlorobenzoic acid were made in single and split treatments on an area heavily infested with salt cedar (Tamarix sp.). The 2,4-D, 2,4,5-T, 2,4,5-TP and 4-(2,4-DB) were applied in water and in 5 percent oil-water emulsion at a total volume of 40 gallons per acre. Benzoic acid was applied in water only, and the 2,4,5-TP invert emulsion was applied in an oil-water emulsion. Check plots consisted of untreated plots and 6 sets of plots sprayed with the 5 percent oil-water emulsion. The treatments were applied to 1/2 square rod plots which were randomly located and were replicated 4 times.

The area was mowed with a rotary mower during the previous winter while the salt cedar was dormant. At the time of the first treatment regrowth from the salt cedar stumps was 2-3 feet tall.

Treatment dates were June 20, July 22, and September 25. On each date a different set of plots was treated at the rates indicated above. On three additional sets of plots the above rates were split, and applications were made such that one set of plots received a treatment in June and again in July, another set of plots was sprayed in June and in September, and the third set in July and September.

Preliminary readings were made November 4 to determine the injury sustained by the salt cedar. While the full effectiveness of the treatments cannot be evaluated for another year, the following information was observed: (1) The 2,3,6-trichlorobenzoic acid was ineffective on salt cedar as the highest rates did not give over 50 percent top kill. (2) The carrier used had little influence on the effectiveness of any given chemical. (3) The plots receiving a September treatment showed more injury than plots treated at other dates. (4) 2,4,5-TP at 4 lb/A was consistently more effective than the other chemical treatments. (New Mexico Agricultural Experiment Station)

Use of fire in control of juniper in Arizona. Jameson, Donald A. Fire use in juniper control is considered in four categories.

1. Burning of slash following mechanical control operations. In 1954 a study was begun on an area where one-seed juniper (Juniperus monosperma) had been cabled to determine whether burning the slash would kill the remaining live trees and increase forage production. Replicated 6-acre plots were burned in December 1954 and in April and August 1955. Slash, trees, and forage were measured by line interception in 1955, 1956, and 1958. Forage production was determined by weight estimates in 1958. On the average, burning reduced the crown intercept of live trees that remained after cabling by about 85 percent. By 1958 there was no significant difference between the unburned check and any of the burning treatments for either intercept or production of perennial grasses.

2. Broadcast burning of dense stands of live trees. Practically all successful tests of burning dense stands have been on the Hualapai Indian Reservation. In 1956 the Reservation burned about 8,000 acres of pinyon (Pinus edulis) and Utah juniper (J. osteosperma) and in 1957 about 2,500 acres. The areas chosen for burning had deep canyons downwind to serve as natural firebreaks and stands were dense enough to burn (400 or more trees per acre). Seeding was considered essential and had been successful on nearby burned areas. In early spring trees were bulldozed from a strip 100-150 feet wide on the upwind side and pushed against the stand to be burned. By June the weather was warm and dry and the pushed trees were dry enough to ignite easily. On days when burning was successful the temperatures were more than 100° F., relative humidity less than 10 percent, and winds 12 m.p.h. or more. These are hazardous conditions on any scale of fire danger. Kills were complete on all areas actually burned.

3. Burning grass stands to kill small invading trees. Three small control burns in January, March, and April 1956 indicate that spring days when the air temperatures are 55-75° and winds are 8-12 m.p.h. are favorable for burning small trees of one-seed juniper. Stands of black grama (Bouteloua eriopoda) and galleta (Hilaria jamesii) carried the fires. Burning with very gentle winds gave kills of more than 50 percent only on trees up to 3 feet high. Burning with stronger winds ignited windblown debris, such as tumbleweeds, under the larger trees and killed more than 50 percent of trees up to 12 feet high. Both grass species had recovered from the effects of burning, if any, when measured three years after the burn.

4. Individual tree burning. Studies have been made on two operations that used propane torches for burning one-seed juniper trees. The propane was carried in 300-gal. tanks mounted on pickups or trailers. Eight-foot torches with a pilot flame were connected to the tanks with 25 to 50 feet of hose. Each tree was given a blast of flame for 1-1/2 - 2-1/2 seconds per foot of tree height for a total of 1 to 60 seconds. This method gave about a 95-percent kill and was cheaper than bulldozing, where most of the trees were less than 12 feet high or where there were less than 50 trees/A. (Rocky Mountain Forest and Range Experiment Station, Forest Service, U.S.D.A., Fort Collins, Colorado)

Effect of herbicide resprays on several brush species in southwestern Oregon. Gratkowski, H. In 1955, screening tests were established to determine the effect of herbicides on mature shrubs of thirteen brush species on forest lands in southwestern Oregon (Res. Prog. Rpt., W.W.C.C., 1957). Four species were readily killed, but the other nine proved moderately resistant or highly resistant to herbicides. Resprouting shrubs in the resistant categories were resprayed with the most effective formulations in midsummer, 1957. All formulations were applied as foliage sprays to drip point.

A high degree of control was obtained with the initial spray plus one respray on snowbrush ceanothus and varnishleaf ceanothus. Formulations containing 2 ahg and 4 ahg of LV esters of 2,4,5-T in a diesel oil emulsion killed 80 and 95 percent, respectively, of the snowbrush ceanothus shrubs and 95 and 100 percent, respectively, of the varnishleaf ceanothus shrubs.

A moderate amount of kill was obtained in mountain whitethorn ceanothus and Saskatoon serviceberry. Two treatments with a 2 ahg solution of LV esters of 2,4,5-T in water killed 45 percent of the mountain whitethorn ceanothus shrubs, and a 1/2 ahg formulation of LV esters of 2,4-D killed 40 percent of the treated serviceberry shrubs.

Greenleaf manzanita, golden chinkapin, golden evergreenchinkapin, scrub tanoak, and canyon live oak proved resistant to the respray treatments. Best percentages of kill ranged from 15 to 30 percent on the first four species; no kill was obtained after two treatments of canyon live oak. While 2,4-D was most effective on scrub tanoak, there was no pronounced difference between effects of 2 ahg concentrations of 2,4-D or 2,4,5-T on the chinkapins. Only 2,4-D was used in the respray tests on greenleaf manzanita and live oak. (Pacific Northwest Forest and Range Experiment Station, Forest Service, USDA)

Grass control in pine seedlings. Jordan, L. S.* and Hosner, John** On April 1, 1958, Bluegrass sod (*Poa pratensis*) was placed on soil in two-gallon glazed pots and allowed to become established. Three Scotch pine (*Pinus sylvestris*) seedlings were transplanted to each pot. Five days later the seedlings and grass were sprayed with various herbicides using 50 gallons of water per acre. Six pots with three trees each were used for each treatment. The pots were placed outside the greenhouse where the plants were exposed to the normal weather conditions throughout the rest of the trial (8 months). The results are presented in the following table:

Herbicide	Rate (lb/A)	Grass Control 1/	Surviving Trees 2/ Number	Height (cm)
Simazine	2	9	17	34.5
Simazine	3	10	14	32.5
Simazine	4	10	13	32.7
Monuron	3	9	14	27.9
Diuron	3	10	1	23.5
Erbon	2	1	9	23.6
Dalapon	5	10	18	35.0
CIPC	10	6	10	26.1
CIPC + Monuron	10 1	10	9	30.2
Check	0	0	14	26.5

1/ 0 = No control; 10 = Complete control
2/ Number of trees surviving, at the end of 8 months, out of 18 seedlings set per treatment.

(*Formerly at Southern Illinois University, now at University of California, Riverside, California. **Southern Illinois University, Carbondale, Illinois.)

Soil moisture and snow depth studies of sprayed and non-sprayed sagebrush areas. Sonders, Leslie and Fabricius, Lee J. Soil moisture studies were conducted in the Bighorn Mountains and the Red Desert of Wyoming in 1958 on 90- to 100-percent controlled areas and compared with live sagebrush areas.

These studies tend to show that there is a larger amount of soil moisture present in the sprayed areas than in the non-sprayed areas. Results have also shown throughout the growing season that, although both areas are lacking in soil moisture, the soil moisture percentage had decreased proportionately throughout the season.

The snow surveys made above Hyattville in the Bighorns show reason to believe that heavy stands of grass on the sprayed areas have a better capacity to hold snow than a dense stand of sagebrush.

When the survey was made on the non-sprayed areas a snow depth of 5 to 6 inches and 2 inches of ice were measured. The ground was found to be frozen under the layer of ice on the non-sprayed area, but on the sprayed area there was no ice or frozen ground present under a layer of snow 24 to 26 inches in depth.

Snow surveys on the Red Desert have shown no definite conclusion, although there are indications that the sprayed areas hold as much or more snow than the non-sprayed areas. (Wyoming Agricultural Experiment Station)

Chemical control of low-growing big sagebrush. Fabricius, Lee J. Applications of 2,4-D butyl and propylene glycol butyl ether esters at 2 lb/A of active ingredient with and without wetting agents were made in 1957. A typical site, where the annual precipitation is 12 inches, of the low growing type of big sagebrush (Artemisia tridentata) was selected. Approximately 100 acres were involved.

The butyl ester gave slightly better control than did the low volatile esters although both gave better than 90 percent control. Both formulations gave better control when a wetting agent was added.

Composition of vegetation was changed considerably by chemical control of sagebrush. Non-sprayed areas produced 98 lb/A of air-dry forage while sprayed areas produced 191 lb/A. (See following table)

Vegetative Composition by Species of Big-Sagebrush/Grass-Type Rangeland in the Divide Grazing District of Southern Wyoming 1/

Species	Ground Cover 2/		Basal Density 3/	
Shrubs	1957	1958	1957	1958
Big Sagebrush (A. tridentata)	25.4	16.5	4.5	5.8
Semi-Shrubs				
Slenderbush Eriogonum (E. microthecum)	.6	.5	.2	.6
Low Douglas Rabbit Brush (Chrysothamnus pumilus Nutt.)	2.4	1.5	.7	.1
TOTAL	3.0	2.0	.9	.7

(continued)

(continued)

Species	Ground Cover 2/		Basal Density 3/	
Forbs				
Smooth Hoods Phlox (Phlox glabrata)	2.9	1.0	1.9	1.0
Stemless goldenweed (Aplopappus acaulis)	.6	.1	.2	---
Prickly pear (Optunia polyacantha)	.3	.1	---	---
Other species 4/	.3	.7	.2	.3
TOTAL	4.1	1.9	2.3	1.3
Grass and Grass-like Species				
Thickspike wheatgrass (A. dasystachyum)	5.4	12.5	1.3	5.6
Pr. junegrass (Koeleria cristata)	1.2	13.4	.4	7.1
Needlegrass (Stipa comata & S. lettermani)	1.5	1.5	.3	.3
Indian ricegrass (Oryzopsis hymenoides)	.8	1.1	.3	---
Sandberg bluegrass (Poa secunda)	4.0	1.7	1.7	1.0
Bottlebush squirreltail (Sitanion hystrix)	1.2	3.0	.3	1.5
TOTAL	14.1	33.2	4.3	15.5
Bare Area	53.2	46.4	87.9	76.7

1/ Experimental area located on the Divide Grazing District, 26 miles west of Rawlins, Wyoming and 2 miles south on Highway 789.
2/ Data are an average of 6,000 points taken on 50 acres by the point-transect method and indicates vegetation as observed from directly above.
3/ Data are an average of 6,000 sq. cm. taken on 50 acres by the line-transect method and indicates vegetation as observed at ground level.
4/ Other species: Bushy birdbeak (Cordylauthus ramosus) and a species of clover which contributed less than .2 percent abundance.

(Wyoming Agricultural Experiment Station)

2,4-D effectiveness on big sagebrush and green rabbitbrush as influenced by nutrient and gibberellin additives. Hyder, D. N., Furtick, W. R., and Sneva, F. A. Previous spraying trials on green rabbitbrush (Chrysothamnus viscidiflorus) indicated suppression in 2,4-D effectiveness by additives of boron, iron, and magnesium (Hyder, et al, Weeds 6:289-297). Additives of urea, copper, zinc, and MH did not alter 2,4-D effectiveness. Since growing conditions were unfavorable during those trials, it was important to conduct additional trials under favorable growing conditions.

In 1957 a mixed stand of green rabbitbrush and big sagebrush (Artemisia tridentata) was selected and sub-divided into 1/50-acre plots measuring 9.9 by 88 feet. Individual plants of each species, on an area 8 by 80 feet centered within each plot, were counted in April 1957 prior to spraying and recounted in May 1958 to determine mortality percentages. 2,4-D butyl ester at 1.5 lb/A of active ingredient was emulsified in water and applied at a volume of 10 gal/A with a hand boom containing four 8001 nozzles. Spraying was accomplished at a pressure of 35 psi.

The plots were arranged in a split-plot design with 4 replications. There were 4 dates of spraying at 5- to 9-day intervals on whole plots and 6 treatments on sub-plots. The treatments were spray-additives as follows: (1) None for check, (2) urea at 5 lb/A of elemental nitrogen, (3) boric acid at 0.5 lb/A of elemental boron, (4) copper chelate (Na_2Cu EDTA) at 0.5 lb/A of elemental Cu, (5) zinc chelate (Na_2Zn EDTA) at 0.5 lb/A of elemental Zn, and (6) gibberellic acid at 2 p.p.m. in total spray volume. The gibberellic acid was contributed by Eli Lilly and Company, Indianapolis, Indiana.

Spray applications were made on June 4, June 13, June 18, and June 25, 1957. Precipitation during the period March-June, inclusive, was 63 percent above average, and growing conditions were excellent on each date of spraying.

Dates of spraying introduced significant differences in mortality of each species, but mean differences among dates were relatively small as good effectiveness was obtained on all dates. The additives did not influence 2,4-D effectiveness in terms of mortality of either species at any time. Mean rabbitbrush mortalities in the order of treatments as listed were 67, 65, 67, 62, 63, and 63 percent, respectively. Mean sagebrush mortalities in the same order were 77, 81, 78, 79, 81, and 78 percent, respectively. (Crops Research Division, Agricultural Research Service, U. S. Dept. of Agriculture, and Oregon Agricultural Experiment Station, Corvallis, cooperating)

Chemical control of prickly pear cactus. Fabricius, Lee J. Treatments on prickly pear cactus (*Opuntia polyacantha*) were established on the Red Desert in 1957. Various chemicals were tried with only one showing any promise. Benzac at rates of 20 to 40 pounds of acid per acre gave excellent control, while 2,4-D, Ureabor, Boron, and DB granular gave little control. (Wyoming Agricultural Experiment Station)

PROJECT 4. ANNUAL WEEDS IN CEREALS AND FORAGE CROPS

W. Orvid Lee, Project Chairman

SUMMARY

Ten reports were received from five states. Of the ten reports three were concerned with weed control in cereals, five with weed control in legumes, one with control of weeds in perennial grasses and in one, no crop plant was noted.

Cereals. In work conducted in Oregon, Furtick and Chilcote report selective removal of wild oats from wheat and barley by use of the chemical 4-chloro-2-butynyl N-(3-chlorophenyl) carbamate (S-847). Wild oat control ranged from 40 percent at 1/2 pound per acre to 95 percent at 4 pounds per acre with no detectable injury to the wheat or barley.

In work reported from California, Viste found that 5 percent granular formulations of CDEC, CDAA and EPTC showed promise for control of watergrass in rice. The timing of irrigation, prior to or following chemical treatment, and the rate of applications were very important in determining the degree of weed control and the injury to rice.

Viste also reported that MCPA applied at rates of .85 and 1.5 pounds per acre did not reduce rice yields when the applications were made at various intervals from the early tillering to booting stages of growth. 2,4-D applied at the same rates was much more injurious to rice, especially when applied at the early tillering or the jointing or booting stages of growth.

Legumes. In work conducted in Arizona, Arle, Hamilton and McRae found that five chemicals, 4-(2,4-DB), dalapon, DNBP, MCPA and diuron all caused reductions in alfalfa yields when applied in February to seedling alfalfa 4 to 6 inches high. Percent yield reductions varied with the chemical and the rate of application.

In another test Hamilton, Arle and McRae applied diuron at 1.5 and 3.0 pounds per acre to established stands of six alfalfa varieties. Alfalfa yields were reduced at both rates of application in the case of all 6 varieties. The yields of certain varieties were more severely reduced than others indicating a difference in varietal tolerance of alfalfa to diuron.

In work conducted in Oregon, Lee found that EPTC applied as a preplant, soil-incorporated treatment showed considerable promise for the control of annual weeds in the establishment of small seeded legumes. When applied at rates of 6 to 8 pounds per acre this chemical also gave season long control of quackgrass.

Lee also reported that MCPA gave excellent control of hairy vetch in crimson clover seed fields. Seed yields were not reduced when the applications were made at 1/4 pounds per acre in late February or early March. Treatments made at earlier dates failed to control vetch while treatments made after the latter part of March caused severe reductions in crimson clover seed yields. Higher rates of application generally cause yield reductions.

Excellent control of annual weeds in peas was reported by Hodgson in Montana using CDAA as an early post emergence spray. 4(2,4-DB) was found to be more toxic than 4 (MCPB) to peas.

Perennial Grasses. In another test conducted in Oregon, Lee found that burning grass seed fields after harvest resulted in reduced weed control from fall applications of diuron. As the amount of residue burned on the field increased, the degree of weed control decreased. It was also found that the time interval between burning and chemical treatment had an influence on the herbicidal activity of diuron.

Miscellaneous. Szabo and Gould of New Mexico compared the amine salt of 2,4-D and a low volatile ester of 4-(2,4-DB) for control of mustard. They found that 4-(2,4-DB) was only slightly less effective in controlling mustard than was 2,4-D when applied at the same rates of application.

CONTRIBUTORS REPORTS

Selective control of wild oats and barley by post-emergence treatment with 4-chloro-2-butynyl N-(3-chlorophenyl) carbamate (S-847). Furtick, W. R. and Chilcote, D. O. A planted stand of spring wheat, Hannchen malting barley, and wild oats were sprayed in the two-leaf stage with rates of 1/2, 1, 2, and 4 pounds of an experimental carbamate from Spencer Chemical Co. coded S-847. The results of this treatment were evaluated when the cereals were completely headed. There was no detectable injury to the wheat or malting barley. Wild oat control was estimated at 40% at the 1/2 pound rate, 90% at the 1 and 2 rates and 95% at the four pound rate. Broad-leaved weeds in the treated area were not affected by this chemical. Annual ryegrass was injured to about the same extent as wild oats.

Sugar beet was another test plant in the trial which was tolerant of this treatment. Other crops which were severely injured in this test were corn, beans, cucumbers, and cultivated oats. (Oregon Agricultural Experiment Station)

Pre-planting herbicide treatment for the control of watergrass (Echinochloa crusgalli) in rice. Viste, K. L. Several herbicides were applied as 5% granular formulations prior to planting rice. The rates of application were 2, 4 and 8 lbs/A for each herbicide except EPTC which was applied at 1, 2, and 4 lbs/A. Two irrigation treatments were: 1) an irrigation before chemical application, or wet soil application, and 2) chemical application prior to irrigation, or dry soil application. The plots were flooded with 2 to 4 inches of water immediately after the herbicides were applied. Rice was broadcast into the water 9 days after the dry soil chemical application and 4 days after the wet soil chemical application.

On the wet soil 2-chloro-N, N-diallylacetamide (CDAA) at 4 and 8 lbs/A and Ethyl N,N-di-n-propylthiolcarbamate (EPTC) at 4 lbs/A gave good grass control and no rice injury. 2-chloroallyl diethyldithiocarbamate (CDEC) gave fair grass control at 8 lbs/A but it reduced rice stands. Rice recovered from CDEC treatment because of reduced competition as a result of the control of sedges. Isopropyl N-(3-chlorophenyl) carbamate (CIPC) gave good grass control at rates of 2 to 8 lbs/A, but it severely reduced stands of rice.

Treatments on the wet soil that produced yields significantly greater than the check were CDAA at 4 and 8 lbs/A, EPTC at 4 lbs/A and CDEC at 8 lbs/A. No treatment reduced yield below that of the check.

The dry soil treatment with EPTC gave excellent control of watergrass at all rates but reduced the stand of rice at rates over 1 lb/A. CDAA had no effect as a dry soil treatment. CIPC and CDEC had little effect on watergrass, but injured rice to some extent at 8 lbs/A. Significant differences in yield did not result from dry soil treatments with CDAA, CIPC and CDEC.

The most promising treatment of all those evaluated was EPTC at 1 lb/A applied on the dry soil. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, United States Department of Agriculture and the California Agricultural Experiment Station)

Effects of 2,4-dichlorophenoxyacetic acid (2,4-D) and 2-methyl, 4-chlorophenoxyacetic acid (CPA) on yield of rice. Viste, K. L. The alkanolamine salts of 2,4-D and MCPA were applied to rice at different stages of development to compare their effects on rice. Very low weed populations were present in the plot area. In 1956 treatments were made at two rates on three growth stages. Treatment at the early tillering stage (46 days after planting) with 2,4-D caused severe injury to rice and reduced yields by 45%. There was no difference in injury caused by the two rates of 2,4-D (0.85 and 1.5 lb/A). Little injury and no yield reduction occurred when treatment was at the late tillering stage (60 days). A slight reduction in yield occurred when treatment was at the jointing stage (74 days). MCPA did not reduce yield at any rate or on any stage of growth.

In 1957 and 1958 treatments were made at 1.5 lb/A at six stages of growth. In 1957 the response was similar to the previous year with a 30% yield reduction at early tillering. There was increased tolerance of rice at later stages until late tillering. During jointing and booting stages yields were reduced by 2,4-D. In 1958 2,4-D did not cause reductions in yield at any date. The seasonal differences in response were undoubtedly connected with temperature. High temperatures occurred in June and July 1957, with average maximum temperatures of 93.1 and 96.0°F, respectively, for the two months. In 1958 the average maximums for the same two months were 85.1 and 91.7°. In 1958 there was a cloudy period accompanied by some rain in June at the time the earlier treatments were made. No MCPA treatment caused significant reduction in yield in the three years. These results indicate that MCPA was less injurious than 2,4-D to rice under most conditions and especially at early dates and at higher temperatures. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, United States Department of Agriculture and the California Agricultural Experiment Station)

Control of annual weeds in seedling alfalfa. Arle, H. F., Hamilton, K. C., and McRae, G. N. An experiment was conducted during the 1958 season to evaluate the effect of various chemical treatments on young alfalfa. Five chemicals were applied on February 7 to African alfalfa when it had attained a height of 4 to 6 inches. Treatments, replicated four times on plots 5 x 20 feet, were as follows: butyl ester of 4-(2,4-dichlorophenoxy) butyric acid (4-(2,4-DB)) applied at rates of .5, 1.0, 1.5 and 2.0 lbs/A.; sodium salt of 2,2-dichloropropionic acid (dalapon) at 4.0, 6.0 and 8.0 lbs/A; ammonium salt of 4,6-dinitro o secondary butylphenol (DNBP) at 1.0 lb/A.; alkanolamine of 2-methyl-4-chlorophenoxyacetic acid (MCPA) at .5 and 1.0 lb/A.; and a liquid formulation of 3-(3, 4-dichlorophenyl)-1,1-dimethylurea (diuron) at .5 lb/A. Hay yields were taken at the five cuttings following treatment (4/14, 5/10, 6/10, 7/11 and 8/5).

Alfalfa was killed by both applications of MCPA. Diuron caused a severe reduction in stand and a corresponding yield reduction. DNBP caused a rapid burning of the foliage, however, plant recovery was very rapid and the temporary retardation was not reflected in total yields. Applications of 4-(2,4-DB) caused a reduction in plant vigor which persisted throughout the season. Reduced yields were measured at each of the five cuttings following treatment. Total yields varied from 85 percent of check on plots treated with .5 lb/A. of 4-(2,4-DB) to 70 percent where the rate of application was increased to 2.0 lbs/A. Dalapon treatments caused a significant yield reduction at each of the first two cuttings. The next three cuttings were equal to the checks. Total yields were reduced 12 percent and 13 percent by applications of 6 and 8.0 lbs/A. of dalapon. (Crops Research Division, ARS, USDA, and the Arizona Agricultural Experiment Station, cooperating)

<u>Effect of soil applications of diuron on alfalfa varieties</u>. Hamilton, K. C., Arle, H. F., and McRae, G. N. In Arizona the use of diuron in alfalfa has not been recommended because of its susceptibility under our growing conditions. In past tests there have been indications that certain varieties may be more susceptible than other varieties. A test was conducted at Mesa to determine if varietal differences occurred.

On May 14, after the third cutting, diuron was applied at rates of 1-1/2 and 3 pounds per acre to 6 varieties; Ranger, Lahontan, Vernal, African, Chilean, and Hairy Peruvian. The herbicide was applied to the soil and stubble and the area irrigated. Plots were 2-1/2 by 19 feet; treatments were replicated 4 times. Yield data was obtained from hay harvests on June 11, July 11, and August 5.

The 3 pound per acre application of diuron caused chlorosis and stunting of all varieties. Vernal was effected most severely, followed by Chilean and Ranger, while Lahontan, African, and Hairy Peruvian showed the least symptoms. The data showing the effect of diuron on hay yield of the six varieties is summarized in the following table.

	Yield of hay		
	Untreated check	1-1/2 lb/A. diuron	3 lb/A. diuron
Variety	lb/A.	Expressed as percent of check	
Ranger	6,222	86	46
Lahontan	7,960	97	69
Vernal	4,869	77	30
African	9,296	87	67
Chilean	5,399	85	46
Hairy Peruvian	5,911	85	72
	Average	87	57

In this test applications of diuron significantly reduced alfalfa yields. The most severe yield reductions occurred in the first cutting after treatment. Although there was no significant interaction between alfalfa varieties and diuron treatment, the yield of certain varieties were more severely reduced than others. Winter dormancy did not appear related to susceptibility, for certain varieties in both classes showed susceptibility while others were little effected. (Crops Research Division, ARS, USDA, and the Arizona Agricultural Experiment Station, cooperating)

Pre-plant soil-incorporated herbicides for control of annual weeds in the establishment of alfalfa, birdsfoot trefoil, and red clover. Lee, William O. Four herbicides including isopropyl N-(3-chlorophenyl) carbamate (CIPC) and ethyl N, N-di-n-propylthiolcarbamate (EPTC) at 4, 6, and 8 and sodium salt of 2,2-dichloropropionic acid, (sodium salt of dalapon) at 12 and tetrachlorobenzene at 4, 8, and 12 pounds per acre were applied May 3, 1958, to experimental plots located on a sandy loam, river-bottom soil located near Corvallis, Oregon. Immediately after application a rotovator was used to incorporate the herbicides with the soil to a depth of 4 inches. On May 19, 4-foot strips of DuPuits alfalfa, Granger birdsfoot trefoil, and Kenland red clover were drilled through each plot as test species with a standard grain drill. During the interval between treating and seeding only .15 inch of precipitation fell. This came as rain on May 11. On May 24 approximately 1 inch of water was applied to the field by sprinkle irrigation.

Weeds infesting the experimental area included annual smartweed (Polygonum pensylvanicum), wild buckwheat (Polygonum convulvulus), lambsquarter (Chenopodium album), red-root pigweed (Amaranthus retroflexus), and watergrass (Echinochloa crusgalli).

EPTC at all rates of application gave outstanding season-long weed control. At 4 lb/A it completely controlled watergrass and greatly reduced stands of the other species. At 6 and 8 lb. it eliminated growth except for a few annual smartweed plants. EPTC caused temporary injury to the legumes, especially red clover. By the first of August injury symptoms had disappeared. By fall the legumes in the treated plots showed better stands than the untreated checks and were much more vigorous. CIPC at 6 and 8 lbs/A gave fair to good control of watergrass, smartweed, and buckwheat but had little effect on lambsquarter or pigweed. It was much less effective on all weeds than EPTC at similar rates. Dalapon and tetrachlorobenzene had little effect on weeds of legumes when soil-incorporated before planting time.

A relatively heavy quackgrass infestation was present in the experimental area. The stand and growth of quackgrass were greatly reduced throughout the season on plots receiving 4 or 6 lb/A of EPTC. EPTC at 8 lb/A gave complete control of quackgrass for the entire season. Thus, this chemical should be more thoroughly evaluated when soil-incorporated for the control of quackgrass and other perennial weeds. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and the Oregon Agricultural Experiment Station)

Time and rate of applying 2-methyl-4-chlorophenoxyacetic acid (MCPA) for control of hairy vetch in crimson clover seed fields. Lee, William O. During the winter and spring of 1957-58, an experiment was conducted to determine the optimum stage of growth and rate to apply 2-methyl-4-chlorophenoxyacetic acid (MCPA) for the control of hairy vetch in crimson clover. MCPA was applied at 1/4, 1/2, and 1 lb/A on December 30, February 5, February 28, March 11, March 27, and April 25. On December 30 the crimson clover had 5 to 10 leaves and was 1-1/2 to 3 inches high. The plants continued growth through the experimental period and by April 25 were approaching the bloom stage.

MCPA applied at 1/2 lb/A on December 30, February 5, February 28, and March 11 retarded the growth of crimson clover and caused minor temporary injury symptoms, but did not reduce seed yields. The March 27 and April 25 applications of MCPA at 1/4 lb/A caused severe injury to the crimson clover and resulted in drastic reductions in seed yield. MCPA at 1/2 and 1 lb/A caused significant reductions in crimson clover seed yields at most times of application.

MCPA applied at 1/4 lb/A did not control hairy vetch satsifactorily when the applications were made on December 30 or February 5. For all other times of application, control of vetch approached 100 percent. These preliminary studies indicate that MCPA should be applied at 1/4 lb/A during the latter part of February or the first part of March to control hairy vetch in crimson clover without reducing crimson clover seed yields. (Cooperative investigation of Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture and the Oregon Agricultural Experiment Station)

Weed control in peas with post-emergence herbicide treatments. Hodgson, J. M. Several chemicals were applied post emergently on peas. The treatments were made in random arrangement in 5 replications. Individual plots were 6 feet x 24 feet and were seeded with a cereal drill. Yield samples of peas were obtained at canning maturity and at seed maturity on all plots. Visual estimates of control of annual broadleaved weeds and Setaria spp. were made at canning maturity of peas.

The herbicides applied and stages of growth are listed in the following table with the summarized data.

Stage of Peas and Chemical Name		Yields: Forage at canning maturity	Yields: Seed	Seed Germination	Weed control: Setaria spp.	Weed control: broadleaved
	lb/A	Grams	Bu/A	Percent	Percent	Percent
4- to 7- node stage						
CDAA	4	796	39.8	93	86	84
CDAA	6	787	38.4	96	88	75
CDAA	8	688	41.4	91	90	56
4(MCPB) amine	2	745	37.6	94	30	62
MCPA amine	.5	756	40.6	94	22	47
7- to 9- node stage						
4(MCPB) amine	1	737	37.9	92	0	97
4(MCPB) amine	2	702	40.5	96	12	100
4(MCPB) sodium	2	595*	26.9*	92	2	97
MCPA amine	.5	657*	28.7*	93	0	100
MCPA sodium	.5	680	32.0*	94	30	66
4(2,4-DB) amine	1	670	29.6*	95	0	91
4(2,4-DB) amine	2	673	29.9*	86*	14	100
10- to 12- node stage						
4(MCPB) amine	2	696	24.3*	82*	14	66
MCPA amine	.5	588*	25.5*	71*	0	84
Check		755	40.4	96	0	0
Handweeded		865	46.3	91	96	90
L.S.D. .05 =		99	8.0	8		

*Significantly lower than check

Peas apparently were not injured by CDAA at any of the rates of application. This chemical gave very good control of weeds when applied post emergence at the 4-7 node stage of peas.

4(2,4-DB) amine was more toxic to peas than 4 (MCPB) in this experiment. Pea yields were reduced by 1 or 2 ppa of 4(2,4-DB) at the 7-9 node stage of growth.

MCPA, 4(MCPB), and 4(2,4-DB) were all more toxic to peas at the later stages of growth. Germination of peas was adversely affected by treatments of MCPA and 4(MCPB) at the 10-12 node stage and by 4(2,4-DB) at the 7-9 node stage.

The sodium salt formulation of 4(MCPB) was apparently more toxic to peas than the amine formulation which is contrary to previous results. The product used in the sodium salt application had been carried over from a previous season. It is possible that a breakdown of this product in storage may have caused an error in the treatment. (Crops Research Division, ARS, USDA, and Montana State Agricultural Experiment Station, cooperating)

The influence of burning grass seed fields on the effectiveness of 3-(3,4-dichlorophenyl)-1,1-dimethylurea (diuron) in controlling winter annual weeds. Lee, William O. 3-(3,4-dichlorophenyl)-1,1-dimethylurea (diuron) is one of the chemicals recommended for control of winter annual weeds in western Oregon. A recently adopted practice is to burn grass seed fields after harvest to control weeds and numerous disease-producing organisms and insect pests. It was noted that in fields burned after harvest the effectiveness of fall applications of diuron was reduced as compared to treatments on unburned fields.

In an experiment started near Corvallis, September 7, 1957, 0, 1, 2, 4, and 6 tons of crop residue/acre were burned on experimental plots located in a Merion bluegrass seed field. Diuron was applied at 2 and 3 pounds of active ingredient per acre on September 14 and October 22, 1957. No rain fell between the date of burning and September 14. Approximately 4 inches of rain fell between the date of burning and October 22. Ryegrass (Lolium sp.), a serious weed particularly in perennial grass seed fields, was drilled through each plot as an indicator species because the heavier rates of burning destroyed most of the weed seeds on the plots.

As shown by the accompanying table, burning the crop residue prior to the application of diuron had a definite influence on the effectiveness of this chemical in controlling weeds. When applications were made soon after burning, the herbicidal activity was greatly impaired at both rates of application. As the amount of residue burned increased, the effectiveness of diuron decreased. (It is estimated that residue burned by farmers varies from 1 to 3 tons/acre.) When the application was delayed until October 22, burning still greatly reduced the effectiveness of diuron at the rate of 2 lb/A. When 3 lb/A was applied, the effect of burning was largely overcome. In crops such as Merion bluegrass, orchardgrass, bentgrass and tall fescues which will tolerate heavier rates of diuron, increasing the rate of application may be a means of overcoming this problem.

Table 1. The effect of the amount and time of burning crop residues on the effectiveness of diuron for weed control in grass seed fields.

Crop residues burned per acre	Weed control rating when diuron was applied at: 1/			
	2 pounds per acre		3 pounds per acre	
Tons	7 days after burning	45 days after burning	7 days after burning	45 days after burning
0	8	9	9	10
1	5	5	5	9
2	4	4	5	8
4	3	5	3	9
6	2	5	4	9

1/ Weeds present included: annual bluegrass (*Poa annua*), repgut brome (*Bromus rigidus*), rat's-tail fescue (*Festuca myuros*, and *Lolium sp.*)

Weed control rating made according to the following scale: 0 = no visual injury; 1-3 = slight temporary injury; 4-6 = moderate injury; 7-9 = severe injury and considerable injury in stand; 10 = all plants killed.

(Cooperative investigations by the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and the Oregon Agricultural Experiment Station)

Fall treatment of mustard (*Sisymbrium Irio*) with 2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4-dichlorophenoxy butyric acid (4-(2,4-DB)). Szabo, S. S. and Gould, W. L. Vigorously growing mustard plants, ranging in height from 1 to 12 inches, were treated on October 18, 1958. The plants were mostly in the pre-bloom to early-bloom stage of growth. The amine salt of 2,4-D was applied at rates of 0.25, 0.50, 1.0, and 2.0 lb/A. The low-volatile ester form of 2,4-DB was applied at rates of 0.5, 1.0, 2.0, and 4.0 lb/A. All treatments were applied to small plots, 90 sq. ft. in area, in water equivalent to 40 gal/A and were replicated four times. At the time of treatment the sky was clear, the temperature was 73° F. and the relative humidity was 48%. The results are summarized in the following table.

Chemical	Rate (lb/A)	% Control
2,4-D	2.0	99.5
	1.0	96.3
	0.5	70.0
	0.25	47.5
2,4-DB	4.0	97.5
	2.0	97.0
	1.0	92.5
	0.5	67.5

(Contribution of the New Mexico Agricultural Experiment Station)

Selective post emergence control of wild oats with S-847. Baker, Laurence O. A chemical supplied by Spencer Chemical Company, 4-chloro-2-butynyl N-(3-chlorophenyl) carbamate (S-847) was applied to wild oats, cultivated oats, wheat, barley, and flax at 0, .5, 1.0, 1.5, and 2.0 pounds per acre when the grains were in approximately the 2, 4, 6, and 7 leaf stages of development. A treatment was made at the 2-leaf stage, but only at the .5 pound rate. Within a few days following treatment, growth inhibition of oats (both wild and cultivated) and flax was apparent. The .5 pound treatment was most effective at the 2-leaf stage providing about 25% growth inhibition without noticeable injury to wheat and barley.

Injury to flax occurred at all rates at all treatment dates. In most cases, the flax was able to recover; however, the plants were not permitted to grow to maturity so the effect on yield is not known for any crop.

Oats were satisfactorily controlled at all rates of 1.0 pound or more per acre at the 4-leaf stage. Treatments applied at later stages of growth were less effective for inhibition of oats. Noticeable injury occurred to wheat and barley only at the 2.0 pound rate when applied at the 6- and 7-leaf stages of growth.

Most control resulted from growth inhibition; however, some oat plants were killed when treated at the earlier stages of growth and at the higher rates. (Contribution of the Montana Experiment Station, Bozeman, Montana)

Control of weeds in summer fallow with herbicides 1958. Baker, Laurence O. November 6, 1957, the amine formulation of polychlorobenzoic acid (ACP-354) (PBA) and simazine at 3 and 4 pounds per acre, EPTC at 10 pounds per acre, tris-(2,4-dichlorophenoxyethyl phosphite) (3Y9) liquid and impregnated on vermiculite each at 6 and 9 pounds were applied to a stubble field for chemical summer fallowing. At treatment time, some Bromus tectorum, Thalaspi arvense, and Camelina sativa had germinated. PBA, and 3Y9 effectively controlled all broadleaf weeds until the area was cultivated June 19, but did not control grasses (downy brome and volunteer barley). EPTC slightly reduced the stand of grasses but did not control broadleaf weeds. Simazine provided 98 and 99 percent vegetation control from the 3 and 4 pound rates. Following the cultivation, simazine continued to control all weeds. A slight, but unsatisfactory, residual effect was obtained from PBA.

Treatments were made June 19 to an adjacent area that had just been cultivated. Three pounds of 3Y9, and 2 pounds of several triazine compounds (G-27901, G-30026, G-30027, and G-31345) all provided satisfactory weed control for the balance of the season. One pound of 2,4-D or 1/2 pound PBA did not give satisfactory weed control even though the weeds were predominately of the broadleaf type, probably because they germinated after treating. Residual effect on spring grain will be studied in 1959. (Contribution of the Montana Agricultural Experiment Station, Bozeman, Montana)

Effect of dalapon as a preharvest treatment. Baker, Laurence O. Dalapon was applied to wheat, barley, and wild oat plants which were in the milk to early dough stages of development at 0, 2, 4, and 8 pounds per acre. All rates of dalapon caused a slight burn that increased with increasing rate. Harvested seeds germinated when placed under suitable conditions; however, many of the seedlings from seeds on treated plants failed to develop beyond the coleoptile stage. Those that recovered did so slowly and it is doubtful that they would have been able to survive if competition had been provided. Yield, test weight and percent abnormal seedlings follow:

Pounds dalapon per acre	Yield Bu/A.	Test weight lbs./bu.	Percent abnormal seedlings
Betzes barley			
0	70.6	54.2	0
2	65.0	52.6	42
4	60.2	50.0	50
8	56.9	51.6	97
Centana wheat			
0	47.0	61.2	0
2	45.9	60.6	83
4	39.7	59.4	100
8	39.8	58.2	100

Due to dormancy it was not possible to germinate the wild oats from this test. However, wild oats from plants in approximately the same stage of development treated a year earlier at 0, 2-1/2, and 5 pounds of dalapon per acre were tested. In this test, four strains of wild oats were seeded June 4 and dalapon was applied August 24, at which time some plants had seeds that were almost ready to shatter and later developing tillers were in various stages of development from the milk stage. Seeds were harvested August 31 and September 7. Because earlier developing seeds shattered the two harvest dates represent seeds at different stages of development when treated. Strains 8 and 17 head approximately 5 days earlier than strains 10 and 23. Percent abnormal seedling development follows:

Wild oat strain	Rate of dalapon	Percent abnormal seedlings 8/31	9/7
8	0	0	0
	2-1/2	29	72
	5	25	95
10	0	0	0
	2-1/2	35	35
	5	26	53
17	0	0	0
	2-1/2	61	75
	5	69	95
23	0	0	0
	2-1/2	38	64
	5	92	88

(Contribution of Montana Agricultural Experiment Station, Bozeman, Montana)

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

Floyd M. Ashton, Project Chairman

SUMMARY

Twenty-six reports were received from 30 investigators in eight states. These reports are summarized below.

Avocados, citrus, and olives. Post-emergence. Cuttings of olive and seedlings of sweet orange and avocado were screened in a tolerance test with numerous herbicides. The results are presented in table form.

Beans, field. Pre-emergence. EPTC at 6 and 9 lb/A gave excellent season-long control of annual weeds without injury to the beans when incorporated. All other herbicides tested were considered unsatisfactory because of inconsistent weed control or crop damage. These other herbicides were CDEC, CIPC, DNBP, NaPCP, and neburon. In general, the herbicides were more effective when incorporated.

Chili. Post-emergence. Diuron at 0.75 and 1.5 lb/A, as well as CDEC (granular) at 12 lb/A, gave the best weed control, with no crop injury. Neburon and sesone caused no crop injury, but did not provide adequate weed control. EPTC and monuron caused crop damage.

Cotton. (a) Post-emergence. Overall, directed, and shielded sprays of monuron and diuron at 1.25 lb/A were applied to cotton prior to the first irrigation. Overall application of monuron caused severe chlorosis and a 12.5 percent yield reduction; directed and shielded sprays of monuron caused moderate chlorosis, but no yield reduction. Overall sprays of diuron caused only slight chlorosis, while directed and shielded sprays did not cause chlorosis.

(b) Post-emergence. A date and rate study of diuron was conducted. The rates were 0.5, 1, and 2 lb/A. The dates were prior to the first irrigation, prior to the third irrigation, and a third treatment both prior to the first irrigation and prior to the third irrigation. The last treatment had a total of 1, 2, and 3 lb/A. None of the treatments caused reduction in yields. Weed control was not satisfactory at 0.5 lb/A. Weed control was satisfactory at the higher rates except for annual morning glory at 1.0 lb/A with the early treatment. Split applications did not appear to have any advantage.

(c) Post-emergence. Applications of diuron at 0.5, 1, 2, and 3 lb/A (single and split applications), propazine at 1.0 lb/A, chorazine at 2.0 lb/A, and G-30044 at 2.0 lb/A did not reduce yields. All but diuron at 0.5 lb/A gave satisfactory control of annual morning glory. All but diuron at 0.5 lb/A, propazine at 1 lb/A, and chlorazine at 2.0 lb/A controlled the annual grasses.

(d) Pre-emergence. Diuron, trietazine, simazin, propazine, G-30031, and G-30044 were applied; one set of plots was irrigated immediately after planting and the other set irrigated about 1 month later. Simazin at 1.0 lb/A irrigated immediately was the only treatment which showed a sharp reduction in yield. This treatment also gave the best weed control. The only material that showed a distinct difference in the two irrigation dates was propazine; the immediate irrigation was superior. All treatments were evaluated for annual grass and annual morning glory control.

(e) Post-emergence. Directed and overall applications of dalapon were applied. Directed sprays at 8 and 12 lb/A applied June 10 and 16 lb/A applied July 1 reduced seed cotton yields. Overall application of dalapon up to 6 lb/A did not effect seed cotton yield.

(f) Post-emergence. Overall applications of dalapon at 1 lb/5 gal of water to 10, 15, 20, 25, and 30 percent of the stand were made to assimilate spot treatments. Treated plants died within 10 days. Stand reductions of 25 percent did not decrease yield of seed cotton. Stand reductions of 30 to 40 percent generally reduced yields.

Corn, field. (a) Pre-emergence. CDAA (Randox-T) at 4 to 6 lb/A and Atrazine at 1 lb/A gave satisfactory annual weed control without yield reductions.

Pre-plant. EPTC at 3 to 6 lb/A incorporated into the soil gave satisfactory annual weed control without yield reductions. Disking appears to be an excellent method for incorporating EPTC. Pre-emergence surface applications of EPTC have not been satisfactory.

(b) Pre-plant. Simazin at rates of 1.0, 1.5, 2.0, 2.5, and 3.0 lb/A was applied 2 weeks before planting and harrowed. All rates controlled volunteer castor beans, but 2.0 lb/A was required for watergrass control. Corn was retarded, but recovered with no yield reductions.

Post-emergence. Overall applications of simazin were made when the corn was 6 to 10 inches high. Good weed control resulted. Corn was retarded, but yields were not significantly reduced.

(c) Pre-emergence (2 days after planting) and post-emergence (7 days after planting) applications of CDAA 4 and 6 lb/A, CDAA (Randox-T) 4 and 6 lb/A, CDAA 5 lb/A + 2,4-D 0.5 lb/A, simazin 1.5, 2, and 2.5 lb/A, DNBP 5 lb/A, Emid 1.5 lb/A, and EPTC 5 and 10 lb/A were made. All treatments except EPTC at 5 lb/A showed increased yields; many treatments gave very substantial yield increases. Simazin at all rates tested gave complete weed control and in general was the best treatment. (Southern Illinois)

Potatoes. Pre-emergence. CDEC at 10 lb/A, CDAA at 10 lb/A, and neburon at 4 lb/A caused no injury to the crop. NPA delayed sprouting and reduced tuber formation at all rates (0.6 to 10 lb/A). Monuron stunted top growth above 3 lb/A and reduced tuber formation above 1.7 lb/A. Diuron stunted top growth above 3.5 lb/A and reduced tuber formation above 1.9 lb/A. Simazin stunted top growth at all rates tested (0.24 to 4 lb/A) and reduced tuber formation above 0.5 lb/A. Logarithmic dilution sprayer used.

Sorghum, forage. Pre-emergence. CDAA at 4 and 6 lb/A, neburon at 2 lb/A, and simazin at 1.5 lb/A applied 3 days after planting increased yields. CDAA and neburon did not injure the crop. Simazin thinned the stand and retarded growth early in the season, but surviving plants tillered and gave yields comparable to the other treatments. (Southern Illinois)

Sugar beets. Pre-emergence. Endothal at 6 lb/A showed promise for control of grasses and broadleaved weeds; however, results were erratic.

Tomatoes, transplants. (a) Post-emergence. Overall application of neburon at 4 lb/A caused damage for about 1 month, disappearing later; perhaps yields were reduced. Overall application of granular CIPC 5 lb/A stunted the plants, caused early fruit ripening, and reduced total yield. Overall application of EPTC 5 lb/A did not damage the tomatoes. Weed control was best with neburon, followed by CIPC, and least with EPTC.

(b) Post-emergence. Overall applications of CIPC 6 lb/A, CDAA 6 lb/A, CDEC 6 lb/A, 2,4,5-TES 4 lb/A, DCE 3 lb/A, neburon 4 lb/A, NaTCA 5 lb/A, and EPTC 6 lb/A did not significantly affect yields.

Vegetable crops (onions, pinto beans, tomatoes, and sweet corn). Pre-emergence. Granular and emulsifiable formulations of EPTC at 6, 4, 2, and 1 lb/A, as well as CDEC 6 and 3 lb/A, CDEA 6 and 3 lb/A, and Emid 2, 1.5, 1.0, and 0.5 lb/A, was applied to the above crops. No injury was noted. The only satisfactory weed control was with the higher rates of EPTC.

Woody ornamentals. Post-transplant. Five species were treated with neburon at 2, 4, and 8 lb/A. No injury was noted. Weed control was satisfactory (greater than 90 percent) for 4 months at 2 lb/A, for 11 months at 4 lb/A, and for over one year at 8 lb/A.

Cymbidium orchids. Post-transplant. Neburon at 4 and 8 lb/A (wettable powder) gave better than 99 percent weed control, and neburon at 8 lb (granular) gave better than 90 percent weed control for one year. No injury was noted.

Flower seed crops. Pre-emergence. Simazin, EPTC, CDEC, DN pre-emerge, and neburon were applied and all gave satisfactory weed control. The crops tested were sweet pea, petunia, alyssum, larkspur, verbena, and antirrihinum. EPTC and simazin seriously damaged all species. CDEC was selective to petunia and sweet pea. ND pre-emerge was selective to larkspur. Neburon was selective to sweet pea. Yields were increased in several instances.

Azaleas. Post-emergence. NPA, 2,4,5-TES, 2,4-DEB, CIPC, and CDEC were screened in 1957 and indicated that CDEC and neburon were promising. In 1958 three varieties were treated with CDEC (granular and emulsifiable) at 8 and 16 lb/A and neburon at 2, 4, 6, 8, and 16 lb/A. Neburon was superior to CDEC for weed control. Results indicate that neburon at 4 to 6 lb/A would give adequate weed control for one season.

Miscellaneous
(a) A series of amino-1,4-napthoquine compounds as post-emergence applications appear to control watergrass, mustard, ground cherry, and pigweed. They appear to be selective for cotton, carrots, onions, peanuts, and large seeded legumes.

(b) A large number of herbicides chemically related to simazin are showing promise for selective and general weed control.

(c) Studies of the movement of surface applied herbicides with furrow irrigation indicate that the movement is predominately lateral, with very little downward movement. Soil type, adsorptiveness, and solubility are important factors in the extent of lateral movement.

(d) The incorporation of a given rate of a pre-emergence herbicide to increasing depths can result in increased effectiveness as the herbicide is placed in close proximity to the germinating weed seeds, or at greater depths can result in reduced effectiveness as the herbicide becomes diluted by the soil. This is most evident at marginal effective rates.

CONTRIBUTOR'S REPORTS

Table 1.

A COMPARISON OF THE TOLERANCE
OF CITRUS SEEDLINGS TO VARIOUS HERBICIDES
Observations 12-weeks post-treatment (Greenhouse Trials)

(O) - No visible injury. (I) - Visible injury. (D) - Plant dead.

Herbicide Applied	Rate of Soil Application in ppm. 0.5	1	2	4	8	16	32	64	128	256	512
Monuron	O	O	O	D	D	D	D	D	D		
Diuron			O	I	I	I	D	D	D	D	
Fenuron		D	D	D	D	D	D	D			
Sessin		O	O	D	D	D	D	D			
Simazine			I	I	D	D	D	D	D	D	
Atrazine		I	D	D	D	D	D	D			
Trietazine		O	O	O	I	D	D	D			
G-30044		O	O	O	O	I	D	D			
Dalapon	O	I	I	I	I	I	I	I			
6249		O-	I	I	D	D	D				
F W-450		O	I	I	I	D	D				
Amizole	O	O	O	O	O	I	I	I			
CIPC		O	O	O	O	O	O	O			
Benzac	I	I	I	I	D	D	D				
2,4,5-T	I	D	D	D	D	D					
2,4-D Acid	D	D	D	D	D	D					
2,4-D Amine	O	D	D	D	D	D					
3-Y-9	O	O	D	D	D	D	D				
EPTC		O	O	O	O	O	O	O			
Alanap-3		O	O	O	O	O	O				
HCA		I	I	I	I	I	I	D	D	D	D
F B . 2					O	O	D	D	D	D	
Propazine	O	O	O	O	O	I	(7-wks. test only)				

Table 2.

A COMPARISON OF THE TOLERANCE OF
AVOCADO AND MANZANELLO OLIVE SEEDLING TO VARIOUS HERBICIDES
Observations 12-weeks post-treatment (Greenhouse Trials)

(O) - No visible injury. (I) - Visible injury. (D) - Plant dead.

Herbicide Applied	Rate of Soil Application in ppm. 0.5	1	2	4	8	16	32	64	128	256
Olives:										
Amizole	O	O	O	I	I	I	I			
Dalapon	I	I	I	I	I	I	I			
Monuron		I	I	D	D	D	D	D		
Diuron		O	I	I	I	D	D	D		
Simazine		I	D	D	D	D	D	D		
Avocados:										
Amizole	O	O	O	O	O	I	I	I		
Dalapon	O	I	I	I	D	D	D	D		
Monuron	O	I	D	D	D	D	D	D	D	
Diuron	O	O	I	I	I	I	D			

(These tables are referred to on page 55.)

<u>Pre-emergence chemical control of annual weeds in field beans</u>. Dawson, J. H. and Bruns, V. F. In a field experiment conducted at the Irrigation Experiment Station, Prosser, Washington, in 1958, herbicides were evaluated for pre-emergence weed control in field beans as follows: ethyl N,N-di-n-propylthiolcarbamate (EPTC), 2-chloro-N,N-diallylacetamide (CDAA), 2-chloroallyl diethyldithiocarbamate (CDEC), isopropyl N-(3-chlorophenyl)-carbamate (CIPC), and aklanolamine salt of 4,6-dinitro ortho secondary butylphenol (DNBP) at 3, 6 and 9 lb/A, sodium salt of pentachlorophenol (sodium salt of PCP) at 20, 30 and 40 lb/A and 3-(3,4-dichlorophenyl)-1-methyl-1-n-butylurea (neburon) at 2, 4 and 6 lb/A. A hand-weeded and an untreated check were included. The Red Mexican beans were planted at a depth of 2-1/2 inches. All herbicides were applied in 12-inch bands over the row after the beans were planted. The herbicides were incorporated into the surface inch of soil with a rototiller on a garden tractor. Differential placement of the herbicides and seed was thus effected. For comparison, all herbicides were also applied without incorporation. Weeds between the rows were controlled by conventional cultivation.

When incorporated, EPTC at 6 and 9 lb/A gave excellent season-long control of annual grasses and broadleaved weeds without injury to the beans. The yields of beans in the treated plots were equal to those in the weed-free check. EPTC at 3 lb/A gave good, but not complete, control. Although some of the other chemical treatments gave fair to good weed control, all were considered unsatisfactory either because of inconsistent weed control or because of damage to the beans. In general, the herbicides were more effective when incorporated than when not incorporated. (Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, and Washington State Agricultural Experiment Stations, cooperating)

<u>The effect of herbicide treatments on chili</u>. Gould, W. L. and Szabo, S. S. Soil applications of monuron and diuron at 3/4 and 1-1/2 lb/A, neburon and sesone at 2 and 4 lb/A, liquid and 5% granular formulations of Eptam at 3 and 6 lb/A, and granular CDEC at 6 and 12 lb/A were made on weed-free plots in chili on July 11, 1958. The treatments were randomly located in blocks and replicated 4 times. The chili was approximately 18 inches tall at the time of treatment. The field was irrigated immediately after treatment, but the beds were not completely saturated. Each plot consisted of three 25 foot rows. Grass counts were made in 3 two-square foot quadrats on each side of the center row. The center row was harvested and yield measurement made on the air-dried chili. An infestation of <u>Fusarium</u> wilt caused the yields to be erratic, so yield data has not been included.

The chili did not show symptoms of herbicidal injury from the diuron, neburon, sesone, or CDEC granular treatments. The 1-1/2 lb/A rate of monuron caused severe chlorosis in all plots. EPTC stopped the marginal growth of the younger leaves with burning of the margins. The central parts of the leaves continued to grow causing a curling and cupping of the leaves. Some leaves were also chlorotic.

Diuron provided 74 and 84 percent grassy weed control at the respective 3/4 and 1-1/2 lb/A rates. Monuron at 1-1/2 lb/A gave 88 percent control, but was too injurious to the chili to be used for weed control purposes. Granular CDEC at 12 lb/A gave 73 percent grass control. The other treatments did not provide adequate weed control. (Contribution of the New Mexico Agricultural Experiment Station)

A study of effects on seedling cotton of urea herbicides applied by different methods. McRae, G. N., Arle, H. F., and Hamilton, K. C. It was observed in previous studies that a large percent of seedling cotton plants are covered by spray in the process of making soil directed applications of (diuron) 3-(3,4-dichlorophenyl)-1,1-dimethylurea and (monuron) 3-(p-chlorophenyl)-1,1-dimethylurea. In the spring of 1958 two experiments were initiated to evaluate the effects of these sprays on cotton.

1. Prior to the first irrigation monuron and diuron were applied at the rate of 1.25 lb/A. by the following methods:

- A. Directed spray to the soil covering a minimum of the lower leaves of the cotton plant.
- B. Spray directed over the top of the cotton covering both cotton and soil.
- C. Directed spray to the soil with a shield protecting the cotton plant.

The cotton was treated on May 15 at the height of 4 to 8 inches when it has 6 true leaves.

The results of this study indicated that monuron applied "over the top" caused severe chlorosis. Plants treated with diuron "over the top" developed only slight chlorosis on the leaves. The yield data from this experiment indicated that monuron applied "over the top" decreased the total yield of seed cotton by 12.5%. Moderate chlorosis was evident on foliage of plants that were treated with the soil directed and the shielded applications of monuron. However, yields were not reduced by these methods of applying monuron. The plants treated with diuron did not develop foliage chlorosis and their yields were not reduced.

2. In this test four rates of diuron (.75, 1.0, 1.25 and 1.5 lbs/A) and three rates of monuron (.75, 1.0 and 1.25 lbs/A) were applied directly over the top of cotton covering both cotton and soil. Applications were made on May 15 as in the previous test.

Severe to moderate chlorosis was evident on all plants treated with monuron. The amount of chlorosis was proportional to the amount of monuron applied. Very slight chlorosis was evident on the leaves of plants treated with diuron. The yield data from this experiment indicated no difference between the treatments. Fiber properties (length, strength, and fineness) and boll components (weight, seeds per boll, and percent lint) were not affected by direct applications of urea herbicides to young cotton. (Crops Research Division, ARS, USDA and the Arizona Agricultural Experiment Station cooperating)

A comparison of rate and date of diuron applications as layby treatments in cotton. Gould, W. L. and Szabo, S. S. Layby treatments were made in Acala 1517C cotton with diuron at two dates. The first treatments, consisting of 1/2, 1, and 2 lb/A, were applied just prior to the first irrigation on June 10, 1958. The second set of treatments, at the above rates, was applied just prior to the third irrigation on July 18-19. All plots were cultivated prior to treatment, but were undisturbed thereafter until weed and yield data were taken. A third group of plots was treated with 1/2, 1, and 2 lb/A of diuron before the first irrigation on June 10, and was then retreated before the third irrigation with 1/2, 1, and 1 lb/A respectively, on July 18-19. Thus, these plots received a total of 1, 2, and 3 lb/A of diuron. These plots were cultivated prior to the first irrigation and prior to the third irrigation, but were undisturbed from the time of the second application until weed and yield data were taken.

All treatments were applied to plots consisting of 4 rows, 40 ft. in length and spaced 40 in. apart. The treatments were applied in water, equivalent to 40 gal/A, and replicated 6 times. The grassy weeds were sown broadcast on the surface over the entire plot. The morning glory was sown along the side of 1 furrow row in each plot with a one-row planet junior seeder. All plots were seeded with the weed seeds just prior to treatment.

Counts on grassy weeds were taken by means of 3' x 4" quadrats. Six quadrat readings were taken from representative areas within each plot. Annual morning glory counts were made by counting all of the plants in 35 ft. of one row per plot. The morning glory plants were pulled up after the counts were made. Cotton yields were taken from the two center rows of each plot, totaling 70 ft. of row. The following table shows the various treatments, treatment dates, weed counts, and lint cotton yields:

Effect of rate and date of diuron application on yield of lint cotton and on weed control.

Appl. date	Appl. Rate (lb/A)	Lint cotton Yield (lb/A)	Grassy weeds per 6 sq'/plot	Ann. morning glory per 35' row
	0.5	1047.4	26.5	9.0
June 10	1.0	1147.8	3.5	7.7
	2.0	1216.8	0.5	2.1
July 18-19	0.5	1317.1	10.7	8.3
	1.0	1179.1	2.3	1.7
	2.0	1266.9	1.5	0.5
June 10				
+	0.5 + 0.5	1210.9	2.5	3.3
July 18-19	1.0 + 1.0	1172.9	1.7	1.0
	2.0 + 1.0	1285.8	0.7	0.2
Check	0.0	1266.9	42.3	12.1
LSD .05		208.2	17.7	5.4

(Contribution of the New Mexico Agricultural Experiment Station)

A comparison of diuron and several triazine compounds as layby treatments in cotton. Gould, W. L. and Szabo, S. S. Acala 1517C cotton plots were treated, before the first irrigation on June 10, 1958, with diuron at 1/2, 1, and 2 lb/A. Prior to the third irrigation, on July 18-19, the above plots were retreated with 1/2, 1, and 1 lb/A of diuron, respectively. Also on July 18-19, diuron was applied at 1/2, 1, and 2 lb/A and three triazine compounds, propazine, chlorazine, and G-30044, were applied at 1, 2, and 2 lb/A, respectively. All treatments were applied to plots consisting of 4 rows, 40 ft. long. The treatments were applied in water equivalent to 40 gal/A and were replicated 6 times. Various grassy weed seeds were broadcast over the plots just prior to treatment. Annual morning glory was drilled in along the edge of one furrow per plot in each plot, using a one-row planet junior seeder.

Weed counts were taken on August 12. Grassy weed counts were taken by means of six 3' x 6" quadrats per plot. Annual morning glory counts were taken by counting all of the plants per 35 ft. of one row per plot.

The morning glory plants were pulled up after the counts were made to remove them from competition. Yields were taken from the two center rows of each plot, totaling 70 ft. of row. The various treatments applied, weed counts, and lint cotton yields are given in the following table:

Effect of diuron and three triazine compounds on yield of cotton and on weed control.

			% Control	
Chem.	Appl. rate (lb/A)	Lint cotton Yield (lb/A)	Grassy Weeds	Ann. Morning Glory
	0.5	1317.1	66.8	31.4
Diuron	0.5 + 0.5	1210.9	92.2	72.7
	1.0	1179.1	92.8	86.0
	1.0 + 1.0	1172.9	94.7	91.7
	2.0	1266.9	95.4	95.9
	2.0 + 1.0	1285.8	97.8	98.4
Propazine	1.0	1135.2	56.6	95.9
Chlorazine	2.0	1273.2	56.4	100.0
G-30044	2.0	1248.1	84.5	90.1
Check		1266.9	0.0	0.0

(Contribution of the New Mexico Agricultural Experiment Station)

Pre-emergence treatments on cotton. Gould, W. L. and Szabo, S. S. Diuron, trietazine, simazine, propazine, G-30031, and G-30044 were applied to duplicate sets of Acala 1517C cotton plots as pre-emergence treatments on May 13, 1958. One set of plots was irrigated immediately after treatment, whereas the other set was not irrigated until June 10. The treatments were applied to plots consisting of 3 rows, 24 ft. long. All treatments were applied in water equivalent to 40 gal/A and were replicated 4 times. Various grassy weeds were broadcast over the plots just prior to treatment. Annual morning glory was drilled in along the edge of the middle row furrow with a one-row planet junior seeder. Counts on grassy weeds were taken from 6 3' x 4" quadrats per plot. Annual morning glory counts were made by counting all of the plants per 20 ft. of row. All plots were hoed after the weed counts were made. The various chemicals used, the treatment rates, weed counts, and yield data are given in the following table:

Effects of pre-emergence treatments on cotton yield and weed control.

		Lint cotton (lb/A)		% grass control		% Ann. Morn'g glory control	
Chemical	Rate	1/	2/	1/	2/	1/	2/
Diuron	0.5	922.2	667.2	47.2	1.5	20.9	0.0
	1.0	902.6	843.8	63.1	99.3	6.5	11.5
	2.0	824.2	647.6	95.8	97.0	65.2	51.9
Simazine	0.25	863.4	863.4	62.1	39.3	26.1	21.2
	0.5	863.4	490.6	75.2	82.1	60.9	50.0
	1.0	196.2	588.6	94.4	93.8	90.4	80.8

(continued)

(continued)

Chemical	Rate	Lint cotton (lb/A) 1/	2/	% grass control 1/	2/	% Ann. Morn'g glory control 1/	2/
Propazine (G-30028)	0.25	941.9	706.4	27.8	0.0	4.4	0.0
	0.5	784.9	804.5	86.6	29.2	56.5	1.9
	1.0	608.3	569.1	78.6	11.6	87.8	44.2
Trietazine G-27901	1.0	647.6	981.2	30.1	50.2	10.9	0.0
	2.0	726.1	412.1	56.6	83.2	65.2	73.1
	3.0	647.6	686.8	98.3	67.9	82.6	51.9
G-30031	0.5	667.2	784.9	56.1	12.4	22.6	13.5
	1.0	843.8	922.2	37.6	45.9	63.0	86.5
	2.0	745.6	686.8	60.8	92.4	84.8	98.1
G-30044	1.0	824.2	588.6	80.2	54.4	16.5	0.0
	2.0	961.5	686.8	88.8	96.7	80.9	30.8
	3.0	686.8	843.8	97.0	98.3	34.8	42.3
LSD .05		281.7	352.7				

1/ Irrigated immediately after treatment.
2/ Not irrigated immediately after treatment.

(Contribution of the New Mexico Agricultural Experiment Station)

Effects on cotton of dalapon applied to the soil and foliage. Hamilton, K. C., Arle, H. F., and McRae, G. N. The use of dalapon in cotton has raised questions as to the effect on cotton of low rates of this herbicide applied (1) to the soil and (2) to cotton foliage.

(1) A test was conducted at the Cotton Research Center at Tempe to determine the effect of soil applications of dalapon on cotton. The soil was a McClellan clay loam. On June 10 prior to the second irrigation, when the cotton (Acala-44) was 16-20 inches high, 4, 8, and 12 lbs/A of dalapon was applied as a directed spray to the soil. On July 1, when the cotton was 24-30 inches high, other plots were sprayed with 4, 8, 12, and 16 lbs/A. Plots were 4 rows, 40 feet long; treatments were replicated 4 times. In September, ten boll samples were taken from each plot for fiber analysis. Cotton was hand picked in October and December.

The applications of dalapon made June 10 caused foliage malformation proportional to the amount applied. During July, flowers were malformed, no bolls were set, and cotton plant growth was rapid on plots given the early dalapon treatment. There was no visible effect on cotton treated on July 1. The data showing the effect of soil application of dalapon on cotton yield and boll weight are summarized in the following table.

Dalapon treatment		Yield of seed cotton expressed as percent of the untreated	Boll weight in grams*
Date	lbs/A.	checks*	
Check		100 abc	6.4a
6/10	4	100 abc	6.5a
6/10	8	91 cd	6.1abc
6/10	12	83 d	6.2ab
7/1	4	97 abc	5.6 cd
7/1	8	103 ab	5.5 cd
7/1	12	108 ab	5.7 bcd
7/1	16	94 bc	5.4 d
Calculated yield of checks in lbs/A.		3,535	

*Values with the same subscript are not significantly different.

The total yield of seed cotton was reduced by 8 and 12 lb/A. of dalapon applied June 10 and by 16 lbs/A applied July 1. Dalapon treatments reduced the yields of the first pickings more severely than they reduced the total yields. Dalapon applications did not affect fiber length, strength, or fineness. The weight of bolls on plants treated on July 1 was significantly reduced while the number of seeds per boll and percent lint were not affected.

(2) Two tests were conducted to determine the effect of low rates of dalapon applied to cotton foliage. At Tempe 1/2, 1, 2, 3, 4, 5, and 6 pounds of dalapon per acre were applied on May 9 directly over-the-top of young cotton. At Marana 1, 2, 3, 4, and 5 pounds of dalapon per acre were applied May 23. The plants were 5 inches high and had 4 to 6 true leaves. Plots were 4 rows 40 or 50 feet long; treatments were replicated 4 or 6 times. In September ten boll samples were taken from each plot for fiber analysis.

Application of 3 or more pounds of dalapon per acre caused foliage malformation to develop within one week. These plants produced normal foliage within 3 to 6 weeks. Slight stunting of cotton plants was caused by application of 5 and 6 pounds of dalapon per acre. At harvest all plants appeared normal. Applications of up to 6 pounds of dalapon per acre to seedling cotton had no effect on seed cotton yield, fiber properties or boll components. (Crops Research Division, ARS, USDA, and the Arizona Agricultural Experiment Station, cooperating)

Effect of spot treating portions of cotton stands with dalapon. Hamilton, K. C., Arle, H. F., and McRae, G. N. Spot treating with dalapon to control Johnson grass in cotton fields is an accepted grower practice in Arizona. Young cotton plants sprayed while applying dalapon die and crop stands are reduced.

In 1958 four tests were conducted to determine the amount cotton stands could be reduced before yields would be affected. These tests were at Yuma (elevation 50 feet), Tempe and Mesa (1000 feet), and Marana (1800 feet). Different elevations were selected to determine if growing conditions affected cotton's ability to compensate for stand reductions.

At the higher elevations the growing season is shorter, growth is slower, and the mature cotton plants are usually shorter.

Dalapon was applied before the first irrigation, simulating a spot treatment for Johnson grass control. In each test two-foot to three-foot sections equivalent to 10, 15, 20, 25, and 30 percent of the total row were treated. The spray solution containing 1 pound of dalapon per 5 gallon of water was applied directly to the foliage of young cotton. Applications were made when the cotton (Acala-44) was about 5 inches high and had 4 to 5 true leaves (May 8 at Yuma to May 24 at Marana). In these tests 4-row plots were 30 to 50 feet long; treatments were replicated 4 to 8 times.

Sprayed cotton plants died within ten days. The growth of plants, adjacent to treated plants, covered most bare spots within 2 months. The data showing the effect on yield of seed cotton of spot treating portions of plant populations are summarized in the following table.

Percent of cotton stand killed with dalapon	Yield of seed cotton expressed as percent of the untreated checks				
	Yuma*	Tempe	Mesa	Marana*	Average of 4 tests
Check	100a	100	100	100a	100
10%	92 c	97	90	101a	95
15%	96ab	94	95	99a	96
20%	95 bc	100	97	88 b	95
25%	92 cd	96	102	100a	97
30%	88 d	93	100	91ab	93
35%	89 d	92	---	---	90
40%	90 d	79	---	---	85
Calculated yield of check in lbs/A	4913	3914	2492	2300	

*Values with the same subscript are not significantly different.

Stand reductions of 25 percent did not decrease the yield of seed cotton. Stand reductions of 30 to 40 percent generally reduced yields. In these tests there was no relation between elevation and the ability of cotton to compensate for stand reductions. (Crops Research Division, ARS, USDA, and the Arizona Agricultural Experiment Station, cooperating)

New herbicides for weed control in field corn. Chilcote, D. O. and Furtick, W. R. From extensive tests in western Oregon, three new herbicides have appeared outstanding for the control of annual broadleaf and grass weeds, particularly watergrass (*Echinochloa crusgalli*) in field corn. These are Randox T (CDAA plus an undisclosed additive), atrazine (4-isoproprylamino-6 ethylamino -s- triazine) and Eptam (EPTC).

Randox T, developed by Monsanto Chemical Company, has given excellent annual broadleaf and grass control as a pre-emergence treatment at rates of four to six pounds per acre. This material is easily activated with limited moisture.

Atrazine, a new herbicide developed by Geigy Chemical Corporation, overcomes some of the undesirable characteristics of Simazin. This material is more soluble than Simazin and more easily activated with less moisture. It does not present as much of a residue problem. In addition, it is much more effective on annual broadleaf and grass weeds. Pre-emergence applications as low as one pound active per acre have given effective annual weed control. Atrazine differs from Simazin in that it possesses some foliage activity.

Eptam, developed by Stauffer Chemical Company, has given excellent control of grass and broadleaf weeds when incorporated into the soil at rates of three to six pounds per acre prior to corn planting. As a pre-emergence surface application, results have not been satisfactory. Disking appears to be an excellent method for incorporating Eptam.

These new materials have given season-long weed control and increased yields of grain over cultivated checks at most locations. In no instance has yield been reduced. Continued tests will be condected with these materials to determine the most effective methods of utilizing them in field corn production.

The control of annual weeds in field corn with simazin. Arle, H. F., McRae, G. N., and Hamilton, K. C. Pre-planting and post-emergence applications of 2-chloro-4,6-bis-(ethylamino)-s-triazine (simazin) were made at rates of 1.0, 1.5, 2.0, 2.5, and 3.0 lbs/A. Pre-planting applications were made on March 26, two weeks prior to planting, and were followed immediately by harrowing to mix the chemical into the surface soil. One and one-quarter inches of rainfall occurred during the week after treatment. Post-emergence applications were made on April 22 when the corn (Texas 17W) was 6 to 10 inches tall. The herbicide was applied as an overall spray to the soil and young corn plants. The weed population that developed during the season consisted primarily of watergrass, (*Echinochloa colonum*), and volunteer castor beans. The soil type of the test area was a Laveen clay loam.

All pre-planting applications of simazin resulted in good control of castor beans, while at least 2.0 lbs/A was required to control watergrass. Early growth of corn was definitely retarded, especially by the higher rates of simazin. The retarded condition continued until late May at which time recovery was rapid. Despite the retarded initial corn growth, there were no significant yield reductions when ear corn was harvested. Post-emergence treatments also resulted in good control of weed growth, especially where 2.5 and 3.0 lbs/A of simazin were applied. The growth of corn was retarded, but less severely than by comparable rates applied post-emergence. Although there was a tendency toward lowered yields as a result of herbicide treatments, these reductions were not significant. (Crops Research Division, ARS, USDA, and the Arizona Agricultural Experiment Station, cooperating)

Annual weed control in corn. Jordan*, L. S. and Browning**, D. R. Hybrid field corn was planted in 40 inch rows June 12, 1958. Various herbicides were applied as broadcast sprays in 40 gallons of water per acre on moist soil two days (pre-emergence) and seven days (post-emergence) after planting. Three replications of square rod plots were used. The corn and many annual weeds were in the one to two leaf stage when the post-emergence treatments were applied. The plots were not cultivated because of excess moisture during the growing season. The results are presented in the following table:

Herbicide	Rate (lb/A)	Time of Application	Weed Control 1/ Early Season 2/ Monocots 3/	Dicots 4/	Late Season Monocots	Dicots	Corn Yield (Bu/A)
CDAA	4	Pre-emergence	6	1	0	0	89.1
CDAA	4	Post-emergence	7	3	4	0	108.2
CDAA	6	Pre-emergence	7	2	2	0	97.0
CDAA	6	Post-emergence	9	3	5	0	121.1
CDAA-T	4	Pre-emergence	7	4	0	0	93.1
CDAA-T	4	Post-emergence	7	4	4	0	110.2
CDAA-T	6	Pre-emergence	8	5	4	2	104.6
CDAA-T	6	Post-emergence	9	6	6	4	115.2
CDAA +	5	Pre-emergence	10	10	7	6	115.6
½2, 4-D	½	Post-emergence	10	10	8	6	106.5
Simazine	1½	Pre-emergence	10	10	10	10	115.0
Simazine	1½	Post-emergence	10	10	10	10	129.8
Simazine	2	Pre-emergence	10	10	10	10	121.5
Simazine	2	Post-emergence	10	10	10	10	124.2
Simazine	2½	Pre-emergence	10	10	10	10	120.8
Simazine	2½	Post-emergence	10	10	10	10	124.0
DNBP	5	Pre-emergence	6	6	0	0	91.6
DNBP	5	Post-emergence	10	10	4	4	108.0
Emid	1½	Pre-emergence	5	6	0	0	94.5
Emid	1½	Post-emergence	7	6	0	0	102.4
EPTC	5	Pre-emergence	2	3	0	0	66.4
EPTC	10	Pre-emergence	2	3	0	0	81.2
Check			0	0	0	0	75

1/ 0 = No Control; 10 = Complete Control
2/ Early season = weed control during first five weeks.
Late season = weed control after first five weeks.
3/ *Digitaria spp.*, *Echinochloa crusgalli*, *Panicum dichotomiflorum*, *Setaria spp.*
4/ *Amaranthus retroflexus*, *Mollugo verticullata*, *Abutilon theophrasti*, *Ipomoea purgurea*.

(*Formerly at Southern Illinois University, now at University of California, Riverside, California; **Southern Illinois University, Carbondale, Ill.)

Tolerance of White Potatoes to Seven Herbicides. McCarty, C. D., Purnell, D. C., and Little, T. M. Alanap-3, CDAA, CDEC, neburon, monuron, diuron, and simazine were applied pre-emergence to white potatoes. Soil was Hanford fine sandy loam which had been well worked prior to planting. Rain fell the day after planting; the herbicides were applied the next day on moist soil. During the following ten days a little over two inches of rain fell.

Application was made with a logarithmic dilution sprayer which varied the concentration of herbicide but kept the spray volume constant at 100 gpa. Herbicides were applied over a range of rates designed to produce injury at the higher concentrations in order to determine the tolerance of the potatoes to the herbicides. With three of the herbicides used, injury did not occur at the highest rate used. Rates for alanap-3, CDAA, and CDEC ranged from 0.6 to 10 pounds per acre. Rates for neburon, monuron, diuron, and simazine ranged from 0.24 to 4 pounds per acre.

Results on breaking points for injury to the potatoes are given in the following table.

Table 1. Breaking point for crop injury. Average of four replicates

Herbicide	Rates Tested (Lbs. per Acre)	Top Injury	Tuber Injury
CDAA	0.6 to 10	None	None
CDEC	0.6 to 10	None	None 1/
Alanap-3	0.6 to 10	Delayed sprouting of seed tubers 4 to 5 weeks	Reduced tuber formation at all rates 2/
Neburon	0.24 to 4	None	None
Monuron	0.24 to 4	Stunted top growth of young plants above 3 lbs/acre. Injury soon outgrown.	Reduced tuber formation above 1.7 lbs/acre
Diuron	0.24 to 4	Stunted top growth of young plants above 3.5 lbs/acre. Injury soon outgrown.	Reduced tuber formation above 1.9 lbs/acre
Simazine	0.24 to 4	Stunted top growth of young plants at all rates tested. Injury outgrown.	Reduced tuber formation above 0.5 lbs/acre

1/ Based on 2 replicates
2/ Based on 3 replicates

(University of California Agricultural Extension Service)

Annual weed control in forage sorghum. Jordan*, L. S. and Browning**, D. R. Sorghum was planted in 40-inch rows. Square rod plots were broadcast sprayed three days later with CDAA 4 and 6 lb/A, Neburon 2 lb/A and Simazine 1-1/2 lb/A. The herbicides were applied to wet soil in 40 gallons of water per acre. Three replications were used. The plots were cultivated once when the sorghum was about 24 inches tall.

The sorghum treated with simazine was thinned and retarded early in the season but the surviving plants tillered and yielded about the same as the other treated plots. No apparent injury to sorghum resulted from the CDAA or Neburon treatments. The results are presented in the following table.

Treatment	Weed Control 1/		Forage Yield
	Monocots 2/	Dicots 3/	(tons/A)
CDAA 4 lb/A	8	2	9.0
CDAA 6 lb/A	10	6	9.5
Neburon 2 lb/A	10	10	9.9
Simazine 1-1/2 lb/A	10	10	9.2
Check	0	0	5.9

1/ 0 = No Control; 10 = Complete Control
2/ *Panicum dichotomiflorum*, *Setaria spp*, *Echinochloa crusgalli* and *Digitaria spp*.
3/ *Chenopodium album*, *Amaranthus retroflexus*, *Mollugo verticullata* *Ipomoea purpurea*, and *Ambrosia spp*.

(*Formerly at Southern Illinois University, now at University of California, Riverside, California. **Southern Illinois University, Carbondale, Illinois)

Endothal for weed control in sugar beets. Comes, R. D., Fabricius, Lee J. Endotahl showed a great deal of promise as a pre-emergent herbicide for control of grasses and broadleafed weeds in sugar beets again in 1958. Results were again erratic, however. The chemical applied at 6 pounds per acre acid on a 6-inch band and on a heavy clay soil gave good results, although the seed bed was relatively dry at planting time and no rain was received until a month after planting.

The yield from monogerm plots seemed to be more affected than the multigerm plots. They varied from 5 tons per acre less then untreated areas to the equal of untreated areas. (Wyoming Agricultural Experiment Station)

Sugar beet weed control with preplanting and pre-emergence herbicide treatments. Hodgson, J. M. Four chemicals that have shown promise for weed control in sugar beets in previous experiments were applied as pre-planting and pre-emergence weed control treatments in sugar beets in 1958. The treatments were applied in randomized block design arrangement with four replications. Pre-seeding applications were made and sugar beets seeded immediately. Part of the treatments were incorporated by a Howry Berg mixing apparatus mounted ahead of each planter. Pre-emergence treatments were sprayed broadcast immediately after planting. Individual plots consist of four rows each 2 feet apart and 38 feet long.

The treatments are listed and results summarized in the following table.

Time of application chemical and formulation			Beets			Weed Control	
			Before Thinning Per 100" Row	At Harvest Per 66'Row	Yield	Broad-leaved	Setaria spp.
		lb/A	Number	Number	Tons/A	Percent	Percent
Pre-emergence							
Endothal	Spray	6	48	98	12.67	31	62
Endothal	Spray	8	52	92	11.37	52	79
Endotahl	Granular	8	57	98	11.80	66	53
EPTC a/	Spray	4	60	93	12.09	62	84
EPTC	Spray	6	51	91	11.58	70	92
EPTC	Granular	4	40*	82	11.01	82	99

(continued)

Time of application chemical and formulation			Beets			Weed Control	
			Before Thinning Per 100" Row	At Harvest Per 66'Row	Yield	Broad-leaved	Setaria spp.
		lb/A	Number	Number	Tons/A	Percent	Percent
Dalapon	Spray	4	44	98	11.20	21	80
TCA	Spray	8	37*	84	9.93	85	99
Check			57	89	7.34	0	0
Handweeded	--	-	57	90	12.82	100	100
Preseeding and Incorporated							
Endothal	Spray	8	26*	79	11.09	56	79
Endothal	Granular	8	43*	77	11.72	56	71
EPTC	Spray	6	30*	74	10.99	77	89
EPTC	Granular	6	26*	66*	10.59	90	97
Dalapon		4	38*	78	12.01	21	49
TCA		8	31*	82	11.86	55	90
L.S.D. .05 =		16.2	16	14	1.9		

* - Significantly lower than check or handweeded plot.
a/ - EPTC, or ethyl N,N-di-n-propylthiolcarbamate.
b/ - Lambsquarter, red root pigweed, and *Kochia scoparia*.

The sugar beets generally were less tolerant to these chemicals than in previous years. All preseeding soil-incorporated treatments reduced the stand of beets, indicating higher toxicity when incorporated. However, beets treated with endothal at 8, Dalapon at 4, and TCA at 8 recovered so that yields were not significantly lowered. The granular formulation of EPTC was more toxic to beets and weeds than the spray when applied pre-emergence. Dalapon was much less effective in controlling Setaria when incorporated than when applied pre-emergence. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and Montana Agricultural Experiment Station, cooperating)

Annual weed control in tomatoes. Jordan*, L. S. and Andrew**, Wm. T. Seeds of the Glamour Variety of tomatoes were seeded in plots of Vermiculite on March 6, 1958. Seedlings were pricked out to 2-1/2" x 2-1/2" x 4" veneer bands of plotting soil April 2, 1958. Transplants were set in the field May 20, 1958. Plots were 25 feet long and 4 feet wide with a single row of 6 plants set 4 feet apart. There was a border row of the same dimensions between each treated plot. Four replications were used.

The treatments were: (1) unsprayed check, (2) EPTC 5 lb/A (3) CIPC 5 lb/A and Neburon 4 lb/A. Neburon and EPTC were applied as 40-inch bands in 50 gallons of water per acre over the tomatoes. CIPC was applied as a 10% granular material. First harvest was July 17 with subsequent harvests on July 22, 24, 29, 31 and August 5, 7, 12, 14. Fruit showing any color was harvested on each date.

The foliage of the tomatoes treated with neburon was severely damaged for about one month after treatment but the symptoms disappeared as the plants matured. Those treated with CIPC were stunted and the fruit matured earlier than on other plots. No damage to the tomatoes was apparent from the EPTC treatment. Results of the trial are presented in the following table.

Treatment	Weed Control 1/ Monocots 2/	Dicots 3/	Tomato Yield 4/ First 3 Harvests	Total
EPTC 5 lb/A	4	2	2.9	40.5
CIPC 5 lb/A	8	4	5.8	25.3
Neburon 4 lb/A	9	9	2.5	31.9
Check	0	0	3.6	40.9
LSD 5%			1.3	9.5
1%			1.9	N.S.

1/ 0 = No control; 10 = Complete control
2/ *Setaria* spp., *Echinochloa crusgalli*, *Digitaria* spp.
3/ *Ambrosia* spp., *Molluga verticullata*
4/ Average of 4 replications in pounds of marketable tomatoes per plot.

(*Formerly at Southern Illinois University; now at University of California, Riverside, California. **Southern Illinois University, Carbondale, Illinois)

Effect of eight herbicides on yield and quality of tomatoes for canning. Hamson, Alvin. Herbicides were applied in 2-1/2 foot bands directly over the tomato rows after the second cultivation. Plants were transplanted May 28 and herbicides applied June 27 with 25 lbs. p.s.i. pressure and 30 gallons per acre of water. An application of starter fertilizer vs. plain water was superimposed on herbicide treatments to determine a possible effect of recovery of plants after transplanting on injury from herbicide treatments.

A randomized block design was used with four replications. Yields were recorded for No. 1, No. 2 and cull fruits based on grades for canning. The Analysis of Variance indicated highly significant differences between starter fertilizer vs. no starter and for the interaction grade X herbicide tratement. Differences between herbicide treatments were not significant indicating similar yields of all plots treated with herbicides.

Table 1 indicates herbicides and rates applied, yield per acre of marketable fruit, and the percentages of No. 1, No. 2, and cull fruit.

Table 1.

Chemical and Rate		Yield in tons/A	% No. 1	% No. 2	Cull
CIPC	6 lbs.	14.04	52.8	26.3	20.8
CDAA	6 lbs.	14.04	70.2	17.1	12.7
CDEC	8 lbs.	17.56	59.2	22.2	18.6
Natrin	4 lbs.	14.35	52.9	25.7	21.4
DCU	3 lbs.	15.60	60.1	21.6	18.3
Neburon	4 lbs.	15.40	65.9	21.0	13.1
NaTCA	5 lbs.	12.04	65.4	16.9	17.7
EPTC	6 lbs.	16.37	63.4	17.3	19.3
Check		16.89	65.5	18.5	16.0

(Department of Horticulture, Utah State University, Logan, Utah)

Pre-emergence treatments on vegetable crops. Szabo, S. S. and Gould, W. L. The purpose of this experiment was to evaluate several chemicals for possible use as pre-emergence chemicals in vegetable crops. In this test, onions, pinto beans, tomatoes, and sweet corn were seeded in listed and flattened beds 40 inches apart. The individual vegetables were seeded, with a one-row planet junior seeder, in single rows near the outer edges of the beds, with two of the given vegetables per bed. The onion and tomato seeds were planted 1/2 inch deep. The pinto beans and corn were planted 3/4 inches deep. Plots 20 ft. long were laid out and treated on August 6, 1958, with Eptam (both liquid and granular), CDEC, CDEA, and Emid. The treatments were applied in a randomized block design and were replicated four times. The granular formulation of Eptam was applied with a Gandy spreader. All other treatments were applied in water solution, equivalent to 40 gal/A, with a small plot sprayer. The plots were irrigated immediately after treatment and kept moist until emergence of the various vegetable plants. The plots were watered, thereafter, as required.

Weed counts were taken 1-1/2 months after treatment. The weed counts were taken from two representative square yard quadrats per individual plot. Crop yields were not taken since they did not have sufficient time to mature. There was no apparent chemical injury to any of the crops in this trial. The results are summarized in the following table.

Chemical	Rate (lb/A)	Total No. Weeds	% weed Control
Eptam	6.0	25	90.0
(liquid)	4.0	34	86.4
"	2.0	72	71.3
"	1.0	98	61.0
Eptam	6.0	28	88.8
(granular)	4.0	51	79.5
"	2.0	57	77.0
"	1.0	139	45.0
CDEC	6.0	94	62.0
"	3.0	169	32.0
CDEA	6.0	209	16.0
"	3.0	229	8.0
Emid	2.0	85	66.0
	1.5	109	56.0
	1.0	124	50.0
	0.5	207	17.0
Check	0	250	0.0

(Contribution of the New Mexico Agricultural Experiment Station)

Tolerance of field grown woody ornamentals to herbicides applied as post-transplanting sprays. Bivins, Jack L. and Harvey, William A. Field planted Ulmus semperniveus, Podocarpus macrophylla, Juniper tomlosa, Chamaerops excelsa and Cocos plumosa were treated with neburon (1-n butyl-3-(3,4-dichlorophenyl)-1-methylurea) at 2, 4, and 8 pounds active per acre. Plots were not replicated but 5 plants of each species were included in each treatment.

Weed control of 90 percent lasted for 4 months at 2 pounds per acre. At 4 pounds 96 percent weed control was obtained for 11 months. Weed control at 8 pounds has remained over 97 percent for more than one year. There was no visible damage to any of the nursery species at any rate. The soil type is a Watsonville fine sandy loam. Over 30 inches of rainfall plus 9 inches of irrigation fell on the soil over a 12 month period after the neburon was applied. (Santa Barbara County Agricultural Extension Service and University of California Agricultural Extension Service, cooperating)

Chemical weed control in cymbidium orchids. Bivins, Jack L. and Harvey, William A. Tests conducted with neburon (1-n butyl-3-(3,4-dichlorophenyl)-1-methylurea) 18.5 percent wettable powder at 4 and 8 pounds active and 2 percent granular at 8 pound active per acre gave excellent weed control. Weeds controlled included Poa annua, Cardamine aligosperma and Oxalis corniculata. The 4 and 8 pound rates of wettable powder formulation killed mature Cardamine aligosperma. There has been no visible damage to cymbidium for periods of 12 months after treating with any formulation at any rate.

Cymbidium plants were set in raised ground beds filled to a depth of 12 to 14 inches with 1/3 redwood fiber, 1/3 peat and 1/3 fine sand and watered one week before treating with neburon. The wettable powder formulation was suspended in 150 gallons of water per acre and sprayed over the foliage of the plants. The material was applied with a 2 gallon Hudson sprayer and kept in suspension by frequent shaking. The granular formulation was broadcast dry by hand. The plots were 8 by 10 feet replicated 3 times. Weed counts were made at regular intervals for 12 months by pulling weeds from 3 separate square foot blocks in each plot. The granular formulation gave 92.6 and the wettable powder at 4 and 8 pounds 99.1 and 99.9 percent weed control. (Santa Barbara County Agricultural Extension Service and University of California Agricultural Extension Service, cooperating)

Control of annual weeds in flower seed crops by use of pre-emergence chemical treatments. Bivins, Jack L., Hall, Harwood, Harvey, Willam A. During 1957, an extensive chemical screening test was conducted at William MacDonald Seed Company, Santa Maria, in an attempt to find chemicals that could be used for weed control in flower seed crops. Five herbicides were compared, some at two rates each, replicated 3 times in randomized blocks.

The treatments were made immediately after planting on plots 20 feet long consisting of 4 rows each of sweet pea, petunia, alyssum, larkspur, verbena and antirrhinum spaced 40 inches apart. Each plot was handweeded and weeds counted March 22, 1957. Weeds growing in the check included common knotweed (Polygonum aviculare), small nettle (Urtica urens), rough pigweed (Amaranthus retroflexus), tumbling pigweed (Amaranthus graecizans), lambs'-quarter (Chenopodium album), bull mallow (Malva nicaeensis), and volunteer pansy. Of the 5 materials tested, all gave satsifactory weed control. Simazin and EPTC caused excessive damage to all flower species tested. CDEC (2-chloroallyl diethyldithio-carbamate) was selective to petunia and sweet pea at 3 and 6 pounds active per acre applied in 40 gallons of water. CDEC at 3 pounds active per acre gave 75 percent weed control and 80 percent at 6 pounds. Pre-emerge dinitro was selective to larkspur at 6 and 9 active per acre. These were applied immediately after planting, diluted in 40 gallons of water. Pre-emerge dinitro at 6 pounds per acre gave 56 percent weed control and 74 percent at 9 pounds. Neburon (1-n butyl-3-(3,4-dichlorophenyl)-1-methylurea) was selective to sweet pea at 2 and 4 pounds active per acre suspended in 40 gallons of water. The solution was kept in suspension by frequent shaking of the sprayer. Neburon at 2 pounds active per acre gave 96 percent weed control and 97 percent at 4 pounds.

Seed yield of larkspur was increased 22.9 percent at the low rate of pre-emerge dinitro and 20.1 at the high rate. Sweet pea seed yield was increased 41.4 and 40.9 percent with neburon and 40.9 and 44.8 percent with CDEC. Petunia seed yield increased 8.8 and 17.5 percent with CDEC. (Santa Barbara County Agricultural Extension Service and University of California Agricultural Extension Service, cooperating).

Control of annual weeds in azaleas growing in raised ground beds. Bivins, Jack L. and Harvey, William A. Preliminary trials using Alanap (NPA), Natrin (2,4,5-TES), Sesin (2,4-DEB), CIPC, CDEC, and neburon during 1957, indicated that CDEC and neburon might have promise for annual weed control in azaleas.

In 1958, trials were established using CDEC and neburon on Redwing, Madam Mistag, and Early Wonder azaleas. CDEC was used at 8 and 16 pounds per acre as a liquid and as a granular. Neburon was used at 2, 4, 8 and 16 pounds active ingredient per acre.

The weeds in the plots were Poa annua, Cardamine oligasperma, Oxalis corniculata, and Taraxacum vulgare. The raised beds were filled with 90 percent peat and 10 percent wood shavings to a depth of 8 to 10 inches. Weed control counts and azalea injury ratings were made at monthly intervals from April 10 through September 15. Each experiment consisted of 3 replications with plots 5 feet by 5 feet. At each weeding all weeds were pulled and counted. The only visible evidence of damage to azaleas from neburon was at the 16 pound per acre rate. The symptoms showed as yellowing of main veins of the leaf. Azalea Madam Mistag was severely damaged at both rates of liquid CDEC. This is thought to be due to young tender growth at time of treatment. Damaged plants were defoliated but many did recover. The other two varieties were not visibly damaged by liquid CDEC. Neburon at 2, 4, 8, and 16 pounds active per acre resulted in weed control of 75.1, 91.3, 97.3, and 99.5 percent as averages of the three replicates. CDEC granular at 8 and 16 pounds active per acre resulted in weed control of 44.4 and 52.3 percent. CDEC liquid diluted in 30 gallons of water at 8 and 16 pounds active per acre resulted in weed control of 59.4 and 55.5 percent.

Final observation and commercial grade out was taken at time of shipment. Both the 16 pound per acre rate neburon and liquid CDEC graded out at a smaller grade than did the check or the lower rates or other forms of the chemicals.

It would appear that 4 to 6 pounds of active neburon per acre would give adequate weed control for one season. No damage to azaleas occurred at 8 pounds or lower of the active neburon per acre. (Santa Barbara County Agricultural Extension Service and University of California Agricultural Extension Service, cooperating)

A new group of napthoquinone herbicides. Corkins, Jack P., Wilkerson, James A., and Riddell, John A. A series of amino-1,4-napthoquinone compounds were discovered to be active post-emergence herbicides. Limited logarithmic field tests indicate that herbicidal activity exists on water-grass, mustard, ground cherry and pigweed. These tests further indicate some degree of selectivity on cotton, carrots, onions, peanuts and large seeded legumes. This group of napthoquinones appear to be more effective on young weeds than on older, more mature weeds. (Naugatuck Chemical Division of the United States Rubber Company)

Simazine and other triazine herbicides. Olney, Vernon W. With the development of Simazine (2-chloro-4, 6-bis(ethylamino)-s-triazine) by Gysin and Knusli in the laboratories of J. R. Geigy, Basle, Switzerland a long list of promising herbicides are becoming available for selective weed control in a number of annual and perennial crops as well as for general weed control. The proposed trade name, chemical structure, and solubility in water of each compound will be presented along with the crops where each has shown promise as an herbicide. (Research Department, Geigy Agricultural Chemicals, Fresno, California)

The relative toxicity of herbicides to citrus, avocados, and olives. Day. B. E., Hendrixson, R. T., Smith, J. A screening program was conducted in the greenhouse to establish the relative tolerances to each herbicide tested. The general objective was to develop data with the various herbicides under like conditions to serve as a basis for their evaluation in orchards.

Sweet orange and avocado seedlings were grown in flats and later transplanted to tin cans. Rooted Manzanillo olive cuttings obtained from a nursery were also established in cans. To prevent loss of herbicide the cans were not perforated for drainage. Weighed amounts of air-dry Vista sandy loam soil was used and cultures were regularly watered to 65% of field capacity by weight, using de-ionized water.

Treatments were applied to cultures sorted into size and quality groups so as to statistically equalize variations in plant size and vigor. Herbicides were watered into the soil surface without contact with the plant foliage. Some treatments were fully randomized and others were in randomized blocks. Measurements of plant height and visible symptoms were recorded weekly. Cultures were replicated four times at each concentration of herbicide.

The extent of injury was rated after 12 weeks, and for citrus and avocados, the fresh weight of roots and tops was determined. The results are given in table 1 for citrus, and table 2 for olives and avocados. (See page 38) Neburon was tried separately on citrus and was found to cause injury at 25-ppm and death at 200-ppm. Simazine injured avocados at 2-ppm but did not actually kill the plants below the 1600-ppm level.

Other studies conducted in the field have shown a close correlation with injury levels found in the greenhouse except in the case of some of the slighty-soluble, soil-acting herbicides such as Simazine. This apparent discrepancy is probably due to the more intimate contact of the herbicide with the roots of potted plants than is found in the field. (University of California Citrus Experiment Station, Riverside)

Movement of four substituted urea herbicides in three soil types with furrow irrigation. Ashton, Floyd M. and Braun, T. R. The experiments were conducted in plywood boxes 12 inches wide, 18 inches deep, and 24 inches long. One side of the box, 12 inches by 18 inches, was glass. This permitted observation of the wetting front as the irrigation proceeded. The box was filled with air dried soil to within 2 inches of the top. The soil had been passed through a 1/4 inch screen. The experimental arrangement was approximately 1/4 of typical field dimensions. For example, the furrow was 1.5 inches deep and 3 inches wide at the top; the band of herbicide was 1 inch wide and 0.5 inches from the edge of the furrow. The furrow was placed in the center of the 12-inch dimension and was 24 inches long.

Fenuron, monuron, diuron, and neburon were applied to the surface of the three soil types in a band parallel to the irrigation furrow at the rate of 10 pounds per acre. These soil types were Yolo sandy loam, Sacramento clay, and Stanton Island peaty muck. Water was added to the furrow by means of a constant leveling device which maintained the level of the water in the furrow 3/4 full. The irrigation was terminated when the wetting front reached the outside edge of the soil mass. This was equivalent to 2/3 of an acre-inch for the Yolo sandy loam, 1 acre-inch for the Sacramento clay, and 2.5 inches for the Stanton Island peaty muck.

Blocks of soil 1 inch by 1 inch by 18 inches were removed from the wetted soil zone and bioassayed for the herbicides. The test plant was oats, and a reduction in fresh weight indicated the presence of the herbicide. Standard curves were constructed from the fresh weight of plants grown in soils with known amounts of herbicide. The concentration of herbicide in the soil from the trial could then be determined.

In all three soil types and with all four herbicides, detectable quantities of the herbicide could not be found below the top inch of soil except with fenuron in the Stanton Island peaty muck. This was only in 2 symmetrical samples at the 1 to 2 inch depth; the remaining samples at the 1 to 2 inch depth with fenuron in the Stanton Island peaty muck had no detectable quantities of the herbicide. In all three soil types fenuron moved the greatest lateral distance, followed by monuron, diuron, and neburon in that order. All four herbicides moved the greatest lateral distance in the Yolo sandy loam, an intermediate distance in the Sacramento clay, and the least in the Stanton Island peaty muck.

Depth of incorporation as a dilution factor with pre-emergence herbicides. Ashton, Floyd M. and Dunster, K. CDEC, CDAA, and EPTC were "incorporated" into soil at 0, 0.5, 1.0, 2.0, and 3.0 inches at the rates of 1, 2, and 4 pounds per acre. In order to prevent movement of the herbicides from the "incorporation" zone, it was essential that no water be added once the herbicide was in the assigned zone. This requirement made it necessary to apply the herbicide in sufficient water to bring the soil to a field capacity moisture content and cover the culture cans with a polyethylene plastic bag. The addition of soil and herbicide solution in 0.5 inch increments gave uniform distribution of the herbicide in the specified soil mass. The soil was air dried, screened, and sterilized prior to use.

Watergrass and tomato seeds (15 of each species) were planted at a half inch depth and fresh weights taken 10 days after planting. The tomato plants did not appear to be affected by any of the treatments. The effect of watergrass is given in the following table:

Percent of Control (Based on fresh weight per plant of watergrass)

Depth of Incorporation (inches)	CDEC			CDAA			EPTC		
	1 #/A	2 #/A	4 #/A	1 #/A	2 #/A	4 #/A	1 #/A	2 #/A	4 #/A
0	23.5	14.5	16.8	7.8	10.1	6.7	66.0	74.9	24.6
0.5	26.8	22.4	11.1	14.6	10.1	10.1	33.6	23.5	15.7
1.0	15.7	17.9	14.6	10.1	10.1	5.6	14.5	16.8	10.1
2.0	50.3	29.1	21.3	13.4	13.4	4.5	31.3	15.7	12.3
3.0	74.9	32.4	15.7	15.7	7.8	10.1	53.7	25.7	15.7

<u>Effect of several chemicals used for weed control in field corn</u>. Baker, Laurence O. Treatments were made in triplicate to plots 10 x 20 feet May 30, during emergence of hybrid field corn. The surface soil was dry and very few weeds had emerged at the time. June 26 additional treatments were made at which time there was a good stand of weeds about 1-1/2 inches tall, consisting principally of <u>Amaranthus retroflexus</u>, <u>Chenopodium album</u>, and <u>Setaria viridis</u>.

Simazine at 3 pounds per acre provided the best weed control of all chemicals and also the highest yield. Yields in excess of the cultivated check were obtained with Randox T at 4 and 6 pounds, EPTC at 10 pounds, G-30027 and Simazine at 2 and 3 pounds per acre. Broadleaf weed control followed the same general pattern, being most complete where simazine was used.

Weed control observations and yield for each treatment follow:

Chemical	Rate	Weed Control* Broadleaf 6/26	7/10	8/8	Grass 6/26	7/10	8/8	Yield in tons silage per acre
Check	cultivated	10	10	10	10	10	10	20.8
Check	non-cultivated	1	1	1	1	1	1	14.9
<u>Treated May 30</u>								
Randox	4	7		3	6		7	17.8
	6	7		3	6		4	17.4
Randox T	4	9		7	7		5	21.3
	6	9		8	8		6	22.7
EPTC	2-1/2	7		4	7		8	16.9
(liquid)	5	9		3	8		8	17.2
	10	9		5	9		8	22.8
(granular)	5	9		5	9		8	18.4

(continued)

(continued)

		Weed Control*						Yield in
		Broadleaf			Grass			tons silage
Chemical	Rate	6/26	7/10	8/8	6/26	7/10	8/8	per acre
Premerge	5	8		4	7		4	16.7
	7	8		5	6		4	20.1
Simazine	2	9		8	8		9	22.0
	3	9		8	8		9	25.0
Treated June 26								
G-30026	2		5	4		5	4	16.9
	3		6	8		6	5	20.4
G-30027	2		10	9		7	5	20.7
	3		10	10		7	7	21.6
G-31345	2		5	4		5	5	14.6
	3		7	5		7	5	17.3

* 1 to 10 with 1 representing no effect.

(Contribution of the Montana Agricultural Experiment Station, Bozeman, Montana)

PROJECT 6. AQUATIC WEEDS, SUBMERSED AND EMERGENT

T. R. Bartley, Project Chairman

SUMMARY

Fifteen abstracts were submitted on the control of submersed and emergent equatic weeds and on related studies. This is an increase of 8 reports over last year. These reports are presented by 9 different authors from 6 states.

The reports cover a broad area of investigations in the field of aquatic weed control. They include studies regarding weed control in and along irrigation systems, in lakes, and the tolerance of crop plants to promising aquatic weed killers. The authors are commended for reporting on their studies in this area of weed control where only a limited number of workers are employed.

Water Sedge (Carex Aquatilis). This is a continuation of an experiment being made in Wyoming and the preliminary results of the study were reported in the 1958 WWCC Research Progress Report. Repeated applications of 2,4-D, amitrol, and DNBP-fortified fuel oil over a 2-year period have given good to excellent control of water sedge, while dalapon, erbon, DB granular and burning with LP gas have shown only fair results. The study indicates that dalapon treatments have to be repeated 3 to 5 times per season to achieve excellent results. Results also indicate that low rates of amitrol applied 4 times in 2 years are as effective as higher rates applied 3 times in 2 years. The addition of diesel oil and emulsifier to the spray solutions of amitrol and dalapon did not increase or have any significant effect on the results. None of five surfactants added to amitrol increased its herbicidal effectiveness.

Miscellaneous Weeds in an Irrigation Ditch. This is another experiment being continued in Wyoming on which the preliminary results were reported in the 1958 WWCC Research Progress Report. This study includes 23 chemical and 3 burning treatments each replicated 3 times on plots 0.5 by 1 rod, extending across both banks and the bottom of the ditch. Good to excellent results were obtained during 1957 and the first half of 1958 from all soil sterilant treatments except the lightest rates of erbon and chlorea. Soon after July 1, 1958, a rank growth of annual weeds developed at and below the waterline on most of the plots. Combinations of dalapon and amitrol with 2,4-D were much more effective than either of the two alone. Excellent weed control was obtained during the 2-year period from frequent spraying with DNBP-fortified fuel oil or burning with LP-gas every 3 weeks. The less frequent oil sprayings became progressively more effective in 1958.

Sago Pondweed (Potamogeton pectinatus). This study was conducted in two different canals in Wyoming to determine the effect of acrolein on sago pondweed.

Wise Canal. The upper 5 miles of this canal supported none to a medium dense infestation of sago pondweed, and the lower 8 miles contained a uniformly dense growth. Acrolein was applied at the inlet during a 53-minute period. The concentration of acrolein in the water ranged from 200 ppm 100 yards below site of introduction to 175 ppm 3 miles below. Two weeks after application,

the chemical had effected a near complete removal of plant material in the first 10 miles. Six weeks after treatment, there was not enough regrowth in the upper 10 miles to justify retreatment, but weed growth in the lower 3 miles was heavy and should have been retreated about 30 days after the original application.

Old Corral Canal. The entire 7-mile length of this canal supported an extremely dense mature growth of sago pondweed at time of treatment. The concentration of acrolein 1/4 mile below point of introduction was 200 ppm. The canal water was moving extremely slow and the "wave" of acrolein moved only 1 mile during the first 15 hours. Two weeks following treatment, the acrolein had removed nearly all weed growth in the first two miles, about 50 percent in the next 1/2 mile, and no visible effect in the last 4 miles. Six weeks after treatment, a dense regrowth 4 to 10 inches long was present in the first 2 miles. It was obvious that the original treatment should have been made at an earlier date so that the chemical could have moved throughout the 7-mile length of the canal.

Submersed and emergent aquatics (General). Submersed aquatic weeds do not present much of a problem in Region 5 of the Bureau of Reclamation. Emergent aquatics such as cattail and tule which infest drain ditches primarily are usually controlled through routine mechanical cleaning operations. Field trials with fortified oils and dalapon on cattail have given varying results.

Pondweeds and algae. A large wasteway on the Bureau of Reclamation's Columbia Basin Project in Washington was sprayed with 2,4-D in late July, 1958 for control of cattail. The application killed dense growths of sago and other pondweeds, and no regrowth had occurred by September 25.

Pondweed control with low volumes of aromatic solvent. Field trials on the Columbia Basin Project in 1957-58 resulted in control of giant sago pondweed in a large irrigation canal. The solvent introduced into the canal having a flow of about 350 cfs at the rate of 3 gallons per cubic foot per second of flow resulted in an 80 percent plant kill in each of 4 applications. The treatments were effective for a distance of 10 to 13 miles.

Algae. A study on the use of low quantities of copper sulfate for control of algae in large irrigation canals on which the preliminary results were reported in the 1958 WWCC Research Progress Report was continued in 1958 on the Columbia Basin Project. Copper sulfate applied at the rate of 1/3 pound per cubic foot per second of flow gave a peak concentration of 1/2 ppm 15 miles below point of introduction. Algae were killed throughout the entire distance. On one large canal on this project, the points of copper sulfate application were extended from 5 to 10 miles apart and good control of algae was achieved.

Biological control of pondweeds. Water plantain was established by seeding in a limited area in a small lateral on the Columbia Basin Project to study the plant as a competitor to pondweeds. In the canal area where a fair to good stand of water plantain was established, the pondweeds were controlled. The control was aided by one application of aromatic solvent 2 miles upstream. Also, copper sulfate was present in the water in the test area from bi-weekly applications 9 miles upstream.

Submersed aquatics. In August 1958, two granular formulations of 2,4-D were applied at various rates to dense stands of several species of aquatic weeds at two locations in California. All treatments were considered ineffective for weed control. The study is planned for continuation in 1959.

Gigantic sago pondweed (Potamogeton pectinatus var. interruptus). In Montana, xylol was applied at rates of 8 and 10 gallons/cfs over varied times of introduction. The 8 gallons/cfs applications caused the plants to become flaccid and browned the leaves. Regrowth of new leaves was rapid. The 10 gallon/cfs applications killed the stems and leaves. This rate of application also controlled horned pondweed, muskgrass, and algae.

Applications of acrolein at a rate of 1-1/2 gallons/cfs for a 30-minute period killed leaf tissues, but regrowth occurred rapidly. Applications of 2 and 2-1/2 gallons/cfs gave complete control of sago pondweed.

Xylol controlled the sago pondweed for a distance of 1 to 2 miles and the acrolein gave control for 6-1/2 miles, the entire length of the canal. Both chemicals were toxic to aquatic fauna present in the treated water.

Broad-leaved cattail (Typha latifolia). Several herbicides were applied to cattail in Montana in the fall of 1957, 2 weeks prior to the first killing frost. Amitrol and erbon applied at rates of 10 and 20 pounds per acre, respectively, appeared to be outstanding in the trial tests.

Germination of seed of gigantic sago pondweed (Potamogeton pectinatus var. interruptus). Seeds of sago pondweed were treated by various methods to enhance germination and to determine viability. Maximum germination was obtained by liberating the seed by prying open the operculate-like trapdoor at the unhinged end and pricking the seed coat with a pin.

Germination of seed of broad-leaved cattail (Typha latifolia). Lots of 100 fruits of cattail were given various treatments to enhance seed germination. Maximum germination was obtained by treating the hard exocarp of dry fruits with concentrated sulfuric acid 1/2 to 1 minute. The average number of fruits or seeds per cattail spike is approximately 222,694.

Response of field crops to acrolein. In Montana, 3 crop plants were irrigated with water containing 0, 60, 120, and 180 ppm of acrolein. Yield data results indicate that as the concentration of acrolein is increased there is an appreciable reduction in yield of pinto beans, a slight decrease in yield of corn, and a very slight increase in yield of sugar beets. No residual acrolein was found in any of the 3 crops.

Response of cotton to acrolein. An experiment was conducted in Arizona during 1958 to determine the effect of acrolein on cotton when applied in irrigation water. Based on yield of cotton seed, single applications of acrolein at concentrations of 80 and 160 ppm and 2 applications at 80 ppm caused a slight decrease in yield. However, a single application at a concentration of 240 ppm and 2 applications at 160 and 240 ppm indicate significant yield reductions in yield.

CONTRIBUTOR'S REPORTS

Control of water sedge (Carex aquatilis) along an irrigation canal. Timmons, F. L. and Weldon, L. W. An experiment on which a preliminary report was made in the 1958 WWCC Research Progress Report was continued through 1958 with retreatments and observations of results. The treatments and data are summarized in table 1.

The treatments were initiated May 15 and June 5, 1957, and replicated three times on plots that included both banks of a canal with a continuous flow of 40 cfs. The treatments included various rates of (1) the amine salt of 2,4-dichlorophenoxyacetic acid (2,4-D), (2) 3-amino-1,2,4-triazole (amitrol), (3) the sodium salt of 2,2-dichloropropionic acid (dalapon),(4) 2-(2,4,5-trichlorophenoxy) ethyl 2,2-dichloropropionate (erbon), (5) a mixture of disodium borates and 2,4-D (DB Granular), (6) different frequencies of spraying with 120 gal/A of diesel oil fortified with 3 quarts/A of 4,6-dinitro-o-secondary butylphenol (DNBP), and (7) different frequencies of burning with liquid propane gas.

As is shown in table 1, good to excellent control of water sedge over the two-year period was accomplished by repeated applications of 2,4-D, amitrol, and DNBP-fortified fuel oil. Dalapon, erbon, DB Granular and burning with LP gas gave only fair results. Dalapon gave excellent control in 1957 when treatments were repeated 3 ot 5 times but was much less effective in 1958 when treatments were made only once or twice. Amitrol was as effective at 5 lb/A repeated 4 times in 2 years as at 10 lb/A repeated 3 times or at 20 lb/A repeated 3 times in 2 years, but was less effective when repeated only once each year at 20 lb/A. Spraying with DNBP-fortified fuel oil every 6 weeks and burning with LP gas every 3 weeks finally resulted in good control of Carex in the latter part of the second year.

Adding diesel oil and emulsifier to the spray solution did not increase the effectiveness of amitrol and had no consistent or significant effect on the results from dalapon. In a supplemental experiment none of the five surfactants added to amitrol spray solution significantly increased its effectiveness on water sedge. (Contributed by the Crops Research Division, ARS, USDA, and Wyoming Agricultural Experiment Station, cooperating.)

Table 1. Control of Carex along an irrigation ditch at Torrington, Wyoming.

Chemical	Initial rate lb/A	No. of treatments 1957	1958	Total chemical 1957-58	Percent Control 1957 6-21	9-4	1958 5-16	7-2	9-25
2,4-D (amine)	40	1	2	100	63	93	57	92	86
2,4-D (amine)	80	1	2	160	87	94	76	93	95
Erbon	80	1	1	160	77	87	20	77	71
Erbon	160	1	1	320	82	88	53	95	74
DB Granular	533	1	1	1066	72	92	83	72	63
Amitrol*	5	3	1	20	92	95	90	85	97
Amitrol	10	2	1	30	83	72	85	83	99
Amitrol*	10	2	1	30	85	67	89	95	95
Amitrol*	10	3	1	40	90	97	98	61	99
Amitrol*	20	1	1	40	92	88	85	100	91
Amitrol*	20	2	2	70	88	87	91	83	97
Dalapon	20	3	1	80	60	92	97	67	58
Dalapon*	20	3	1	80	67	98	95	57	69
Dalapon	20	5	2	140	75	98	96	70	93
Dalapon*	20	5	2	140	68	99	96	57	79
DNBP-fuel oil									
every 3 weeks	120**	5	4	1080	75	95	97	96	99
every 6 weeks	120**	3	3	720	73	42	70	62	98
LP gas burner									
every 3 weeks	none	5	4	none	47	73	79	63	97
every 6 weeks	none	3	3	none	42	33	30	27	57
Untreated	-	-	-	-	0	0	0	0	0

*Diesel oil and emulsifier were added to the spray solution at the rates of 5 gallons diesel oil and 0.2 gallon of emulsifier per acre.

** Gallons per acre.

The control of miscellaneous weeds in a farm irrigation ditch. Weldon, L. W. and Timmons, F. L. An experiment on which a preliminary report was made in the 1958 WWCC Research Progress Report was continued in 1958 with retreatments and observations of results. The treatments and data are summarized in table 1.

The 23 chemical- and 3 burning-treatments were each replicated 3 times on plots 0.5 by 1 rod, extending across both banks and the bottom of the ditch. The treatments included 2 or 3 rates of (1) 3-(p-chlorophenyl)-1, 1-dimethylurea (monuron), (2) 3-(3,4-dichlorophenyl)-1,1-dimethylurea (diuron), (3) 2-(2,4,5-trichlorophenoxy) ethyl 2,2-dichloropropionate (erbon), (4) 2-chloro-4, 6-bis(ethylamino)-s-triazine (simazin), (5) a mixture of disodium borates and monuron (Ureabor), (6) a mixture of sodium borate, sodium chlorate, and monuron (Chlorea), (7) sodium salt of 2,2-dichloropropionic acid (dalapon), and (8) 3-amino-1,2,4-trizole (amitrol), (9) 3 frequencies of spraying with 120 gal/A of fuel oil fortified with 3 qt/A of 4,6-dinitro-o-secondary butylphenol (DNBP), and (10) 3 frequencies of burning with liquid propane (LP) gas. The initial applications of all soil sterilant chemicals: monuron, diuron, erbon, simazin, Ureabor, and Chlorea were made April 19, 1957. The initial dalapon and amitrol treatments were made May 22, 1957, and the oil-spraying and LP gas-burning treatments were began June 5, 1957. Retreatments of all rates of erbon and Chlorea and of the lightest rates of monuron, diuron, and Ureabor were applied May 17, 1958. Treatments of dalapon, amitrol, DNBP-fortified fuel oil, and LP-gas burning were repeated 2 to 5 times each year as is shown in table 1.

Abundant rainfall in spring and summer of both 1957 and 1958 probably was an important factor in determining the results, especially from the soil sterilant herbicides. Good to excellent weed control was maintained during 1957 and the first half of 1958 by all soil sterilant treatments except the lightest rates of erbon and Chlorea. However, soon after July 1, 1958, a rank growth of annual weeds developed at and below the waterline in the ditch on most of these plots and interfered seriously with the flow of water besides producing a heavy crop of weed seeds.

Dalapon and amitrol alone each gave fair to good control of weeds in 1957 but in 1958 broadleaved weeds became a serious problem. The combinations of dalapon and amitrol with 2,4-D were much more effective.

Frequent spraying with DNBP-fortified fuel oil or burning with LP-gas every 3 weeks maintained excellent weed control during the 2-year period. The less frequent intervals gave unsatisfactory results in 1957 but became progressively more effective in 1958, especially oil-spraying. (Contributed by the Crops Research Division, ARS, USDA, and Wyoming Agricultural Experiment Station, cooperating)

Table 1. Control of miscellaneous annual and perennial weeds in an intermittently-used farm irrigation ditch at Torrington, Wyoming.

Chemical	Initial rate lb/A	No. of treatments 1957	1958	Total chemical 1957-58	Percent Control 1957 6-21	9-4	1958 5-16	7-2	8-13	9-25
Monuron	10	1	1	20	98	80	85	91	52	40
Monuron	20	1	None	20	99	88	87	89	56	0
Monuron	40	1	None	40	99	95	92	87	21	0
Diuron	10	1	1	18	96	88	82	91	71	33
Diuron	20	1	None	20	99	97	95	91	28	0
Diuron	40	1	None	40	99	99	98	97	71	50
Baron	40	1	1	80	93	45	57	82	73	38
Baron	80	1	1	160	98	87	81	97	51	30
Simazin	20	1	None	20	99	98	97	97	83	39
Simazin	40	1	None	40	99	100	99	99	66	87
Ureabor	125	1	1	250	96	76	82	91	63	27
Ureabor	250	1	None	250	99	89	86	87	43	23
Ureabor	500	1	None	500	99	88	92	88	21	0
Chlorea	250	1	1	500	88	40	40	40	30	17
Chlorea	500	1	1	1000	97	81	71	85	75	27
Chlorea	1000	1	1	2000	97	87	71	96	84	23
Dalapon	10	2	2	40	83	67	64	50	26	17
ATA	5	2	2	20	81	95	83	63	31	33
Dalapon	10	2	2	40	80	93	85	88	70	40
+ 2,4-D	2			8						
ATA	5	2	2	20	83	93	90	90	80	73
+ 2,4-D	2			10						
DNBP-fuel oil										
every 3 weeks	120**	5	4	920*	60	95	88	100	99	100
every 6 weeks	120**	3	3	720	63	35	49	89	85	93
every 9 weeks	120**	2	2	480	73	65	23	78	86	75
LP gas burner										
every 3 weeks	-	5	5	-	71	90	58	92	90	96
every 6 weeks	-	3	3	-	70	46	20	58	48	67
every 9 weeks	-	2	2	-	81	76	20	66	75	65
Check	-	-	-	-	0	0	0	81	13	0

* Only spot treatment necessary 7/22 and 8/13 requiring less oil and DN.
** Gallons per acre.

Control of pondweed (Potomageton pectinatus) with a formulation of acrolein. Timmons, F. L. and Weldon, L. W. Tests were made July 15, 1958, in two irrigation canals in cooperation with Dr. Rene Blondeau of the Shell Development Company who supplied the chemical and special equipment and supervised the applications.

Wise Canal. The water flow in this canal with a maximum capacity of 35 to 40 cfs was reduced to 15.3 cfs for the treatment which consisted of 45 gallons of a formulation of acrolein applied at the inlet during a 53-minute period. Water temperature was 69° F at the time of application and was 66° F at 9 a.m. the following day. Measured concentrations of the formulated acrolein in the treated canal water ranged from 200 ppm 100 yards below point of introduction to 175 ppm 3 miles below, and 10, 50, 30, and 5 ppm at different points along the treated "wave" 11.5 miles below. The treated "wave" moved downstream at the rate of .9 mph during the first 6 miles but had slowed down to .5 mph at the 11.5-mile point which it reached 18 hours after the beginning of the application.

At the time of treatment the infestation of sago pondweed in this canal varied from none to medium dense in the first 5 miles and was uniformly dense in the remaining 8 miles. Water flow was greatly restricted by pondweed, especially in the heavily infested sections. Observations made 18 hours after treatment showed this growth to be turning brown, becoming flaccid, and slumping lower in the water so that it interfered much less with the flow. Observations made July 31, 2 weeks after the treatment, showed almost complete removal of pondweed growth for about 10 miles below point of introduction. At 11.5 miles below an estimated 80 percent of the pondweed present before treatment had broken loose and sloughed out of the canal. The remaining 20 percent still attached to roots in the bottom mud showed about 1/3 of the leaves and most of the stems to be green and apparently alive. The canal was carrying 30 cfs of water without interference from pondweed growth.

Observations made August 29, 6 weeks after treatment, showed that not enough pondweed growth had developed in the upper 10 miles of the canal to justify retreatment. However, in the lower 3 miles the pondweed was progressively worse with increasing distance from application point, and a growth 3 to 4 feet long was restricting the flow of water. This section of the canal should have been retreated about August 15, 30 days after the original application.

Old Corral Canal. At the time of treatment an extremely dense mature growth of sago pondweed was present throughout the 7-mile length of the canal. Only one-fourth of the normal capacity of 15 cfs of water could be carried in the canal without causing overflows.

The application of 10 gallons of a formulation of acrolein was made to 3.92 cfs of water at the inlet during a 30-minute period. The measured concentration of acrolein 1/4 mile below point of application was 200 ppm. The flow of water in the canal was extremely slow and the treated "wave" moved only 1 mile downstream during the first 15 hours. At that time the measured concentration of formulated acrolein at the center of the wave was only 30-40 ppm so a retreatment of 5 gallons of a formulation of acrolein was introduced during a 10-minute period at that point. The treated wave of water continued to move slowly down the canal another 1.5 miles in 24 hours after which it disappeared due to absorption by the heavy weed growth and dilution by drainage water from another canal.

The pondweed growth became brown and flaccid within 18 to 24 hours after being exposed to the treated water. Observations made on July 31, 2 weeks after treatment, showed that the acrolein had removed 95 to 100 percent of the pondweed growth from the first 2 miles of the canal below point of introduction, had given a 50-percent kill of pondweed topgrowth in the next 0.5 mile and a slight effect in the next 0.25 mile, and no visible effect in the remaining 4 miles of the canal. It had been necessary to resume chaining of the lower 4.5 miles of the canal to remove pondweed growth and permit the desired flow of water. The canal was carrying the maximum flow of 15 cfs of water without interference from pondweed growth in the first 2 miles where the chemical treatment had been completely effective.

Observations made August 29 showed a dense regrowth of pondweed 4 to 10 inches long from the bottom mud in the first 2 miles of the canal where the treatment had given good control. The pondweed growth in the remainder of the canal had been controlled by chaining. It was obvious that the original treatment in this canal on July 15 should have been made at least 2 weeks earlier while the pondweed growth was short enough to permit the treated "wave" of water to flow throughout the 7-mile length of the canal within 15 to 18 hours. Judging from the rapidity of regrowth, a second treatment about 30 days after the first would then have been necessary to give season-long control of pondweed in this canal. (Contributed by the Crops Research Division, ARS, USDA, and the Wyoming Agricultural Experiment Station, cooperating)

Aquatic weeds. Lowry, Orlan J. Aquatic weeds, particularly submersed, are only scattered and of very little significance in this area. Periodic chaining has prohibited the isolated infestations from interfering with the flow of water. Emergent weeds, such as tule and cattail, are primarily controlled through routine mechanical cleaning operations. These emergent plants primarily infest drain ditches. Small areas of cattails have been sprayed with fortified oils and dalapon with varying results. Fortified oils result only in burn back of the plants and temporary control. Limited application of dalapon at rates up to about 30# per acre have resulted in kills up to 75 percent. (Bureau of Reclamation, Region 5, Amarillo, Texas)

Control of pondweeds and algae with 2,4-D amine. Suggs, Delbert D. Coincident with the spraying of a large wasteway to remove cattails, approximately 2 pounds of the butyl ester of 2,4-D (2,4-dichlorophenoxyacetic acid) and the amine salt of 2,4-D were introduced into the water which contained dense growths of sago and other pondweeds. It also contained growths of Spirogyra and Cladophora. The application was made in late July. Pondweeds were killed and no re-emergence had occurred by September 25. (Bureau of Reclamation, Columbia Basin Project, Washington)

Low application rates of aromatic solvent suppress a high percentage of aquatic weeds in large canals. Suggs, Delbert D. An extended trial through 1957-58 in Potholes East Canal resulted in the control of giant sago pondweed, (Potamogeton pectinatus), by applying 3 gallons of aromatic solvent per cubic foot per second in each of four applications. The designed capacity of the canal was 500 cubic feet per second but the delivery of 320 to 380 cubic feet per second was endangered by June 15 because of the dense growth and quantity of pondweeds. Each application resulted in about an 80 percent kill (a few shorter stems remained alive) and flow was maintained three to five weeks. Treatment was effective for 10 to 13 miles including most subtended laterals which as a group contained a higher total number of cubic second miles of flow than the canal. Aromatic solvent from two different sources was used. (Bureau of Reclamation, Columbia Basin Project, Washington)

Control of algae in large canals with low quantities of copper sulphate. Suggs, Delbert D. Tests of the movement of copper sulphate in solution in canals carrying 2,000 to 2,600 cubic feet per second showed that 1/3 pound per cubic foot per second was retained as a peak concentration of 1/2 part per million for at least 15 miles. Algae were killed through the entire distance. Application points were extended from five miles apart to ten miles apart on the East Low Canal with good control of algae in the canal and the subtended laterals. (Bureau of Reclamation, Columbia Basin Project, Washington)

Seeding of water plantain as a competitor to pondweeds. Suggs, Delbert D. Water plantain, (Alisma gramineum var. geyeri), was seeded in a small lateral, having a 10 to 15 cubic feet per second capacity in 1958, by dropping handfuls of seed containing debris on the lateral bottom during the winter when the channel was dry. A full stand was obtained on the 300 lineal feet which were seeded. A 25 to 50 percent stand was obtained on the next 700 feet and an occasional plant occurred on the last 1,000 feet. Pondweeds were controlled on the first 1,000 feet aided by one application of aromatic solvent two miles upstream. Copper sulphate was present from the bi-weekly application of 1/3 pound per cubic foot per second on the West Canal approximately 9 miles upstream. (Bureau of Reclamation, Columbia Basin Project, Washington)

Granular 2,4-D trials for the control of five submerged aquatic weed species. McHenry, W. B. In August, 1958, granular formulations of BDM[1] and the iso octyl ester of 2,4-dichlorophenoxy acetic acid[2], were applied to dense aquatic weed stands at two locations in California. In Napa County the species were American pondweed, Potamogeton nodosus; sago pondweed, Potamogeton pectinatus; and common water nymph, Najas guadalupensis. In Lake County the weeds included American pondweed, P. nododus; curl-leaved pondweed, P. crispus; sago pondweed, P. pectinatus, and coontail, Ceratophyllum demersum.

The 2,4-D ester formulation was applied at 10, 20 and 40 lb. of active ingredient/A at both sites. In each case replications were used. The BDM was included only in the Napa County trial at the rate of 20 lb. of active 2,4-D/A.

Applications were made with a rotary chest spreader from a boat. Repeated passes were made over the length and width of the 30' x 85' plots. Plot corners were marked by anchoring 16 inch long, white plot stakes in an up-right floating position. Plot dimensions were measured with a steel tape drawn taut between two boats.

A slight degree of kill was noted with the Common Water Nymph at the 20 and 40 lb. rates of both materials; however, the results in every case were considered ineffective.

A more expanded trial will be made in the spring of 1959 to determine if young active plants are more sensitive to these materials. (University of California, Agricultural Extension Service, Davis)

1 7.5% 2,4-Dichlorophenoxyacetic acid, 29.2% boron trioxide.
2 20% acid equivalent, iso octyl ester of 2,4-Dichlorophenoxy acetic acid impregnated on 8-20 mesh Attaclay granules.

Control of gigantic sago pondweed (*Potamogeton pectinatus* var. *interruptus*) in irrigation waters. Yeo, R. R. and Harris, A. Wayne. Applications of xylol were applied to gigantic sago pondweed. The quantity and time of injection of the herbicide were varied. 8 gal/cfs and 10 gal/cfs were each injected over a period of 15, 30, 45 and 60 minutes. The emulsions were stabilized with 2% Agrimul 70B. The 8 gal/cfs rate at all periods of injection caused the plants to become flaccid but allowed increased quantities of water to pass over. The leaves became brown but did not defoliate. Regrowth of new leaves was rapid. The 10 gal/cfs at all periods of injection killed the stems and leaves. Other plant species controlled by the 10 gal/cfs were horned pondweed, *Zannichellia palustris*, muskgrass, *Chara* sp., and algae. Applications made in mid-July controlled the weeds for the remainder of the irrigation season.

Applications of acrolein were made in cooperation with the Shell Oil Co. A rate of 1-1/2 gal/cfs killed the leaf tissues. Regrowth rapidly occurred. Rates of 2 and 2-1/2 gal/cfs were applied and gave complete control of the gigantic sago pondweed. Other weeds also controlled at 2 gal/cfs were horned pondweed, algae, and duckweed, *Lemna minor*. All applications were made over a 30-minute period.

The top growth killed by both chemicals began to break free from the bottom in about 7 days after treatment and was complete in 16 days. Xylol controlled the gigantic sago pondweed for a distance of one to two miles. The 2-1/2 gal/cfs rate of acrolein controlled the pondweed for 6-1/2 miles, the entire length of the ditch.

The aquatic fauna present in the water when the 2 and 2-1/2 gal/cfs applications of acrolein were made were killed. These included the leather-side chub, *Snyderichthys copei*, blackhead minnow, *Pimephales promelas promelas*, western white sucker, *Catostomus commersonnii sucklii*, mountain sucker, *Pantosteus jordani*, carp, *Cyprinus carpio*, horse leech, *Haemopis marmoratis*, leopard frog tadpole, *Rana pipens*, and 12 muskrats, *Ondatra zibethica*. Xylol killed the named fishes when they occurred in treated water, plus the walleyed pike, *Stizostedion vitreum vitreum*, and yellow perch, *Perca flavescens*. (Contributed by the Crops Research Division, ARS, USDA, and the Huntley Branch Station of the Montana Agricultural Experiment Station and Bureau of Reclamation, Region VI, cooperating)

Control of broad-leaved cattail (*Typha latifolia*) with fall applications of systemic herbicides. Yeo, R. R. Several treatments, consisting of two trials, were made in mid-September of 1957, two weeks prior to the first killing frost. The treatments and their results are shown in the table. The plant counts were made in mid-July of 1958 and represent an average of 10% of the treated area taken from each of three replicated plots.

Symbol	Herbicide	Rate/A	Stand Count	Statistical Significance*
	I			
a	Amitrol	10 lb	4.7	ab
b	Dalapon plus brush killer	15+1 lb	15.0	abcdef
c	Dalapon plus brush killer	10+1 lb	16.7	bcdefg
d	Dalapon plus maleic hydrazide	10+8 lb	17.7	bcdefgh
e	Dalapon	15 lb	18.3	bcdefgh
f	Dalapon plus silvex	15+1 lb	19.0	bcdefgh
g	Dalapon plus silvex	10+1 lb	21.3	bcdefgh
h	Dalapon	10 lb	27.7	defghi
i	Amitrol plus maleic hydrazide	10+8 lb	34.0	hi
j	Polychloroamine salts of 2,3,6-TBA	15 lb	58.7	jklm
k	Polychloroamine salts of 2,3,6-TBA	10 lb	59.3	jklm
l	Low volatile ester of 2,4-D plus Mineral oil	8 lb + 10 lb	63.7	jklm
m	Low volatile ester of 2,4-D	8 lb	65.0	jklm
n	Control	-	81.0	n
	II			
a	Erbon	20 lb	9.0	ab
b	Erbon	10 lb	23.0	ab
c	Gamet	1-1/2 gal	61.7	cde
d	Gamet	3 gal	64.3	cde
e	Control	-	66.0	cde

Confidence interval: (I)=10.4, (II)=19.1. Snedecor, 1956, p 251. *Mean separation, ARS-20-3 May, 1957. Symbols under statistical significance following symbol "a" treatment denote the treatments that are not significantly different from treatment "a".

The amitrol at 10 lb/A and erbon at 20 lb/A appeared to be outstanding in these trials. (Contributed by the Crops Research Division, ARS, USDA, and the Huntley Branch Station of the Montana Agricultural Experiment Station, cooperating)

Germination of gigantic sago pondweed (Potamogeton pectinatus var. interruptus). Yeo, R. R. Lots of fifty mature fruits, replicated three times, were treated to enhance germination and determine the viability of gigantic sago pondweed seed. The following treatments and respective percent germination were as follows: (a) chilled wet for three months at 36° F - 11.3%, (b) chilled dry for three months at 36° F - 6.3%, (c) alternate wetting and drying three times over a nine month period, 1st - 5.3%, 2nd - 5.3%, 3rd - 8.7%, (d) outer integument of fruit pricked - 56.7%, (e) seed liberated from outer integument and seed coat pricked - 70.0%, (f) untreated fruits - 2.0%, and (g) 100 seed overwintered in the soil - 14%.

Maximum germination of gigantic sago pondweed seed was obtained by liberating the seed by prying open the operculate-like trapdoor at the unhinged end and pricking the seed coat with a pin. Sound seed germinated 100% when the seed coats were pricked. (Contributed by the Crops Research Division, ARS, USDA, and the Huntley Branch Station of the Montana Agricultural Experiment Station, cooperating)

<u>Germination and number of seeds per spike of broad-leaved cattail</u> (*Typha latifolia*). Yeo, R. R. Lots of 100 fuits, replicated three times, were treated to enhance seed germination. The following treatments and respective percent germination were as follows: (a) fruits soaked over night in water and placed in concentrated sulphuric acid for 1/2 minutes - 0.0%, (b) dry fruits placed in concentrated sulphuric acid for 1/2 minutes - 15.7%, (c) dry fruits place in concentrated sulphuric acid for 1 minute - 12.3%, (d) dry fruits placed in concentrated sulphuric acid for 1-1/2 minutes - 1.0%, (e) dry fruits placed in concentrated sulphuric acid for 2 minutes - 0.0%, (f) untreated fruits at 70° F (control) - 1.0%, (g) untreated fruits at 40° F - 3.0%, and (h) untreated fruits at 110° F - 0.0%. Maximum germination was obtained by treating the hard exocarp of dry fruits with concentrated sulphuric acid 1/2 to 1 minute. Fruits that were wet before treating with acid or left too long in acid or exposed to high temperature reduced germination. Acid-treated seed rapidly imbibed water and upon swelling broke through the remaining exocarp. Germinating seed were distinguished by their elongation and greening in the presence of light.

The fruits from ten spikes, an average of seven inches in length, were counted. The number of fruits or seed per spike averaged approximately 222,694. One pound contained 9,639,000 fruits. (Contributed by the Crops Research Division, ARS, USDA, and the Huntley Branch Station of the Montana Agricultural Experiment Station, cooperating)

<u>Response of field crops to acrolein</u>. Yeo, R. R. Silage corn, pinto beans and sugar beets were irrigated with the equivalent of three acre inches of water contaminated with 0, 60, 120 and 180 ppm of acrolein. The experiment was arranged in 4 x 4 latin squares for each crop. The chemical was applied when the crops were in the following condition: corn - tassels forming, pinto beans - flowering to early pod formation, and sugar beets - 18 inches tall, and on July 29, 30 and 31 respectively. The pinto beans, corn and sugar beets were harvested September 1, 19 and 24, respectively.

		YIELD					
		Pinto Beans		Corn		Sugar Beets	
Symbol	Conc. (ppm)	Bu/A	Statistical Significance	Tons/A	Statistical Significance	Tons/A	Statistical Significance
a	180	23.2	All	8.99	Not	12.78	Not
b	120	30.1	Significantly	9.71	Significantly	13.81	Significantly
c	60	37.5	Different	10.32	Different	13.35	Different
d	0	46.1		10.57		12.45	

Confidence interval: Pinto beans = 5.9, corn = 2.45, sugar beets = 5.68. Snedecor 1956, p. 251.

The yields from the pinto beans were significantly different at all concentrations. Corn yields showed a trend of decreasing yields with an increase in concentration. Sugar beet yields appeared to be slightly increased by the acrolein. The percent of soluble sugar were as follows: 0 ppm - 16.1%, 60 ppm - 16.3%, 120 ppm - 15.9%, and 180 ppm - 15.6%. The reductions due to higher rates suggested a slight reduction in the percent soluble sugar. No effects due to acrolein were noted on the germination of the pinto beans. No acrolein residues were found in any of the three crops. (Contributed by the Crops Research Division, ARS, USDA, and the Huntley Branch Station of the Montana Agricultural Experiment Station, cooperating)

Cotton tolerance to applications of acrolein in irrigation water. Arle, H. Fred and McRae, G. Neil. During 1958 an experiment was conducted to determine possible injury to cotton by the presence of acrolein in irrigation water. Acrolein was metered from a constant head vessel into a flow of irrigation water to be used on cotton. Concentrations of 80, 160 and 240 ppmv were desired; however, chemical analysis of treated water showed that for each treatment the actual values were slightly less.

The first series of applications were made May 27 when cotton had a height of 10 inches and approximately 10 true leaves. There were 6 replications of each treatment. Air temperature varied from a minimum of 90 degrees F. to a maximum of 105 degrees F. during the application period. Initial effects of the highest concentration became evident very rapidly, a drooping and bleaching of foliage was distinctly evident within two hours after treatment. The following day all foliage, except the terminal leaf which remained unaffected, was desiccated. A few of the most severely affected plants did not recover. Others developed new foliage and developed as normal plants except for very definite retardation. Volatilization from plots treated at the highest concentration affected adjacent plots and served to slightly confuse results. However, it was apparent that injury caused by the lower rates of treatment was much less severe.

Half of the original treated plots were retreated on July 1 when cotton was approximately 24 inches tall. These treatments, including the highest concentration caused very minor toxicity to cotton foliage. However, greatest decreases in yield were noted on plots receiving two applications of treated water. Cotton yields were as follows:

Treatment	lbs of seed cotton
80 ppm - 1 app.	4.64
160 ppm - 1 app.	4.21
240 ppm - 1 app.	3.32
80 ppm - 2 app.	4.58
160 ppm - 2 app.	2.96
240 ppm - 2 app.	2.71
Check	5.60

The application of acrolein at a concentration of 80 ppmv either as a single or repeat treatment did not cause significant yield reductions. Reductions were significant when the concentration of acrolein was raised to 160 and 240 ppmv. The two higher rates are considerably in excess of anticipated requirements for the control of aquatic weeds. (Crops Protection Research Branch, ARS, USDA, and the Arizona Agricultural Experiment Station cooperating)

The control of submersed aquatic weeds with AQUALIN Herbicide*. Blondeau, Rene. During the past two years more than 75 field trials have been conducted with AQUALIN Herbicide** (active ingredient, acrolein) in ten western states, Arkansas, and Florida in cooperation with public and private agencies. Canals ranged in size from 1-200 cubic feet per second at treatment and up to 20 miles in length. Ponds were 1-2 acres in area.

Effective dosages are from 1-3 gallons per cfs in canals, and from 0.5-2 gallons per acre-foot in ponds. In canals, weed control is obtained at these dosages with application times from 15-300 minutes, indicating that the product of concentration and time is a constant. In 10 tests in long canals, a single introduction gave good weed control for 15-20 miles. All typical submersed aquatic weed species and algae appear to be sussceptible. Floating forms such as water cress, water hyacinth and water primrose can be controlled at higher dosages. Emergent species such as cattails and tules are not affected.

Numerous phytotoxicity studies were conducted in which treated water was applied to crops by furrow, flood, or sprinkler irrigation. When toxicity occurred, it resulted from actual contact of the crop with the solution, as in flood irrigation, or by vapor action. Many factors, such as wind, temperature, crop species, etc., influence the results. Therefore, until more data are obtained, the concentration of AQUALIN Herbicide in water reaching crops should not exceed 15 ppm.

Concentrations in this range are obtained readily by (1) controlling water offtake downstream from the point of application until natural dissipation has reduced the herbicide concentration to 15 ppm, or (2) extending the application time so that the concentration never exceeds 15 ppm. Weed control is equally effective by either method.

Field observations and laboratory data show that fish vary considerably in their tolerance to AQUALIN Herbicide. Carp and thread-fin shad are particularly sensitive, being killed at 1-2 ppm. Black bass, blue gill, and lamprey eel larvae appear to tolerate up to 5 ppm.

Although AQUALIN Herbicide is flammable, highly reactive chemically, and a lachrymator, the process of controlling weeds with this product can be carried out safely and effectively. Application equipment has been developed that permits introduction of AQUALIN Herbicide with a minimum of handling. The herbicide is withdrawn from the shipping drum and through a meter by the suction pressure of an eductor placed on the discharge of a water pump. In passing through the eductor and discharge hose, the herbicide is mixed with the water and enters the canal in solution.

The product is expected to be available commercially to licensed operators in some sections of the United States in 1959. Shell Development Company, Agricultural Research Division, Modesto, California.

* Trademark Shell Chemical Corporation
** Formerly called F-98 Aquatic Herbicide

PROJECT 7: CHEMICAL AND PHYSIOLOGICAL STUDIES

V. H. Freed, Project Chairman

SUMMARY

The response for abstracts this year was particularly gratifying. Once again the number of abstracts submitted showed an increase - jumping from twelve last year to seventeen this year. The nature of the material covered also is significant indicating the growing interest in the fundamental problems of soil behavior, absorption and translocation and physiological effects of herbicides. The radiochemical approach appears to be coming into increasing use in herbicide studies.

The abstracts submitted appear to fall into several broad areas of work as considered below.

Soil behavior of chemicals. Day and his co-workers have continued their fine studies of the persistence of Amitrol in the soil. They find that the disappearance of the chemical from the soil is a function of microbiological activity. Sheets investigated the comparative toxicity of seven different triazines in the soil and found it to vary. He was able to rank these compounds in order of their activity. Montgomery et al have reported on the leaching of simazine and atrazine as a function of the amount of water applied.

Foliar absorption and effectiveness of herbicides. Hull has a very interesting report on the comparison of the effectiveness of normal and invert emulsions on velvet mesquite. He finds in every case the invert emulsion is more effective.

Foy in studying the herbicidal action of 2,2 dichloropropionic acid and its derivatives found that while the material penetrated as the non-dissociated molecule, maximum herbicidal activity occurred at pH 6.

Szabo and Gould in New Mexico were able to demonstrate an increased effectiveness of growth regulating type herbicides against salt cedar by the addition of gibberellic acid.

Physiological effect and metabolism of herbicides. Eight abstracts ranging from a study on the accumulation and persistence in seed to the effect of herbicides on oxidative phosphorylation are to be found in this category. Extensive use of isotopes has been made in this type of study with a high degree of success. They have been used to ascertain the effects of herbicides on glucose and acetate metabolism as well as the absorption and metabolism of the herbicides themselves.

Among the other abstracts submitted is a very interesting one on the effect of 2,4-D on morphogenesis of bindweed roots by Whitworth and Muzik.

It is sincerely hoped that thoughtful consideration of these abstracts will stimulate even more research in this area in the coming year.

Factors affecting the rate of depletion of amitrol in soils. Day, Boysie E. and Hendrixson, R. Ted. The laboratory study of the fate of Amitrol in soils was started last year and continued throughout 1958. The scope of investigation was expanded to include more soils, the effects of soil moisture, and steam sterilization. Other studies dealt with rate of leaching of Amitrol in several soils and a survey to compare the rates of depletion in representative citrus soils from throughout the citrus areas of California. Determinations of recoverable Amitrol residues were made by a modification of the method of Sund, (Journal of Agricultural and Food Chemistry, 4: (1) 57-60. January, 1956).

The rates of depletion of Amitrol in several soils stored at 30°C. was found to vary widely between soils. (Figure 1). Steam sterilization produced substantial changes in depletion rates when compared with those of unsterilized samples. (Figure 2). The results of further temperature studies confirm our previous findings that the depletion rate of Amitrol has a temperature optimum around 20-30°C. Low soil moisture was found to reduce the rate of depletion of Amitrol in the several soils studies. It was also found that the rate of downward leaching of Amitrol is inversely related to the amount of the herbicide absorbed on the soil colloids.

In the survey of the effects of soil type on breakdown of Amitrol, fresh soil samples were collected from throughout the citrus areas of the State, treated with Amitrol, and analyzed promptly and again after storage for 2-weeks. Our findings are reported in table 1.

Conclusions: Amitrol applied to the soil is depleted by the action of one or more soil microorganisms. The rate of depletion is controlled by soil temperature, moisture, and the population of active microorganisms. Generally, decomposition is slower in desert and non-cultivated areas. The depletion rate does not correlate with the soil texture or classification. (University of California, Citrus Experiment Station, Riverside)

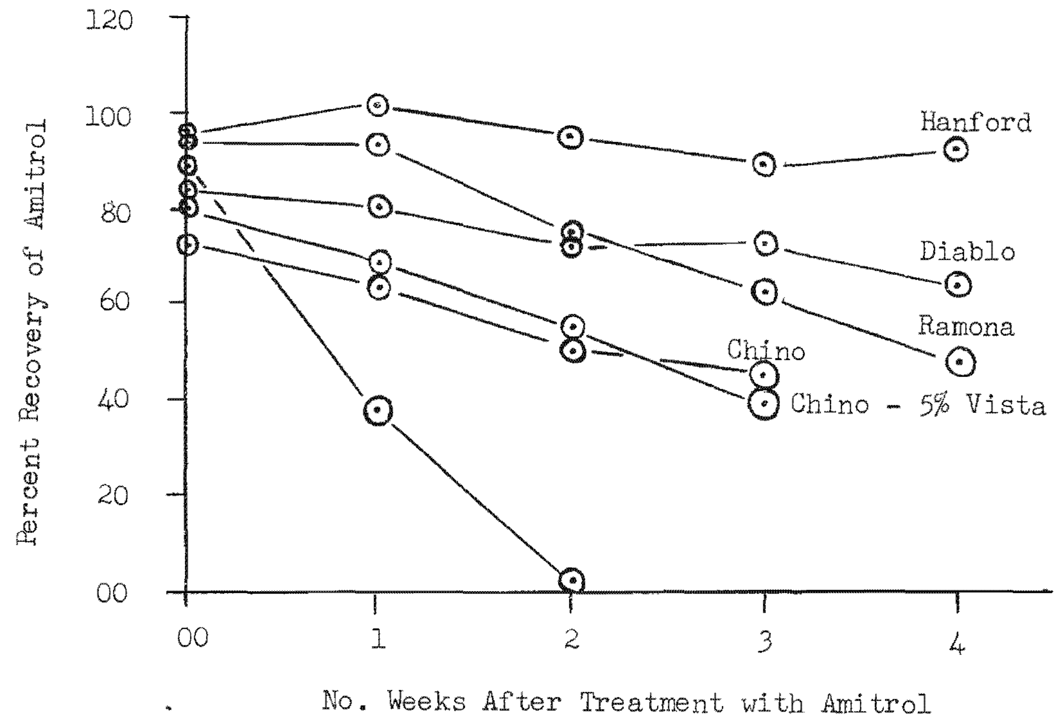
Table 1. - Comparative Rates of Depletion of Amino Triazole in a Selected Group of California Soils.

Code#	Soil Classification	Location	Average % Recovery of 3-AT from soil after: No Storage	2-wks Storage
19	Hanford St. Sa. Lo.	Pauma	73.6	0
20	Hanford Lo. Sa.	Pauma	86.3	40.1
(23)	Hanford Gr. Sa. Lo.	La Verne	90.3	0
(17)	Hanford Sa. Lo.	Highgrove	87.6	15.8
(18)	Hanford Sa. Lo.	Highgrove	79.0	45.2
(13)	Hanford Sa. Lo.	Arlington	68.3	0
52	Hanford Sa. Lo. (Virg.)	Mentone	97.3	94.3
49	Bautista Sa. Lo.	Hemet	96.3	Trace
34	Superstition V. St. Sa.	Coachella	109.0	60.4
25	Superstition St. Sa.	Coachella	108.3	78.7
26	Coachella V. Fi. Sa.	Coachella	105.7	23.0
27	Fallbrook F. Sa. Lo.	Fallbrook	74.4	40.0
51	Vista Sa. Lo. (Virg.)	Fallbrook	89.0	7.5
48	Vista Sa. Lo. (Virg. #2)	Escondido	89.0	0

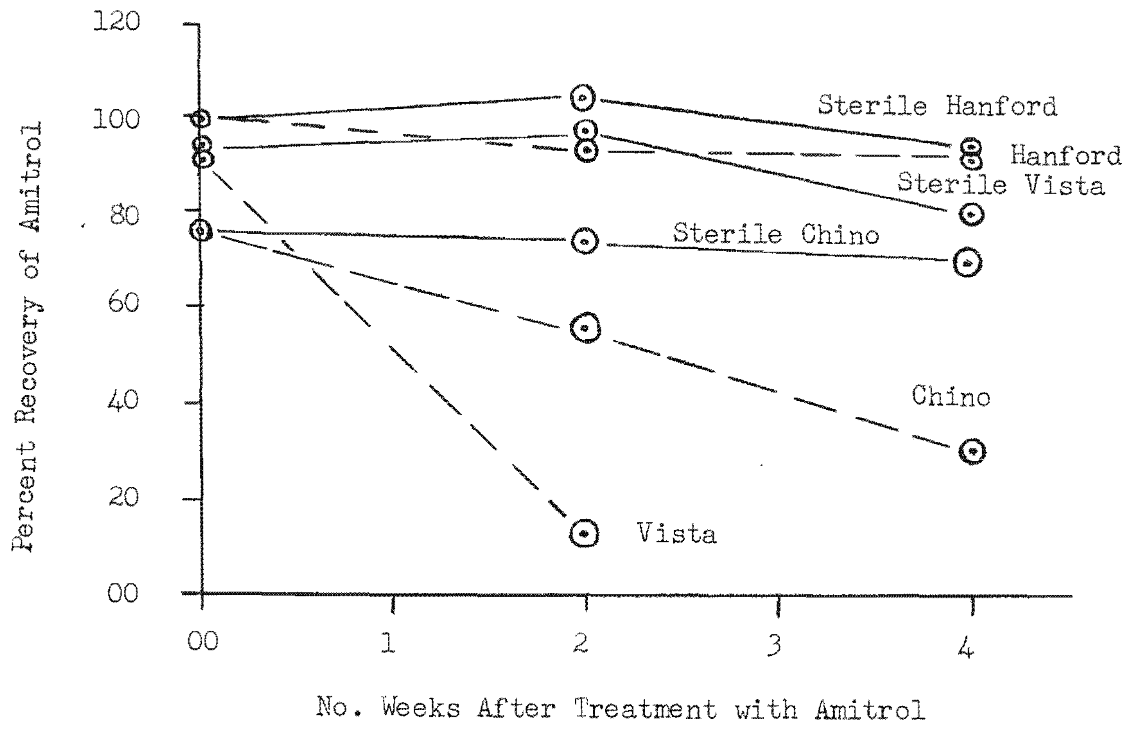
Table 1 -(continued)

Code#	Soil Classification	Location	Average % Recovery of 3-AT from soil after	
			No Storage	2-wks Storage
(1)	Vista Sa. Lo.	Escondido	99.0	27.1
(2)	Vista Sa. Lo.	Escondido	73.8	10.7
(3)	Vista Sa. Lo.	Escondido	92.3	0
(14)	Greenfield Sa. Lo.	Riverside	92.3	24.1
(15)	Greenfield Sa. Lo.	Riverside	96.9	23.0
(16)	Greenfield Sa. Lo.	Arlington	96.3	31.9
(22)	Greenfield Sa. Lo.	Highland	87.6	Trace
6	Sorrento F. Sa. Lo.	Goleta	88.9	Trace
7-a	Rikhorn Lo. Sa.	Encinitas	89.5	8.3
7-b	Rikhorn Lo. Sa.	Encinitas	82.9	13.9
8	Indio Lo.	Coachella	98.4	35.4
9	Indio Cl. Lo.	Coachella	94.0	37.1
10	Las Posas Lo.	Fallbrook	87.6	0
(21)	Ramona Lo.	Mentone	80.0	0
11	Ramona Lo.	Riverside	84.3	0
53	Ramona Lo. (Virg.)	Riverside	96.3	75.8
(12)	Yolo St. Lo.	Corona	82.9	0
(33)	Yolo St. Lo.	Ojai	86.9	0
(4)	Yolo Sa. Lo.	S. J. Capistrano	87.6	0
(5)	Yolo Lo.	Santa Ana	54.2	0
(23)	Yolo Lo.	Northridge	70.6	0
(30)	Yolo Lo.	Camarillo	79.0	0
(29)	Yolo High Fan Phase	Corona	89.0	0
31	Yolo Lo.	Goleta	78.0	Trace
32	Yolo Lo.	Ventura	82.6	Trace
34	Yolo Lo. or Cl. Lo.	Ventura	49.5	0
35	Hovey Adobe Cl.	Orsage Cove	75.5	0
(36)	Ducor Adobe Cl.	Porterville	84.0	0
(42)	Exeter Lo. Gr. Phase	Strathmore	50.0	Trace
(37)	Exeter Lo.	Exeter	71.6	0
43	Exeter or San Joaq. Lo.	Lindsay	54.0	0
(35)	Porterville Adobe Cl.	Terra Bella	80.6	0
44	Porterville Adobe Cl.	Orange Cove	85.8	0
(39)	San Joaquin Sa. Lo.	Ivanhoe	53.2	0
(40)	San Joaquin Sa. Lo.	Ivanhoe	84.4	0
(45)	San Joaquin Lo.	Strathmore	25.3	0
46	San Joaquin Lo.	Woodlake	94.2	0
47	San Joaquin Cl. Lo.	Orange Cove	91.0	26.1
50	Chino Si. Lo.	Chino	73.3	32.9
54	Diablo Cl. (Virgin)	Oceanside	84.0	74.3
41	Muck (Not plotted)	Isleton	19.3	9.9

Graph 1. Rate of Amitrol Depletion in Soils at 30°C.



Graph 2. Effect of Steam Sterilization on Rate of Depletion of Amitrol in Three Soils



Soil toxicity studies with seven s-triazine herbicides. Sheets, T. J. The toxicities of seven s-triazine herbicides to oats were investigated in five soil types. The herbicides were 2-chloro-4,6-bis-(diethylamino)-s-triazine (CDT), 2-chloro-4,6-bis-(ethylamino)-s-triazine (simazin), 2-chloro-4-ethylamino-6-diethylamino-s-triazine (G-27901), 2-chloro-4,6-bis-(isopropylamino)-s-triazine (G-30028), 2-chloro-4-diethylamino-6-isopropylamino-s-triazine (G-30031), 2-methoxy-4,6-bis-(ethylamino)-s-triazine (G-30044), and 2-chloro-4-n-propylamino-6-isopropylamino-s-triazine (G-30451).

A series of 8 to 11 concentrations was prepared for each chemical in each soil type. Portions of soil, weighing 500 g on an oven dry basis, were taken. The chemical for individual cultures was suspended in sufficient water to wet the soil to field capacity. The herbicides were combined with the soils by alternately adding one-third of the soil and one-third of the herbicide-water suspension to No. 2 metal cans. The experimental design was a randomized split block with three replications.

After treatment, 13 oat seeds were planted per can. At the end of 1 month fresh weights of tops were determined, and the data were a measure of the initial toxicity. The cultures were allowed to dry for 1 month. At the close of the second 1-month period, the soil in each can was pulverized, and the plant residue from the previous harvest was returned to the container. The soil was wet to field capacity and seeded again. This system of cropping was continued for a total of eight crops, or 15 months.

The effectiveness of the herbicides initially varied among soil types. Higher concentrations were required in clays than in sandy soils to produce the same degree of injury. The data indicate that the compounds with a single substitution on each of the amino groups (simazin, G-30028, G-30044, and G-30451) were most toxic to oats initially. Compounds with a single substitution on one amino group and two substitutions on the other amino group (G-30031 and G-27901) were intermediate in phytotoxicity. CDT with two substitutions on each amino group was least phytotoxic.

The rate of inactivation of the herbicides varied. They were ranked for effectiveness on the basis of the fresh weights of the eighth crop of oats. The relative order over all soil types with the most active one listed first was G-30044, simazin, G-30028, G-27901, G-30031, G-30451, and CDT.

Several of the cultures treated with CDT became more toxic to oats during the first few crops in all soil types. This trend reversed after about the fifth crop, and thereafter the effectiveness of the CDT cultures decreased with time.

In this experiment the containers did not drain. This experimental condition would tend to minimize differences among soil types caused by the effect of moisture and aeration on microbial decomposition. Loss of herbicides by leaching was completely eliminated. Both of these factors are related to soil type and are presumed to affect the activity of herbicides under field conditions. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture and the California Agricultural Experiment Station, cooperating)

A comparison of the leaching behavior of simazine and atrazine in Chehalis sandy loam. Montgomery, M., and Freed, V. H. The leaching behavior of the two substituted triazines, Simazine and Atrazine, was studied using C^{14}-labeled chemicals. The chemicals were applied at the rate of 10 pounds per acre. Twelve inches of water were percolated through the columns over a 3-day period. Upon completion of the leaching period, the soil columns were broken into one-inch sections. The soil was dried and radio analyses were carried out on each 1 inch of soil up to a depth of 12 inches. The results are presented in table 1.

Table I. Leaching of Simazine and Atrazine in Soil

	Simazine	Atrazine
Maximum depth, inches	7	12
Maximum concentration, inches	0-1	7-8

Only a small amount of Simazine penetrated the first inch of soil. Of that which left the surface, about one-third is found in the first inch. Decreasing amounts are found to a depth of 7 inches. A considerably larger amount of atrazine is leached from the surface of the soil. The maximum concentrations are found in the 7 and 8-inch sections. Decreasing amounts are found to a depth of 12 inches.

The results point out the importance of solubility in the leaching characteristics of a chemical. Simazine has a water solubility of 5 parts per million, while that of atrazine is about 70 parts per million.

Effect of normal and inverted emulsions as carriers for several formulations of 2,4,5-T. Hull, Herbert M. Studies involving the effect of normal and inverted emulsion carriers on absorption and translocation of the butoxyethanol ester of 2,4,5-T have led to interesting results with velvet mesquite. In preliminary work, the herbicide (18,700 ppmw) was formulated in a 1:9 emulsion of nontoxic oil and water, made up in either the normal or the inverted form. Applications were made to the basal leaf of seedlings at the four-leaf stage of growth. Mean values of certain specific reactions which followed are shown in table 1.

Table 1. Effect of carrier on herbicidal response of velvet mesquite

Type of carrier	Apical epinasty in degrees curvature after - 5 hr.	24 hr.	8 da.	Formative effect on apical portion of plant after 3 wk.	Degree of injury to leaf above treated leaf after 6 wk.	Height 12 wk. after treatment (cm.)
Normal emulsion	14	20	33	Very slight	Very slight	19.9
Inverted emulsion	20	59	166	Severe	Severe	7.2
No treatment	0	0	0	None	None	26.9

Clearly, the inverted emulsion carrier resulted in a markedly greater response.

A more detailed experiment involved the use of 2,4,5-T (4800 ppmw) in various combinations of formulation and carrier. Thus, either the butoxyethanol ester or the triethylamine salt was used in either a normal or an inverted emulsion carrier (1:9, nontoxic oil and water). In one case both ester and amine were combined in a single mixture at 2400 ppmw each so that both phases of the inverted emulsion would contain an active ingredient. Application was made either by spraying at the rate of 1 ml. per 10 plants or by painting directly on the three central leaves of plants at the nine-leaf stage. Specific responses including (1) apical epinasty, (2) contact injury, (3) later formative effect on apical portion of plant and on basal leaves, (4) callus formation on stem, and (5) final dieback of stem, were recorded at intervals from 2 hr. to 12 wk. after treatment. Over-all herbicidal responses were calculated from the above observations, excluding items (2) and (4), in which a positive response is not necessarily desirable. They are shown in table 2 on a scale rating of 0 to 100.

Table 2. Effect of formulation, carrier, and method of treatment on herbicidal response.

Formulation of 2,4,5-T and type carrier	Sprayed plants	Partial foliage treatment
Butoxyethanol ester of 2,4,5-T in inverted emulsion	85	31
Butoxyethanol ester of 2,4,5-T in normal emulsion	67	22
Oil-soluble amine salt of 2,4,5-T in inverted emulsion	65	45
Triethylamine salt of 2,4,5-T in normal emulsion	58	44
Butoxyethanol ester and triethylamine salt (1:1) of 2,4,5-T in inverted emulsion	67	30

In every case, the sprayed plants showed considerably greater response than those receiving a partial foliage treatment. As in the original experiment the ester of 2,4,5-T was more effective when carried in an inverted emulsion than in a normal one. Considering only plants receiving a partial foliage treatment, the oil-soluble amine in an invert emulsion and the triethylamine in a normal emulsion both resulted in superior absorption and translocation than the other combinations. Inclusion of both an ester in the oil phase of an invert emulsion and an amine in the water phase failed to demonstrate superior results to the ester only at a total equivalent concentration. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Box 5735, Tucson, Arizona.

The toxicity of foliar-applied dalapon to Zea mays as influenced by the pH of aqueous spray solutions. Foy, Chester L. Among the chemical and physical properties of compounds which may influence biological behavior, the degree of ionization and pK_i of acids are of known physiological importance. Many experiments have indicated that 2,4-D compounds are readily absorbed and, like other substituted phenols, are apparently taken in and translocated most readily in the non-dissociated form. Other weak acids are known to exhibit the same phenomenon.

On the basis of work conducted in this department, (1) inhibition of corn coleoptile elongation (Wilkinson, 1955) and (2) coloimetric determination of the leakage of anthocyanins from red beet root slices, dalapon also appears to conform to a similar pattern, i.e., penetrating most readily at low pH. The importance of the pH of systemic herbicidal solutions applied to the foliage of intact plants is still a matter of conjecture.

Studies were conducted to determine the sensitivity of corn to pH differences in foliar sprays of dalapon. Here, growth inhibition (which is dependent upon penetration and translocation) was the criterion of herbicidal activity. The experiments were considered desirable for two reasons: (a) to determine whether dalapon follows the pattern reported of other weak acids, and (b) to investigate the effects of acute toxicity upon total absorption, translocation, and final systemic action.

Zea mays L. var. Morses Grain Hybrid was grown in 4-in. diameter greenhouse pots for 10 days, thinned to 4 plants per pot, and fertilized. Fourteen days after planting, when the corn was 25 to 35 cm tall and growing vigorously, the foliage only was treated by use of a calibrated spraying table or a compressed air-operated De Vilbiss atomizer and turntable. Just prior to treatment, the plants were selected for uniformity and ranked according to replication; coefficients of variability were consistently no higher than 4 to 10 percent.

In the first experiment, when 10 lb. in 40 gal/A were used, all plants showed some contact injury, and all treatments were so inhibitory in comparison with untreated checks that no differences were apparent from pH 1 through 10. In the second run, only 2 lb. in 40 gal/A were used. Without additional surfactant, wettability was limiting and all treatments were relatively ineffective (not significantly different from untreated checks). In the third test, 4 lb. in 40 gal. were chosen and the plants were sprayed to wet. The results are shown in tables 1 and 2. Similar trends were also established later using 2 lb. in 40 gal., with the addition of 0.05 percent Vatsol OT to insure adequate wetting. It is clear that dalapon does indeed penetrate most readily as the non-dissociated molecule or at low pH in aqueous solution; however, an interesting deviation was observed in the case of intact plants using growth inhibition as the criterion of effectiveness. Acute toxicity, which may be caused by higher concentrations of dalapon (a fairly strong acid), Vatsol OT (a somewhat toxic surfactant), and/or H ions at low pH, introduced an additional complicating factor. Thus translocation of dalapon was impaired or prevented and an opposite trend was created at the lower pH ranges. Maximum herbicidal effect was obtained at or near pH 6.

The acid, 2,2-dichloroporpionic acid, was reported early to be essentially equal in herbicidal activity to equivalent amounts of the sodium salt. Investigation of several derivatives of dalapon (Na, K, NH_4, Ca salts, etc.) in this laboratory has failed, thus far, to reveal any with any greater biological activity than the sodium salt. (Botany Department, University of California, Davis, California)

Table 1. The influence of pH upon the toxicity of foliar sprays to corn. Solutions contained McIlvaine's Standard Buffer or Buffer plus dalapon (four lbs/40 gals). Plants were harvested two weeks after treatment, and values shown are averages of four replications. 1/

	McIlvaine's buffer		Buffer plus dalapon	
pH 2/	Height (cm)	Weight (gm)	Height (cm)	Weight (gm)
1	39.5	6.40	25.0	.75
2	66.0	39.18	38.8	20.08
3	67.5	42.38	38.5	21.95
4	71.8	49.08	37.8	20.35
5	71.3	45.25	31.0	11.33
6	69.0	41.68	29.5	7.43

Table 1 - (continued)

pH 2/	McIlvaine's buffer Height (cm)	Weight (gm)	Buffer plus dalapon Height (cm)	Weight (gm)
7	68.8	45.93	32.5	10.03
8	67.5	45.75	37.8	17.65
9	71.0	47.40	39.5	20.75
10	67.8	43.55	42.0	22.33
Check	67.0	43.10	66.3	45.98
L.S.D. (5%	5.7	3.86	4.3	2.52
L.S.D. (1%	7.6	5.21	5.8	3.40

1/ Height of plants at treatment 29.1 cm.
Weight of plants at treatment 7.23 gm.

2/ pH's 1 and 2 obtained by adding concentrated HCl
pH's 9 and 10 obtained by adding concentrated NaOH

Table 2. Characterization of injury symptoms produced by foliar sprays of dalapon on corn. Figures are visual ratings of an arbitrary scale of 0 to 10 (0 = no injury and 10 = plant foliage completely affected) taken two days after treatment. (Four replications).

pH	Acute, acid-type contact injury. Localized necrotic areas against normal green foliage. Plants erect.	Slower, non-localized injury. General gray-green wilted appearance, insidious.
1	9 - 10 (growing point not always killed)	10 (types of symptoms not distinguishable)
2	5.0	1.8
3	3.0	1.3
4	1.0	2.0
5	0.5	3.9
6	0	5.1
7	0	4.8
8	0	3.6
9	0	3.3
10	0	2.4
Check	0	0

<u>The influence of gibberellic acid on the effectiveness of various growth regulators for the control of salt cedar</u> (<u>Tamarix</u> <u>sp</u>.). Szabo, S. S. and Gould, W. L. Gibberellic acid, at 100 ppm, was applied to salt cedar in combination with 4 lb/A of 2,4-D, 2,4-DB, 2,4,5-TP, and TBA. Duplicate sets of treatments were applied. In the first set of treatments the gibberellic acid was applied alone to the salt cedar on June 21, 1958. Fifty hours later, on June 23, the various growth regulators, alone, were applied to the previously treated gibberellic acid plots. In the second

set of treatments the gibberellic acid was applied as a mixture with the individual growth regulators on June 23.

The treatments were applied to 1/2 sq. rod plots and were replicated four times. The treatments were applied in water solution equivalent to 40 gal/A. The treated area consisted of salt cedar regrowth three to four feet in height. The salt cedar top growth had been chopped off at ground level three months before treatment. The degree of control was estimated on November 4. The rating scale used was: 0 = no effect; 10 = complete top kill with no regrowth.

The plots which received the gibberellic acid 50 hrs. prior to the growth regulators were rated as follows: 2,4-D - 3.0; 2,4-DB - 4.5; 2,4,5-TP - 5.3; TBA - 1.8. The plots which received the gibberellic acid as a mixture with the growth regulators were rated as follows: 2,4-D - 2.0; 2,4-DB - 2.8; 2,4,5-TP - 3.3; TBA - 1.5. Although the degrees of control obtained were not overly impressive, it appears that gibberellic acid may have value in increasing the effectiveness of growth regulator-type chemicals on salt cedar. (Contribution of the New Mexico State Experiment Station)

<u>The role of surfactants in foliar absorption</u>. Hughes, R. E., and Freed, V. H. A preliminary study of the role of surfactants in foliar absorption was done. Indol acetic acid was used as the growth regulator and determined at various time intervals by washing the material from the plant leaves with a basic wash and determining the concentration with an Aminco-Bowman Spectrophotofluorometer.

Surfactants were found to increase both the rate and total amount of chemical absorbed, as well as reduce the variability of the amount absorbed. Reduction of surface tension was not the controlling factor affecting the increase in foliar absorption and some sort of interaction between chemical and surfactant is indicated. The absorption appeared to follow a first order rate equation. (Department of Agricultural Chemistry, Oregon Agricultural Experiment Station)

<u>The accumulation and persistence of dalapon in the seeds of cotton and small grains</u>. Foy, Chester L. Despite the fact that considerable information has been accumulated within a relatively short period on the herbicidal efficacy of dalapon, little is known of the basic behavior of the compound in eliciting certain rather characteristic responses in plants. As is usually the case, fundamental understanding of the mechanisms of absorption, translocation, toxicity, and disappearance or de-toxification has lagged far behind popular acceptance of the chemical as a herbicide.

Field, greenhouse, and laboratory investigations were designed to study the distributional and metabolic fate of dalapon in plants in relation to phytotoxicity. Only one phase, the accumulation and persistence in seeds, will be presented here.

Basally directed sprays of low rates of dalapon (3 to 6 lb/A) to field-grown cotton at mid-season resulted in delayed maturation of the crop and accumulation of 8 to 21 ppm dalapon in the seeds, as indicated by either isotope dilution analysis or by a colorimetric method based on the hydrolytic conversion of dalapon to pyruvate. Treatments had no deleterious effects upon eight seed and fiber properties, except that germination was measurably retarded (viability not reduced). The retarding influence was deep seated as indicated by the failure of all attempts (pre-soaking, leaching, varying temperature, etc.) to nullify it, and persisted for more than two years in air dry storage. The amount of dalapon accumulated in the seed, and therefore the influence on germination, was correlated with the rate and time of application in relation to reproductive development (table 1). The retardation of germination was suggestive of dalapon-induced dormancy in crown and rhizome buds of perennial grasses, except that no characteristic dalapon symptoms were observed in cotton in either generation.

Radioactive tracer studies with dalapon-2-C^{14} and-Cl^{36} later showed that, in addition to protracted movement from the point of foliar application and rapid distribution in the xylem (following uptake by the roots, severed veins, or severed petiole), retranslocation involving xylem-phloem interchange and movement in response to shifts in loci of high metabolic activity also occurred. High accumulation in all flower and fruit parts (especially heavy in the embryos of cotton) was confirmed by autoradiography.

Extraction and fractionation procedures were developed, and the techniques of paper partition chromatography and autoradiography were adapted for the detection of dalapon and related metabolic degradation products. It was concluded that dalapon is absorbed, translocated, and accumulated in higher plants as the original molecule or dissociable salt thereof, and may remain essentially non-metabolized for long periods, expecially in dormant or quiescent tissues. Slight decomposition slowly resulting in the release of Cl^{36} (from dalapon-Cl^{36}) or the incorporation of C^{14} (from dalapon-2-C^{14}) into other compounds is indicated.

At rates of 4 lb/A, applied as a pre-plant treatment in the winter (under conditions unfavorable for leaching or breakdown by micro-organisms), dalapon was absorbed by wheat and barley and caused severe inhibition of growth. The dalapon stimulus was traced through three generations of wheat by transmission in the seeds, again confirming the persistence of dalapon in higher plants. (Botany Department, University of California, Davis, California)

Table 1. Analysis of residual dalapon recovered from cotton seed. Plots were treated with basally-directed sprays of commercial dalapon.

Date of treatment	Lb. dalapon acid equivalent/A	Dalapon residue in seed (ppm)
June	3	12
	6	21
July	3	8
	6	9

<u>The effect of herbicides on the metabolism of radioactive acetate in pea roots</u>. Stevens, V. L., Fang, S. C., and Butts, J. S. The metabolic alterations which occur in a plant cell as a result of herbicide treatment are at present poorly understood.

During the past year, experiments were carried out to investigate the influence of various herbicidal chemicals as well as several plant growth regulators on the metabolic oxidation of acetate, hoping that this information may be of some value in extending the over-all knowledge of selective weed control.

Preliminary experiments indicate that C^{14}-acetate is readily metabolized by plant tissues, and some of the carbons appear in respiratory CO_2 presumably by way of the Krebs cycle and the rest are incorporated into many cellular constituents. In view of the consistent results of the C^{14} distribution in control plants it is reasonable to believe that any influence on the pathways of acetate metabolism should be easily detected from the distribution ratio.

Pea root tissue after 2 hours of pretreatment with herbicide was incubated in phosphate buffer containing either acetate-1-C^{14} or acetate-2-C^{14} for a period of 4 hours. The radioactivities of respiratory CO_2, ethanol extract, and insoluble residue were determined and the distribution of C^{14} recoveries are tabulated in the following table.

The results indicate that:

1. α-NAA, β-NAA, PMA, and TIBA greatly inhibit the acetate absorption; 2,4-D, 2,4,5-T, 2,4,6-T, and IAA show a slight reduction; and IPC, simazine, monuron, gibberellic acid, and 2,4-D at 10^{-5}M. show no effect. A slight increase in absorption is observed in dalapon and EPTC treated tissues.

2. The C^{14} distribution ratio obtained from acetate-1-C^{14} differs greatly from those found in acetate-2-C^{14}.

3. In the acetate-1-C^{14} experiments, 2,4-D is the only chemical which shows a slight decrease in respiratory CO_2. All the other chemicals exhibit a slight stimulatory effect. No change is found in dalapon treated tissues. On the other hand, the incorporation of C^{14} into alcohol insoluble residue is generally decreased. The effect of most chemicals on C^{14} incorporation into ethanol soluble fraction is not significant.

4. The effect of 2,4-D on acetate metabolism depends greatly on its concentration.

5. Both 2,4,5-T and 2,4,6-T exhibit a rather similar influence on acetate metabolism. Therefore, it may be concluded that the toxic effect produced by 2,4,5-T is not due to a disturbance in acetate metabolism.

Table 1. The Effect of Herbicides on the Metabolism of C^{14} Labeled Acetate in Pea Roots

Type of Herbicide	Concentration	SUBSTRATE ABSORPTION		THE DISTRIBUTION OF C^{14} INTO VARIOUS FRACTIONS					
				Respiratory CO_2		Alcohol Extract		Residue	
		1 C^{14}	2 C^{14}	1 C^{14}	2 C^{14}	1 C^{14}	2 C^{14}	1 C^{14}	2 C^{14}
		% *	%	%	%	%	%	%	%
Control	---	63 ± 9 (22)	53 ± 4 (10)	55 ± 2	30 ± 4	28 ± 2	44 ± 6	17 ± 3	26 ± 3
α- NAA	10^{-4}	36 ± 2 (4)	37 ± 2 (5)	62 ± 1	35 ± 4	26 ± 1	44 ± 4	12 ± 1	21 ± 2
β- NAA	10^{-4}	29 ± 2 (4)	31 ± 4 (5)	61 ± 2	34 ± 3	32 ± 2	47 ± 3	8 ± 1	19 ± 3
2,4-D	10^{-4}	56 (2)	40 ± 3 (5)	52	32 ± 3	33	44 ± 2	14	23 ± 2
2,4-D	10^{-5}	66 (2)	53 ± 4 (5)	49	27 ± 1	31	44 ± 2	20	29 ± 3
2,4,5-T	10^{-4}	50 ± 6 (5)	38 ± 3 (3)	63 ± 2	40 ± 4	24 ± 3	38 ± 3	13 ± 3	22 ± 1
2,4,6-T	10^{-4}	43 ± 1 (4)	41 ± 4 (3)	61 ± 3	38 ± 2	28 ± 4	44 ± 2	11 ± 4	18 ± 1
PMA	10^{-5}	27 (2)	32 ± 8 (5)	60	28 ± 3	31	57 ± 4	9	15 ± 2
EPTC	10^{-4}	68 ± 3 (4)		60 ± 3		27 ± 1		13 ± 2	
IPC	10^{-4}	66 ± 3 (4)		59 ± 2		28 ± 2		12 ± 1	
Dalapon	10^{-4}	74 ± 2 (4)		57 ± 1		29 ± 1		14 ± 1	
IAA	10^{-4}	57 ± 6 (6)	45 ± 7 (3)	64 ± 4	28 ± 2	23 ± 2	36 ± 3	13 ± 3	27 ± 4
TIBA	10^{-4}	33 ± 2 (4)	26 ± 4 (3)	61 ± 2	42 ± 2	31 ± 2	43 ± 3	8 ± 1	16 ± 2
Simazine	Sat.	61 ± 4 (3)	56 ± 14(3)	60 ± 2	35 ± 3	26 ± 3	39 ± 6	14 ± 2	26 ± 3
TBA	10^{-4}	58 ± 5 (4)	45 ± 4 (3)	63 ± 2	39 ± 3	22 ± 1	36 ± 3	16 ± 1	25 ± 1
Gibberellic A	10^{-4}	61 ± 3 (4)		63 ± 2		24 ± 2		13 ± 1	
Monuron	10^{-4}	60 ± 6 (4)		61 ± 5		22 ± 2		17 ± 2	

* - ( ) indicates number of runs.

The effect of various herbicides on glucose metabolism. Bourke, J. B., Fang, S. C., and Butts, J. S. The effect of herbicides on the plant has been studied on many levels and by various methods. The experiments carried out here simulate work done many times before on glucose oxidation but included not only the evolution of CO_2, but also the incorporation of glucose carbons into the cellular tissue. In this work glucose-U-C^{14} was incubated with young pea seedling root tips previously treated with herbicides. A herbicide concentration of 0.0001 M was selected because it demonstrated the toxic effects of the herbicides without changing either the physical characteristics, i.e., caused dehydration or wilting, or a rapid cessation of oxidative metabolism of the seedling when the treatment period was limited to two hours and the incubation period to six hours.

The results tabulated in table 2 of 17 different herbicides indicated that the type of herbicide used affected the utilization of glucose in the pea root tip. The absorption of glucose into the pea root tip was influenced greatly by the herbicide type. ATA, MH, monuron, simazine, and gibberellic acid had little effect on glucose absorption, although a slight decrease of 4% to 8% can be noted. EPTC (Ethyl, N N di-n-propylthiocarbonate); IPC; IAA; 2,4-D; 2,4,5-T, dalapon and 2,3,6-TBA all show a marked decrease of 12% to 28% in absorption while naphthalene A.A., β naphthalene A.A., and TIBA show a great decrease of 56% to 72%. PMA which causes a dehydration and wilting at this concentration results in almost complete inhibition of glucose absorption.

Generally, if inhibition to absorption was the only action of the herbicide, we would expect to find the same percentage of radioactivity in the different fractions extracted in various experiments since the deviation of the control is within the accepted limits. This, however, does not seem to be the case since the percent C^{14} recovered as carbon dioxide under various herbicidal treatments ranges from 40% to 60% with the control at 47%. PMA, which was physically damaged, has been omitted here. This represents both a stimulation (those value above 47%), and an inhibition (those values below 47%). Likewise, the residue gives values of 23% to 47% while the control contains 41% of the recovered C^{14}. Again, both stimulation and inhibition are demonstrated. The C^{14} found in the ethanol extract deviates from the 11% found in the control.

It will be noticed that 2,4,6-T which is inactive as a herbicide, causes a larger shift in both oxidative catabolism and structural incorporation of glucose-U-C^{14} than either 2,4-D or 2,4,5-T, which are herbicidally active. Table 1, which includes work now under investigation with glucose-1-C^{14} and glucose-6-C^{14}, also shows a greater shift in oxidative catabolism and structural incorporation. A shift to the pentose oxidative pathway can also be noted for 2,4-D, 2,4,5-T, and 2,4,6-T by examination of the C_6/C_1 ratio. This information then would tend to indicate that the toxicity of 2,4-D and 2,4,5-T is not due to glucose catabolism since the shift in metabolism by 2,4-D or 2,4,5-T is paralleled by an equal or greater shift caused by non-toxic 2,4,6-T.

From the data presented, the following conclusions can be drawn:

1. The method presented for describing the effects of herbicides is a valid one, since deviations found between experiments are small for biological material and the effect of a herbicide can easily be understood.

2. Two hour treatment of a concentration of 0.0001 M is ideal for most herbicides since no physical damage is apparent and a biochemical response is induced.

3. A six hour incubation period is generally accepted since no recovery from herbicide treatment is found as born out by the consistency of the results.

4. The data indicates that there is a general inhibition of absorption caused by herbicidal treatment.

5. There is no trend common to all herbicides at the concentration used toward either stimulation or inhibition of oxidative catabolism or structural growth.

6. The data would seem to indicate that glucose catabolism is not the site of herbicidal activity of 2,4-D or 2,4,5-T.

Table 1. % Recovery of C^{14} from Absorbed Glucose.

	Glucose-U-C^{14}				Glucose-1-C^{14}				Glucose-6-C^{14}				
	Respiratory CO_2	Residue	ETOH Extract	No. Runs	Respiratory CO_2	Residue	ETOH Extract	No. Runs	Respiratory CO_2	Residue	ETOH Extract	No. Runs	C_6/C_1
Buffer	47.4±5.8	41.0±4.6	11.5±2.7	27	49.1±5	40.5±2	10.4±3	6	38.9±2	49.6±2	11.1±3	6	.77±.04
2,4-D	54.5±6	36.0±5	9.5±2	5	52.6±4	34.5±2	12.9±2	3	39.3±3	45.9±3	14.8±3	3	.68±.03
2,4,5-T	50.3±8.6	32.5±5.7	17.1±2.1	8	55.6±6	28.3±1	20.3±1	2	32.9±1	41.8±1	25.4±1	2	.49±.01
2,4,6-T	61.0±7.2	23.2±4.3	15.8±4.0	8	58.3±-	24.5±-	17.2±-	1	45.0±-	36.2±-	18.8±-	1	.55±-

Table 2.

Herbicide	% Substrate Abs. as % of Control	% Recovery of C14 from Absorbed Glucose			No. of Exp.	C14 Recovery as % of Control		
		CO_2	Residue	ETOH Sol.		CO_2	Residue	ETOH Sol.
Control	100	47.4 ± 5.8	41.0 ± 4.6	11.5 ± 2.7	27	100	100	100
ATA *	96.3 ± 10.2	42.1 ± 5.9	44.1 ± 1.5	13.8 ± 5.6	4	106 ± 5	92.8 ± 3	95.8 ± 3.8
Simazine **	91.1 ± 8.5	41.3 ± 4.0	47.1 ± 4.3	11.6 ± 0.8	6	86.7 ± 3	111 ± 9	113 ± 3.5
MH	92.0 ± 3.9	40.4 ± 2.9	45.8 ± 3.8	13.8 ± 1.0	5	87.8 ± 6	108 ± 6	104 ± 9.1
(monuron)	94.7 ± 6.3	39.2 ± 7.7	43.4 ± 4.6	17.4 ± 7.9	8	96.8 ± 5	103 ± 9	102 ± 15.6
2,4-D	81.0 ± 8.0	54.5 ± 6.0	36.0 ± 5.0	9.5 ± 2.0	5	126 ± 19	77.5 ± 14	81.4 ± 11.8
2,4,5-T	72.0 ± 5.0	50.3 ± 8.6	32.5 ± 7.5	17.1 ± 2.1	8	110 ± 6	78.1 ± 7	80.2 ± 7.3
2,4,6-T	59.0 ± 8.0	61.0 ± 7.2	23.2 ± 4.3	15.8 ± 4.0	8	119 ± 6	61.7 ± 8	61.7 ± 6.4
IAA	81.4 ± 4.3	51.4 ± 5.2	37.4 ± 6.8	11.1 ± 5.1	5	96.0 ± 4	98.5 ± 9	98.5 ± 5.0
Dalapon	80.4 ± 4.9	57.6 ± 7.6	40.1 ± 5.7	12.2 ± 2.2	5	99.8 ± 6	96.0 ± 5	96 ± 4.8
EPTC	87.6 ± 2.5	47.1 ± 7.9	42.4 ± 5.4	10.5 ± 2.9	6	94.1 ± 6	106 ± 6	106 ± 5.7
IPC	84.5 ± 2.8	43.8 ± 5.0	43.6 ± 4.1	12.7 ± 0.8	5	96.7 ± 7	98.7 ± 5	98.7 ± 5.2
αNap.AA	44.0 ± 3.7	46.6 ± 4.7	31.5 ± 2.3	21.1 ± 5.2	5	105 ± 7	75.3 ± 8	75.3 ± 7.9
βNap.AA	42.0 ± 6.5	50.5 ± 4.9	25.7 ± 4.7	24.5 ± 5.6	6	124 ± 15	55.5 ± 5	57.4 ± 4.5
TIBA	27.9 ± 5.9	46.5 ± 12.3	23.6 ± 8.0	30.3 ± 6.7	7	93.7 ± 15	58.5 ± 9	53.7 ± 12.1
2,3,6-TBA	79.9 ± 4.3	49.3 ± 2.1	39.1 ± 2.2	11.6 ± 1.2	6	103 ± 7	93.6 ± 4	104 ± 6.5
PMA	12.5 ± 6.4	13.1 ± 3.6	11.7 ± 2.0	75.3 ± 7.3	5	25.2 ± 8	29.4 ± 5	26.0 ± 5.0
Gib ***	97.5 ± 5.8	46.1 ± 5.5	41.7 ± 5.4	12.2 ± 3.8	6	101 ± 9	99.4 ± 6	95.8 ± 5.7

* - Abbreviations used are those proposed by the Terminology Committee of the Weed Society of America. Weeds. 4 278-284. 1956.

** - 10^{-5} M solution used because of low water solubility

*** - 5 mg/l

<u>Absorption of EPTC-S^{35} by seeds and its metabolic fate during early stages of germination</u>. Fang, S. C. and Teh Chang Yu. Experiments were conducted to determine the rates of absorption and the subsequent breakdown of EPTC-S^{35} in both susceptible and resistant plant seedlings during early stages of germination. The seeds used in these studies were kidney beans, Mung beans, garden peas, corn, wheat and oat. Several hundred seeds were germinated between two sheets of filter paper which were moistened with 200 ml. of water solution containing 50 to 80 ppm of EPTC-S^{35}. At the end of 48 hours, all seeds were removed, washed thoroughly with water, and allowed to germinate without further exposure to EPTC-S^{35}. A group of randomized seedlings was removed at various intervals and assayed for EPTC-S^{35} residue, radioactive inorganic sulfate, S^{35} in hot water extract and S^{35} in water insoluble residue, in order to determine its rate of breakdown in plant seedlings. Four separate runs were carried out with each specie. The average value of EPTC-S^{35} residue in various seedlings was shown in table 1. The amount of free EPTC-S^{35} in each seedling of the resistant variety, namely, kidney beans, corn, pea, and wheat, decreased with time, while in those of the suscpetible variety, oat and Mung bean, no change was observed. This result provided conclusive evidence that the resistant plants are capable of metabolizing this chemical very readily, so that reaching a toxic concentration of EPTC in seedlings is rather difficult. On the other hand, the oat and Mung bean seedlings are not able to break down this chemical significantly after 48 hours of exposure to EPTC.

Data in table 2 indicated the percentage distribution of radioactive sulfur as found in different fractions in various plant seedlings. Twenty-three percent of the absorbed EPTC-S^{35} remained unchanged in oat seeds. Only one percent or less of radioactivity was found in inorganic sulfate, and the majority of S^{35} was incorporated into many sulfur-containing compounds which were either soluble in water or remained in insoluble residue.

Paper chromatographic study of the water extracts revealed the presence of radioactive cysteic acid, cystine, methionine, methionine-sulfone, and two unidentified compounds. The proportion of radioactive sulfur incorporated into these compounds varied with species. It is believed that EPTC-S^{35} may be metabolized by higher plants in such fashion that the sulfur atom is oxidized and forms inorganic sulfate as indicated from the experimental results. The sulfate then may incorporate through the normal metabolic pathways into all sulfur-containing compounds. (Department of Agricultural Chemistry, Oregon State College)

Table 1. Effect of time on the amount of free EPTC-S^{35} in various seedlings after exposure to 50 ppm of EPTC-S^{35} for 48 hours.

Plant Species	Time after removal from EPTC-S^{35}, hr.				
	0	24	48	72	96
	μg/seed	μg/seed	μg/seed	μg/seed	μg/seed
Kidney bean	3.76	0.92	0.34	0.28	0.10
Mung bean	0.22	0.21	0.21	0.19	0.19
Pea	0.27	0.17	0.16	0.11	0.03
Corn	0.97	0.42	0.30	0.11	0.03
Wheat	0.28	0.16	0.11	0.05	--
Oat	0.31	0.30	0.25	0.25	0.37

Table 2. Percentage distribution of radioactive sulfur as found in different fractions in various plant seedlings after exposure to EPTC-S^{35} for 48 hours.

Plant Species	Free EPTC-S^{35}	Inorganic sulfate	Hot water extract	H_2O insoluble residue
	%	%	%	%
Kidney bean	10.7	0.4	80.1	8.8
Mung bean	4.3	0.2	89.7	5.9
Pea	2.6	1.2	87.4	8.7
Corn	8.7	0.4	70.7	20.1
Wheat	8.0	0.6	74.2	17.2
Oat	23.0	0.3	62.8	13.9

Uptake of radioactive ethyl N,N-di-n-propylthiolcarbamate (EPTC-S^{35}) and translocation of Sulfur^{35} in various crops. Fang, S. C. and Theisen, Patricia. The experiments were carried out to study the extent of EPTC uptake by various crops when a pre-emergence application of radioactive EPTC was made to soil. The rates of application were one and four pounds per acre. The crops used in these experiments were kidney beans, sweet corn, garden peas, radishes, carrots, cabbage, mustard, swiss chard, table beets, sugar beets, and cucumbers. The results indicated that there was an uptake of this chemical from soil and that it was translocated throughout the entire plant. Differences of EPTC-S^{35} accumulation patterns among the crops tested were demonstrated by use of radioautographic technique and by determination of the amounts of radioactivity in different plant parts. Total absorption of EPTC-S^{35} by individual crops at various stages of growth was determined. During 38 days presentation time the amounts of EPTC-S^{35} absorbed from soil, treated at a rate of 4 lb. per acre, by the individual plants of various crops, were as follows: bean plant, 40.7 μg; pea plant, 16.1 μg; corn plant, 32.7 μg; radish plant, 2.6 μg; carrot plant, 2.5 μg; cabbage, 6.0 μg; mustard, 2.1 μg; swiss chard, 3.0 μg; table beet, 4.0 μg; cucumber, 5.0 μg.

Kidney bean, corn, radish, carrot, cabbage, and mustard plants were allowed to grow to maturity; and the bean pods, corn ears, radishes, carrots, cabbage leaves and mustard leaves were harvested and analyzed for free EPTC-S^{35}. The radiochemical assay method with a sensitivity of 0.2 μg was employed. All samples were shown to contain no free EPTC-S^{35} residue. Other plant samples which were harvested at early growth stages and which were also shown to contain no EPTC-S^{35} residue were bean leaves, stems and flowers, corn leaves and radish roots. A few samples harvested at early growth stages were found to contain small amounts of EPTC-S^{35} residues. They were bean roots, pea plants, radish leaves, corn roots, table beet plants, sugar beet plants, and carrot plants. The highest concentration of EPTC-S^{35} residue found was 0.4 ppm in bean roots and 0.25 ppm in pea plants. All the others range from 0.024 to 0.076 ppm. Results also indicated that only 0 to 3% of the absorbed EPTC-S^{35} was found to remain in free form. In comparison to other herbicides (2,4-D, 2,4,5-T, monuron and dalapon), EPTC appears to be much less persistent in higher plants. (Agricultural Chemistry Department, Oregon State College)

<u>Oxidative phosphorylation in cabbage mitochondria</u>. Lotlikar, P. D., Heisler, C. R., and Remmert, L. F. Cabbage mitochondrial preparations which carry out oxidative phosphorylation have been made with a homogenizing medium containing 0.1 M K-succinate, 0.1% cysteine, 1 M sucrose, 0.01 M versene, and 0.1 M phosphate buffer at pH 7.4. Such a medium gave consistently uniform and active enzyme preparations.

A comparative study of various herbicides was continued. A total of 22 different compounds were tested. The best inhibitors of oxidative phosphorylation included 2,4-Dichlorophenoxy acetic acid, (2,4-Dichlorophenoxy) butyric acid and 2-Chloro-4,6-bis(ethylamino)-S-triazine. These compounds are among those known to be the most effective herbicides in the field.

Preliminary experiments indicated that 2,4-D inhibits the phosphorylation coupled to electron transport between substrate and cytochrome c. (Agricultural Chemistry Department, Oregon Agricultural Experiment Station)

<u>The absorption of C^{14} of radioendothal by table beets and spinach</u>. Montgomery, M., Freed, V. H., and Fang, S. C. The studies on uptake of C^{14} of radioendothal by chenopod crops as a result of pre-emergence application were continued. The crops used in this study were table beets and spinach.

The plants were found to take up appreciable radioactivity and contained measurable amounts at time of harvest. Distribution of this activity between residue, ethanol extract, and ether extract indicated that the C^{14} was not in the endothal ring. Since the fraction expected to contain radioendothal was the alcohol extract, this fraction was studied in detail. Ion exchange chromatography of this fraction revealed that the radioactivity found in this extract was not radioendothal by carbohydrate.

In an attempt to account for the occurrence of radioactivity in the plant since radioendothal was lacking, two experiments were carred out. In the first study, radioendothal was added to the soil and the $C^{14}O_2$ given off collected. By this means it was found that the bulk of the endothal was broken down in moist soil within 7 - 10 days. It was felt, therefore, that a great deal of the C^{14} found in the plants at harvest must come from absorption of $C^{14}O_2$. Accordingly, a closed system with one pot containing soil treated with radioendothal and the other containing the plants was set up. In this case, the plants could receive radioactivity only as $C^{14}O_2$. It was found that the plants acquired a measurable amount of radioactivity with the same distribution pattern as the treated plants. It was concluded, therefore, that the major portion of radioactivity acquired by the treated plants was in the form of $C^{14}O_2$ or that the endothal was rapidly metabolized to this product. (Agricultural Chemistry Department, Oregon Agricultural Experiment Station)

<u>The uptake and metabolism simazine and atrazine by corn plants</u>. Montgomery, M., and Freed, V. H. The uptake and metabolism of the triazines, Simazine and Atrazine, were studied using C^{14} ring-labeled materials. The chemicals were applied as pre-emergent treatements of 2 and 8 pounds per acre. Plants were harvested periodically up to and including maturity of the ear. Upon harvest, the radioactivity in the

plants was measured. Then the percentage of radioactivity which was chloroform soluble was determined, as simazine and atrazine are removed by an exhaustive chloroform extraction.

It was found that considerable quantities of radioactivity were taken up by corn plants, and even though the concentration diminished after about 4 weeks, there were appreciable amounts in both the ear and plant at the time of harvest. Also, it was shown that, just as the concentration of radioactivity diminishes with time, so does the percentage of radioactivity that is chloroform soluble. Chromatography of the chloroform extract revealed that only trace amounts, if any, of simazine of atrazine remained in the plant at the time of harvest. These results indicated an extensive metabolism of the triazine ring. Accordingly, an experiment was carried out to demonstrate the ability of corn plants to degrade these triazines.

Corn seedlings were put into aqueous solutions of the triazines and placed in an airtight system. The $C^{14}O_2$ given off by the plants was drawn off and collected as barium carbonate. At the end of the experiment, which was 3 days, the radioactivity in the plants and in the carbonate was measured. By this means it was shown that 9 percent of simazine taken up was metabolized, while about 17 percent of atrazine taken up was metabolized. The actual values are probably larger, as fragments of the triazine ring resulting from metabolism would be incorporated into plant constituents and would not be given off as $C^{14}O_2$ during the short duration of the experiment.

These experiments show that corn plants can readily degrade simazine and atrazine so there will be no residue problem at recommended rates of application. (Department of Agricultural Chemistry, Oregon Agricultural Experiment Station)

Effect of herbicides on root morphogenesis in bindweed plants. Whitworth, J. W., and Muzik, T. J. Plants of two strains of bindweed (Convolvulus arvensis) differing in susceptibility to 2,4-D were foliage-treated with rates of 10, 50, 100, 200, 500, and 1000 ppm, and daily measurements of root growth were taken. Histological studies were made of normal and abnormal roots.

When treated with 1000 ppm, the rate of elongation of roots on plants of the susceptible strain progressively decreased starting on the first day after treatment until complete inhibition on the third to fourth day. Roots of the resistant strain followed a similar pattern except that complete inhibition did not occur until the fifth to sixth day, and the amount of growth after treatment was considerably greater (based on the growth rate of the untreated check plants for the two strains). At lower rates of 2,4-D, differences in response of the two strains became more pronounced.

In one experiment, the inhibition of root growth occurred in roots six feet long within four to six days after the foliage was treated with 2,4-D at 1000 ppm.

The inhibited root tips usually showed pronounced swelling that occurred in the region of the cortex just above the root cap which appeared to mechanically restrict the radial enlargement of the cortical cells. This was usually accompanied by excessive meristematic activity in the endodermis and pericycle regions of the apex resulting in a thick ring of tissue from the fusion of several lateral root primordia. At rates of 200 ppm, lateral root primordia were stimulated in number and size in certain areas of the old roots as well as in the relatively immature regions next to the growing tip. In many regions of the older roots so affected, ruptured and necrotic areas associated with emergence of the new laterals were apparent on roots of the susceptible strain. When roots of both the resistant and susceptible strains were less severely affected, the numerous lateral root primordia near the root apex grew into short, clubby roots. The pattern that they assumed was different for the susceptible and resistant strains. (Washington Agricultural Experiment Station)

Some of the properties of 4(2,4-dichlorophenoxy) butyric acid. Kief, Mabel, and Freed, V. H. 4(2,4-dichlorophenoxy) butyric acid is receiving considerable attention as a selective herbicide. Interest in investigation of this compound leads to the desirability of possessing some knowledge as to its physical and chemical properties. The following is a preliminary compilation of some of these data.

Molecular Weight	249.0
Melting point	119-120
Solubility	
Water	46 ppm
Alcohols	very sol.
Chloroform	soluble
Benzene	soluble
Cyclohexane	poorly soluble
Hexane	poorly soluble

4(2,4-DB) is selectively retained on anion exchange resins from whence it may be eluted quantitatively by 0.05 M KCl in 50% aqueous methanol. Elution by means of a purely aqueous system requires a great deal of solvent. 4(2,4-DB) may be determined spectrophotometrically at its maxima of either 283 Mμ or 230 Mμ . The chemical is stable and does not yield a colored product with chromotropic acid. 4(2,4-DB) forms poorly soluble salts of divalent metals, salts of poorer solubility than those of 2,4-D with alkali metals and soluble salts with amines. (Department of Agricultural Chemistry, Oregon Agricultural Experiment Station)

PROJECT 8. RESEARCH TECHNIQUES

T. J. Sheets, Project Chairman

CONTRIBUTORS REPORTS

A quantitative technique for direct counting of radioactive ground plant material. Foy, Chester L. Studies on the absorption, translocation, and toxic action of herbicides are greatly facilitated by the use of radioisotopes. Too often, however, gross autoradiography is the sole approach used. This permits only semi-quantitative interpretation of the results, at best, and does not characterize the translocation radioactive substance as the original compound or some degradation product(s) thereof. Usually when counting is done the data obtained are relative rather than absolute.

In recent studies on the absorption, distribution, and metabolism of dalapon in relation to phytotoxicity, the techniques of (a) autoradiography, (b) counting, and (c) paper partition co-chromatography were combined. This report describes a fast, simple method for quantification of data obtained by direct counting of ground plant tissue which contains radioactive herbicide.

Wet and dry combustion methods are available for analysis of materials containing C^{14}. Also a plating and counting technique following the hydrolysis of dalapon-Cl^{36} to pyruvate has proven quantitatively satisfactory. Both methods, however, are rather laborious and time consuming and have certain limitations not encountered in the procedure described below. Moreover, in these studies where both C^{14}- and Cl^{36}-labeled dalapon were used, two analytical methods would have been required. Instead, standardization curves were constructed for direct counting of dry, ground plant material containing either Na dalapon-2-C^{14} or -Cl^{36}. Whole cotton plants comparable to those used in the experiments were dried and ground to 40 mesh in a Wiley mill. Then 600 μg (approximately 115 μl) of either Cl^{36}- or C^{14}-labeled dalapon were added to two grams of plant material and mixed thoroughly. In the case of dalapon-Cl^{36}, the amount added was equivalent to 0.054 μc (6635 cpm, GM tube); for dalapon-2-C^{14}, 1.130 μc (46,869 cpm, GM tube). Care was taken to prevent movement to the external surfaces of the plant mass. Vaporization losses were negligible during the drying process (40° C for one hour). Aliquot samples ranging from 20 to 1000 mg, but uniform in concentration, were spread smoothly in stainless steel planchets, tamped firmly with a special tamping device which just fitted inside the planchet, and counted (GM tube). Curves were constructed, plotting measured net activity (cpm) against sample thickness (mg/cm^2). Based on the known radioactivity in comparison with the measured net activity in each sample, corrections for self-absorption were calculated and plotted. The percent self-absorption in any sized sample of the plant material within this range could then be read directly from the latter pair of curves.

The lower specific activity, but higher energy of radiation, of Cl^{36} in comparison with C^{14} was readily apparent. The reliability of the technique was shown by the facts that relatively smooth curves were obtained and individual points on the curves were reproducible within 6 percent variability. Also both curves extrapolated well back to zero at infinite sample thinness. The over-all error in this simple yet convenient procedure is not considered excessive for most biological studies, and it is probably no greater than the combined errors encountered in other methods. (Botany Department, University of California, Davis, California)

PROJECT 10. VEGETATION

R. N. Raynor, Project Chairman

CONTRIBUTORS REPORTS

The comparative effectiveness of several soil sterilant compounds under western and eastern Oregon conditions. Chilcote, D. O. and Furtick, W. R. Many different compounds and combinations of compounds are being marketed at the present time for general vegetation control (soil sterilization). Each of these materials possesses inherent differences in solubility, adsorption and weed species affected. With the wide variety of climatic conditions in Oregon it was desirable to test the compounds for residual life and tolerant species under various rainfall and vegetation conditions.

Tests were established at a number of locations in the fall of 1957 and spring of 1958 in western Oregon and in the fall of 1957 in eastern Oregon. Materials tested were Sodium chlorate, Polybor chlorate, Atlacide and 2,4-D, Concentrated borascu, Karmex diuron, Telvar monuron, Simazin, Urox, Chlorea and Ureabor.

The more soluble compounds were applied only during the spring in western Oregon.

The Chlorate and Borate materials were ineffective for general vegetation control under the rainfall conditions of western Oregon even when spring applied. This lack of residual quality was also observed in eastern Oregon in some of the higher rainfall areas.

Diuron, Simazin and Telvar possessed considerable residual properties, but were ineffective on some of the deeper rooted perennial weeds.

In western Oregon, Diuron and Simazin compared quite closely as to effectiveness and residual life. Urox and Telvar also gave similar results although Urox appeared to be somewhat more effective on the perennial grasses.

The perennial weeds bracken fern and horsetail rush were controlled effectively only by the Borate type compounds. Canada thistle was best controlled by Chlorate or Borate materials.

Ureabor and Chlorea which are combinations of Telvar monuron with Borate and Chlorate respectively, were excellent for general vegetation control. These materials combined the effectiveness of the more soluble materials on the deep rooted perennial weeds and the residual control of monuron. In some of the higher rainfall areas, Ureabor appeared to be more residual than Chlorea.