March 17-19
Albuquerque, New Mexico

1
9
6
5

RESEARCH PROGRESS REPORT

Research Committee
Western Weed Control
Conference

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

Page

PROJECT 1. PERENNIAL HERBACEOUS WEEDS

Ken W. Dunster, Project Chairman

SUMMARY

Twenty-one reports were submitted for publication in this section. Research was conducted on thirteen perennial weed species with major emphasis on Canada thistle. Six abstracts were received on Canada thistle. Perennial smartweed and common tansy were the only other weed species receiving attention from more than one investigator.

Picloram and dicamba once again received considerable attention. Of the twenty-one reports, fifteen include results with picloram and fifteen concern control with dicamba.

Progress on each reported specie is briefly summarized.

Canada Thistle (Cirsium arvense). Idaho results indicate soil levels of nitrogen and phosphorus influence control obtained with 2,4-D. High temperatures increase toxicity with 2,4-D.

Canada thistle ecotypes collected in California and the mountain states show wide differences in response to treatment with 2,4-D, 2,4-DB, Amitrole and dicamba in California trials. The California strains vary markedly from those collected from the inter-mountain area in morphological characteristics. One strain collected from Montana was resistant to all chemical treatments.

Picloram produced excellent, consistent thistle control at rates of 1 to 2 lbs/ac. Dicamba appeared to give less consistent control at rates less than 5 lbs/ac. Picloram gave good control when applied as a late fall treatment. There is evidence that picloram is active through the soil.

Common Tansy (Tanacetum vulgare). Several herbicides including picloram, dicamba, oil soluble amine of 2,4-D and 2,4,5-TP gave excellent control of tansy at relatively low rates in Oregon and Idaho trials. Silvex appeared to be the most practical treatment in the Idaho series.

Perennial Smartweed. Work in Oregon indicates satisfactory control of Polygonum punctatum with picloram at rates of 1 and 2 lbs/ac. Considerable regrowth of Polygonum coccineum was noticed on picloram plots treated with rates as high as 4 lbs/ac. in California plotwork. Dicamba was considerably less effective at equivalent rates in both the Oregon and California trials.

Russian Knapweed (Centaurea repens). Treatments including picloram (1-2 lbs.), dicamba (5 lbs.), Tritac D (16 lbs.), and a combination of fenac 6 lbs.-2,4-D 4 lbs. gave outstanding knapweed control in a Wyoming trial. Only tritac-D injured native grass species.

Field Bindweed (Convolvulus arvensis). Picloram (1 lb/ac.), 2,4-D (40 lb/ac.), tritac-D (16 lb/ac.), benzabor (1.5 lb/ac.) and fenac granules (1 lb/sq. rod) produced 95% control of bindweed in a Wyoming study.

Leafy Spurge (Euphorbia esula). Picloram provided complete control of spurge at rates above 2 lbs/ac. Ammonium thiocyanate did not improve herbicidal properties of dicamba. Three treatments with 2,4-D per year for 5 years failed to kill spurge. Control with several herbicides is influenced by strain differences.

Yellow Toadflax (Linaris vulgaris). Surfactant added to 2,4-D at the 1% level improved toadflax control in an Idaho trial. Application made at the early flower stage produced better control than applications made in the vegetative or mature stages of growth.

Woolly Pod Milkweed (Asclepias eriocarpa). California trials showed picloram and dicamba to be ineffective at rates below 4 lbs/ac. Amitrole at 4 lbs/ac. and picloram at rates of 4 and 8 lbs/ac. were the most promising treatments in this series.

Horsetail Rush (Equisetum arvense). Ammate at 3 lbs/sq. rod has given the most consistent control in an Oregon trial. Amitrole-T at rates of 4 lbs/ac. has given good but somewhat inconsistent control.

Bitter Dock (Rumex obtusifolius). Of 9 treatments applied in an Oregon trial, only picloram at 2 lbs/ac. is giving continued control.

Wild Garlic (Allium vineale). Dicamba at 4 lbs/ac., 2,4-D ester at 2 lbs/ac., TBA at 1 lb/ac. and MH-30 at 10 lbs/ac. were treatments which looked extremely promising for the control of wild garlic in an Oregon trial. Picloram at rates as high as 2 lbs/ac. did not give adequate control.

Bracken Fern (Pteris aquilina). Many of the herbicides reported effective on this species in 1964 have failed to produce long term control or eradication. Dichlobenil, picloram, TH-073-H and hexafloroacetone are treatments which look promising in 1964 trials.

Bermuda Grass (Cynodon dactylon). A California trial indicates SMDC will provide effective control of established Bermuda grass when applied at the rate of 1 qt./100 sq.ft. and watered in.

Isocil was effective in controlling Bermuda grass at 10 and 15 lb/ac. levels of application 18 months after treatment.

The interaction of temperature, moisture, nitrogen and phosphorus levels on the response of Canada thistles to herbicides. Pennington, Lawrence R. and Erickson, Lambert C. The objectives of the study were to determine the influence on growth and herbicide sensitivity of two levels of nitrogen, phosphorus, moisture and temperature.

In the autumn of 1963 root segments were obtained from a single (Moscow) clone of Canada thistle. These segments were propagated and increased in the greenhouse and placed in 6 x 6 x 24 inch metal cans filled with a low nutrient fine sandy loam soil. After about six months of preconditioning with respect to soil aspects; moisture levels (1 and 1/3 atmosphere), phosphorus (0 and 50 lbs/A added), and nitrogen (50 and 150 lbs/A added), the respectively treated plants (4 reps. of each) were subjected to 2,4-D amine treatments at 3/4 and 1-1/2 lbs/A. Thereafter, they were maintained at two temperature levels (greenhouse and field) for one month. The plants were then removed from their containers, washed, oven-dried and weighed. Preconditioning was done to obtain a more uniform foliage. All top-growth was removed two and four months after transplanting. Top-growth thus removed served to indicate the growth response per treatment. On the day the 2,4-D treatments were applied half of the individual treatments were removed outdoors (low temperature) whereas the other half remained in the greenhouse (high temperature) for one more week, then moved outdoors.

Using dry root weight the following statistically significant differences were found between or among treatments: (1) high phosphorus levels decreased 2,4-D toxicity; (2) 2,4-D reduced root weight of check plants; (3) 2,4-D reduced rootweight most when associated with high nitrogen levels in the soil; (4) phosphorus increased root growth; (5) more root weight developed with 2,4-D x high phosphorus than with 2,4-D x low phosphorus; and (6) high temperature increased the toxicity of 2,4-D. (Plant Science Department, University of Idaho, Moscow.)

<u>Preliminary greenhouse trials on the susceptibility of several ecotypes of Canada thistle to four herbicides.</u> Smith, Leon W. and D. E. Bayer. Four ecotypes of Canada thistle designated YM, AI, G4 and FM obtained from Montana in 1961 and 4 selections collected from 4 localities in California in 1964 were grown in 6 inch plastic pots under greenhouse conditions.

The herbicides 2,4-D, 2,4-DB, amitrole and dicamba were applied at rates of 3/4 and 1-1/2 lb/A for 2,4-D and 2,4-DB, and 2 and 4 lb/A for amitrole and 1/8 and 1/4 lb/A for dicamba when the plants were 8 to 9 weeks old. Visual ratings were made of top growth effect after 3 weeks and regrowth and root effect ratings were made 6 to 8 weeks after application.

Montana ecotypes. FM was the most susceptible to 2,4-D and 2,4-DB, AI and YM were intermediate and G4 the most resistant.

YM was the most susceptible to amitrole, FM was intermediate and AI and G4 were the most resistant.

G4 was the most resistant to dicamba, AI intermediate, and no difference could be observed between the other clones which were the most susceptible.

California selections. The California selections designated by TC, SB, QS and RV show marked morphological differences from the Montana ecotypes, especially in leaf shape and growth habit. Of the California selections, SB was the most resistant to 2,4-D and 2,4-DB, QS the most resistant to amitrole and TC showed marked resistance to dicamba.

Comparisons in susceptibility between ecotypes from Montana and California cannot be made until the rootstocks from California selections have adjusted to greenhouse conditions. (Department of Botany, University of California, Davis.)

Chemical control of Canada thistle (Cirsium arvense Scop) in the Willamette Valley. Fechtig, A. D. and Furtick, W. R. This experiment was initiated in 1963 in an attempt to find a material(s) that would control this noxious perennial weed.

A completely randomized block design consisting of three replications of 10' x 40' plots was sprayed with a field plot sprayer. Approximately 34 gallons of water per acre were used to apply each of twelve chemicals. The compounds were applied on a cloudy day with a temperature of 68° when the thistle was from 6"-10" high.

After two years, Tordon 22K at two pounds per acre has essentially eradicated this species from two different locations in the Willamette Valley. Excellent control with dicamba was obtained at one location with a two pound rate, while at the second location eight pounds was not effective. These compounds appear, at the present time, to be the most promising of those tested in contolling this species.

Additional plots were established during the 1964 season to gain information on other herbicides. To date, Tordon 101 and a combination of one-half pound per acre of Tordon 22K and dicamba are showing excellent activity. (Dept. of Farm Crops, Corvallis, Oregon).

Control of Canada thistle with picloram and certain other chemicals. Hodgson, J. M. A preliminary application of 4-amino-3,5,6-trichloropicolinic acid (picloram) in this area by the Dow Chemical Company personnel in June 1962 resulted in outstanding control of Canada thistle. To investigate this new material further, a series of rod^2 plots infested with Canada thistle were treated with picloram and several other promising chemicals in July and November of 1963.

The July spray treatments compared 2-metholy-3, 6-dichlorobenzoic acid (dicamba) and picloram at four rates of application and replicated three times. The November applications included six chemicals at different rates. These were also replicated three times on rod^2 plots. The plots were located in an abandoned field infested with Canada thistle. Thistles were in the late bud and early bloom stage of growth for July treatments; the November treatments were made to the soil and dead top growth. The borders of all plots were treated with sodium chlorate at 10 lb/rod^2 to limit effects from one plot to another.

Picloram treatments in July at 1/2, 1, 2, and 4 lb./acre gave an estimated control of 90, 100, 100, 100 percent, respectively, 15 months after application. Dicamba at the same rates gave control of 10, 10, 25 and 75 percent, respectively.

The November treatments with results eight months after treatment again indicated picloram to be very effective (Table). Several other chemicals also gave excellent control of Canada thistle as evaluated on this date. Later evaluation of this series of plots was not possible as they were taken over by a housing development.

CANADA THISTLE
Willamette Valley, Oregon
Chemicals Applied - June 13, 1963
Plots Evaluated - July 2, 1964

		Location I			Location II			
	#/A	% Thistle Control			% Thistle Control			
Chemical	Rate	R1	R2	Ave.	R1	R2	R3	Ave.
1) Banvel D	2	10	70	40	95	98	95	96
2) Banvel D	4	10	30	20	95	100	85	93
3) Banvel D	8	50	90	70	95	100	75	90
4) Tordon 22K	2		98		99	100	95	98
5) Tordon 22K	4	90	99	95	100	100	100	100
6) Tordon 22K	8	98	98	98	100	100	100	100
7) Banvel D + 2,4-D (A)	.5+.5	0	0	0	75	95	95	88
8) Banvel D + 2,4-D (A)	1 + 1	0	60	30	95	95	95	95
9) MCPB (E)	3	30	10	20	100	85	75	88
10) MCPB (E)	6	10	40	25	90	95	85	90
11) 2,4-DB (E)	3	0	0	0	70	95	100	88
12) 2,4-DB (E)	6	10	10	10	75	95	90	87
13) 2,4-D (A)	3	20	0	10	70	40	75	61
14) 2,4-D (A)	6	10	0	5	50	95	98	81
15) DP-634	2	0	0	0	0	0	0	0
16) DP-634	4	0	0	0	0	0	0	0
17) DP-634	8	0	0	0	0	0	0	0
18) DP-762	2	0	0	0	0	0	0	0
19) DP-762	4	0	0	0	0	0	0	0
20) DP-762	8	0	0	0	0	10	10	6
21) Hyvar X	2	0	0	0	0	0	0	0
22) Hyvar X	4	0	0	0	0	0	0	0
23) Hyvar X	8	0	0	0	0	0	0	0
24) Amitrole	4	40	60	50	70	75	90	78
25) Amitrole	6	50	70	60	85	95	99	93
26) Amitrole	8	--	80	--	80	95	95	90
27) Tritac	8	0	0	0	0	0	0	0
28) Tritac	16	0	0	0	0	0	0	0
29) TBA	10	0	10	5	60	90	98	82
30) TBA	15	50	30	40	85	75	85	81
31) TBA	30	90	98	94	100	85	98	94
32) Check		0	0	0	0	0	0	0

The picloram treatments caused considerable injury to the few perennial grasses present at 2 and 4 lb./acre in the July treatments. Perennial grasses did not show injury symptoms from any of the dicamba treatments.

Several of the November treatments prevented emergence of annual weed growth in 1964. Picloram, 2,3,6-trichlorophenylacetic acid (fenac), and 2,3,6-trichlorobenzyloxypropanol (tritac) exhibited considerable residual effects as indicated by the absence of spring germinating annual weeds. Dicamba, 2,4-dichlorophenyxyacetic acid (2,4-D), and 2-methyl-4 chlorophenoxyacetic acid (MCPA) had very little residual effect on spring germinating annual weeds. (Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture; and Plant and Soil Science Department of the Agricultural Experiment Station, Bozeman, Montana.)

Table 1. Canada thistle control with chemicals applied November 29, 1963 Bozeman, Montana[1]

Chemical	Formulation	lbs/acre[2]	Control on June 25, 1964
			Percent
Picloram	K Salt	2.5	100
Picloram	K Salt	5	100
Fenac	Na Liquid	2.5	60
Fenac	Na Liquid	5	90
Fenac	Na Liquid	10	97
Dicamba	Amine	5	98
Dicamba	Amine	10	87
2,3,6-trichloro-benzel-oxypropanol	Amine	10	98
2,3,6-trichloro-benzel-oxypropanol	Amine	15	100
MCPA	Acid	20	91
MCPA	Acid	40	100
2,4-D	Acid	40	94

[1] Data are averages of three replications

[2] Expressed as acid equivalent or active ingredient of the chemical.

Chemical control of Canada thistle (Cirsium arvense (L.) Scop.). Alley, H. P. and Chamberlain, E. W. In the summer of 1963 an extensive research project was initiated to study the effect of new and promising compounds on control of Canada thistle at two stages of growth.

The first test was established when the thistle plants were in the bud to bloom stage of growth. A completely randomized block consisting of three replications of square rod plots was established. Each replication consisted of 42 different treatments with only six treatments showing satisfactory control one year after application. These treatments are tordon (1 lb/A) 90% control; tordon (2 lb/A) 98+% control; tordon (4 lb/A) 100% control; tordon granules (3 lb/A) 100% control; dicamba (5 and 10 lb/A) 95% control; and benzabor (1.5 lb/sq. rod) 96% control.

Test number two was initiated October 11, 1963, on six inch regrowth of Canada thistle that had been previously mowed. Twenty treatments were established in a randomized block of three replications giving a total of sixty treatments. Treatments giving satisfactory Canada thistle control nine months after application were: tordon (1, 2, 3, and 4 lb/A) 100% control; benzabor (1.5 lb/sq. rod) 95% control; 2,3,6-TBA (20 lb/A) 95% control; tritac-D (16 lb/A) 98% control; dicamba (5 lb/A) 90% control; and dicamba (10 lb/A) 98+% control.

Tordon treatments at rates below 4 lb/A did not injure grasses and dicamba treatments resulted only in slight injury to grasses. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Canada thistle control. Lange, A. H., Bayer, D. E., Street, J. E., Smith, P. D., and Rimbey, C. W. Several herbicides were applied to heavy stands of Canada thistle (Cirsium arvense) July, 1963 at two locations; one in the Round Valley of Inyo County and the other near Quincy in Plumas County, California. Both experiments were on river bottom fine sandy loam soil. Materials were applied by use of a knapsack sprayer. Plot size was one square rod in the Inyo experiment and 10 ft. x 15 ft. in the Plumas experiment. The herbicides were applied in aqueous solution at about 150 gallons per acre.

Of the herbicides tested, picloram gave outstanding thistle control at rates above 2 lb/A (Tables 1 and 2). They were evaluated approximately one year after application. The early burn-down was most striking with paraquat at 2 lb/A evaluated two months after application. Although the initial top growth had been destroyed, there was almost a solid stand of regrowth two months after application (Table 2). Judging from the considerable regrowth in the 2,4-D and dicamba treatments, there was only limited translocation to the underground storage system. In view of the amount of regrowth in the picloram plots, at two months after application we would expect some of the control evident at one year to be soil uptake from picloram, particularly at the higher rate of 4 pounds per acre.

2,4-D at four pounds gave better Canada thistle control, particularly in the Inyo experiment, than dicamba. Neither herbicide gave outstanding control in both experiments. Amitrole-T at 4 lb/A appeared to be about equivalent to 1 lb/A of picloram which still might be more economical if the relative cost of materials is taken into consideration. (University of California, Davis).

Table 1. The average control of Canada thistle applied 7/3/63--evaluated 6/5/64. Inyo County.

Herbicide	lb/A	Percent control after 1 year
2,4-D LVE	2	20
2,4-D LVE	4	65
dicamba	2	10
dicamba	4	30
picloram	2	85
picloram	4	95
amitrole	2	5

Table 2. The average control of Canada thistle applied 7/18/63--evaluated 9/18/63 and 7/3/64. Plumas County.

Herbicide	lb/A	% initial burn-down 2 mo.	% young regrowth in plots 2 months	% control after 1 year
2,4-D amine	2	57	45	5
2,4-D acid	2	52	36	2
dicamba	2	49	42	15
dicamba	4	51	29	8
picloram	1/2	51	46	35
picloram	1	55	28	52
picloram	2	66	16	82
picloram	4	73	15	98
Amitrole-T	4	34	21	52
paraquat	2	100	100	8
check	--	0	67	8

Chemical control of tansy ragwort (Tanacetum vulgare) in western Oregon. Fechtig, A. D. and Furtick, W. R. The primary objective of this experiment was to find a herbicide that would control this poisonous weed prevalent in pastures which is responsible for the annual loss of a number of cattle.

These research plots were established during the 1963 growing season at two different locations, one in the Willamette Valley and the other in the Coastal Mountain Range.

Completely randomized block designs consisting of three replications of 10' x 40' plots were sprayed with a field plot sprayer. Approximately 34 gallons of water per acre were used to apply the various herbicides.

Tordon 22K, dicamba, 2,4-D (E), bromacil, and atrazine appear to be the most promising compounds of those tested, Tables 1 and 2. Additional plots were established during the 1964 growing season, but Tordon 101 was the only additional compound found to be effective in controlling tansy ragwort. (Dept. of Farm Crops, Corvallis, Oregon).

Table 1. Tansy Ragwort control in the Oregon Coastal Range
Chemicals Applied - May 21, 1963
Plots Evaluated - August 28, 1964

Chemical	Rate #/A	% Tansy Control August 28, 1964			
		R1	R2	R3	Ave.
1) Hyvar	1	0	0	--	0
2) Hyvar	5	0	0	0	0
3) Hyvar	10	0	0	0	0
4) Atrazine	5	90	98	100	96
5) Atrazine	10	100	95	100	98
6) Tordon 22K	0.5	100	100	100	100
7) Tordon 22K	1	100	99	--	99
8) Tordon 22K	2	100	100	100	100
9) Banvel D	0.5	98	95	--	97
10) Banvel D	1	98	95	--	97
11) Banvel D	2	98	98	100	98
12) Hyvar X	1	0	0	0	0
13) Hyvar X	5	90	98	100	96
14) Hyvar X	10	100	100	100	100
15) 2,4-D ester	1.5	95	100	--	97
16) Dacamine D	1.5	98	100	--	99
17) 2,4-D amine	1.5	90	60	60	70
18) 2,4-D (75WP)	1.5	100	95	98	98
19) Check		0	0	0	0
20) Check		0	0	0	0

Table 2. Tansy Ragwort control in the Willamette Valley, Oregon
Chemicals Applied - May 29, 1963
Plots Evaluated - August 14, 1964

Chemical	Rate #/A	%Tansy Control August 14, 1964 R1	R2	R3	Ave.
1) Hyvar	1	0	0	0	0
2) Hyvar	5	0	0	0	0
3) Hyvar	10	0	0	0	0
4) Hyvar X	1	0	10	0	3
5) Hyvar X	5	100	99	100	99
6) Hyvar X	10	100	100	100	100
7) Atrazine	5	99	100	99	99
8) Atrazine	10	100	100	100	100
9) Tordon 22K	.5	98	85	35	73
10) Tordon 22K	1	99	98	90	96
11) Tordon 22K	2	--	100	100	100
12) Banvel D	.5	0	0	85	28
13) Banvel D	1	85	100	80	88
14) Banvel D	2	100	90	100	96
15) 2,4-D ester	1.5	95	100	75	90
16) Dacamine D	1.5	30	30	80	46
17) 2,4-D Amine	1.5	75	60	75	70
18) 2,4-D (757-WP)	1.5	30	0	95	41
19) Check		0	0	0	0
20) Check		0	0	0	0

Chemical control of common tansy (Tanacetum vulgare). Erickson, Lambert C. and Pennington, Lawrence R. Common tansy is best adapted to ruderal situations, thus, its most dominant invasions are found along roadsides, canals and ditchbanks, in permanent pastures and on occasionally flooded or otherwise lightly disturbed areas. It does not prevail in cultivated fields. Its persistence and further encroachment in areas annually or intermittently treated with 2,4-D prompted this investigation.

These treatments were applied in a dense stand along a highway border and fenceline north of Moscow in 1963. The highway border had been treated intermittently with 2,4-D for several years. An understory of Kentucky bluegrass prevailed throughout, and one or more additional weed species were present in several plots. The plots were 10 x 20 or 10 x 50 feet parallel to the highway.

Of all the herbicides tested, silvex appeared to be one of the most practical. Others which appeared to be especially toxic to tansy without causing soil sterility were: picloram, 2,4,5-T, dicamba and TBA. The relative performance of 17 herbicides or formulations is given in the following table. (Idaho Agricultural Expt. Sta., University of Idaho, Moscow.)

Average percentage kill of tansy obtained one year following the herbicide applications

Date Appl.	Herbicide	Rate lbs/A	% kill	Remarks
4/25	2,4-D, amine	2,4,8	25,25,50	Tansy stunted
6/10	"	2,4,8	25,35,90	" " grass ok
5/11	" (dacamine)	2,4,8	80,90,95	" " " "
6/10	" "	2,4,8	0,25,75	" " " "
6/10	" (emulsamine)	2,4,8	0,4,90	" " " "
5/11	amitrole	4,6,8	0,0,0,	Tansy & grass chlorotic
6/6	amitrole T	2,4	50,75	Grasses normal
		6,8	95,99	" "
5/25	atrazine	5	60	Tansy & grass abnormal
	"	10,15,20	(100)	Soil sterile
5/25	bromacil	5,10	0,0	Grasses killed
	"	15,20	20,20	Soil variably sterile
5/11	dicamba	1,2	(80)	Tansy stunted, grass normal
	"	4,8	90,100	Grass normal
5/25	diuron	5	0	Tansy stunted, grass normal
	"	10	40	Tansy stunted, grass killed
	"	15,20	(100)	Plantain present
5/25	fenac	2,4	0,0	Tansy stunted, grass normal
	"	6,8	50,80	" " " "
5/25	monuron	5,10	0,50	Grasses killed
	"	15,20	95,100	Grasses killed, buckhorn and dandelion present
6/6	picloram	0,5,1	0,99	Tansy darker green
		2,4	(100)	Grasses normal
5/11	silvex	2,4,8	(100)	Grasses normal
6/6	simazine	5,10	0,60	Plots disturbed
5/11	TBA	5,10	50,90	Grasses normal
	"	15,20	(100)	" "
6/6	tritac	5,10,20	0,0,0	Tansy malformed
5/11	2,4,5-T(LVE)	2,4,8	35,80,100	Grasses normal

Chemical control of perennial smartweed (Polygonum punctatum) in Astoria bentgrass. Fechtig, A. D. A solution for controlling perennial smartweed in bentgrass seed fields, hay, and pasture areas in the extremely wet areas of western Oregon was needed. Therefore, in an effort to find a chemical control, three replications were sprayed on a sunny day in 1963, with an air temperature of 78°.

After one year, Tordon 22K at one pound per acre is giving 90% control. Increasing the rate to two pounds per acre gives 95% control of this species. A two-pound per acre rate of dicamba was responsible for 70% control of this species after one year. 2,4-D amine at two pounds per acre was not effective. No observable injury was noted on the established Astoria bentgrass. (Dept. of Farm Crops, Corvallis, Oregon)

Control of perennial smartweed (Polygonum coccineum) by foliar applied herbicides. Elmore, C. L. and Lange, A. H. Trials using the herbicides, dicamba and picloram, were applied at three locations in California in 1964. The herbicide 2,4-D was used in two of these trials. All herbicides were applied with knapsack sprayer with Teejet 8004 nozzles at 30 psi. All plots were replicated four times and located in dense stands of smartweed. It was found that after one month most treatments were very similar with all showing browning of the leaves and stems. However, 7 to 9 months after application regrowth was extensive in the 2 and 4-pound rates of 2,4-D and dicamba. Picloram at the rates of 1, 2, and 4 pounds appeared to give 20 to 85% control. After one year the 2-pound rate gave 50%, 58%, and 30%, respectively, whereas the 4 pound rate gave 67%, 85%, and 53%, respectively. The plots of 1 pound per acre of picloram were approximately 80% regrown with smartweed. It would appear from these tests that 2 to 4 pounds of picloram per acre are needed for control of perennial smartweed. (University of California, Davis.)

		Percent Reduction								
	Rate*	Test I			Test II			Test III**		
Herbicide	#/A	1 Mo	9 Mo	12 Mo	1 Mo	7 Mo	12 Mo	2 Mo	11 Mo	15 Mo
2,4-D	2	59	0	0	68	5	0	--	--	--
	4	80	27	0	80	18	0	--	--	--
Dicamba	2	42	17	0	85	40	0	13	0	0
	4	65	27	0	90	50	5	23	10	0
Picloram	1	78	100	20	85	80	28	--	--	--
	2	83	100	50	88	90	58	70	70	30
	4	95	100	67	95	95	85	73	90	53
Check	-	0	0	0	12	15	5	10	0	0

* Rates of herbicides are based on active ingredient.
** In Test III, 2,4-D and 1 lb/A picloram was not included.

Chemical control of Russian knapweed (Centaurea repens L.). Alley, H. P. and Chamberlain, E. W. New research plots for control of Russian knapweed were established in 1963. Sixteen different treatments were applied at the pre-bud stage of growth on May 30, 1963, and plot evaluations were taken one year later. Tordon (1 and 2 lb/A) gave 100% control with no damage resulting to native grass species. Other outstanding treatments were tritac D (16 lb/A) 100% control; fenac liquid (10 lb/A) 100% control; dicamba (5 lb/A) 99% control; and fenac + 2,4-D mixture (4 gal/A) 99% control. Severe grass damage was observed only in the tritac D treated plots. (Wyoming Agricultural Expt. Sta., University of Wyoming, Laramie.)

Chemical control of field bindweed (Convolvulus arvensis L.). Alley, H. P. and Chamberlain, E. W. In the fall of 1963 plots for the control of field bindweed were established in two locations in Wyoming. In both areas the bindweed was in the full bloom stage of growth. Evaluations of these plots ten months after treatment show the following results: tordon (1, 2, 3, and 4 lb/A) 100% control; tordon granules (3 lb/A) 100% control; tordon 10K brush control pellets (4 lb/A) 97% control; 2,4-D amine (40 lb/A) 96% control; tritac D (16 lb/A) 96% control; benzabor (1.5 lb/sq. rod) and fenac granules (1 lb/A) 98% control. Fifteen other treatments in this test did not give satisfactory bindweed control. Tordon treatments at rates less than 4 lb/A did not injure grasses. (Wyoming Agricultural Expt. Sta., University of Wyoming, Laramie.)

Chemical control of leafy spurge (Euphorbia esula.). Baker, Laurence O. Twelve leafy spurge strains obtained from several states and provinces and asexually propagated were further tested for reaction to various herbicides. (See 1964 WWCC Research Report). Strain differences were observed with treatments of 2,4-D at 2 pounds and amitrole at 3 pounds, but not with tordon at 3 pounds per acre. However, there was an indication that strain differences existed when tordon was applied at a rate of 1 pound per acre.

Two to 4 foliage treatments with 2,4-D were necessary to kill even the most susceptible strains growing in quart cans. Up to 3 treatments per year for 5 years has failed to control an old established infestation. The strain from Colorado appears to be most susceptible, with one from Montana being most resistant to 2,4-D.

Twelve rod square plots treated with dicamba at 4 pounds per acre applied to the foliage had an average of 23% regrowth 16 months following treatment. Ammonium thiocyanate did not improve the dicamba kills when tested at rates of 2 and 4 pounds in combination with dicamba. Tordon in this same test permitted no regrowth from a 3 pound per acre fall application. In another test where tordon was applied to the foliage at rates of 1, 2 and 4 pounds per acre there was no regrowth at the 2 higher rates and only a trace of spurge was found on the plots treated at 1 pound per acre. Kentucky bluegrass and green needlegrass were severely injured at the 4 pound rate. (Montana Agricultural Expt. Sta., Bozeman.)

Control of yellow toadflax with 2,4-D. Ames, G. D. The variables, 2,4-D dosage, surfactant (X-77) concentration, and stage of growth for application were studied in two experiments. Plot designs were intended to obtain maximum information on a minimum number of plots as uniform patches of large size are rare. Plots 6.6 feet square (acre x 10^{-3}) were found to be large enough to have little border effect with yellow toadflax. Plant cover readings were taken with a decimally divided one square foot sampler in the plot center and adjacent on each of the diagonals.

Three simple tables will convey the general information, whereas a series of three dimensional graphs are required to show the extent of the interactions.

Yellow toadflax in smooth brome railroad right-of-way

2,4-D dosage effect (levels of surfactant and time lumped)		X-77 conc. effect (levels of 2,4-D and time lumped)		Timing effect (levels of 2,4-D and surfactant lumped)		
2,4-D ppa ae.	7/2/64 % grd. cover	X-77 % conc.	7/2/64 % grd. cover	treatment date	growth stage	7/2/64 % grd. cover
0	54	0	34	6/14/63	veg.	50
3.9	64	.2	37	7/6/63	E flower	25
7.8	25	.5	40	8/13/63	M flower	35
10.0	37	.8	42	9/12/63	E seed	50
16.1	44	1.0	26	10/4/63	senescent	80
20.0	31					
32.2	24					

Because the above design assumed a linear influence of time and that assumption is unlikely another set of plots was initiated.

A larger number for degrees of freedom on time but with fewer dates of application gave much the same array as that shown in the above tables.

Yellow toadflax in pasture and sagebrush

2,4-D dosage effect (levels of surfactant and time lumped)		X-77 conc. effect (levels of 2,4-D and time lumped)		Timing effect (levels of 2,4-D and surfactant lumped)		
2,4-D ppa ae.	7/2/64 % grd. cover	X-77 % conc.	7/2/64 % grd. cover	application date	growth stage	7/2/64 % grd. cover
0	70	0	35	7/3/63	E flower*	24
2.5	38	0.5	50	9/1/63	mature	47
5.0	50	1.0	40	6/1/64	veg.	61
10.0	36					
20.0	36					

* Early flower stage of plants protected from grazing by sagebrush.

In summarizing one year's work of the two experiments with consideration to interactions, 1% surfactant enhanced the effect of 2,4-D slightly over no surfactant, and .2 to .8% gave poorer control at all dates and 2,4-D dosage levels. Early to mid-flowering stage of growth (early July spraying in upper Snake River valley) was superior to spraying at other times. (University of Idaho Tetonia Br. Exp. Sta., St. Anthony, Idaho.)

Chemical control of woollypod milkweed (Asclepias eriocarpa Benth.). Bayer, D. E. and Schoner, C. Four herbicides, picloram at 1, 2, 4, and 8 lb/A ai, dicamba at 2 and 4 lb/A ai, amitrole at 4 lb/A ai, and 2,4,5-T at 2 lb/A ai, were applied July 17, 1963, to woollypod milkweed plants, in the 1/2 bloom stage. The plots were located in a previously cultivated field in the Sacramento Valley. Four replications were used. Evaluations made June 30, 1964, may be seen in the table below. Amitrole at 4 lb/A and picloram at 4 and 8 lb/A showed the greatest promise for the control of woollypod milkweed. (Department of Botany, University of California, Davis)

Evaluation of amount of regrowth of woollypod milkweed one year after treatment

Herbicide	lb/A ai	Percent control
Picloram	1	15
	2	40
	4	75
	8	95
Dicamba	2	10
	4	20
Amitrole	4	75
2,4,5-T	2	15
Control	-	0

Chemical control of horsetail rush (Equisetum arvense). Fechtig, A. D. and Furtick, W. R. In an attempt to find a herbicide that would control this species, several research plots were established in 1963. Additional plots were established in 1964 employing those chemicals which had previously shown activity on this species.

Individual 10' x 40' plots were arranged in a randomized complete block design at each location. These plots were sprayed with a field plot sprayer in a volume of approximately 34 gallons of water per acre.

Evaluations which were made fourteen months after the chemicals were applied indicate that Amitrole T at 4 pounds per acre is giving as high as 95% control in some areas. However, these results have not been consistent. Isocil at 15 pounds per acre has eradically controlled this species as high as 98% at some locations. Ammate at 3 pounds per square rod has given consistent control of 95% of the horsetail population. Dichlobenil applied in May of 1964, has effectively controlled this species four months after application. (Dept. of Farm Crops, Corvallis, Oregon).

Chemical control of bitter dock (Rumex obtusifolius L.). Fechtig, A. D., and Furtick, W. R. This experiment was initiated in order to determine which, if any, of several potential bitter dock controlling herbicides would be effective in the wet pasture, hay and seed producing fields in western Oregon.

Three replications of 10' x 40' plots were sprayed with a field plot sprayer. Of the nine initial candidates, only Tordon 22K at two pounds per acre is giving continued control of this species. Other chemicals which have proven ineffective in the control are: 2,4-D amine, 2,4-DB amine, MCP amine, dicamba, barban, isocil, and atrazine, at four pounds per acre; and tritac at ten pounds per acre.

Additional plots of this species were established in the Astoria, Oregon, area during 1964. From these plots, Tordon 101 has shown excellent initial control of this species at one gallon per acre. Dicamba has continued to be ineffective for controlling this particular Rumex species.

It should be brought to the attention of the readers that this species was reported in the 1964 Research Progress Report, page 14, as Rumex crispus. This species has since been definitely identified by the Oregon State University herbarium to be Rumex obtusifolius. (Dept. of Farm Crops, Corvallis, Oregon.)

Chemical control of wild garlic (Allium vineale) in the Willamette Valley. Fechtig, A. D. and Furtick, W. R. Wild garlic is a serious perennial weed in many areas in the Willamette Valley, and is responsible for yield and quality reduction of cereal grains, forages, and pastures. Due to the climatic conditions of the Willamette Valley, garlic is extremely difficult to control by employing a proper crop rotation; therefore, a good economical chemical means of controlling garlic is needed.

Completely randomized field plots, 8' x 30', replicated three times were sprayed with several different herbicides in 1963. After one year, four of the compounds that were applied are showing excellent control of this species, see table. These four compounds have given consistent control of wild garlic at all locations. Picloram (Tordon 22K), however, has shown eratic results in all plots. (Dept. of Farm Crops, Corvallis, Oregon).

Wild Garlic Control, Corvallis, Oregon
Sprayed April 2, 1963 - Evaluated February 28, 1964

Chemical	Rate lb/A	Percent Control R1	R2	R3	Average
1) Dicamba	.50	20	40	40	33
2) Dicamba	1	50	65	80	65
3) Dicamba	2	60	80	70	70
4) Dicamba	4	95	95	98	96
5) Picloram (22K)	.25	20	0	40	20
6) Picloram (22K)	.50	85	0	40	41
7) Picloram (22K)	1	90	30	50	56
8) Picloram (22K)	2	60	98	0	53
9) 2,4-D (E)	1	20	20	40	26
10) 2,4-D (E)	2	90	90	98	92
11) 2,4-D (E)	4	98	100	98	99
12) TBA	1	90	98	98	95
13) TBA	2	95	98	90	94
14) TBA	4	100	98	100	99
15) TBA	8	100	100	100	100
16) MH-30	10	100	100	100	100
17) Check		0	0	0	0
18) Check		0	0	0	0
19) Check		0	0	0	0

Chemical control of bracken fern (Pteris aquilina L.) in western Oregon. Fechtig, A. D. and Furtick, W. R. In an attempt to find an economic method of controlling bracken fern, a number of research plots were established in 1963 and again during 1964. This particular species has become a serious problem in tree plantations, pastures, and many other areas in western Oregon. Therefore, the ultimate aim of this research program has been to find a chemical means of controlling or eradicating this species.

In 1963, twelve different herbicides were applied at each of two locations of randomized blocks, with plots 10' x 40'. The herbicides were applied with a field plot sprayer in a volume of 34 gallons per acre. This same method was employed to establish the plots in 1964.

Although initial control of this species was obtained from a number of the herbicides, only a few of the compounds are still showing activity (see table next page).

Herbicides which were applied during May of 1964 and which are showing excellent activity on this species include: dichlobenil, 4% granular; TH-073-H; Tordon 22K, and hexafloro acetone. The dichlobenil at eight pounds per acre is giving approximately 85% control four months after the date of application. Sixteen pounds of this material increased the control to 100%. The experimental herbicide, TH-073-H, at 4 pounds per acre gave comparable results to the lowest rate of dichlobenil; however, an eight pound rate of this chemical did not increase the % control. Picloram (Tordon 22K) at six and nine pounds per acre is giving 75 and 95% control, respectively. Hexafloro acetone at twenty and forty pounds per acre are comparable with the two picloran rates, respectively. (Dept. of Farm Crops, Corvallis, Oregon).

Control of Bermudagrass (Cynodon dactylon (L.) pers.) with SMDC. Bayer, D. E. and H. R. Drever. A trial was initiated to compare the effectiveness of SMDC when applied to areas infested with established Bermudagrass. The top growth of the Bermudagrass was removed prior to any treatment by under-cutting at the soil surface with a shovel. Five days prior to treatment with SMDC one area was loosened by turning the soil. The other was left undisturbed.

SMDC was applied at the equivalent rate of 1 qt/100 sq ft in 2 gallons of water and sprinkled uniformly over the area. Immediately following the application of SMDC, the equivalent of 1/2 inch of water was applied to the surface of the treated plots. This amount of water was repeated each day for the following 2 days.

The Bermudagrass was severely injured by the second day and by the fourth day all plant growth appeared dead. Seven weeks later the only regrowth was in the plots that were loosened prior to treatment. Regrowth was from plant parts near the surface. (Department of Botany, University of California, Davis.)

Bracken Fern Control
Chemicals Applied - April 24, 1963
Alsea, Oregon
Plots Evaluated - September 12, 1963 & July 17, 1964

		% Fern Control September 12, 1963				% Fern Control July 17, 1964			
Chemical	Rate	R1	R2	R3	Ave.	R1	R2	R3	Ave.
1) Tordon 22K	2	*	50	50	50	*	0	0	0
2) Tordon 22K	4	50	*	*		50	*	*	*
3) Tordon 22K	8	20	*	*		60	*	*	*
4) Tordon 10K	2	10	*	*		80	*	*	*
5) Tordon 10K	4	*	10	10	10	*	0	90	45
6) Tordon 10K	8	*	50	30	40	*	90	50	70
7) Hyvar	5	70	90	80	80	0	10	20	15
8) Hyvar	10	90	100	100	96	60	80	80	73
9) Hyvar	15	95	100	100	98	85	90	70	81
10) Hyvar X	1	0	10	0	3	0	0	0	0
11) Hyvar X	2	0	10	30	13	0	0	0	0
12) Hyvar X	4	60	80	60	66	0	0	0	0
13) Banvel D	2	20	10	10	13	0	0	0	0
14) Banvel D	4	40	60	70	56	0	0	20	6
15) Banvel D	8	60	70	80	70	0	0	30	10
16) Amitrole T	4	60	30	50	46	0	0	0	0
17) Amitrole T	8	90	60	60	70	40	20	20	27
18) Amitrole T	16	80	90	80	83	20	20	20	20
19) TD-191	4	20	60	60	46	0	0	0	0
20) TD-282	4	50	40	40	43	0	0	0	0
21) MH-30	12	10	40	10	20	70	40	50	53
22) Tritac	10	20	20	20	20	10	0	0	3
23) Tritac	30	60	50	50	53	35	0	0	11
24) Prometone	16	10	10	0	6	0	0	0	0
25) Borascue	12#/rd^2	10	10	*	10	10	50	*	20
26) Check		0	0	0	0	0	0	0	0
27) Check		0	0	0	0	0	0	0	0
28) Check		0	0	0	0	0	0	0	0

* Chemicals not applied.

Evaluation of soil sterilant herbicides for use along roadsides. Elmore, C. L., Buschmann, L. L., Bayer, D. E. An area of sandy soil with a uniform weed stand was chosen to evaluate a number of common soil sterilant herbicides. All herbicides were applied with a knapsack sprayer with 8004 Teejet nozzles at 30 psi.

Visual ratings (0 = no control, 10 = complete control) were taken 6, 12, and 18 months after a winter application. Averages of four replications are shown below for annual weed control for each herbicide and rate. All herbicides and rates except 5 pounds per acre of isocil gave good weed control for six months. Diuron gave acceptable weed control although it was not as good as the other herbicides. After one year, simazine at 5 and 10 pounds, prometone at 80 pounds and atrazine at 10 and 15 pounds per acre were maintaining good weed control. It was apparent that isocil and diuron were lost quite rapidly at all rates. There was no residual control even at the high rates at 18 months. There was acceptable weed control 18 months after application with simazine, atrazine, and prometone at 10, 15, and 80 pounds, respectively.

Average Weed Control Ratings for 18 Months - Months After Applications
Applied: January 9, 1963 0 = no control; 10 = complete control

Herbicide	lb/A	Annual Weed Control 6 Mo.	12 Mo.	18 Mo.
Prometone	20	9.1	5.3	4.0
Prometone	40	9.8	4.0	7.0
Prometone	80	10.0	9.5	9.0
Isocil	5	4.2	2.2	0.0
Isocil	10	7.9	3.6	3.0
Isocil	15	9.0	4.5	5.0
Atrazine	5	9.2	4.0	3.0
Atrazine	10	10.0	7.5	5.0
Atrazine	15	10.0	8.5	9.0
Simazine	5	9.8	7.7	7.0
Simazine	10	10.0	9.0	9.0
Diuron	5	7.5	3.0	4.0
Diuron	10	8.7	5.7	5.0
Control	--	0.0	0.0	.0

The two perennial weeds present, field bindweed and Bermudagrass, were only affected by two herbicides. Isocil at 10 and 15 pounds per acre was effective in controlling Bermudagrass after 18 months. Prometone showed some effect on field bindweed; however, control was limited. Annual ryegrass was found to be quite tolerant of the 80 pound rate. (University of California, Davis).

PROJECT 2. HERBACEOUS RANGE WEEDS

W. C. Robocker, Project Chairman

SUMMARY

If relative importance of range weeds were determined by the number of reports submitted on a given species, medusahead (Elymus caput-medusae L., or as preferred by some researchers, Taeniatherum asperum (Sim.) Nevski) would now rank first with the largest number of contributions on this species.

Ecological studies showed that response of downy brome (cheatgrass) and medusahead were not parallel in eastern Oregon under the same environmental conditions. In another study, evidence indicated that a differential in rate of winter survival of medusahead and downy brome could be a substantial reason for replacement of downy brome by medusahead in many areas. Establishment of two wheatgrasses on plots treated with combinations of tillage and herbicides was not satisfactory. Atrazine at 1 lb/A applied in the fall gave good control of medusahead in Oregon.

Clubmoss was controlled 100 percent with 20 lb/A of ammate or 2 lb/A of atrazine with an increased percentage yield of other vegetation. Picloram, referred to by the proprietary name of Tordon* in three reports, controlled tall larkspur, plains larkspur, prickly pear cactus, common milkweed, Dalmatian toadflax and rush skeletonweed at rates up to 3 lb/A. Prickly pear and plains larkspur were also controlled with silvex, while Dalmatian toadflax was controlled with both silvex and dichlorprop.

Response of cheatgrass (Bromus tectorum L.), medusahead (Taenietherum asperum (Sim.) Nevski) and other annuals to variable climatic conditions. Turner, R. B. The pattern of growth and development of annual range vegetation was markedly different at a site in eastern Oregon in 1964 than the preceding year. The interaction of temperature and available moisture apparently influenced strongly the character of a deteriorated range plant community under ecological study near Huntington, Oregon, in the Snake River hills. The vegetation at this site is normally dominated by cheatgrass, scattered patches of medusahead and sparse clumps of bluebunch wheatgrass (Agropyron spicatum (Pursh.) Scribn. and Smith).

In 1963, temperatures at Huntington were much above average in February, slightly above in March, slightly below in April, above in May and near normal in June (see table). Precipitation during this period was below the long time average in early spring, but much above in April, near normal in May and above in June. In 1964, on the other hand, mean temperatures were below average for the entire spring growing period. Moreover, February, March and May were drier than average, while April

* Tordon is the Dow Chemical Company trade name for 4-amino-3,5,6-trichloro-picolinic acid. The common name of "picloram" has been assigned by the Terminology Committee of the Weed Society of America.

was slightly above average in 1964. An unusually wet June followed.

Fall temperatures were near normal previous to both 1963 and 1964 seasons, while winter was below average. Early fall precipitation was more favorable prior to the 1963 growing season, whereas November and January were much above average prior to the 1964 season. Since temperatures were so cold during these months, however, it seems unlikely that much of this moisture was later available for plant growth.

At the site studied, cheatgrass grew vigorously in 1963, whereas growth was extremely impoverished in 1964. Typically, the plants flowered from a poorly developed panicle which contained only one or a few spikelets. Moreover, under stress of the adverse environment, flowering occurred when the plants were but a few inches in height. Medusahead, on the other hand, developed at this site as a vigorous plant with a normal-sized spike. Medusahead normally flowers from two to three weeks later than cheatgrass and apparently was able to take advantage of the late spring moisture and warming temperatures. Flowering did occur somewhat later than in 1963, however.

Perhaps even more striking than the reduced vigor of cheatgrass in 1964 was the conspicuous abundance and vigor of two annuals, namely, fiddleneck (Amsinckia intermedia Fisch. and Mey.) and sunflower (Helianthus annuus L.). The normally late development of sunflower, however, likely had little competitive effect upon the annual grasses, particularly the earlier cheatgrass. The dense and vigorous growth of fiddleneck was indicative that this species thrived exceptionally well under the cool, dry spring conditions in which normally agressive cheatgrass competition was lacking.

Vegetative sampling of the same replicated plots showed quantitatively the sharp contrast of the composition of the annual species in the community between 1963 and 1964. Not a single fiddleneck plant was recorded in 1963 in 200 sample plots of a one square-foot size. Conversely, in 1964, the frequency of this species was 46 percent in 200 plots of a two-square-inch size. Likewise, sunflower was recorded in only two of the large plots in 1963 but had a frequency of 24 percent in the small plots in 1964. Both species had a frequency of 99 percent in the large plots in 1964.

In contrast with these broadleaved annuals, cheatgrass decreased in frequency within the small plots from 95 percent to 39 percent. Even in the large plots, cheatgrass decreased from 100 percent frequency to 84 percent. Frequency of medusahead, conversely, increased in the small plots from 6 percent in 1963 to 11 percent in 1964.

In addition to the dominance of the community by broadleaved weeds, except where dense patches of medusahead occurred, the total number of broadleaved annual species recorded also increased from three to seven between the two years. These were of very low frequency, however, but likely played a minor competitive role in the community. (Oregon Agric. Expt. Station in cooperation with the Bureau of Land Management, Oregon State Univ., Corvallis.)

Monthly average temperature and precipitation, Huntington, Oregon

(U. S. Weather Station data)

1963	Temperature Averages Degrees Fahrenheit Max.	Min.	Mean	Long Time Mean	Mean Departure	Precipitation Averages Inches Mean	Long Time Mean	Mean Departure
Feb.	54.7	32.0	43.4	34.3	+9.1	.80	1.58	- .78
March	57.6	32.5	45.1	43.1	+2.0	.41	.97	- .56
April	60.8	36.3	48.6	52.4	-3.8	2.21	.78	+1.43
May	77.6	50.7	64.2	61.7	+2.5	.79	.84	- .05
June	82.4	53.9	68.2	69.3	-1.1	1.33	.80	+ .53
1964								
Feb.	38.9	15.4	27.2	34.3	-7.1	.05	1.58	-1.53
March	50.1	26.2	38.2	43.1	-4.9	.81	.97	- .16
April	63.9	35.4	49.7	52.4	-2.7	.95	.78	+ .17
May	73.8	43.9	58.9	61.7	-2.8	.62	.84	- .22
June	79.3	52.3	65.8	69.3	-3.5	2.31	.80	+1.51

Failure of crested and pubescent wheatgrass establishment on medusahead (*Taeniatherum asperum* (Sim.) Nevski) infested rangeland. Turner, R. B. Seedings of crested and pubescent wheatgrass were made in spring 1964 on medusahead infested rangeland following chemical and mechanical seedbed preparation. Herbicides including atrazine, isocil and bromocil were applied at variable rates from 1/4 to 1-1/2 lb/A active material in fall 1962 and spring 1963; and bromocil at 1/2 lb/A and IPC wettable powder at 4 lb/A were applied in fall 1963. The mechanical seedbed treatments included discing in spring 1963 and spring 1964.

Establishment of the wheatgrasses varied from poor to completely absent for all treatments. The surface soil was very moist at the time of seeding in early April, which appeared to be suitable conditions for germination. Several of the herbicide treatments, however, undoubtedly contained active residue which prevented germination. Moreover, annual broadleaved competition, particularly by fiddleneck (*Amsinckia intermedia* Fisch. and Mey.) and sunflower (*Helianthus annuus* L.) was intense for most treatments. The spring 1964 discing treatment, however, was relatively free of either annual grasses or broadleaved competition until early summer, but yet resulted in a very poor establishment of the wheatgrasses.

Evaluation was made in summer 1964 of spring 1963 seedings of crested and pubescent wheatgrass on spring 1963 disced treatments on medusahead infested range. Establishment of these wheatgrasses appeared to be excellent by late June 1963. An infestation of grasshoppers, however, had clipped the plants to the mineral soil surface by the middle of July. Observations in 1964 showed that these seedings all resulted in failure.

At another location in north-central Oregon, a dense medusahead site was summer fallowed in spring and summer of 1963. In January 1964 herbicide treatments included IPC wettable powder at 4 lb/A, amitrol-T and 2,4-D mixture at 2 and 3/4 lb/A, respectively, paraquat at 2 lb/A (with X-77 surfactant) and des-i-cate at 2 lb/A were applied on the tilled block and on an adjacent control block. All treatments were seeded in April 1964 with crested, pubescent and intermediate wheatgrass.

All herbicide treatments gave very poor medusahead control on the non-tilled area. IPC, on the other hand, gave excellent control on the tilled area. The remainder of the herbicide treatments were all poor on the tilled block. Establishment of the wheatgrasses was poor on all treatments. Extreme drought was thought to be the cause of the failure, at least where medusahead and cheatgrass competition was controlled by the IPC treatment. However, competition from filaree (Erodium cicutarium L'Her.) was noticeably evident here and likely contributed toward the seeding failures. Even though a very droughty growing season occurred, medusahead and cheatgrass growth was tall and vigorous on control plots within the tilled block, thus showing the effect of moisture storage from summer fallowing. (Oregon Agric. Expt. Station in cooperation with the Bureau of Land Management, Oregon State Univ., Corvallis.)

Continued evaluation of herbicide treatments for control of medusahead (Taeniatherum asperum (Sim.) Nevski) in eastern Oregon. Turner, R. B. Investigations continued on the evaluation of herbicides on medusahead infested rangelands of eastern Oregon. Atrazine at 1 lb/A applied in fall 1963 gave excellent control of medusahead, which was somewhat more effective than this same rate when tested in previous years. Atrazine at 1/2 lb/A gave good control, but was less effective than the higher rate. Bromocil and isocil at 1/2 lb/A were slightly less effective than was the higher atrazine rate, and at a 1/4 lb/A rate were considerably less effective than the 1/2 lb/A atrazine rate. The isocil treatments were selective for fiddleneck (Amsinckia intermedia Fisch. and Mey.) and sunflower (Helianthus annuus L.), which were vigorous and dense. These weeds were present but sparce on the atrazine and bromocil plots.

An amitrol-T and 2,4-D mixture applied in fall 1963 at a rate of 3 and 3/4 lb/A, respectively, gave excellent medusahead control. A 2 lb/A rate without 2,4-D gave only a slightly less effective performance. Fiddleneck and sunflower were dense and vigorous on both treatments.

Other herbicides evaluated included IPC wettable powder (3, 4 and 6 lb/A), duPont 1318 (2 and 8 lb/A), duPont 1071 (2 and 8 lb/A), duPont 1018 (2 and 6 lb/A) and Des-i-cate (2 and 4 lb/A). IPC gave fair control of medusahead at the 4 lb/A rate, whereas the remainder were poor at all rates.

Several herbicides including atrazine, bromocil, amitrol-T, and IPC, were applied in fall 1963 at variable rates on a good stand of bluebunch wheatgrass (Agropyron spicatum (Pursh.) Scribn and Smith) and Sandberg's bluegrass (Poa secunda (Presl.) to observe damage, if any to these perennial grasses. Atrazine at the highest rate applied of 1-1/2 lb/A resulted in moderate to severe burning of the bunchgrass and severe burning of Sandberg's bluegrass. The high rate of amitrol-T of 3 lb/A showed severe burning of the bluegrass but no noticeable effect upon the bunchgrass. Bromocil at high rates of 1 and 0.6 lb/A, respectively, showed a light burn only on the bluegrass. All of these treatments will be evaluated later for residual damage, if any. (Oregon Agric. Expt. Station in Cooperation with the Bureau of Land Management, Oregon State Univ., Corvallis.)

Ecology of Medusahead. Hironaka, M., Tisdale, E. W. and Dahl, D.E. Vegetational and soil data from 43 sites on which medusahead has had ample opportunity to invade and replace cheatgrass (downy brome) in southern Idaho were analyzed. Multiple regression and correlation analysis indicate that dominance and abundance of the two species were associated with soil and site characteristics. Soil characters that reflect moisture and aeration conditions were highly significant and accounted for more than one-half of the variation in frequency of occurrence of the two species.

Replacement of cheatgrass by medusahead is not easily explained. From the phenological viewpoint, cheatgrass should have the advantage over medusahead. But it does not. Experimental evidence indicates that differential winter mortality of the two species may be a significant contributing factor. Experimental plots were bared of vegetation in 1961 and a known number of seed of the two species was introduced. Total numbers of plump seed per unit area were counted each fall and the numbers of seedlings surviving the winter were counted the subsequent spring, prior to the period of moisture stress. From this ratio the mortality percentage was calculated. For the past three seasons, the mortality of cheatgrass seedlings has been 10 to 25 percent higher than for medusahead. This differential in survival can explain, at least in part, why the slower maturing medusahead is able to replace cheatgrass, and become the dominant.

Sixteen medusahead seed packets, buried in the field for four years, were recovered. No plump seed were recovered from the packets. Last year's recovery indicated that medusahead seed can retain its viability in the soil for at least three years. The average germination after three year's buriel was two percent. (Forest, Wildlife and Range Expt. Sta., Univ. of Idaho, Moscow.)

Chemical control of clubmoss (Selaginella densa Rydb.). Wagner, Stephen and Baker, Laurence O. Clubmoss, a low, slow growing perennial may occupy up to 75 percent of the ground cover in portions of the Northern Great Plains. It has a dense, shallow root system that prevents much of the precipitation from penetrating into the soil where it can be utilized by other vegetation. It is highly resistant to desiccation, and after a prolonged drouth, greens up within hours after moisture is received.

Twenty of the most promising herbicidal treatments from preliminary greenhouse trials were applied in triplicate to half-square-rod plots with a knapsack sprayer in the spring of 1964 at two widely spaced locations.

Observations were made at intervals throughout the growing season. Vegetation other than clubmoss was clipped from a portion of each plot and dry matter determined. The ratio of grass to forbs varied according to herbicide treatment. None of the phenoxy or benzoic acid type chemicals were effective in killing clubmoss. Tordon discolored, but apparently did not kill clubmoss.

Estimated average clubmoss control and the dry weight of vegetation other than clubmoss follows for six of the most promising treatments.

Treatment Chemical	Rate lb/A	Percent clubmoss control	Yield of other vegetation
Ammate	20	100	138*
Atrazine	2	100	126
Monuron	2	95	86
Paraquat	1	95	72
Hyvar	1	90	10
Diquat	1	80	83

* Average dry weight expressed as a percent of the check.

Additional treatments were made at three locations in late fall 1964. (Montana Agricultural Expt. Sta., Bozeman).

Control of tall larkspur (Delphinium occidentalis) with tordon. Baker, Laurence O. Tall larkspur on an open, grassy west exposure at an elevation of about 6500 feet was treated July 1, 1963, with tordon at a rate of 3 pounds per acre. Treatment was made to rod square plots on which the larkspur plants were about 2 feet tall and in an early bud stage of development. This treatment was injurious to timothy which was the predominant grass species present.

One year later no larkspur plants could be found on any of the plots treated with tordon. Timothy had largely recovered from injury noted the fall before. (Montana Agricultural Expt. Sta., Bozeman).

Chemical control of pasture and rangeland weeds in Wyoming--pricklypear cactus, plains larkspur, and common milkweed. Alley, H. P. and Chamberlain, E. W. The large experimental pricklypear plots established in June 1962 and reported on in the 1963 Research Progress Report looked even better in 1964. The percentage control on these areas had increased from the previous year as follows:

Chemical	Rate lb/A		Percent control 1963	1964
Silvex	2	without mechanical injury	65	85
"	2	with mechanical injury	90	100
"	4	without mechanical injury	95	100
"	4	with mechanical injury	99	100

Small square rod plots were established in 1963 in two locations to test five new compounds along with silves. Silvex and tordon were the only compounds showing activity. Tordon (1 lb/A) and silvex (2 lb/A) gave similar results of 80-90% control. Either chemical at 4 lb/A gave 95-98% control one year after treatment. It is quite evident that the second year reading in 1965 will show better control due to the slow kill obtained on prickly pear plants.

Plains larkspur appears to be quite susceptible to tordon. Rates of 1, 2, and 4 lb/A tordon gave 100% control one year after treatment. Extensive tests with lower rates of tordon were established in 1964.

Common milkweed has always been resistant to most herbicides; however, the new herbicide tordon appears to be very toxic to this plant. Tordon at rates of 1-2 lb/A looked promising in 1964 tests in Wyoming. (Wyoming Agricultural Expt. Sta., University of Wyoming, Laramie.)

Comparative response of Dalmatian toadflax (Linaria dalmatica (L.) Mill.) to picloram and other herbicides. Robocker, W. C. The results of a number of herbicide trials on Dalmatian toadflax in recent years have shown that silvex at 2 to 3 lb/A gives the most consistent control. The trial herein reported was initiated in order to compare a number of new herbicides with silvex for possible use on Dalmatian toadflax. The area selected was on an established stand north of Spokane, Washington. Plots were 10 by 20 feet, and three replicates were treated with herbicides when toadflax was in early bloom (June 3, 1964) with water at 20 gpa as a carrier. Crown counts on each plot were made on September 24. Results are shown in the accompanying table.

Comparison of average numbers of living crowns shows that at 3 lb/A 2,4-DP and silvex were similar in performance. Control equivalent to 2,4-DP and silvex at 3 lb/A was indicated with 1/2 lb/A of picloram, but not less than 1 lb/A would be required for a complete kill of Dalmatian toadflax. 2,3,6-trichlorobenzyl-oxypropanol (Tritac)1/ was not satisfactory at the highest rate tested. (Crops Research Division, Agricultural Research Service, U. S. Dept. of Agriculture, and the Washington Agricultural Expt. Sta., Pullman, cooperating.)

1/ Tritac is the U. S. Borax trade name for this compound. Its mention is for benefit of the reader and implies no endorsement or preferential treatment of the product.

Average number of new or surviving crowns per plot of Dalmatian toadflax treated with herbicides June 3, 1964, and counted September 24, 1964.

Treatment	Rate, lb/A	Average number per plot
Check	0	53
2,4-D	2	55
2,4,5-T	2	30
2,4-DP	1	54
	2	19
	3	7
Silvex	1	48
	2	11
	3	6
Picloram	.5	7
	1	2
	1.5	0
Picloram + silvex	.5 + 1	6
Tritac	2	35
	4	11

Response of rush skeletonweed (Chondrilla juncea L.) to several herbicides. Robocker, W. C. Rush skeletonweed is comparatively unknown in the United States. It is a perennial composite of Eurasian origin which is rapidly invading both range and crop land in eastern Washington and northern Idaho. It was first reported in Australia in 1914, and it is now considered the worst weed in the wheat-growing area of that country by reason of its competitive ability, interference with harvesting equipment, and indifferent response to selective herbicides. Rush skeletonweed is a tap-rooted plant which reproduces from seed as well as lateral roots. Severed portions of the root moved by tillage equipment are also capable of regeneration and reproduction.

Objectives of the study reported were to find an effective, economical herbicide suitable for use in either or both crop land and range land. Herbicide screening trials were begun on May 14, 1964, on duplicate, 10- by 20-foot plots on formerly cultivated land near Spokane, Washington. Plants were in rosette and early bolt stage of development. Herbicides were applied in water at 20 gpa. Treatments with respective preliminary results at the end of the growing season are shown in the accompanying table.

In spite of high variability between plots of a given treatment, data indicate that while temporary suppression of rush skeletonweed may occur as a result of treatment with herbicides, low rates of all except picloram tended to increase subsequent rosette formation, possibly a partial result of killing much other competing vegetation. Picloram at 2 lb/A appears to be the most promising treatment, although a higher rate may be required for complete control. Dicamba at a higher rate than 6 lb/A may also have possibilities. (Crops Research Division, Agricultural Research Service, U. S. Dept. of Agriculture, and the Washington Agricultural Expt. Sta., Pullman, cooperating.)

Average number of rosettes of rush skeletonweed per plot as a result of treatment with indicated herbicides.

Treatment	Rate, lb/A	Rosettes
Check	0	231
2,4-D	2	284
	4	113
MCPA	2	494
	4	298
2,4-DP	2	368
	4	376
Fenac + 2,4-D	3 + 2	112
Dicamba	2	343
	4	100
	6	80
Dicamba + 2,4-D	3 + 1	199
Diuron + 2% X-77	3	151
Picloram	.5	67
	1	90
	2	3
Picloram + 2,4-D	.5 + 2	135
Picloram + MCPA	.5 + 2	46

Chemical control of gorse (*Ulex europaens*). Fechtig, A. D. and Furtick, W. R. This species has long been a serious problem in the southern coastal areas of Oregon, and has been responsible for a number of serious fires in the past. It still remains a possible fire threat in these areas.

Several herbicides were applied to seedling and mature gorse during the 1963 growing season in an attempt to find an outstanding herbicide that could eradicate this species. Of those chemicals applied, Tordon 22K is the most promising. It has essentially eradicated all seedling and mature plants, at two pounds active ingredient per acre (see table).

2,4,5-T at four pounds per acre has been an effective means of controlling both the seedling and mature plants. Bromacil and diuron at ten pounds per acre contolied approximately 90% of the seedling gorse, but was not an effective means for controlling the mature plants. (Dept. of Farm Crops, Corvallis, Oregon).

Gorse Control, Port Orford, Oregon
Chemicals Applied - June 29, 1964
Plots Evaluated - July 23, 1964

Chemical	Rate lb/A	% Seedling Gorse Control R1	R2	R3	Ave.	% Mature Gorse Control 7/23/64 R1
1) Dicamba	.5	0	0	0	0	0
2) Dicamba	1	20	20	0	13	0
3) Dicamba	2	40	30	0	23	0
4) Tordon 22K	.5	60	30	85	59	35
5) Tordon 22K	1	85	90	95	90	95
6) Tordon 22K	2	99	99	99	99	100
7) Isocil	5	0	0	0	0	0
8) Isocil	10	75	--	50	63	0
9) Diuron	10	95	98	95	96	70
10) Bromacil	5	75	70	80	75	0
11) Bromacil	10	98	85	90	91	0
12) 2,4,5-T	4	98	98	98	98	85
13) 2,4-D Sol. Acid	2	0	15	0	5	0
14) 2,4-D Sol. Acid	2	0	15	15	10	0
15) Hexafloro acetone	10	10	0	5	5	0
16) Hexafloro acetone	20	5	0	5	3	0
17) Check		0	0	0	0	0
18) Check		0	0	0	0	0

Chemical control of gian Himalaya blackberry (Rubus procerus P. J. Muell). Fechtig, A. D. and Furtick, W. R. This experiment was initiated in 1963 to acquire information concerning the herbicidal properties of a number of organic chemicals on this species. Blackberries have become a serious problem invading pastures, woodlands, fence rows, and many other places in western Oregon. Lack of information concerning the specific activity of a number of these herbicides, and the increasing seriousness of blackberry infestation were the main reasons for the initiation of this project.

Picloram (Tordon 22K) at 2 pounds per acre is the only compound that has given eradication of this species. The other herbicides have failed to give control of the new cane growth.

The herbicides which were evaluated but which failed to give control are as follows: Dicamba at 8 lb/A, Tordon 10K at 8 lb/A, isocil at 16 lb/A, 2,4,5-T, 2,4-D, TD-191, and TD-282 at 4 lb/A. Evidently the failure of Tordon 10K to show activity was due to the poor distribution of the herbicide because of the heavy pellet formulation.

Additional plots were established in 1964 to investigate the most promising rates of various herbicides for complete eradication. A combination of one pound each of Tordon 22K and 2,4,5-T after three months gave complete top kill, as did three pounds of Tordon 22K. Two pounds per acre of Tordon 22K in this experiment after four months has only given approximately 80% control. (Dept. of Farm Crops, Corvallis, Oregon).

Response of rush skeletonweed (Chondrilla juncea L.) to several herbicides. Robocker, W. C. Rush skeletonweed is comparatively unknown in the western United States. It is a perennial composite of Eurasian origin which is rapidly invading both range and crop land in eastern Washington and northern Idaho. First reported in Australia in 1914, it is now considered the worst weed in the wheat-growing area of that country by reason of its competitive ability, interference with harvesting equipment, and indifferent response to phenoxy herbicides. Rush skeletonweed is a tap-rooted plant which reproduces from seed as well as lateral roots. Severed portions of the root moved by tillage equipment are also capable of regeneration and reproduction.

To find an effective herbicide suitable for use in either or both crop land and range land, herbicide evaluation trials were begun on May 14, 1964, on duplicate, 10 x 20 ft. plots on formerly cultivated land near Spokane, Washington. Plants were in rosette and early bolt stage of development. Herbicides were applied in water at 20 gpa. Treatments with respective preliminary results at the end of the growing season are shown in the accompanying table.

There was high variability between plots. However, data indicate that while temporary suppression of rush skeletonweed may occur as a result of treatment with herbicides, low rates of all except picloram tended to increase subsequent rosette formation from the roots. This may have been partly due to the killing of other competing vegetation. Picloram at 2 lb/A appeared to be the most promising treatment, although a higher rate or repeated treatments may be required for complete control. Dicamba at a higher rate than 6 lb/A or as repeated treatments may also have possibilities. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and the Washington Agricultural Expt. Stations, Pullman, cooperating.)

Average number of rosettes of rush skeletonweed per plot as a result of treatment with indicated herbicides.

Treatment	Rate, lb/A	Rosettes
Check	0	231
2,4-D	2	284
	4	113
MCPA	2	494
	4	298
Dichlorprop	2	368
	4	376
Fenac + 2,4-D	3 + 2	112
Dicamba	2	343
	4	100
	6	80
Dicamba + 2,4-D	3 + 1	199
Diuron + 2% X-77	3	151
Picloram	.5	67
	1	90
	2	3
Picloram + 2,4-D	.5 + 2	135
Picloram + MCPA	.5 + 2	46

Comparative response of Dalmatian toadflax (Linaria dalmatica (L.) Mill.) to picloram and other herbicides. Robocker, W. C. The results of a number of herbicide trials on Dalmatian toadflax in recent years have shown that silves at 2 to 3 lb/A effects the most consistent control. The trial herein reported was initiated in order to compare a number of new herbicides with silves for possible use on Dalmatian toadflax. The area selected was on an established stand north of Spokane, Washington. Plots were 10 x 20 ft., and three replicates were treated with herbicides when toadflax was in early bloom (June 3, 1964) and water at 20 gpa was used as a carrier. Crown counts on each plot were made on September 24. Results are shown in the accompanying table (see next page).

Comparison of the average number of living crowns shows that, at 3 lb/A, dichlorprop and silvex were similar in performance. Control equivalent to dichlorprop and silvex at 3 lb/A was indicated with .5 lb/A of picloram, but not less than 1 lb/A would be required for a complete kill of Dalmatian toadflax. 2,3,5-trichlorobenzyloxypropanol was not satisfactory at the highest rate tested. The chlorophenoxypropionic acid formulations still appear to be satisfactory herbicides for Dalmatian toadflax. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and the Washington Agricultural Expt. Sta., Pullman, cooperating.)

Average number of new or surviving crowns per plot of Dalmatian toadflax treated with herbicides June 3, 1964, and counted September 24, 1964.

Treatment	Rate lb/A	Average number per plot
Check	0	53
2,4-D	2	55
2,4,5-T	2	30
Dichlorprop	1	54
	2	19
	3	7
Silvex	1	48
	2	11
	3	6
Picloram	.5	7
	1	2
	1.5	0
Picloram + silvex	.5 + 1	6
2,3,6-trichlorobenzyloxypropanol	2	35
	4	11

PROJECT 3. UNDESIRABLE WOODY PLANTS

H. Gratkowski, Project Chairman

The number of abstracts in this section was considerably smaller than last year, but these continue to show the diversification of effort evident in last year's report. Sixteen abstracts were sent in by authors from five western states. Research reported in the abstracts includes not only the very necessary screening tests of herbicides on grass, herb, shrub, and tree species; they also cover studies of environmental contamination, ecology of brush species, and methods of application. Briefly, these abstracts report the following research results.

Periodic sampling in Oregon revealed only a light and short-lived contamination of stream water as a result of aerial spraying with 2,4-D and 2,4,5-T. In forest floor litter, both 2,4-D and 2,4,5-T are degraded; but 2,4-D disappears more rapidly than 2,4,5-T.

Screening tests continue to take up a good deal of research time, but is decreasing from the levels evident in Progress Reports of the past. Work on Gambel's oak has been continued with both plot tests and project-scale aerial spraying. The Stull bi-fluid spray system was employed in the latter. In both cases, repeated treatments gave best results. Repeated sprays also proved necessary on poison oak in California. In southwest Oregon, 13 brush species showed great variation in susceptibility to herbicides in tests conducted over a 5-year period; some species were readily killed with one treatment while others required one or more re-sprays. Of three new chemicals tested on Rocky Mountain juniper, only Tordon was effective.

In Oregon, Newton tested injector treatments for pre-commercial thinning of Douglas-fir stands and has developed an injector hatchet for use in such thinning and in treating weed trees.

In southwestern Oregon, studies of seasonal variation in susceptibility of conifers and brush species to herbicides lead to early fall aerial spraying to release pines from brush competition. A problem often encountered in releasing very young conifers is that the small trees suffer from extensive browsing. A trial of planting large wildling Douglas-firs in a brushy area seems to have reduced damage from rabbits. It was also believed that use of such stock might reduce the need for respraying in order to keep the trees ahead of the brush.

Other work has shown that atrazine is effective in controlling herbs and grasses to increase survival of planted conifers and conifer seedlings. And finally, laboratory and greenhouse experiments indicate that wildfires and broadcast burning of logging slash will induce germination of dormant deerbrush and snowbrush ceanothus seeds in forest soils.

<u>Streamwater contamination by herbicides resulting from brush-control operations on forest lands.</u> Norris, Logan A., Newton, Michael, and Zavitkowski, Jerry. An extensive program of streamwater sampling in connection with chemical brush control projects on forest and range lands has

been underway since March 1964. The object of this study is to assess the impact of brush control operations on water quality with respect to herbicide residues. The expanding use of chemicals for vegetation manipulation makes it desirable to determine the safety of these operations to local stream organisms and downstream industrial, agricultural, municipal, and domestic water users.

A series of eleven sample points were located in the Alsea River Basin in Western Oregon in connection with brush control operations on the Siuslaw National Forest. Three additional sample points were located in another drainage on a private ownership. The treated areas ranged in size from about 5 to 100 acres. 2,4-D, 2,4,5-T or a 1:1 mixture of 2,4-D and 2,4,5-T low volatile esters in diesel oil were applied at rates around two pounds per acre by helicopter in March and April of 1964.

Samples were collected in one gallon polyethylene jugs starting just before application was made and continuing through December of 1964. Each jug contained 15 gms. of NaOH to prevent microbial degradation during storage and to aid in hydrolysis of the ester. The analytical procedure involved a 12-hour liquid-liquid extraction with benzene of an acidified three liter aliquot of the sample. The benzene extract was evaporated to dryness and esterified with BF_3 methanol solution. Distilled water was added to destroy the excess esterifying agent, and the methyl ester extracted with benzene by shaking. Aliquots of the benzene extract containing the methyl ester were injected into a Dohrmann Gas Chromatograph with microcoulometric titration cell for determination of the herbicide. The procedure described allowed a quantitative measure to 0.5 parts per billion (ppb) acid equivalent of herbicide in the streamwater to be made. A qualitative identification was possible to 0.2 ppb.

In general, the following results were obtained: 1) detectable quantities of herbicide were found in virtually all streams from which samples were taken. 2) The quantities found were low, ranging from less than 0.2 ppb (the minimum level of qualitative detection) to about 70 ppb. 3) The length of time the herbicide persisted was fairly short. Usually in a matter of days, the level had fallen below 0.2 ppb.

Data from two sampling points are presented below as an example of the type of information obtained in this study.

Sample point 10: 96 acres treated with 1 lb./acre each of 2,4-D and 2,4,5-T esters in diesel oil. Treatment was made between 1755-1900 hours on 3/22/64. The sampling point was located one mile downstream from the lower boundary of the spray unit.

Sample point 13: 75 acres treated with 2.2 lbs./acre of 2,4-D ester in diesel oil. Treatment was made between 1230-1400 hours on 4/7/64. The sample point was located at the lower boundary of the spray unit.

Additional samples were taken at several different locations in Western Oregon with results similar to those reported here. Samples from Central and Eastern Oregon have shown considerably higher concentrations, and an intensive program of sampling is planned in what may be a problem area the next year. This research was supported by the U. S. Public Health Service grant number WP-00477. (Oregon Agricultural Experiment Station, Oregon State University, Corvallis, Oregon)

Herbicide Concentrations in Streamwater Samples
Taken at Sample Points 10 and 13

SAMPLE POINT 10				SAMPLE POINT 13		
Sampled		ppb*		Sampled		ppb*
Date	Time	2,4-D	2,4,5-T	Date	Time	2,4-D
3/22	1755	T**	T	4/7	1350	61.5
	1830	T	T		1455	70.8
	1945	10.2	4.2		1545	58.3
	2030	7.7	4.3		1650	43.8
	2130	9.1	3.6	4/9	1805	25.4
	2250	3.6	1.7	5/13	1335	0
3/23	0945	2.6	1.1	6/11	1920	0
	1200	2.4	1.1	7/10	1500	0
	1615	2.1	1.3	7/15	1540	0
	2100	6.5	3.6	8/5	1015	0
3/24	0905	2.1	1.3	10/3	1400	0
	1510	1.1	0.9	11/3	1625	0
3/25	1135	0.9	0.6	11/25	1433	0
3/26	1730	5.7	2.6	11/27	1225	0
3/27	1550	T	T	12/4	1500	0
4/2	1730	5.3	3.3			
4/9	1420	6.9	5.4			
5/13	1730	0	0			
7/10	1000	0	0			
7/15	1030	T	T			
8/8	1505	0	0			
9/19	1200	0	0			
11/3	1430	0	0			
12/3	1000	0	0			

* The concentration of herbicide is given in parts per billion acid equivalent in the stream water.
T**Trace, i.e. more than 0.2 ppb but less than 0.5 ppb.

<u>The degradation of 2,4-D and 2,4,5-T in forest floor litter.</u> Norris, Logan A. Herbicides applied for brush control are expected to reach the forest floor as directly applied spray, in rain washings from the treated overstory and in treated foliage following abscission. Since a large portion of the applied chemicals will eventually enter the forest floor litter layer, their persistence in this layer will be an important factor in possible streamwater contamination.

This preliminary experiment is part of a larger study to examine the rates and pathways of degradation of 2,4-D and 2,4,5-T in forest floor litter. The objectives of this experiment are to establish whether or not 2,4-D and 2,4,5-T are degraded in forest floor litter, and if differences in the rates at which they are degraded exist.

A 1/2 inch layer of forest soil was covered with 1 inch of forest floor litter and placed on an elevated screen platform in a respiration study chamber. The surface of the litter layer was treated with the equivalent of 2 lbs. per acre of 2,4-D-1-C^{14} or 2,4,5-T-1-C^{14} formulated as the triethanol amine salt in 5 mls. of water. The system was swept with 100 mls. per minute of CO_2-free air, and the respired CO_2 trapped in 0.5 N NaOH. The basic trapping solution was assayed periodically for radioactivity with a Geiger counter by preparing $BaCO_3$ in the usual manner. The study system was held in the dark at 24 to 26° C. for the duration of the study.

The data were corrected for variation in the respiration rate of the microbial population and are presented in the following table. The data are expressed as follows: 1) Columns one and four show the number of hours elapsed since treatment; 2) columns two and five show the cumulative breakdown of the herbicide as a percentage of the total activity which was recovered as $C^{14}O_2$ up to a given time after treatment; and 3) columns three and six are an expression of the rate of breakdown between sampling times. The rate of breakdown is shown as a percentage of the activity present at the start of a given sampling period which was liberated as $C^{14}O_2$ per hour during that sampling period.

The results of this experiment indicate that 2,4-D and 2,4,5-T are degraded in forest floor litter but at markedly different rates. Graphic presentation of the cumulative breakdown of these compounds shows that 88% of the 2,4-D was degraded in 300 hours compared to 22% of the 2,4,5-T in the same period. The lower cumulative breakdown of 2,4,5-T as compared to 2,4-D may represent a lower availability due to differences in their physical properties which could influence adsorption phenomena, a lower rate of adaption by the microorganisms to the use of 2,4,5-T as a substrate or a combination of these factors.

Examination of the rate data in column three of the table shows that the agents responsible for the degradation of the 2,4-D-1-C^{14} had an adaptation to the use of this chemical as a substrate which increased rapidly with time until more than 75% of the applied material had been degraded. Data from column six, on the other hand, show that microbial adaptation to the use of 2,4,5-T as a substrate also increased with time but at a much slower rate.

These results suggest that 2,4-D and 2,4,5-T will be degraded in the forest floor litter, but that 2,4-D will disappear more rapidly than 2,4,5-T. The result should be less opportunity for stream contamination with 2,4-D than with 2,4,5-T due to leaching or surface flow from forest floor litter layers.

This research was supported by the U. S. Public Health Service grant number WP-00477. (Oregon Agricultural Experiment Station, Oregon State University, Corvallis, Oregon.

The Liberation of $C^{14}O_2$ From Forest Floor Litter
Treated With Two Lbs. Per Acre of 2,4-D-1-C^{14} or 2,4,5-T-1-C^{14}

2,4-D-1-C^{14}			2,4,5-T-1-C^{14}		
Hours after treatment	Cumulative breakdown as a % of applied	Rate of breakdown as a % of avail. per hour, during a sampling period	Hours after treatment	Cumulative breakdown as a % of applied	Rate of breakdown as a % of avail. per hour, during a sampling period
		0.09			0.09
3.0	0.26		16.0	1.51	
		0.16			0.06
7.0	0.89		31.0	2.41	
		0.23			0.06
12.0	2.05		48.0	3.41	
		0.16			0.08
20.5	3.37		96.0	5.61	
		0.18			0.08
35.0	5.92		110.0	7.24	
		0.22			0.08
52.5	9.60		143.0	9.05	
		0.30			0.09
74.5	15.47		167.5	10.95	
		0.43			0.09
97.5	23.74		192.0	12.89	
		0.53			0.09
121.5	33.38		216.0	14.83	
		0.78			0.10
145.5	45.84		239.0	16.72	
		0.99			0.09
170.5	59.20		264.0	18.72	
		0.98			0.09
189.0	66.61		283.0	20.14	
		1.02			0.11
217.0	76.16		310.0	22.43	
		0.82			0.12
242.0	81.07		332.0	24.51	
		0.79			0.11
266.5	84.75		355.5	26.37	
		0.79			0.10
289.5	87.52		379.5	28.22	
		0.70			0.10
313.0	89.57		403.0	29.97	

Herbicide studies on Gambel's oak in southwestern Colorado. Jefferies, Ned W. Research on the chemical control of Gambel's oak (Quercus gambellii) was started in 1962 at the San Juan Basin Branch Station at Hesperus, Colorado. The objectives were to evaluate various herbicide treatments for the control of Gambel's oak and to examine the effects of the brush control on understory vegetation and livestock management.

Three herbicides (2,4,5-T butoxyethanol ester, 2,4,5-T tertiary dodecyl primary amine and 2,4,5-TP propylene glycol butyl ether ester) were applied to 1/10 acre plots using an orchard type sprayer. The herbicides were applied at 1, 2, and 3 lbs a.e./A during three periods: mid-June, late-June, and mid-July. An oil-water emulsion (1:40) was used as the carrier at the rate of 100 gpa. In 1963, two-thirds of each plot were retreated with the same herbicides, but at the 1 pound rate only. In 1964, one-third of each plot was again retreated with 1 pound of the original herbicide.

Evaluations based on ocular estimates of percent defoliation were made in August, 1964. Plots receiving three successive treatments averaged 82% defoliation. Plots receiving two successive treatments averaged 58% defoliation. Plots receiving the initial treatment only averaged 24% defoliation. Differences between treatment dates were significant on plots receiving only the initial treatment. With two or three successive treatments, differences between application dates, herbicides, or initial rates were small. However, those plots treated with the amine were lower in percent defoliation than those treated with the esters.

Plots treated initially with 2 lbs a.e./A of either the 2,4,5-T or 2,4,5-TP ester and followed with two successive treatments of 1 pound appeared to be most successful at the time of evaluation. (Colorado Agri. Expt. Sta., San Juan Basin Branch, Hesperus, Colorado.)

Gambel Oak Control in New Mexico. Pearl, Robert W. There are 70,000 acres in National Forests in New Mexico which have been invaded by Gambel Oak following wild fires or cutting in ponderosa pine stands. The dense thickets hamper or exclude the regeneration of the most valuable commercial timber species in the state. These thickets must be opened to allow pine regeneration. Broadcast burning, mechanical treatment and the use of conventional herbicide treatments were considered and rejected because of scenic, wildlife, soil, or economic values. The treatment of sample plots with a tree injector and a portable mist blower indicated that chemicals would give us an adequate reduction in the crown canopy. In 1963, an area of about 500 acres was strip treated by helicopter using the Stull Bi-Fluid system. This system releases the herbicide in a heavy mayonnaise-like, drift-reducing, water-in-oil emulsion. Three chemicals were used on separate areas: (1) 2,4,5-T oil soluble amine, (2) 2,4,5-TP and (3) 2,4,5-T iso-octyl ester. The chemicals were applied at the rate of 2 lbs/A in a total volume of eight gallons per acre.

At the end of 16 months, general defoliation observed under the treatments was about 65% under all chemicals. Top-kill was better and there was less sprouting under the 2,4,5-T amine strips. The heavy emulsion provided by the bi-fluid system penetrated the overstory and was evident on the understory. Drift was minimal with clearly defined strips appearing as the foliage discolored from the chemical reaction. Though top-kill was a somewhat disappointing 28% at 16 months after treatment, reaction was still evident by current dieback and odd shaped, discolored leaves. The canopy had been reduced sufficiently to increase the plantable area from about 10% to 70% of the treated area. It was estimated that though competition was still present, planted trees could survive on the plantable area and grow above the oak canopy. The area will be treated again this year to further reduce competition. (U.S. Dept. of Agriculture, Forest Service, Region 3, Albuquerque, New Mexico.)

Studies on the control of poison oak. Leonard, O. A. and Jack Herr. Poison oak (Rhus diversiloba) was sprayed with a mist blower in May, 1963, when the plants were in full leaf and growing vigorously. Sprays were applied at 5 gallons per acre (except for an invert preparation of silvex ester, which was applied at 2.5 gallons per acre). The herbicides and dosages per acre were used as follows: amitrole at 2.5 pounds, picloram at .5 and 2 pounds, an equal mixture of 2,4-D and 2,4,5-T esters at 2 pounds, silvex ester (normal emulsion) at 2 pounds, and an invert emulsion of silvex at 1 pound. The results as obtained in May of 1964 indicated the following apparent plant kills: 2,4-D, 2,4,5-T mixture at 2 pounds--5%; amitrole at 2.5 pounds--40%; silvex (normal emulsion) at 2 pounds--62%; silvex (invert emulsion) at 1 pound--72%; picloram at .5 pound--51%, at 2 pounds--66%. The grass was both taller and darker green on the plots sprayed with silvex and picloram than on the untreated plots. In contrast, the grass on the amitrole treated plots was less vigorous than the controls.

Results with silvex applied by a mist blower had appeared favorable in previous tests. Control was nearly as good on plots sprayed twice (in alternate years) as when sprayed for 3 years in a row. (University of California, Davis and Auburn).

Repeated application of herbicides on brush species. Gratkowski, H. Brush species on forest land in southwestern Oregon show great variation in susceptibility to herbicides. Some species are highly susceptible and are readily killed by a single treatment with herbicides applied as a foliage spray. A few are slightly resistant, but can be controlled with 2 or 3 sprayings. Still others are highly resistant and are not satisfactorily controlled even after 3 spray treatments.

Thirteen species of brush were subjected to repeated midsummer foliage sprays of herbicides over a five year period. Mature shrubs of all species were first sprayed during screening tests in 1955, and resprouting shrubs were sprayed again in 1957 and in 1959 using the most effective treatments from the initial tests. When rated in September 1960, these species were classified as follows:

Highly Susceptible (90-100 percent dead after 1 spray)
- Ceanothus integerrimus H. & A..
- Arctostaphylos patula Greene (non-sprouting)
- Arctostaphylos columbiana Piper
- Arctostaphylos canescens Eastw.

Moderately Susceptible (95-100 percent dead after 2 sprays)
- Ceanothus velutinus Dougl.
- Ceanothus velutinus var. laevigatus T. & G.

Slightly Resistant (90 percent dead after 3 sprays)
- Arctostaphylos patula Greene (burl-producing form)
- Ceanothus cordulatus Kell.

Moderately Resistant 50-60 percent dead after 3 sprays)
- Castanopsis chrysophylla (Hook.) DC.
- Castanopsis chrysophylla var. minor (Benth.) A. DC.
- Amelanchier alnifolia Nutt.
- Lithocarpus densiflora var. echinoides (R. Br.) Abrams

Highly Resistant (Less than 10 percent kill after 3 sprays)
- Quercus chrysolepis Liebm.

When a high percentage of shrub kill is required in reclamation of sites occupied by mixed brush species, results of this study indicate that one or more resprays will often be needed after the initial treatment on mature shrubs. (Pacific N.W. Forest and Range Experiment Station, Roseburg, Oregon.)

Chemical control of Rocky Mountain juniper. Alley, H. P. and Chamberla[illegible] E. W. In June, 1963, three new herbicides were tested for control of Rocky Mountain juniper in Wyoming. Only one compound, tordon, showed activity and the results of this compound were very striking. Tordon applied either in the pellet form or the emulsifiable concentrate in water were equally effective. Evaluations one year after application indicate that 1 lb/A active ingredient is sufficient for a 100% kill.

On July 3, 1964, large 5 to 10 acre plots were established in Wyoming by aerial applications. These are the first aerial plots established in the Western United States for chemical control of juniper. Tordon at .5, 1, and 2 lb/A and tordon 101 mixture 1 and 2 gal/A were the two compounds used in this study. Observations on September 3, 1964, showed all rates exhibiting considerable activity to the juniper trees. Final evaluations cannot be made until at least one year after application. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Injector treatments for pre-commercial thinning of Douglas fir. Newton Michael. Natural stands of conifers often develop with far more trees than will ever reach salable size. As the trees grow, much of the growth potential of the land is accumulated in trees that will die before reaching merchantability, and the trees that eventually survive to maturity grow much more slowly while crowded. Thinning young stands with a power saw is very costly, yet tens of thousands of acres are receiving this treatment. Chemical treatments which would replace the power saw would greatly reduce costs. Hatchet and oil can treatments were reported last year which showed promise. The development of an injector hatchet provided an economical means of application. The following table illustrates some of the results obtained to date with this instrument.

Injections were made in randomly tagged trees marked out for a pre-commercial thinning in a 25-year-old stand of Douglas fir. Trees ranged from three to seven inches in diameter. Five chemicals were used, including Tordon 22K; Tordon 101: 2,4-D amine; a mixture of 2,4-D, x two pounds per gallon, 2,4,5-T, .5 pound per gallon and TBA, 1.5 pounds per gallon; and cacodylic acid aqueous solution, two pounds per gallon technical. All chemicals were injected in the undiluted form, with .5 cc per injection. Dosage was varied by spacing cuts three, six and nine inches apart. Treatments were administered in June, September and November, 1964; the June treatments show the only responses considered representative to date, since the later applications have not yet developed typical symptoms. The table that follows serves to illustrate the relative effectiveness of the various treatments, however, and also gives some indication of rapidity of effect.

It will be noted in these results that the most consistent kills were obtained with Tordon treatments, in which relatively high mortality occurred In view of the objective of removing trees from active competition, it may be seen that even where mortality was not complete, the trees have been

Results of chemical thinning treatments on 25-year-old Douglas fir

Season	Space between cuts, inches	Tordon 22K	Tordon 101	2,4-D	Mixture	Cacodylic
		Percent of trees dead				
June	3	75	80	0	0	60
	6	100	50	20	0	20
	9	40	100	20	20	20
Sept.	3	0	0	0	0	20
	6	0	0	0	0	20
	9	0	0	0	0	0
		Percent of trees too badly injured to compete				
June	3	100	100	20	0	60
	6	100	75	20	0	80
	9	80	100	40	20	40
Sept.	3	0	20	20	0	60
	6	20	0	0	0	40
	9	0	0	20	0	100

damaged to a satisfactory degree with the greatest spacing between injections, hence lowest dosage. The other chemical which produced substantial damage was cacodylic acid. This compound tended to concentrate in terminal whorls of branches, killing tops but not the entire trees in many cases. The effects of cacodylic acid occur very soon after treatment, however, with defoliation occurring within a month after both June and September application. Much higher concentrations of this material may be used before the cost approaches that of Tordon, hence it is felt that both compounds warrant further attention for this use. (Oregon State University, School of Forestry, Corvallis)

<u>Labor saving injection device for weed tree control.</u> Newton, Michael. Conventional injectors used in killing unwanted trees are known to provide good control of a variety of species, but have several disadvantages. They are heavy, cumbersome, and require two hands for manipulation. For small stems, relatively good marksmanship is required to avoid damaging or clogging the tip by missing the woody stem, and glancing blows do not place the herbicide effectively. Injectors which place the herbicide in the cut automatically do so during the penetrating stroke, causing some losses of herbicide from premature release of chemical. Notwithstanding the disadvantages, the injector concept is sufficiently good to warrant wide usage, and it was felt that a need existed for an instrument which would employ the principles of injection while avoiding the major difficulties of the current models.

The instrument designed to overcome these shortcomings is a hatchet-shaped injector, weighing some three pounds. The principle of operation involves small, accurately-metered dosages of herbicide automatically released into a small cut through the action of an inertia-operated pump. The pump does not operate until penetration is complete, so that all the chemical is placed within the pocket created by the cutting action of the bit. The instrument is made so that it may be used with either hand, with right or left strokes. The chemical reservoir is a light polyethylene bag which hangs on the belt of the operator. Feed to the instrument through a plastic tube need not be downhill, as the pump operates with positive displacement, hence the injector may be used at any height which is convenient and effective.

Some of the additional advantages of this type of instrument are that it may be carried while the operator is primarily involved with other duties, leaving both hands free while hanging on the belt. Labor requirements are generally substantially lower for the hatchet than for conventional injectors, partly owing to ease of moving through dense timber, and partly due to the ability of the operator to treat the back side of a tree without physically going around it. In addition, strands of sprout origin, where clusters of stems make the complete circumference inaccessible to conventional injectors, are readily treated with the hatchet.

Production models of the hatchet will be equipped with an option of bit width so that trees may be treated with narrow cuts for systemic insecticides and fungicides. Moreover, coaxial chemical hoses will be available so that two chemical reservoirs may be carried, offering a choice of treatments with a single instrument with merely a shift of a selector valve.

It is anticipated that this instrument will make available to the managers of large and small forest tract and tree infested range lands, an economical method of undesirable tree control, and to pathologists and entomologists a practical and efficient method of introducing systemic control chemicals. (Oregon State University, School of Forestry, Corvallis)

<u>Seasonal variation in toxicity of herbicides to coniferous trees and associated brush species.</u> Gratkowski, H. Results of a study now completed are expected to lead to large scale aerial spraying to release ponderosa pines from brush competition in southwestern Oregon.

A preliminary experiment completed in 1958 showed that young ponderosa pines become resistant to herbicides during late summer or early fall. A more detailed experiment was then designed to determine more precisely when this resistance develops and to learn whether associated brush species remain susceptible or become resistant at the same time.

Four stands of conifers were selected for experimental installations under different environmental conditions. Douglas-firs 5 to 8 feet tall were treated in the Cascade Range and in the Coast Range. Ponderosa pines 3 to 5 feet tall were studied in the hot, dry Rogue River valley, and pines 5 to 8 feet tall were studied in a cooler, wetter habitat near Crater Lake in the Cascade Range. On each site, a complete experiment was set up as a 2 x 2 x 10 factorial in a completely randomized design testing low volatile esters of 2,4-D vs. 2,4,5-T in water or oil-in-water emulsion carriers applied on 10 dates ranging from late June to mid-September. Treatment dates were June 24, July 1, 8, 15, 22, and 29, August 10, 20, and 30, and September 15. On each date, 5 trees at each site were sprayed to drip point with .5 aihg formulations of the two herbicides.

At each of the four sites, 10 shrubs of a brush species commonly associated with the treated conifer were sprayed with a selected formulation of herbicides on the same dates. With Douglas-fir and ponderosa pine in the Cascade Range, the brush species selected for treatment was snowbrush ceanothus (Ceanothus velutinus). With Douglas-fir in the Coast Range, the selected brush species was varnishleaf ceanothus (C. velutinus var. laevigatus); and with ponderosa pines in the Rogue River valley, sprays were tested on large sprouts of Pacific madrone (Arbutus menziesii).

As in the earlier experiment, Douglas-firs proved more resistant than ponderosa pines when treated with herbicides as foliage sprays. Use of oil-in-water emulsions caused more damage than water carriers on both Douglas-fir and ponderosa pine.

More important were the results on ponderosa pines. Resistance of the pines increased rapidly after cessation of height growth, reaching a level of no damage in late August or early September on both areas.

In contrast, snowbrush ceanothus remained highly susceptible (80 to 100% of the shrubs killed) throughout the entire period from late June to mid-September on both sites. And both varnishleaf ceanothus in the Coast Range and madrone sprouts in the Rogue River valley were at least as susceptible and possibly even more susceptible to herbicides in mid-September.

The lack of damage on conifers sprayed with herbicides in early fall when brush species were readily killed indicates that early fall is a desirable season for aerial spraying to release ponderosa pines from brush competition in southwestern Oregon.

Results of this experiment are in agreement with results obtained in the earlier experiment. They also agree with results obtained on an unreplicated series of 1/100th-acre plots where Douglas-firs were treated with 3 lbs. ae of 2,4,5-T/acre in an emulsion carrier and with results on a similar series of plots where pines were treated with 2 lbs. ae of 2,4,5-T/acre in water. The plots were sprayed on 9 of the treatment dates at the two experimental areas in the Cascade Range. And finally, data from these experiments have proved reliable when tested in a project-scale trial on ponderosa pines in deerbrush and redstem ceanothus on the Willamette National Forest.

Fall spraying provides a second season when young Douglas-firs may be successfully released from brush competition and--for the first time--allows the use of economical aerial spraying to release the more susceptible ponderosa pines in southwestern Oregon. (Pacific N.W. Forest and Range Experiment Station, Roseburg, Oregon).

Large planting stock of Douglas-fir helps evade damage by animals and sprouting brush on favorable sites. Newton, M. and Black, H. C. Reforestation of highly productive sites occupied by dense brush in the Pacific Northwest often involves aerial brush-control with selective herbicides. Such areas are usually planted before spraying with two-year old coniferous seedlings. Many of these plantations have failed because of severe damage by animals. There is some indication that the herbicide treatments to control brush may lower the effective height of the canopy and open it sufficiently to allow rapid increase in growth of grass and herbaceous species, thus making the habitat more attractive to wildlife. As a result, use of the area by animals may be intensified by the treatments needed for release of the conifers. Coating seedlings with animal repellents provides partial protection only from the time of planting until bursting of buds, and the new, unprotected shoots often are utilized by deer and rabbits. Since dormant sprays are mostly effective in top killing brush, sprouts will dominate seedlings kept in check by animals and greatly reduce the ultimate effectiveness of the chemical.

An experiment was established in the Coast range of western Oregon in an area well-used by animals and occupied by thick brush, to determine whether or not large seedlings would be damaged less heavily by animals than small seedlings, and if they would attain a good rate of growth without being suppressed by sprouts. A stand of brush consisting largely of vine maple, red alder, and bitter cherry was sprayed aerially with 2,4-D at the rate of 2.5 pounds of herbicide in 10 gallons of diesel oil to an acre. The herbicide was applied in April following planting with an average of 350 wild, untreated Douglas-fir seedlings on each acre. The seedlings ranged in height from 4 to 47 inches. Control of brush was estimated as poor to good, depending on the species and the flight pattern. After spraying, 300 seedlings along randomly selected lines were marked with stakes, and the height and the amount of animal damage to each seedling were recorded.

Results at the end of the first year showed that the chances of a seedling being damaged by animals, particularly rabbits, in this environment were related inversely to the height of the seedling. These results are demonstrated in the following table, which shows the percentage of damaged seedlings in each height-class by deer and rabbits, net gain or loss in height, and height of live seedlings after one growing season.

Two-year-old plantations in the same vicinity indicate that the larger seedlings have the capacity to grow very rapidly during the second year if they are only lightly damaged or undamaged the first year. Moreover, the large size of the seedlings reduces the likelihood that they will be suppressed or heavily browsed during subsequent years.

Conclusions are that a large proportion of seedlings capable of evading problems of suppression by brush and severe damage by animals may help avoid the need for repeated treatment with herbicide in reforested areas occupied by heavy brush. The use of large planting stock of Douglas-fir also may enable a forest manager to use a less costly spray in marginal types of brush. (Oregon State University, School of Forestry, Corvallis.)

Performance of Douglas-fir Seedlings Planted in 2,4-D Project, by Height-class

	Height-class, inches			
	0-12	12-24	24-36	36+
Survival, percent	72	87.5	85.0	86.0
Seedlings with net gain in height, percent	44.5	66.2	66.7	58.3
Seedlings browsed by deer, percent	11.1	9.7	10.1	5.5
Seedlings browsed by rabbits, percent	22.2	14.2	5.0	0
Unbrowsed gain in height, inches	2.4	2.4	2.5	2.8
Average net growth browsed seedlings, inches	-3.1	-2.0	0.4	2.0
Average one-year height, live seedlings, inches	8.0	20.9	30.8	39.3

Effect of two triazine herbicides on germination and survival of several coniferous and herbaceous species. Zavitkovski, J., and M. Newton. This experiment was conducted to determine the relative susceptibility to atrazine and propazine of several important coniferous species, and of weeds represented by grasses, legumes, and woody species frequently found on planted clearcuttings in competition for moisture and nutrients.

This experiment was conducted in a greenhouse from March to June, 1964. The herbicides were spread evenly on the surface of sterized fertile clay loam soil, with small quantities of dry soil as a carrier. Both chemicals were applied at rates equivalent to 1.5, 3, and 4.5 pounds of active material to an acre; one flat was left untreated. Twenty-five seeds of each of the 14 species used in this experiment (except for medusahead grass, Scotch broom, and red alder), were planted in each flat. The flats were watered regularly.

The results are summarized in the following table.

As can be seen from the table, atrazine at 3 pounds an acre provided almost the same degree of control as at 4.5 pounds an acre, but survival of the conifers was higher at 3 pounds. Applying 1.5 pounds an acre was not satisfactory in controlling some grasses; on the other hand, survival of the conifers was excellent. Propazine provided acceptable control of grasses, particularly ryegrass, only at the highest rate of application. Detrimental effect on conifers was about the same with both herbicides.

	Species	Seeds planted	Atrazine 1.5	Atrazine 3	Atrazine 4.5	Propazine 1.5	Propazine 3	Propazine 4.5	Untreated
			Survival Count						
1.	Medusahead grass	22	11	1	0	2	0	0	20
2.	Cheatgrass	25	4	0	0	0	1	0	19
3.	Ryegrass	25	1	0	0	14	11	2	25
4.	Crested wheat	25	2	0	0	1	0	0	24
5.	Red fescue	25	0	0	0	0	1	0	24
6.	Alta fescue	25	1	0	0	8	1	0	22
7.	Alfalfa	25	0	0	0	0	0	0	21
8.	Red clover	25	0	0	0	0	0	0	17
9.	Grand fir	25	2	3	0	1	0	6	2
10.	Noble fir	25	2	0	0	5	0	1	1
11.	Douglas-fir	25	19	10	2	20	6	2	23
12.	Ponderosa pine	25	19	10	9	12	22	14	21
13.	Alder	appr 50	0	0	0	0	0	0	4
14.	Scotch broom	19	0	0	0	0	0	0	0

Germination of the two most important conifers, ponderosa pine and Douglas-fir, was good, but growth of pine was best. This tendency may have been even more pronounced if the growth of roots had not been restricted by the shallow depth of the flats.

The results indicate that reforestation by aerial seeding of areas covered by weeds and by grasses in particular may be feasible if the areas are treated with one of these herbicides, particularly atrazine, concurrently with the seeding, and if protection could be assured from other sources of damage, especially rodents. (Oregon State University, School of Forestry, Corvallis.)

Atrazine improves survival of Douglas-fir seedlings and ponderosa pine seed spots. Bickford, M. L.*, J. Zavitkovski, and M. Newton. Planting trees is often unsuccessful where herbaceous cover is dense unless some special measures are taken to reduce competition. One of the most effective and least costly methods is control of vegetation by chemicals.

A series of trial plots was established near Corvallis, Oregon, to test the suitability of atrazine for use with coniferous seedlings and seeded spots. The plots were located on a gently inclined south slope with a heavy clay soil. Three rates of application were tested: 5, 3-1/3, and 1-2/3 pounds an acre, of 80% active material. The atrazine was suspended in water and applied late in March with a commercial plot sprayer.

The seedlings used were two-year-old Douglas-fir which were planted with a planting bar. Spots seeded with Douglas-fir and ponderosa pine were placed randomly in the plots also, with four spots of each species and five seeds to a spot. Spots were seeded April 30; Douglas-fir seedlings were planted on five dates ranging from November to March on all plots.

*Data presented are based partly on a thesis submitted by Bickford to Oregon State University.

The seedlings were examined periodically throughout the summer. In October, survival was recorded and the seedlings were examined in detail. Growth of both roots and tops clearly was increased in the chemically treated plots. Survival was doubled on the plots where 1-2/3 pounds an acre was applied, and increased to nearly five times the survival obtained on untreated plots, in situations where 3-1/3 pounds were applied. There was little difference in survival between plots with 3-1/3 pounds an acre and plots with 5 pounds an acre. In view of an estimated 70% reduction of weed cover with 1-2/3 pounds an acre, and 95 percent or more in the higher rates, aiming for applications that provide nearly weed-free conditions appears necessary. Response from seeded spots indicated comparable weed-control requirements for planted Douglas-fir and seeded ponderosa pine. Poor germination caused failure of nearly all Douglas-fir seed spots. Better success with both species would be anticipated with mid-winter seeding.

The following table shows survival of planted Douglas-fir seedlings and seeded pine treated chemically. Relatively high mortality of planted Douglas-fir even in high rates of application was caused partly by edge-effect of small plots, but was consistent among rates. Seeds were protected from animals by screens. (Oregon State University, School of Forestry, Corvallis.)

Percent survival of planted Douglas-fir and seeded Ponderosa pine with three rates of atrazine.

	Atrazine - pounds per acre			
	0	1-2/3	3-1/3	5
Douglas-fir seedlings	13	27	62	60
Ponderosa pine seeds	0	3.3	36.7	41.7
Stocked 5-seed spots, pine	0	16.7	83.3	83.3

Weed-control predictions for conifer plantations in grassy areas. Newton, M. Drought is a primary cause of mortality in plantations of conifers in western United States, even where annual precipitation is relatively great. Annual patterns of rainfall are rather consistent in most of the highly productive forest regions, with cessation of effective rains occurring sometime from April to June, followed by prolonged warm, dry summers. Depletion of soil moisture during the dry season is often related strongly to the net incoming solar radiation. The time required for moisture depletion may be predicted with the following equation:

$$D = \frac{780\ (M+R)}{0.30\ (\text{Cos } A)\ (\text{Rad})\ (\%\ \text{Cover})} \times 100$$

When:

D = Days of available moisture after last effective rainfall.
M = Inches of available moisture in soil profile within reach of weed roots.
A = Slope difference between plantation and 28° south slope along north-south line.
Rad = Average daily incoming solar energy expected during drying period in langleys.
% Cover = Percent of point frame hits in herbaceous vegetation, (equals percent interception of sunshine by green vegetation).
R = Inches of rainfall in spring showers after soil profile begins to dry.

Conversely, the most cover that may be tolerated may be expressed as:

$$\% \text{ Cover} = \frac{78000 \ (M+R)}{0.30 \ (\text{Cos } A) \ (D) \ (\text{Rad})}$$

when the number of days of rainless weather is predictable within reason, and when moisture is expected to be uniformly available throughout the soil profile below the zone of surface evaporation.

Applications of herbicide that have provided reduction in cover consistent with the above predictions have improved performance of seedlings to acceptable levels. However, a margin of 50 percent should be allowed in calculating herbicide to allow for unusually severe conditions and light spots in application. (Oregon State University, School of Forestry, Corvallis.)

Heated soils induce germination of snowbrush and deerbrush ceanothus seeds. Gratkowski, H. Earlier detailed work showed that dormant varnishleaf ceanothus seeds in forest soils germinate after the soils are heated to high temperatures by wildfires or by controlled burning of logging slash. Laboratory and greenhouse experiments just completed indicate that seeds of snowbrush ceanothus (*Ceanothus velutinus*), an evergreen species, and seeds of deerbrush ceanothus (*C. integerrimus*), a deciduous species, respond in the same way to high soil temperatures.

Seeds were buried in fine sandy soil heated to temperatures of 30°, 45°, 60°, 75°, 90°, 105°, or 120° Centigrade for periods of 4, 13, 22, 31, and 40 minutes. Seeds of each species were tested separately in replicated 5 x 7 factorial experiments in a randomized block design.

The response of snowbrush seeds to high soil temperatures paralleled that of varnishleaf ceanothus (*C. velutinus* var. *laevigatus*). Germination was not induced at soil temperatures of 30°, 45°, or 60° Centigrade. A 75° C. soil temperature induced germination of some seeds, but maximum germination was obtained after heating in soils at temperatures of 90° to 105° Centigrade. A 120° C. soil temperature killed snowbrush seeds. Minimum effective duration of exposure was less than 4 minutes.

Deerbrush seeds responded in a similar manner but at somewhat lower temperatures. A 60° C. soil temperature induced some germination in the seed lot tested, but maximum germination was obtained at 90° Centigrade. The 105° soil temperature killed some seeds, and only a few seeds survived a 4-minute exposure to soil temperatures of 120° Centigrade.

Results of these experiments indicate that broadcast burning of light accumulations of logging slash will induce germination of dormant deerbrush and snowbrush ceanothus seeds in forest soils. (Pacific N.W. Forest and Range Experiment Station, Roseburg, Oregon).

PROJECT 4. WEEDS IN HORTICULTURAL CROPS

Don F. Dye, Project Chairman

Summary

Investigators from four states have contributed fourteen abstracts which represent ten crops. Three abstracts were received for tomatoes and three for deciduous fruit. Only one abstract was received on the other crops.

Tomatoes. Tillam, trifluralin, diphenamid, Betasan and CDEC were reported as having shown promise.

No toxicity from these herbicides to the crop was reported except for diphenamid when applied at 16 pounds per acre.

Deciduous Fruit Trees. These abstracts deal primarily with the tolerance of certain varieties of established fruit trees and seedlings to herbicides. Most of the emphasis is on the effect of the triazines, uracils on the trees, with some reference to other classes of herbicides.

A progress report of annual weed control in California deciduous fruit orchards. Lange, A. H. A summary of the 1963-64 cooperative weed control work in orchards indicated generally good weed control with both simazine and diuron without excessive phytotoxicity symptoms in most orchard crops. Direct comparisons indicated better weed control on a pound for pound basis with simazine than with diuron. When 28 trials comparing simazine and diuron at 1 lb., 2 lb., 4 lb., and 8 lb. in 5-10 foot strips. Simazine appeared to be better 60 percent of the time and diuron better 30 percent of the time. The remaining 10 percent than were equal. From these results several conclusions can be drawn. (1) In these tests, simazine was consistently better for annual weed control than diuron on a pound for pound basis this year. (2) There were points of comparison, probably related to soil type, rainfall, species of weeds, etc., where one or the other chemical was much superior. (3) Both herbicides gave commercial weed control in most of the tests. This then means that both chemicals have value in controlling annual weeds in orchards.

In summarizing the periodic phytotoxicity ratings (severity of symptoms) simazine and diuron appeared fairly safe in orchards when applied during the winter months. However, there were instances where excess phytotoxicity occurred generally associated with young trees growing in sandy soils. Some tentative conclusions can be drawn. (1) Simazine, although having given better weed control, resulted in more toxicity to the trees. This was particularly true with almonds, where seven injurious symptoms were recorded to one for diuron. Symptoms were noted down to 2 lb/A (this occurred in a sandy soil on one year old trees). These findings do not exclude use of simazine even at higher rates on older trees in different soil types. Nonetheless it serves to point out that if this herbicide moves into the root zone of almond trees, particularly the Mission variety, severe injury may occur.

Insufficient information was gathered this year on the use of these materials in apricots. No definite symptoms occurred up to 4 pounds when used around young trees.

The information on peaches was somewhat more complete since more trials have been conducted. The results were somewhat encouraged showing safety up to and including 4 lb/A.

Prunes appeared to be more sensitive than peaches, showing injury as low as 4 lb/A of simazine in one test in bearing trees on moderately heavy soil.

Diuron showed no injury to pears up to the highest rate tested (8 lb/A) On the other hand, simazine showed considerable toxicity at the same rate in a number of trials.

Although the number of trials reported here is somewhat limited, no injury occurred up to and including 8 pounds in either apples or walnuts.

Simazine and diuron are now recommended for use in California walnuts. Considerably more data will be necessary for the recommendation of pears, apples, almonds, and the stone fruits. (California Agricultural Extension Service, University of California, Davis, California).

Diphenamid for weed control in irrigated tomatoes. Lange, A. H., and Ashton, F. M. A summary of nine separate cooperative county experiments conducted throughout California indicated that diphenamid preplant incorporated at 4 to 6 pounds per acre gave as good weed control as Tillam and Vegadex (Table 1). A summary of the toxicity ratings recorded at various intervals after crop emergence showed no apparent toxicity except when a rate of 16 lb/A was used. The toxicity, expressed as a stand reduction with early stunting, occurred in only two out of three trials. Weeds in other crops in the plots were essentially eliminated at 16 pounds of diphenamid per acre. In other tests there was no reduction in yield up to the highest rate tested, 8 pounds per acre. Weed control was generally commercially acceptable in excess of two months. DCPA (Dacthal) included in some of the early trials did not give adequate weed control up to 10 pounds per acre and showed considerable toxicity to direct seeded tomatoes at 8 pounds per acre (Table 1). Stand reduction and stunting were both observed. Although 10 pounds of DCPA per acre did not affect yield there was a suggestion of phytotoxicity expressed by considerable delay in maturity as noted in the small number of ripe fruits compared to the number of green fruits. (University of California, Davis).

Summary of nine trials testing several herbicides for weed control in tomatoes (1962-64)

Herbicide	lb/A	% weed control 2/	Average 1/ Toxicity rating (0-10)	Percent of untreated check plant/ft.	Yield of fruit green	ripe	total
Tillam	4	68	0.7	--*	110	112	113
Vegadex	4	50	0.8	--*	107	102	110
Tillam+Veg	2+2	56	0.1	--*	92	115	114
Diphenamid	4	72	1.0	100	96	149	122
Diphenamid	6	82	0.1	95	103	89	103
Diphenamid	8	94	0.2	117	104	128	116
Diphenamid	16	--*	2.4	49	--*	--*	--*
Dacthal	8	36	4.4	42	--*	--*	--*
Dacthal	10	50	3.0	33	104	76	99
Dacthal	12	--*	6.8	--*	--*	--*	--*
Dacthal	32	75	6.8	22	--*	--*	--*

1/ Average of parts of 9 separate experiments. Not all data was taken in every trial so averages represent averages of 2-9 figures.
2/ Weed control averages based on the untreated check (counts) and weed control ratings for the first 100 days.
* Not included in more than one trial or no data collected.

The yield data from two trials was analyzed statistically. In these trials there were no significant differences in number or weight of fruit from any plot. The coefficient of variation for fruit number ranged from 25-30% whereas the coefficient of variation for fruit weight ranged from 7.8-11.7%.

Effect of several uracil herbicides on species of prunus. Lange, A. H. The response of young Lovell peach, Myrobalan plum, and Mission almond seedlings, and Mazzard cherry liners growing in sand to four uracil herbicides was compared with simazine and diuron under greenhouse conditions during the summer of 1964 at Davis, California. Simazine, diuron, bromacil, and isocil, in addition to experimental herbicide 732 (5-chloro-3-tert. butyl-6-methyluracil) and experimental herbicide 733 (5-bromo-3-tert. butyl-6-methyluracil) were applied in aqueous solution at 0.05, 0.5, and 5 ppm. to young plants growing in washed river sand fed with half strength Hoagland nutrient solution.

Uracil herbicides showed differences in selectivity on plum, almond, peach and cherry.

Both herbicides 732 and 733 appeared to be safer on peaches than simazine or diuron showing about the same toxicity or slightly less than isocil (Table 2). Even bromacil appeared to be somewhat safer than simazine or diuron on peaches in contrast to earlier experiments.

All three uracils tested on plums appeared to be no more toxic than simazine or diuron, with 733 showing less toxicity than the other herbicides on plums but considerably less on almonds (Table 1).

The degree of toxicity was not as striking in the Mazzard cherry liners possibly because of the older tissue involved (Table 2). These liners were one year old (pruned back and brought in from the field and repotted in sand). Again 733 was least toxic of the herbicides tested although the differences were not great either in the toxicity readings or fresh weights of the tops.

After the peach seedlings were harvested and the roots removed, the containers were replanted to oat and bean seeds (one month after the initial herbicide application). The bean and oat plants were rated two weeks after seeding and harvested at one month.

Both simazine and diuron displayed more residual carry-over in the sand measured by toxicity to oat and bean plants than any of the uracils. This may have been related to their relative solubilities in water, particularly since washed sand would not be expected to have much in the way of absorptive surfaces. Within the uracils, however, there was no apparent relationship between losses due to leaching, i.e. solubility as expressed by loss of phytotoxicity to oats and beans. The more insoluble 732 and 733 showed less toxicity to beans than the more soluble bromacil and isocil.

The shorter residual of the uracil in sand culture compared to simazine and diuron may indicate a greater safety for the uracils on peaches and almonds growing in sandy soils under field conditions. (University of California, Davis).

Table 1. The effect of several herbicides on the growth and symptom expression of Myrobalan plum and Mission almond seedlings growing in sand-nutrient solution culture as measured by phytotoxicity ratings (0 = no effect, 10 = dead), height and weight.

		Average 1/					
		Plum			Almond		
Herbicide	ppm	Tox.	Top ht. % check	Top wt. % check	Tox.	Top ht. % check	Top wt. % check
Simazine	0.5	0.8	79	104	0	97	68
Simazine	5	5.0	70	28	5.0	80	26
Diuron	0.5	0.2	90	104	0	97	83
Diuron	5	5.0	65	30	4.5	61	12
Isocil	0.5	0.2	94	93	0.5	109	92
Isocil	5	6.7	72	28	6.0	74	18
DuPont 732	0.5	0	97	138	0	100	108
DuPont 732	5	5.2	76	27	3.0	74	25
DuPont 733	0.5	0	107	117	0	114	100
DuPont 733	5	5.0	84	40	4.5	100	75
Check	--	0	100	100	0	100	100

1/ Average of 2 or 4 replications.

Table 2. The effect of several herbicides on the growth and symptom expression of Lovell peach seedlings and pruned-back year-old Mazzard cherry liners growing in sand-nutrient solution culture.

		Peach			Fresh	Cherry (Mazzard)			Fresh
			Tox.		wt.		Tox.		wt.
Herbicide	ppm	1 wk.	2 wk.	4 wk.	% 1/	1 wk.	2 wk.	4 wk.	% 1/
Simazine	0.05	0	0	0	100	0	0	0	127
Simazine	0.5	0	0	3.2	90	0	0	3.0	94
Simazine	5	2.0	4.5	8.8	20	0.2	2.7	6.5	33
Diuron	0.05	0	0	0.2	94	*	*	*	*
Diuron	0.5	0	0	2.0	82	*	*	*	*
Diuron	5	0.5	4.5	9.8	14	*	*	*	*
Bromacil	0.05	0	0	0.2	106	0	0	0	100
Bromacil	0.5	0.2	2.2	3.2	85	0	0.8	2.2	107
Bromacil	5	5.2	5.5	6.5	39	2.5	6.0	8.8	17
Isocil	0.05	0	0	0	112	*	*	*	*
Isocil	0.5	0	0	0	87	0	0	0.5	113
Isocil	5	1	3.5	5.0	50	1.0	3.8	7.2	47
DuPont 732	0.05	0	0	0	100	0	0	1.0	119
DuPont 732	0.5	0	0	0.2	105	0	0	1.2	92
DuPont 732	5	1	3.8	6.0	46	1.0	2.7	7.8	45
DuPont 733	0.05	0	0	0	93	0	0	0.5	114
DuPont 733	0.5	0	0	0	80	0	0	1.5	114
DuPont 733	5	1	2.5	3.5	60	0.8	1.8	6.5	49
Check	0	0	0	0.2	100	0	0.2	0.5	100

* No data.

Table 3. Residual herbicide after growing peach seedlings for one month as measured by phytotoxicity ratings (0 = no effect, 10 = dead) and fresh weight of tops in grams at age 1 month.

	Sol. 1/		Oats			Beans		
	in			Ave fr	Top wt		Ave fr	Top wt
Herbicide	H_2O	ppm	Tox.	Wt.gm	% /	Tox.	Wt.gm	% /
Simazine	5	0.05	0.2	5.3	85	0	6.9	78
Simazine		0.5	0.5	4.6	74	0	5.6	63
Simazine		5	6.8	0.4	6	5.2	0.4	5
Diuron	42	0.05	0	5.4	87	0	6.7	75
Diuron		0.5	0	4.8	77	0	7.4	80
Diuron		5	6.8	0.4	7	6.0	0.7	8
Bromacil	815	0.05	0	5.1	82	0	8.4	95
Bromacil		0.5	0.2	4.8	78	0	8.5	95
Bromacil		5	3.2	2.1	34	4.0	4.1	44
Isocil	2150	0.05	0	5.5	89	0	9.7	109
Isocil		0.5	0	4.2	68	0	7.3	82
Isocil		5	5.2	0.7	11	2.8	3.3	38
DuPont 732	710	0.05	0	4.6	74	0	8.4	94
DuPont 732		0.5	0.5	5.3	85	0	8.0	90
DuPont 732		5	2.8	3.6	58	0.2	8.7	97
DuPont 733	410	0.05	0	5.1	81	0	10.2	115
DuPont 733		0.5	0.2	6.2	99	0.2	8.6	97
DuPont 733		5	1.5	4.8	78	2.2	8.0	94
Check	---	0	0	6.3	100	0	8.9	100

1/ Taken for company technical data sheets.

Response of several deciduous fruit tree seedlings to herbicides. Lange, A. H., Crane, J. C. Several herbicides were applied to month old deciduous fruit tree seedlings growing in 46 ounce cans of washed river sand. Seedlings were periodically measured, rated for phytotoxicity, and harvested at the end of approximately five weeks for fresh weight.

Pre-emergence herbicides. Simazine when applied in this manner showed no particular selective advantage for any of the seedlings tested with the possible exception of Northern California Black Walnuts at levels up to and including 5 ppm. Most severe damage from simazine occurred on the Mahaleb cherry seedlings. Peach appeared to be somewhat more resistant to simazine than some of the other species of Prunus. Diuron showed about the same degree of toxicity as did simazine being safer on walnuts and quite toxic on Mahaleb cherry seedlings. Prometryne did not demonstrate outstanding selectivity in any of the species tested. It may have been more toxic on almonds and peaches than simazine or diuron. Prometryne, like simazine, showed least toxicity to the Northern California Black Walnuts. Isocil showed indications of being quite safe on apricots, plums, and much safer on peaches than simazine or diuron. Isocil may also have been more toxic on cherries and walnuts than simazine or diuron. However, isocil was particularly toxic to Bartlett pear seedlings. Bromacil was considerably more toxic than simazine or diuron on most of the species tested. This herbicide was particularly toxic on Black Walnut and pear. Trifluralin was safer than simazine or diuron on all species tested. There was some indication of stunting at 5 ppm. Dacthal also appeared to be without measurable toxicity up to 0.5 ppm, maximum solubility of this herbicide in water. Diphenamid, likewise, produced very little symptoms in the species tested with the exception of Royal apricot and Bartlett pear seedlings. EPTC showed some toxicity at the 5 ppm level in most of the species with the greatest degree of toxicity showing in the Mahaleb cherry.

Post-emergence herbicides. Dalapon showed a fair degree of safety in these tests, however, it should be pointed out that the herbicides were applied only twice. With daily waterings the highly soluble dalapon could have been leached from the pots before doing the type of damage observed to young trees growing in the orchard.

Amitrole showed considerable symptoms at 5 and 50 ppm in most of the species. Again, much of the affect of this herbicide on total fresh weight could have been leached from the root zone with daily watering. There did appear, however, to be some species difference in tolerance to this herbicide with peaches, plums, and cherries being the most susceptible. Paraquat showed no toxicity symptoms or reduction in growth on any of the species tested up to 50 ppm paraquat in the solution.

Hormone type post-emergence herbicides. 2,4-D was shown to be safe up to 0.5 ppm when applied to the roots of actively growing seedlings. There was no indication of symptoms or leaf malformation in any of the species tested as a result of root applications of this herbicide. Dicamba on the other hand gave considerable toxicity at 0.5 ppm to all the species tested. The most susceptible again appeared to be cherry, Black walnut, and pear. Tordon showed more toxicity than dicamba to all the species tested. Most resistant of the species tested was Black walnut and almond (Table 1). (University of California, Davis).

The comparative effect of several herbicides on the fresh weight of several tree fruit seedlings expressed as percent of an untreated control (each treatment was replicated 4-6 times in sand-nutrient solution culture).

Herbicide	Conc. added ppm	Mission almond	Royal apricot	Lovell peach	Myrobalan plum	Mahaleb cherry	N. Calif. black walnut	Bartlett pear
Simazine	5	26	15	22	14	14	84	22
	0.5	88	78	108	67	14	116	49
	0.05	108	108	112	90	86	98	94
Diuron	5	23	22	25	14	14	67	24
	0.5	98	56	84	24	14	113	52
	0.05	--	89	88	95	77	119	100
Prometryne	5	25	16	24	14	14	96	31
	0.5	30	96	63	19	23	99	63
	0.05	106	100	82	90	--	122	83
Isocil	5	18	26	77	14	14	65	22
	0.5	98	102	120	81	23	92	34
	0.05	104	90	100	90	100	113	107
Bromacil	5	23	27	45	14	14	44	20
	0.5	106	81	82	14	18	59	25
	0.05	109	107	101	90	82	102	101
Trifluralin	5	116	86	84	86	104	98	112
	0.5	118	96	99	90	145	98	98
	0.05	108	97	116	95	136	87	143
DCPA	5	109	87	102	100	136	90	108
	0.5	98	93	110	90	64	102	94
	0.05	102	100	87	105	77	92	81
Diphenamid	5	118	61	112	86	77	94	78
	0.5	104	95	91	105	123	92	74
	0.05	112	81	102	100	95	92	63
EPTC	5	62	75	75	52	32	84	85
	0.5	87	121	100	90	77	99	76
	0.05	125	82	100	114	82	111	98
Dalapon	50	95	94	96	71	42	102	71
	5	105	96	77	105	136	104	78
	0.5	123	79	94	105	100	99	121
Amino triazole	50	91	93	31	38	36	53	51
	5	97	79	79	67	95	107	81
	0.5	119	96	97	95	136	107	87
Paraquat	50	106	111	96	81	122	110	110
	5	106	94	64	90	77	104	109
	0.5	101	112	72	90	86	117	109
2,4-D	0.5	106	106	94	100	59	111	114
	0.05	119	103	95	110	86	124	87
	0.005	111	95	99	100	132	119	69
Dicamba	0.5	62	40	49	62	36	64	33
	0.05	98	97	82	100	73	81	62
	0.005	118	93	111	90	87	98	92
Tordon	0.5	58	24	22	24	18	24	29
	0.05	91	54	55	57	54	78	36
	0.005	129	91	96	90	77	87	87

Screening herbicides for use in Thompson Seedless grapes (1964). Lange, A. H., Lider, L. A., Leonard, O. A. The response of newly rooted Thompson seedless grape rootings growing in sand to twenty-five herbicides (root applied) was evaluated under greenhouse conditions during the spring of 1964 at Davis, California. Only one application of the solutions containing the herbicides was made (200 ml per plant); all subsequent waterings were with 1/2 strength Hoagland's nutrient solution. Readings on phytotoxicity were recorded 18 and 35 days following the application of the solutions containing the herbicides. The study included simazine, prometryne, desmetryne, GS-14254, GS-14260, diuron, linuron, tenoran, C-2059, C-3126, norea, bromacil, isocil, duPont 732, duPont 733, FW 925, pyramin, propanil, TH 073-H at 5, 0.5, and 0.05 ppm and trifluralin, diphenamid, DCPA, EPTC, Tillam, and R-4461 at 50, 5, and 0.5 ppm.

Triazines. None of the new triazines appeared to be less toxic to young Thompson seedless cuttings than simazine with the possible exception of GS-14260. This herbicide produced a striking chlorosis pattern but during the growth period of the experiment did not reduce the fresh weight of the tops.

Substituted ureas. Of the substituted ureas, several appeared to have produced less toxicity than diuron. Least toxic was norea. Linuron produced considerable chlorosis and leaf burn bud did not reduce the fresh weight during the short period of the trial.

Uracils. Generally the uracils were considerably more toxic than either simazine or diuron. Least toxic of this group appeared to be duPont 733.

Carbamates. Neither EPTC or PEBC was as toxic as simazine or diuron but showed symptoms at 50 ppm. EPTC showed some decrease in fresh weight as low as 5 ppm.

Miscellaneous. R-4461 showed some stunting and chlorosis at 50 ppm. Trifluralin showed slight stunting at only 50 ppm. Diphenamid showed considerable toxicity symptoms expressed as a blotchy chlorosis and erratic spotting of the leaf at both 5 and 50 ppm, however, probably due to the short duration of the experiment no effect was noted on the fresh weight. Dacthal showed no appreciable toxicity from any of the amounts applied. FW 925, propanil showed no appreciable phytotoxicity up to 5 ppm. The highest rate tested was 5 ppm. Pyramin showed considerable toxicity and loss in fresh weight at 5 ppm. TH 073-H killed the vines at 5 ppm and caused some noticeable symptoms at 0.5 ppm and loss in weight.

Based on these results and those of field tests, the herbicides deserving further tests are GS-14260, norea, trifluralin, diphenamid, DCPA, R-4461, particularly in soils where simazine and diuron have been found too toxic such as in the desert sands and other coarse sandy soils. (University of California, Davis).

A comparison of several herbicides (single application) for the effect on the growth and symptom expression of young Thompson Seedless rootings growing in sand fed with 1/2 strength Hoagland's solution.

Herbicide	Conc(ppm) added	Ave. phytotoxicity at 18 days	35 days	Ave. fresh wt of tops gms	% of check
Simazine	5	5.0	5.8	3.8	59
	0.5	0.8	2.0	6.2	96
	0.05	0	0	6.7	105
Prometryne	5	8.8	10.0	0.6	9
	0.5	0	0	6.9	108
	0.05	0	0	6.2	97
Desmetryne	5	9.6	10.0	0.6	9
	0.5	5.3	5.0	4.9	77
	0.05	0	0	6.9	108
GS 14254	5	5.5	9.8	2.0	31
	0.5	0.2	1.8	7.4	116
	0.05	0	0	5.6	88
GS 14260	5	1.5	1.5	8.2	128
	0.5	0	0	6.1	95
	0.05	0	0	6.0	94
Diuron	5	8.8	10.0	0.5	7
	0.5	0.2	0.2	6.6	103
	0.05	0	0	6.5	102
Linuron	5	6.3	8.3	5.9	92
	0.5	0.2	0.5	7.7	120
	0.05	0	0	5.7	89
Tenoran	5	3.5	5.0	2.4	37
	0.5	0	0	6.1	95
	0.05	0	0	5.4	84
C-2059	5	7.3	7.8	2.1	33
	0.5	0	0.2	5.2	81
	0.05	0	0.2	5.9	92
C-3126	5	5.8	4.8	3.2	50
	0.5	0	0	5.1	80
	0.05	0	0	3.5	55
Norea	5	0.2	0.2	6.9	108
	0.5	0	0	6.5	102
	0.05	0	0	7.2	113
Bromacil	5	9.6	10.0	0.4	6
	0.5	5.3	5.8	3.4	53
	0.05	0	0.5	6.2	97
Isocil	5	9.8	10.0	0.6	9
	0.5	5.5	5.8	3.0	47
	0.05	0.5	0.5	5.5	86
DuPont 732	5	7.8	9.5	0.9	14
	0.5	3.5	3.8	5.4	84
	0.05	0	0.5	5.1	80
DuPont 733	5	8.0	10.0	0.8	13
	0.5	0.8	2.0	6.1	95
	0.05	0	0	6.5	102

Continued.

Herbicide	Conc(ppm) added	Ave. phytotoxicity at 18 days	35 days	Ave. fresh wt of tops gms	% of check
EPTC	50	6.0	5.8	2.4	38
	5	5.8	2.3	3.7	58
	0.5	2.0	2.0	6.0	94
Tillam	50	6.0	2.0	3.2	50
	5	1.5	1.8	6.4	100
	0.5	0	0	7.6	119
R-4461	50	0.5	2.0	4.0	63
	5	0	0	7.1	111
	0.5	0	0	6.5	102
Trifluralin	50	0.5	0.8	5.8	91
	5	0	0	6.9	108
	0.5	0	0	8.5	133
Diphenamid	50	3.3	3.3	7.9	123
	5	0.5	2.5	6.1	95
	0.5	0	1.0	7.7	120
DCPA	50	0	0.5	6.5	102
	5	0	0	6.4	100
	0.5	0	0	7.0	109
FW 925	5	0	0	6.7	105
	0.5	0	0	7.1	111
	0.05	0	0	6.9	108
Pyramin	5	5.5	5.0	4.7	73
	0.5	0	0	6.4	100
	0.05	0	0	6.7	105
Propanil	5	0.2	0.2	6.2	97
	0.5	0	0	5.7	89
	0.05	0	0	5.2	81
TH 073-H	5	10.0	10.0	0.9	14
	0.5	0.2	1.5	4.9	77
	0.05	0	0	6.5	102
Check	--	0	0	6.4	100

Preplanting, soil-incorporated applications and preemergence applications of herbicides in carrots. Manges, Robert M. and Hubbard, J. L. Soil surface, soil-incorporated (22 days before seeding), and foliar applications of herbicides were compared for weed control in carrots, grown on furrow-irrigated clay. Rainfall was appreciable. Predominant weeds were Palmer amaranth (*Amaranthus palmeri* S. Wats.), common purslane (*Portulaca oleracea* L.), jungle-rice (*Echinochloa colonum*), and barnyardgrass (*Echinochloa crusgalli* (L.) Beav.).

Trifluralin was outstanding and controlled all weeds selectively for an extended period when 1 or 2 lb/A were incorporated with soil; performance was inferior without incorporation.

Regardless of the method of application, the 2-lb rate of linuron and the 3-lb rate of prometryne selectively controlled weeds for an extended period; lower rates were mediocre.

CDEC controlled only early broadleaved weeds for a short period with soil incorporation but failed to control weeds for an extended period regardless of the application method.

Solan failed to control emerged weeds but reduced the yield of carrots at the 4- and 6-lb rates.

Regardless of soil incorporation, no soil-applied herbicide significantly affected yield. (USDA, ARS, CRD, Weed Investigations in Horticultural Crops and Texas Agri. Expt. Sta., Weslaco, Texas).

Effects of depth of soil incorporation and time of planting on the performance of herbicides in furrow-irrigated spinach. Menges, Robert M. and Hubbard, J. L. Soil surface preemergence applications and applications incorporated 1/4 in. at planting and 1 in. 10 days before planting were compared for weed control in spinach. Predominant weeds were common purslane (Portulaca oleracea L.), Palmer amaranth (Amaranthus palmeri S. Wats.), and barnyardgrass (Echinochloa crusgalli (L.) Beauv.). The sandy clay loam was warm and no rain fell within 3 weeks, but soil was slowly dried after treatment.

All herbicides controlled weeds more effectively when soil-incorporated and all but norea controlled weeds best when incorporated 1 in.

CDEC and PEBC were outstanding; CDEC controlled weeds somewhat more effectively but PEBC was the only herbicide tested that selectively controlled weeds when incorporated 1/4 in. at planting. A 10-day delay in planting provided selectivity with CDEC and granular CIPC incorporated 1 in. The 3 carbamates controlled purslane and barnyardgrass efficiently but CDEC was superior in amaranth control.

CDEC performed similarly in liquid and granular formulations.

Pyrazon and norea injured spinach at rates which controlled weeds. (USDA, ARS, CRD, Weed Investigations in Horticultural Crops and Texas Agri. Expt. Sta., Weslaco, Texas).

Soil-incorporated and preemergence applications of herbicides in cabbage. Menges, Robert M. and Hubbard, J. L. Soil-incorporated treatments of herbicides, applied at seeding and 10 days before seeding, were compared with preemergence treatments of herbicides for weed control in cabbage grown on furrow-irrigated sandy clay loam. Predominant weeds were Palmer amaranth (Amaranthus palmeri S. Wats.) and common purslane (Portulaca oleracea L.). A total of 0.22 in. of rain fell in the first 6 days after treatment.

The only herbicide treatment which significantly injured cabbage was the 1-1/2-lb rate of trifluralin soil-incorporated 10 days before seeding.

Trifluralin at 3/4 and 1-1/2 lb/A, R-4461 at 10 lb/A and DCPA at 8 lb/A controlled weeds efficiently regardless of application method; R-4461 at 5 lb/A and granular and liquid CDEC at 6 lb/A controlled weeds satisfactorily regardless of application method but performances were slightly inferior. Lower rates of DCPA and granular and liquid CDEC controlled weeds satisfactorily only when applied on the soil surface. CDEC, however, tended to perform more efficiently incorporated 1 in. than 1-3/4 in. deep in soil.

Rainfall may have enhanced the performances of siol surface applications. (USDA, ARS, CRD, Weed Investigations in Horticultural Crops and Texas Agri. Expt. Sta., Weslaco, Texas).

Preplanting, soil-incorporated applications and preemergence applications of herbicides in lettuce. Menges, Robert M. and Hubbard, J. L. Soil surface and soil-incorporated applications of herbicides were compared for broadleaved weed control in lettuce grown on furrow-irrigated clay. Growth of lettuce was hampered by cold and hot weather and it was difficult to precisely evaluate the selectivity of herbicide applications.

Trifluralin was outstanding for selective weed control in lettuce; soil incorporated applications controlled weeds at the 3/4-lb rate without appreciable injury in lettuce. R-4461 controlled weeds selectively regardless of soil-incorporation. CIPC performed more satisfactorily in soil surface than in soil-incorporated applications whereas CDEC failed regardless of rate or method of application. Rainfall may have altered the performance of the soil-applied herbicides. Cultivation of soil after the initial irrigation and just before the delayed seeding provided insufficient control of weeds.

Herbicides and cultivation had no significant effect on stand, yield, or head size of lettuce. (USDA, ARS, CRD, Weed Investigations in Horticultural Crops and Texas Agri. Expt. Sta., Weslaco, Texas).

Control of weeds in established tomatoes. Menges, Robert M. and Hubbard, J. L. Preemergence sprays of herbicides were applied in established tomatoes with and without soil incorporation. Performances of herbicides were compared with that of polyethylene film on furrow-irrigated soils.

Although some rain fell, soil-incorporated applications of all herbicides performed more efficiently than unincorporated applications; no treatment affected the yield of tomatoes.

The 0.5-lb rate of soil-incorporated trifluralin was outstanding although the incorporated 8-lb rates of diphenamid and CDEC controlled broadleaved and grass weeds effectively. Soil-incorporated PEBC, at 8-lb/A, provided some control of weeds but its performance was inferior.

Polyethylene film appears practicable for weed control where high-quality tomatoes are grown. (USDA, ARS, CRD, Weed Investigations in Horticultural Crops and Texas Agri. Expt. Sta., Weslaco, Texas).

Control of crabgrass (Digitaria sanguinalis) in lawns. Erickson, Lambert C. and Pennington, Lawrence R. The data in the following table are based on results obtained from experimental plots located on the Lewis and Clark Normal School Campus at Lewiston, Idaho. In 1964 the herbicides were applied April 28 to May 8. All plots were sprinkled heavily following the herbicide application. All new entries were replicated four times, all old entries three times. The first evidence of crabgrass germination was cited on May 22. The average crabgrass stand (density of cover) on the check plots increased from 29% on June 25 to 99.9 on September 9.

These screening trials have been in progress for several years. New herbicides are added each year and those which have given unsatisfactory performance in past years are omitted. Seasonal effects have sufficient impact to shift the relative efficiency positions of some herbicides, likewise turf injury is also influenced by weather conditions. Many factors involved in herbicide applications and turf management are not revealed in the data given. (Idaho Agricultural Exp. Station, University of Idaho, Moscow.)

Average performance of herbicides for crabgrass (Digitaria sanguinalis) control Lewiston, Idaho, 1964

Company and product		Lbs/A a.i	Respective percent crabgrass remaining 9/9/64	Turf injury
Diamond Alkali				
Dacthal	(Wp)	8,10,12,14	1,1,0.2,0.1	None
Dow Chemical Zytron	(liq)	8,10,12,14	12,8,3,0.7	"
DuPont Tupersan	(liq)	8,10,12,14	53,45,33,15	"
Elanco Trifluralin	(liq)	2,2.5,3,3.5	16,14,9,3	"
Hercules Azak	(Wp)	8,10,12,14	35,28,26,24	"
Stauffer Betasan	(liq)	14,18,22,26	40,32,12,9	"
"	(gran)	14,18,22,26	62,53,55,38	"
Union Carbide				
UC 22463	(gran)	4,6,8,10	99,96,96,90	Severe
Velsicol Corp.				
ACS 22	(liq)	7,15,22,40	98,60,15,2	Minor
"	(gran)	7,15,22,40	92,24,3,0.7	"
OCS 21944	(liq)	5,7,9,20	55,29,15,0.7	None
"	(gran)	5,7,9,20	97,96,84,26	"
Non-treated check			99.9 ave.	

Chemical weed control in spring-seeded onions with Dacthal and Betasan. Anderson, W. P., Corgan, J. N., and Whitworth, J. W. DCPA (Dacthal) and R-4461 (Betasan) were applied in the following ways for selective weed control in Yellow Sweet Spanish onions: (1) preplant, soil-incorporated, (2) preemergence, not incorporated, (3) preemergence, followed by a postemergence application to clean-tilled soil seven weeks later, (4) postemergence to clean-tilled soil.

DCPA was applied at rates of 3, 6, and 10 lbs/acre, active ingredients; where two applications were applied the total dosage was double that indicated. Of the various treatments with DCPA, the best treatment was where it was applied preemergence and then followed by a postemergence application. Excellent weed control was obtained when the total dosage from the double application totaled 12 and 20 lbs/acre; weed control was not as good at a total dosage of 6 lbs/acre, but still effective. Purslane was readily controlled by DCPA at dosages of 3 lbs/acre and above; contrary to results from previous tests with DCPA, its control of junglerice, Echinochloa colonum L., was erratic and not very effective in this test.

Previous research with R-4461 in onions indicated that this herbicide was effective at rates as low as 2 lbs/acre, active ingredient. On the basis of this, R-4461 was applied in this experiment at rates of 1, 2, and 4 lbs/acre. However, these rates proved to be too low for effective weed control. It would appear that R-4461 should be applied over a dosage range of 4 to 8 lbs/acre, with 6 lbs/acre about optimum. To be effective, R-4461 must be incorporated into the soil. This incorporation may be by mechanical means, such as discing, or it may be by "watering-in", as by overhead or flood irrigation. Applying R-4461 to the soil-surface and then irrigating by "subbing-up" from adjacent furrows is one way to achieve disappointing results.

The degree of weed control obtained with DCPA and R-4461, yield data and a comparison of hand labor requirements for weeding the onions during the remainder of the season are given in the accompanying table.

R-4461 is currently registered with the U.S.D.A. as a herbicide for use in turfgrass under the trade name of "Betasan." It has not been registered as yet for use as a herbicide in any food crop, and indications are that it may not be so registered before late 1965 or sometime in 1966. A new trade name, "Prefar," has been assigned by the company to R-4461 when used for weed control in agricultural crops. According to information received from the company, except for the name, Prefar and Betasan are identical. The cost of Prefar will apparently be considerably less than the current cost of Betasan. (New Mexico State University, Agricultural Experiment Station, University Park, New Mexico.)

Chemical weed control in spring-seeded Yellow Sweet Spanish onions - 1964.

Rate Lb/acre	Applications	Total dosage	Onion yield (% of check)	Weed counts (% of check) lambs-quarter	purslane	jungle-rice	annual grass	Hand labor (% of check)
BETASAN								
1	Preplant	1	67	70	76	173	21	80
2		2	107	80	76	126	42	82
4		4	126	50	88	27	13	35
1	Preemergence	1	56	90	130	93	23	118
2		2	81	70	91	87	13	80
4		4	78	80	55	80	10	70
1	Pre- plus Post-	2	85	90	124	120	42	82
2		4	89	60	45	60	16	62
4		8	100	70	45	42	10	53
3	Post-emergence	3	67	70	48	107	42	101
Untreated	check	0	100	100	100	100	100	100
DACTHAL								
3	Preplant	3	89	60	26	100	13	73
6		6	93	60	33	133	13	58
10		10	137	50	50	93	19	38
3	Preemergence	3	133	60	40	127	19	44
6		6	152	40	19	113	10	42
10		10	155	30	12	87	6	27
3	Pre- plus Post-	6	182	70	29	53	6	38
6		12	130	30	0	120	10	27
10		20	163	20	0	27	0	29
6	Post-emergence	6	67	50	10	60	19	99
Untreated	check	0	100	100	100	100	100	100

Application dates: Preplant - Feb. 15; preemergence - Feb. 18; post-emergence - Apr. 24, 1964.
Onions seeded: Feb. 17, 1964.

Chemical weed control in chili peppers. Anderson, W. P., Corgan, J. N., and Whitworth, J. W. Three herbicides, Dacthal, Betasan, and Trefmid, were tested for selective weed control in chili peppers. Each herbicide was applied at two or more rates and each was applied as a preplant, soil-incorporated, and as a preemergence, not incorporated, treatment. When soil-incorporated, each of the three herbicides gave excellent weed control. When not incorporated, the degree of weed control obtained with Trefmid was still very good, but that from Dacthal less effective, and that from Betasan poor. Of the three herbicides applied, Trefmid was the most outstanding for selective weed control in chili peppers, whether soil-incorporated or not, though Dacthal and Batasan continue to show excellent promise. Yield data was not taken in this experiment. However, none of the treatments appeared to have a detrimental effect on the growth or fruiting of the chili peppers. The accompanying table contains the herbicides applied, their respective rates, the degree of weed control obtained from these rates and the methods of application, and the hand labor requirements for weeding during the season. (New Mexico State University, Agricultural Experiment Station, University Park, New Mexico.)

Chemical weed control in chili peppers, 1964

		Weed Control*					
		Soil-incorp.		Preemergence		Hand labor (% of check)	
Herbicide	Lb/acre	May 6*	June 1*	May 6	June 1	Soil-incorp.	Preemerg.
Betasan	1	4	5	2	3	68	68
	2	9	5	5	5	78	63
	4	8	7	0	4	35	49
	8	10	7	0	4	29	78
Dacthal	3	5	6	6	6	49	39
	6	10	4	8	5	53	63
	9	10	8	6	5	68	--
Trefmid	2.5	10	7	9	3	35	82
	3.75	10	10	10	5	29	63
Untreated check		0	0	0	0	100	100

*Key: 0 - no control; 10 - complete kill. Dates when evaluated. All treatments applied April 6, 1964. Chili peppers seeded immediately after woil-incorporated and before preemergence application.

Screening of herbicides for use in seeded tomatoes. Anderson, W. P., Corgan, J. N., and Whitworth, J. W. Thirteen herbicides were field tested for selective weed control in seeded tomatoes. These herbicides were applied preplant, soil-incorporated, and preemergence, not incorporated. Based upon this test, the most promising herbicides for use in seeded tomatoes are Betasan, Dacthal, Trefmid, Treflan, and Dymid. Dymid was slow to give good weed control but its effectiveness increased with time.

Dacthal was previously registered for use as a herbicide in tomatoes. The company has removed this use from its label due to injury sustained by the tomato plants, a brittleness at the soil-line.

The accompanying tables show the degrees of weed control obtained with the five most promising herbicides and lists the other herbicides tested but which were not effective under conditions prevailing in south-central New Mexico. (New Mexico State University, Agricultural Experiment Station, University Park, New Mexico.)

Weed Control in Tomatoes - 1964

Herbicide	Rate lbs/acre	Soil-incorp.	Pre-emerg.
Betasan	1	0	0
	2	2	3
	3	3	6
	4	6	4
Dacthal	3	3	6
	6	7	8
	9	7	7
Trefmid	1.25	4	2
	2.5	9	2
	5	9	8
Treflan	0.25	3	1
	0.5	5	3
	1	8	4
Dymid	2	3	-
	4	5	-
	6	4	-
Untreated control		0	0

Key: 0 - no control; 10 - complete kill. Incorp. Feb. 28; pre-emerg. Mar. 11, 1964.

Herbicides Tested for Weed Control in Tomatoes but were Ineffective, 1964

Herbicides	Rate lbs/acre	Soil-incorp.	Pre-emerg.
Amiben	4	x	x
Prometryne	1	x	-
R-1910	8	x	x
SD-9515	12	x	-
Tillam	8	x	x
Trietazine	1	x	x
Combination: Randox	3	x	x
Vegedex	3	x	x

Rate is highest tested. (-) indicates no test. Soil-incorp. Feb. 28; pre-emerg. Mar. 11, 1964.

Chemical weed control in onions. Ross, Merrill. Consistently good control in direct-seeded furrow irrigated onions is still largely unobtainable. In 1964 we continued evaluation of preplant materials and in addition tried winter and early spring soil fumigants.

The most commonly encountered weeds were barnyard grass, green foxtail, redroot pigweed, lambsquarter, Russian thistle, and kochia.

Preplant chemicals were applied broadcast to each plot. Rows of one-half each of the plot were incorporated 1.5 inches deep with a rototiller. The chemical remained on the surface in the other plot.

Of the preplant materials (see table) DCPA was the most satisfactory and R-4461 showed some promise. The other materials did not exhibit acceptable safety on onions at rates effective against weeds.

Incorporation of chemicals to a depth of 1.5 inches with a rototiller increased the activity of all materials in the test. This substantiates previous results obtained with DCPA.

Chemicals used in the soil fumigant tests at three locations included calcium cyanamide, Mylone (3,5-dimethyl-1,3,5, 2H-tetrahydrothiazine-2-thione), DD, Vapam (SMDC), and Vorlex (Methylisothiocynate-DD mixture). DD at 31 and 62 gals/A, Vorlex at 15 gals/A, and Vapam at 62 gals/A were injected into the soil. Calcium cyanamid at 570 and 1140 lbs/A and Mylone at 400 lbs/A of 50% formulation were applied to the soil surface. All plots were gone over with a rototiller running about two inches deep. The plots were furrow irrigated as soon as possible and planted four to twelve weeks later.

Mylone and calcium cyanamid gave the most satisfactory weed control of the materials used. They prevented weed growth until shortly after onion emergence. Later emerging weeds were not affected. The use of these materials is probably not economical for weed control alone under conditions encountered in these tests. (Colorado Agri. Expt. Sta., Colorado State University, Fort Collins).

Preplant herbicides in onions, Rocky Ford, Colorado, 1964.

Chemical	Lb/A	Broadleaves I*	Broadleaves U	Grasses I	Grasses U	Total weeds I	Total weeds U	Onions I	Onions U
		Precent stand reduction							
DCPA	8	72	41	88	68	80	54	0	0
	12	84	49	99	63	92	56	0	0
	20	95	58	100	78	97	68	7	0
CIPC	3	33	40	70	28	51	34	35	18
	6	64	46	78	28	71	37	52	35
	9	93	47	77	40	85	43	58	26
G-36393	.5	37	42	29	0	33	21	9	0
	1	76	34	48	12	62	23	16	0
	2	96	65	84	56	90	60	68	40
PCA	4	32	13	60	0	46	7	0	0
	8	66	42	73	0	70	21	31	0
R-4461	4	65	27	99	71	82	49	4	0
	6	73	36	99	60	86	48	38	22
Control	-	0	0	0	0	0	0	0	0

*I = Incorporation 1.5 inches deep with rototiller.
U = Chemical left on surface.
Broadleaves - redroot, Russian thistle, lambsquarter, kochia
Grasses - green foxtail and barnyard grass.

<u>Preplant herbicide tests in tomatoes.</u> Ross, Merrill. Preplant chemical treatments in 1964 for direct-seeded tomatoes included PEBC, CDEC, diphenamid, R-4461, and combinations of PEBC plus diphenamid. PEBC, CDEC, and diphenamid were evaluated at Rocky Ford, Colorado, in 1962 and 1963 and at Fort Collins, Colorado, in 1964. 1964 was the first time R-4461 or combinations of PEBC plus diphenamid had been used.

In these tests, chemicals were applied broadcast to each plot. One-half of the rows in each plot was incorporated 1.5 to 2 inches deep using a Bye-Hoe. The chemical on the other half of the plot remained on the soil surface.

Tomatoes were planted immediately and the plots furrow-irrigated as soon as possible. Neither PEBC nor diphenamid was as effective in 1964 as in 1962 and 1963. A heavier soil and a more dense weed population may have been contributing factors.

The combination of PEBC plus diphenamid gave outstanding weed control in this year's tests. Three lbs/A of PEBC plus 3 lbs/A of dephenamid proved to be more effective than 6 lbs/A of either chemical alone (see Table 1). Incorporation of the chemical into the soil improved the performance of the diphenamid and PEBC, both singly and in combination. This substantiates previous results. The most valuable result of incorporation was reduction of variability of herbicide performance from year to year (Table 2). (Dept. of Botany and Plant Pathology, Colorado State University, Fort Collins.)

Table 1. Preplant herbicides in tomatoes, Fort Collins, Colorado, 1964

		Percent stand reduction							
	Rate	Grasses		Broadleaves		Total Weeds		Tomatoes	
Chemical	lb/A	I*	U	I	U	I	U	I	U
R-4461	3	74	59	53	51	64	55	0	0
	6	53	44	3	50	28	47	0	0
	9	71	64	39	29	55	46	22	39
PEBC	3	50	0	68	54	59	27	0	0
	4.5	87	67	72	33	80	50	0	0
	6	87	72	79	60	83	67	0	0
diphenamid	3	71	80	57	54	64	67	0	0
	6	68	49	67	54	65	52	0	0
	9	82	62	76	52	79	57	0	0
CDEC	3	53	23	60	54	57	39	0	0
	6	61	72	68	56	64	64	0	0
diphenamid + PEBC	3 3	89	77	87	79	88	78	0	0
diphenamid + PEBC	6 4.5	95	90	99	83	97	87	0	0
Control	-	0	0	0	0	0	0	0	0

*I = Incorporated 1.5 inches with a Bye-Hoe; U = no incorporation.

Table 2. Effect of incorporation on effectiveness of pre-plant herbicides

		Percent reduction of weed stand							
	Rate	1962		1963		1964		Average	
Chemical	lb/A	I*	U	I	U	I	U	I	U
PEBC	3	74	60	82	40	59	27	72	42
	1.5	86	92	95	77	80	50	87	73
diphenamid	3	96	76	77	25	64	67	79	56
	6	87	90	90	70	65	52	81	71
Control	-	0	0	0	0	0	0	0	0

*I = Incorporated 1.5 inches with a Bye-Hoe; U = no incorporation.

Weed control in shelterbelts. Guenthner, H. R. Caragana was transplanted into Judith clay loam soil on May 20, 1964. The transplants were spaced three feet apart within the row. The following day the ridge left by the tree planter was leveled and the chemical treatments applied to plots three feet by twenty-five feet. Spray applications were made with a two nozzle boom sprayer applying 47 GPA of carrier. Granular materials were scattered by hand. Incorporation was attempted with a pitchfork immediately after application.

The chemical treatments and the data obtained are presented in the table. Diuron, Prometryne and Urox D provided effective weed control

Data Obtained on Tree Stand Count, Tree Vigor, and Degree of Weed Control from the Chemicals Evaluated for Weed Control in Shelterbelts at the Central Montana Branch Station. Moccasin, Montana - 1964.

Treatment	Lb/A Active	Tree Stand Count 1/ 7/2/64 Live	Dead	9/28/64 Live	Dead	Tree Vigor 2/	Average Weed Control 3/ 7/14/64	9/28/64
Amiben - Inc.*	2.5	27	0	26	1	1	5	5
Amiben, Inc.	5.0	23	0	23	0	1	8	8
Casoron, Inc.	4.0	27	0	26	1	1	9	9
Casoron gran., Inc.	4.0	22	2	22	2	1	9	9
Trifluralin, Inc.	2.0	24	0	23	1	1	9	8
Trifluralin, Inc.	4.0	24	0	24	0	1	9	8
EPTC, Inc.	4.0	26	0	26	0	1	8	6
Sesone, Inc.	4.0	23	1	23	1	1	4	4
Tenoran, Inc.	3.0	22	0	21	1	1	5	4
Tenoran, Inc.	6.0	26	0	26	0	1	7	7
Prometryne	3.0	28	0	27	1	1	10	10
Simazine	3.0	24	0	23	1	3	10	10
Diuron	2.5	23	1	23	1	1	10	9
Diuron	5.0	24	1	23	1	1	9	10
Urox D. Liquid	2.5	24	0	23	1	1	6	6
Urox D. Liquid	5.0	24	0	23	1	1	10	8
Urox D gran.	5.0	24	0	24	0	1	10	10
Weedy Check	-	23	0	23	0	1	1	1
Handweed Check	-	23	0	23	0	1	10	10
Plastic Cover	-	23	0	23	0	1	10	10
Casoran gran.	4.0	24	0	23	1	1	8	7
ACP-63-173	25.0	25	0	25	0	3	10	10
ACP-63-173	40.0	25	0	25	0	4	10	10
Tenoran	3.0	24	0	24	0	1	7	5

* Incorporated

1/ Total number of trees of three replications.

2/ Tree vigor rating of 1 to 5 with 1 representing normal development.

3/ Weed Control rating from 1 to 10 with 1 representing no control, average of three replications.

without causing any noticeable tree injury. Simazine and ACP-63-173 were effective on all weed species but resulted in considerable tree injury. The incorporated chemical treatments were not as effective. Had a better method of incorporation been employed, the weed control of these treatments would have been improved. (Montana Agricultural Experiment Station, Central Montana Branch, Moccasin, Montana)

Banana (Musa spp.) and Papaya (Carica papaya) Herbicide Screening Trials in Hawaii. Romanowski, R. R., Jr., Barba, R. C., Crozier, J. A., and Plucknett, D. L. Herbicide screening trials were initiated with two banana varieties, Musa cavendish cultivar Dwarf Chinese and Musa pome cultivar Brazilian and one papaya variety, Carica papaya cultivar Solo, at the Hawaii Agricultural Experiment Station in July, 1963. A papaya and three banana trials were grown on silty clay soils and one papaya trial was conducted on a coral-rock-soil complex. The herbicides were applied as basal sprays with the first application commencing approximately 3 to 6 months after the establishment of the plantations. The sprays were applied with back mounted fiberglass tanks operated at 30 pounds per square inch of pressure. Forty to eighty gallons of solution were sprayed per acre and no attempt was made to avoid the small banana suckers or basal portion of the papaya trunks.

The following herbicides were tested at the indicated rates (expresse as pounds of active ingredient per acre). A majority of the plots received four applications of the herbicide to date.

Bananas. Soil incorporated - EPTC 6 lb, Pre-emergence to weeds - bromacil 2 lb, Herban 4 lb; Post-emergence - ametryne 4 lb and 8 lb, amino-triazole 8 lb, aromatic oil 55AR, atrazine 4 lb and 8 lb, dalapon 10 lb, atrazine 4 lb + dalapon 10 lb, ametryne 4 lb + dalapon 10 lb, diuron 4 lb and 8 lb + .5% X-77 (V/V), prometryne 4 lb, paraquat 1 lb + .5% X-77 (V/V) and tordon 4 lb.

Papayas. Soil incorporated - EPTC 6 lb, PEBC 6 lb, trifluralin 2 lb; Pre-emergence to weeds - atrazine 4 lb, diuron 4 lb, prometryne 4 lb, trifluralin 4 lb; Post-emergence - aromatic oil 55AR, dalapon 10 lb, diquat 1 lb + .5% X-77 (V/V), diuron 4 lb + .5% X-77 (V/V), paraquat .5 lb, 1 lb and 2 lb + .5% X-77 (V/V).

Bromacil and tordon were very toxic to the bananas. It is suggested that the only possible use for these two herbicides in bananas would be to determine the feasibility of using these chemicals as banana eradicants in areas where a fallow period is desired for disease control. EPTC appears to have slowed growth after the third and fourth applications. A cultivated check is doing well indicating that EPTC and not root pruning is responsible for the reduced growth. Diuron + X-77 injured bananas only slightly on lighter, low organic matter soils. Atrazine resulted in marginal leaf burn and chlorosis at two of the test locations as compared to no injury or reduction in growth with ametryne. All other chemicals tested appeared to exhibit a safe tolerance for use in bananas. The weed control with ametryne and diuron + X-77 was excellent in all three experiments. The two chemicals provided commercially acceptable post- and pre-emergence weed control for periods of three to five months. Residue crop samples are presently being accumulated to aid in registering ametryne with the FDA for use in bananas.

Paraquat was the most satisfactory herbicide for use with papayas on the coral-rock soil when compared to diuron + X-77 and ametryne. Diuron resulted in severe veinal chlorosis on the older leaves and ametryne in marginal chlorosis and burn on the older leaves at the four pound rate. The two pound rate of ametryne showed no visible signs of leaf chlorosis and a broadcast spray of trifluralin at four pounds per acre resulted in no visible signs of injury.

Atrazine was the only herbicide which resulted in papaya injury on the silty clay loam soil. Trifluralin resulted in excellent grass control and prometryne in excellent broadleaf weed control. A mix of the two herbicides appears promising. Data are being summarized so that paraquat can be registered for use with papayas. This contact herbicide will be especially valuable in that, half of the papaya acreage in Hawaii is grown on aa lava rock soils. (University of Hawaii, Department of Horticulture, Honolulu, Hawaii).

PROJECT 5. WEEDS IN AGRONOMIC CROPS

Arnold P. Appleby, Project Chairman

Twenty-four reports were received for publication from personnel in seven states. These reports have been grouped and summarized below:

Cotton. In one experiment in Arizona, pre-plant applications of trifluralin combined with lay-by applications of urea herbicides gave season-long control of annual weeds and increased cotton yields as compared to cultivated checks. Several other herbicides in combinations were tested at the same location. Although certain combinations caused early injury to the cotton, all herbicide combinations resulted in increased yield. There was no difference in weed control or response of cotton when two herbicides were applied separately or in a single pre-plant application. Other tests in Arizona to study the influence of interval between application and incorporation and to compare methods of incorporation of trifluralin indicated that the interval between application and incorporation was not important. No difference was noted between harrowing with a rolling cultivator followed by furrowing as compared to incorporation by furrowing alone. Lay-by treatments of a combination of trifluralin and DCPA followed by a later treatment with diuron provided satisfactory weed control when the lay-by treatments were applied before weed emergence. Weed control was not satisfactory when herbicides were applied after weeds had emerged. A variety of experiments conducted in California with trifluralin on cotton are reported. Although cotton injury occurred from pre-plant applications of trifluralin, no yield reductions were recorded from ten trials conducted over a wide area. Method of incorporation appeared to be important under California conditions. Soil persistence of trifluralin varied with rates and some unknown factors.

Small Grains. CP 45592 and UC 22463 appear promising for selective downy brome control in winter wheat in Eastern Washington. In Montana, formulations of ioxynil and 2,4-D were tested for the control of field gromwell in wheat. Applications of 2,4-D at rates of 1.5 pounds and higher gave good gromwell control but reduced wheat yields. Under most conditions, one pound of ioxynil was required to give 70-80% gromwell control. Several factors influencing the activity of ioxynil were studied in Oregon. Concentration of wetting agent and volume of carrier were important on certain species. The oil-soluble amine or salt formulations with added wetting agent were effective on a variety of weeds. Poor weed control was obtained when the weeds were growing under dry soil conditions.

Alfalfa. Simazine, atrazine, and bromacil were compared for weed control in established alfalfa in Oregon. Control of a number of annual grasses and broadleaves was excellent, with somewhat poorer control being obtained on perennial ryegrass and quackgrass. Some injury was noted from certain treatments in the first cutting, but in most cases the alfalfa tended to recover later in the summer.

Sugar Beets. In Colorado, several herbicides were tested alone and in combination for weed control in sugar beets under greenhouse conditions. The best combination proved to be dalapon and pyrazone at 3 + 6 pounds per acre. Results of studies on the influence of temperature and moisture on weed germination are reported. In Wyoming, combinations of herbicides appeared to be promising for weed control in sugar beets. A pyrazone-PEBC combination was reported as being the best overall treatment. Pyrazone apparently caused sugar beet seedling stimulation in some cases. In further tests in Wyoming, various methods of mechanical incorporation were studied in relation to phytotoxicity of pyrazone. In general, best weed control was obtained when a sinner-weeder was used to incorporate the material; however, toxicity to sugar beets was also highest with this type of incorporation.

Flax. Trials in Oregon indicated that EPTC, atrazine, isocil, and IPC gave adequate ryegrass control in winter flax. Control of various species and flax injury varied depending on timing, rates, and soil types.

Lentils. UC 22463 and FW 925 gave excellent broadleaf control in lentils in trials conducted in Washington. UC 22463 appears more efficient as a pre-emergence treatment, and FW 925 appears better as a post-emergence treatment.

Crambe. Washington tests indicated that trifluralin was the most effective herbicide for weed control in crambe. Diallate, triallate, and R 4572 also appeared promising.

Peppermint. In Oregon two new uracil compounds DP 732 and DP 733 proved very promising for weed control in peppermint. Peppermint seems to have a rather wide margin of tolerance to both materials. Both new materials were effective on a variety of weeds including yellow nutsedge. Safety margin appears to be considerably greater than with bromacil.

Forage Crops. An additional operation has been included in the stale seedbed method for forage establishment in Western Washington. A light scarification of the seedbed immediately prior to seeding has resulted in better seed germination without sacrificing weed control. The stale seedbed method is described.

Corn. A number of combinations of herbicides for selective weed control in corn were tested in Oregon. Good grass control was obtained with EPTC, R 1910, CP 31393, and CP 45592. Giving good control of broadleaves were 2,4-D, 2,4-DEP, dicamba, picloram, OMU, DNBP amine, and three triazines. Several combinations of the above materials gave nearly complete weed control. Linuron at 4 lbs/A gave excellent weed control with no corn injury.

Preplant applications of trifluralin combined with layby applications of other herbicides in irrigated cotton. Hamilton, K. C. and Arle, H. F. Preplant followed by layby applications of herbicides were made at the Cotton Research Center, Phoenix, Arizona, to determine combinations that would control annual weeds for an entire growing season.

The surface soil averaged 33% sand, 43% silt, and 24% clay. Weeds present included *Panicum fasciculatum* Swartz, *Echinochloa colonum* (L.) Link, *Leptochloa filiformis* (Lam.) Beauv., *Physalis wrightii* Gray, and

Amaranthus palmeri S. Wats. Preplant applications of alpha, alpha, alpha-trifluoro-2,6-dinitro-*N*,*N*-dipropyl-*p*-toluidine (trifluralin) were made March 11, 1964, immediately prior to furrowing for the preplant irrigation. Plots were 4 rows wide 42 feet long. Treatments were replicated 4 times. On April 4, Deltapine Smooth Leaf cotton was planted in moist soil under a dry mulch.

The test area received mechanical cultivation until mid-July. The handweeded checks were also handweeded 3 times. Layby applications of 3-(3,4-dichlorophenyl)-1,1-dimethylurea (diuron), 3-(*p*-chlorophenyl)-1,1-dimethylurea (monuron), or 2,4-bis (isopropylamino)-6-methylmercapto-*s*-triazine (prometryne) were directed to the soil covering the entire row middles and the base of cotton plants. Dates and rates of treatment, percent weed control, and cotton yields are indicated in the table. Percent weed control was estimated September 30. In December the two center rows of each plot were hand-picked.

All preplant applications of trifluralin stunted cotton for 2 to 3 months. Combinations of trifluralin applied preplant with diuron applied at layby gave better weed control than either preplant or layby applications alone. Preplant applications of trifluralin failed to control *P. wrightii* after midseason.

Weed control and cotton yield following preplant and layby applications of herbicides.

Treatment					Weed control Percent estimated 9/30/64		Yield* as percent of handweeded checks
Preplant		Layby					
Herbicide	lb/A	Date	Herbicide	lb/A	Broadleaf	Grass	
trifluralin	1/2				65	91	98abc
trifluralin	3/4				79	96	89 bc
trifluralin	1				85	98	99ab
trifluralin	3/4	5/18	diuron	1-1/4	94	96	105a
trifluralin	3/4	6/18	diuron	1	95	97	97abc
trifluralin	3/4	6/18	diuron	1-1/4	98	98	100ab
trifluralin	1	6/18	diuron	1-1/4	98	99	106a
trifluralin	3/4	6/18	diuron	1-1/2	99	98	100ab
trifluralin	3/4	7/1	diuron	1-1/4	99	99	94abc
trifluralin	3/4	7/22	diuron	1-1/4	97	96	100ab
trifluralin	3/4	6/18	monuron	1-1/4	96	94	95abc
trifluralin	3/4	6/18	prometryne	1-6/10	87	77	85 c
		6/18	diuron	1-1/4	95	81	89 bc
		6/18	monuron	1-1/4	95	79	86 bc
Check-handweeded					99	96	100ab
Check-cultivated					0	0	43 d

*Yield of seed cotton on handweeded checks was 2,721 lb/A.
Values with the same subscript letter are not significantly different.

Yields from cotton receiving preplant and/or layby applications of herbicide equalled the yields of handweeded cotton, except for cotton treated with prometryne at layby. Weed competition on the cultivated checks reduced seed cotton yield by 57 percent. Preplant applications of trifluralin combined with layby applications of urea herbicides gave season-long control of annual weeds and increased cotton yields as compared to cultivated checks. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U.S. Dept. of Agriculture, and Arizona Agric. Expt. Sta., University of Arizona, Tucson).

Combinations of herbicides in one or two preplant applications in irrigated cotton. Arle, H. F. and Hamilton, K. C. Combinations of herbicides have the advantages of lower costs, greater crop safety, better weed control, and less soil residue compared to the use of a single herbicide. Two tests were conducted in 1964 at the Cotton Research Center, in Phoenix, Arizona, to evaluate combinations of two herbicides in one or two preplant applications for the control of annual weeds in irrigated cotton.

The surface soil contained 37% sand, 44% silt, and 24% clay. Weeds included *Panicum fasciculatum* Swartz, *Echinochloa colonum* (L.) Link, *Leptochloa filiformis* (Lam.) Beauv., *Physalis wrightii* Gray, and *Amaranthus palmeri* S. Wats. In one test, single applications of two herbicides were made on March 11 immediately before furrowing for the preplant irrigation. Combinations used were 3/4 lb/A of alpha, alpha, alpha-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine (trifluralin) with 3/4, 1, or 1-1/4 lb/A of 3-(3,4-dichlorophenyl)-1,1-dimethylurea (diuron) or 1 or 1.6 lb/A of 2,4-bis (isopropylamino)-6-methylmercapto-s-triazine (prometryne) and 8 lb/A of dimethyl 2,3,5,6-tetrachloroterephthalate (DCPA) with 1.6 lb/A of prometryne or 1 lb/A of diuron.

In the second test, a prefurrowing application of 3/4 lb/A of trifluralin was followed with an application of 1 lb/A of diuron or 3-(p-chlorophenyl)-1,1-dimethylurea (monuron) after furrowing on March 13 or before the final harrowing of the seedbed on April 13. A prefurrowing application of 8 lb/A of DCPA was also combined with 1 lb/A application of diuron after furrowing. Plots were 4 rows wide, 42 feet long. Treatments were replicated 4 times. On April 4, Deltapine Smooth Leaf cotton was planted in moist soil under a dry mulch.

The test area received mechanical cultivation until mid-July. Cotton stands were counted at emergence and at weekly intervals until thinnings. Percent weed control was estimated on September 30. Ten-boll samples were taken from each plot for analyses of fiber properties and boll components. In December the two center rows of each plot were hand-picked.

All preplant herbicide combinations containing trifluralin stunted cotton for 2 to 3 months. Combinations containing diuron, prometryne, and monuron caused temporary chlorosis of cotton foliage. Preplant herbicide combinations containing trifluralin reduced cotton seedlings stands 12 percent at emergence and 25 percent at thinning. Herbicide combinations gave excellent control (95-100%) of annual grasses until harvest. Control of broadleaved weeds was good (77-96%); but some *P. wrightii* became established after midseason. All herbicide combinations resulted in increased yield of cotton. Yields of seed cotton on treated plots averaged 2,985 lb/

the cultivated checks yielded 1,835 lb/A. Boll weight, percent lint, seeds per boll, fiber length, fiber strength, and fiber fineness were not affected by preplant herbicide combinations.

There was no difference in weed control or response of cotton when two herbicides were applied separately or in a single preplant application. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U. S. Dept. of Agriculture, and Arizona Agric. Expt. Sta., University of Arizona, Tucson.)

Time and method of incorporation of preplant applications of trifluralin in cotton. Hamilton, K. C. and Arle, H. F. Tests were conducted during 1964 at the Cotton Research Center, Phoenix, Arizona, to determine the effect of preplant applications of alpha, alpha, alpha-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine (trifluralin) on weeds and cotton. One test concerned the interval between application and incorporation of trifluralin; another compared two methods of incorporation.

Effects of time between treatment and soil incorporation were studied by applying 1 lb/A of trifluralin immediately, 1, 2, 3, 4, 5, and 6 days before harrowing with a ground-driven rolling cultivator and furrowing for the preplanting irrigation on March 11. In the second test, 1/2 and 1 lb/A of trifluralin were applied to the flat soil surface. The herbicide was incorporated immediately by harrowing with the rolling cultivator and furrowing for the preplant irrigation or by furrowing alone.

The surface soil averaged 33% sand, 42% silt, and 25% clay. The weeds, plot size and design, cotton variety and planting, and cultural practices and harvest were as described in other 1964 reports from Arizona.

All preplant applications of trifluralin stunted cotton for 2 to 3 months regardless of time or method of application. Trifluralin gave good control of annual grasses and only temporary control of Physalis wrightii Gray regardless of time and method of application. All trifluralin applications significantly increased seed cotton yields compared to the cultivated checks. Seed cotton yeilds on treated plots averaged 2,500 lb/A, while the yields on cultivated checks averaged 824 lb/A. Time and method of incorporation or rate of trifluralin did not influence yields.

Varying the time between preplant applications of trifluralin and incorporation into the soil, from a few minutes to 6 days, did not influence its effectiveness in controlling weeds or alter its selectivity between weeds and cotton. Harrowing with a rolling cultivator prior to furrowing for the preplant irrigation did not alter the effectiveness or safety of preplant application of trifluralin compared to incorporation by furrowing alone. (Cooperative investigations of Crops Research Div., Agricultural Research Service, U.S. Dept. of Agriculture, and Arizona Agric. Expt. Sta., University of Arizona, Tucson).

Layby applications of trifluralin and DCPA in irrigated cotton. Arle, H. F. and Hamilton, K. C. Research was continued in 1964 at the Cotton Research Center, Phoenix, Arizona, to determine the effectiveness of layby applications of alpha, alpha, alpha-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine (trifluralin) and dimethyl 2,3,5,6-tetrachloroterephthalate (DCPA) for controlling annual weeds in cotton. Interest in postemergence (to cotton) applications of trifluralin has increased because of cotton stand reductions and stunting of seedlings resulting from preplant trifluralin applications.

The surface soil of the test area contained 29% sand, 43% silt, and 28% clay. The dominant weeds were *Panicum fasciculatum* Swartz and *Physalis wrightii* Gray. On May 18, 1 lb/A of trifluralin and 8 lb/A of DCPA were applied as directed sprays to the soil covering the middles from row to row and immediately incorporated into the soil with a rolling cultivator. Cotton was 3 to 4 inches high and no weeds were present. These plots were also treated on July 30 with a 1-1/4 lb/A of 3-(3,4-dichlorophenyl)-1,1-dimethylurea (diuron) to maintain late-season control of *P. wrightii*. On June 18, 1 lb/A of trifluralin, 3/4 lb/A of trifluralin and 1 lb/A of diuron, 8 lb/A of DCPA, or 6 lb/A of DCPA and 1 lb/A of diuron and on July 1, 1 lb/A of trifluralin were applied to the soil as directed sprays and incorporated. Small annual weeds were present in the drill row when these applications were made. Plots were 4 rows wide, 42 feet long. Treatments were replicated 4 times. The test received mechanical cultivation until July.

Trifluralin and DCPA applied May 18, before weeds emerged, controlled annual grasses until harvest. Control of broadleaved weeds was maintained by diuron applied July 30. Applications of herbicides after weeds emerged failed to control annual weeds. Yield of seed cotton from plots treated May 18 averaged 2,720 lb/A; from plots treated June 18 and July 1 averaged 1,586 lb/A; and from the cultivated checks averaged 840 lb/A. Layby applications of trifluralin and DCPA gave satisfactory weed control only when made before annual weeds emerged. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U.S. Dept. of Agriculture, and Arizona Agric. Expt. Sta., University of Arizona, Tucson).

Results with trifluralin in 1964 California Cotton. Kempen, H. M., Carter, C. H., Lange, A. H., Fischer, B. B., and Ford, H. P. Preplant applications of trifluralin at 1/2 or 1 lb/A applied and disced in before listing and pre-irrigation, gave excellent early season control of annual grasses and pigweed without commercially unacceptable injury to cotton. Late season control of pigweed was inadequate on skip-row cotton where only 1/2 lb/A was applied, but most annual weeds were controlled at 3/4 lb/A or more. In ten trials conducted in Fresno, Kings, Kern and Imperial counties, no yield reductions were recorded.

Trifluralin inhibited lateral root development, and therefore, greater injury to young plants occurred where roots had to penetrate several inches of treated soil.

Applications made at planting time were effective where 1/2 lb/A was immediately incorporated with a powered rototiller, but were ineffective where ground-driven equipment (except the rolling cultivator, which was not tested), a spiketooth harrow or a rotary hoe was the incorporation method. Less than 0.35 inches of rain fell in two showers after planting.

Research by Miller and Carter at the USDA Cotton Research Station, Shafter, showed topical sprays of trifluralin at 3/4 lb/A to 4-inch cotton caused internodes on occasional plants to be shortened. The damage was believed due in part to the solvent carrier.

Post emergence directed sprays of trifluralin at 1/2 to 3/4 lb/A which were incorporated with rolling cultivators gave poorer control of weeds than preplant applications. The difference was believed due to shallow incorporation.

Soil persistence of trifluralin applied preplant, varied with rates and other unknown factors. At 1/2 lb/A control of pigweed did not last all season. At 1 or 2 lb/A some injury to sugar beets and annual ryegrass planted in November and December was evident in one Kern County test. In USDA Cotton Research Station tests little or no injury was evident on sugar beets, milo, barnyard grass or German millet in a greenhouse planting on soil sampled from preplant trifluralin treatments of 1/2, 1 or 2 lb/A. However, similar tests in 1963 did cause some stunting of sugar beets, milo and barnyard grass. (Cooperative investigations of the Department of Botany, USDA Cotton Research Station, Shafter, and the University of California Agricultural Extension Service.)

Downy brome (Bromus tectorum) control in winter wheat. Rydrych, D. J. and Muzik, T. J. Downy brome, commonly called cheatgrass in the Pacific Northwest, has consistently reduced winter wheat yields, increased the fire hazard, and complicated tillage operations in the dryland areas of eastern Washington. Yield losses of 10-20% have been recorded when a downy brome understory consisted of only 4-5 plants/sq. ft.--indicating that light stands of downy brome were capable of substantial wheat yield reduction and losses of 30-50% have been recorded from downy brome stands of 8-13 plants/sq. ft.

Two pre-emergence chemicals tested for the selective control of cheatgrass in 1964, CP 45592 and UC 22463 (3,4-dichlorobenzyl-N-methyl carbamate) gave some success. UC 22463 appears to be more effective on broadleaved weeds and 8-10 lb. ai/A of this chemical are necessary for some downy brome control. These higher rates caused slight injury to the wheat.

CP 45592 (1-2 ai/A) has given good selective downy brome control in wheat in both light and medium soils when applied as a pre-emergence treatment.

Other chemicals tested, CP 44176, CP 32179, CP 18907, FW 925, Atrazine, and Hydram, either failed to control downy brome or damaged the wheat. All of the materials were applied as pre-emergence sprays in the fall. (Washington Agricultural Experiment Station, Pullman).

The use of herbicides for control of field gromwell (Lithospermum arvense). Stewart, Vern R. The objective of the reserarch was to determine the effectiveness of fall and spring application of ioxynil. Two formulations were used (1) emulsifiable oil soluble amine (2) 50% wettable powder. A surfactant was used with the amine formulation. Two formulations of 2,4-D were used as spring applications (1) 2,4-D amine and (2) a low volatile ester of 2,4-D. Rate of each herbicide is found in the table. These were applied with 54.4 gallons of water. Fall applications were made October 31, 1963. Temperature was 47°F, the gromwell in the three leaf stage, and wheat in the five leaf stage. Spring applications were made April 24, 1964, temperature was 52°F, the gromwell rosetting, and the winter wheat well tillered.

The two pound rate of the low volatile esters of 2,4-D gave 90% control of gromwell. Seventy to 80% control was obtained with the one pound rate of all herbicides, except ioxynil at one pound applied in the spring, and 2,4-D amine.

Highest yield of all treatments was .50 of ioxynil with a surfactant applied in the spring.

In spring vs fall application, the oil soluble amine form of ioxynil with a surfactant was the most effective when applied in the spring. The wettable powder of ioxynil at one pound per acre was equal to the spring applications applied with a surfactant. In the ioxynil treatments, as the weed control decreased the yield also decreased. In the case of the 2,4-D formulations at the higher rate, the yields were decreased and the weed control increased. (N. W. Montana Branch of the Montana Agricultural Experiment Station, Montana State College, Kalispell, Montana.)

Table 1. Yield and weed score data from field gromwell study conducted at Kalispell, Montana, 1963-64. (Yield in descending order)

Treatment	Rate/Acre	Application Date	Weed Score 0 - 10*	Yield
Ioxynil (70)**	.50	4/24/64	7	64.6
Ioxynil (70)**	1.00	4/24/64	8	60.9
Ioxynil (70)	1.00	10/31/63	7	60.6
Ioxynil (177)	1.00	10/31/63	7	59.8
2,4-D amine	1.00	4/24/64	4	58.7
Ioxynil (70)**	.25	10/31/63	6	57.8
2,4-D LV 4D	1.00	4/24/64	8	57.8
Ioxynil (177)	1.00	4/24/64	7	57.6
Ioxynil (177)	.50	10/31/63	6	57.4
Ioxynil (177)	.50	4/24/64	5	55.1
Ioxynil (177)	.25	10/31/63	3	54.3
Ioxynil (70)**	1.00	10/31/63	7	53.3
Check	0	0	0	52.1
Ioxynil (70)	.25	10/31/63	1	51.9
Ioxynil (70)	1.00	4/24/64	5	51.6

Continued next page.

Continued

Treatment	Rate/Acre	Application Date	Weed Score 0 - 10*	Yield
2,4-D amine	2.00	4/24/64	8	50.7
Ioxynil (177)	.25	4/24/64	2	49.1
2,4-D LV 4D	1.50	4/24/64	9	47.5
Ioxynil (70)**	.50	10/31/63	8	47.1
Ioxynil (70)**	.25	4/24/64	4	46.9
2,4-D LV 4D	2.00	4/24/64	9	46.8
Ioxynil (70)	.50	10/31/63	2	46.1
Ioxynil (70)	.50	4/24/64	3	44.2
Ioxynil (70)	.25	4/24/64	2	43.8

* 0 - no control; 10 - complete control.
**Surfactant used 2% by volume.

Table 2. Yield and weed score data from field gromwell study conducted at Kalispell, Montana, 1963-64. (Fall vs spring treatments)

Treatment	Application Date	Rate/Acre	Weed Score 0 - 10	Yield
Ioxynil 62-70	Fall	.25	1	51.9
Ioxynil 62-70	Spring	.25	2	43.8
Ioxynil 62-70	Fall	.50	2	46.1
Ioxynil 62-70	Spring	.50	3	44.2
Ioxynil 62-70	Fall	1.00	7	60.6
Ioxynil 62-70	Spring	1.00	5	51.6
Ioxynil 62-70*	Fall	.25	6	57.8
Ioxynil 62-70*	Spring	.25	4	46.9
Ioxynil 62-70*	Fall	.50	8	47.1
Ioxynil 62-70*	Spring	.50	7	64.6
Ioxynil 62-70*	Fall	1.00	7	53.3
Ioxynil 62-70*	Spring	1.00	8	60.9
Ioxynil (177)	Fall	.25	3	54.3
Ioxynil (177)	Spring	.25	2	49.1
Ioxynil (177)	Fall	.50	6	57.4
Ioxynil (177)	Spring	.50	5	55.1
Ioxynil (177)	Fall	1.00	7	59.8
Ioxynil (177)	Spring	1.00	7	57.6
Check	-	0	0	52.1
2,4-D amine	Spring	1.00	4	58.7
2,4-D amine	Spring	2.00	8	50.7
2,4-D LV 4D	Spring	1.00	8	57.8
2,4-D LV 4D	Spring	1.50	9	47.8
2,4-D LV 4D	Spring	2.00	9	46.8

* Surfactant used 2% by volume.

Factors influencing the activity of ioxynil. Appleby, Arnold P. and Furtick, W. R. Several experiments were established in 1963-64 to help clarify the influence of several factors on the activity of ioxynil. One experiment was established in October, 1963, to compare various formulations on Amsinckia and Senecio. Results are given in Table 1. The oil-soluble amine and the lithium salt with wetting agent were somewhat more effective on these species than either the wettable powder or the lithium salt without wetting agent.

Table 1. Comparison of ioxynil formulations on Amsinckia and Senecio, applied October 10, 1963.

Formulation	lbs. active material/acre	Percent Control Amsinckia	Senecio
ACP 62-177 (wettable powder)	0.25	52	72
"	0.50	57	92
"	1.00	97	100
ACP 63-166 (oil-soluble amine)	0.25	60	85
"	0.50	97	99
"	1.00	99	97
ACP 63-239 (lithium salt, no wetting agent)	0.25	55	90
"	0.50	70	100
"	1.00	100	100
ACP 63-240 (lithium salt, with wetting agent)	0.25	56	96
"	0.50	95	100
"	1.00	98	100

Another experiment was established in the spring of 1964 to compare various formulations of ioxynil and bromoxynil. The results of this experiment are given in Table 2. Very little difference was observed between the lithium salt and the sodium salt supplied by AmChem products. The sodium salt supplied by Chipman was considerably more effective, presumably because of additional wetting agent. Bromoxynil and ioxynil were quite comparable in their activity on three of the weed species, but the bromoxynil was much more effective against dog fennel (Anthemis cotula).

Two experiments were established in the spring under dry soil conditions. One experiment was designed to test the influence of volume of carrier on ioxynil activity. Volumes ranged from 5 gallons to 40 gallons of water per acre with an ioxynil rate of .5 pounds per acre. Results are given in Table 3. On Anthemis and Brassica, a rather consistent increase in control accompanied increase in volume per acre. The control of lambsquarters under the dry soil conditions was uniformly poor for all volumes of carrier and is not reported in this table.

Table 2. Comparison of ioxynil and bromoxynil formulations on four weed species, applied on June 25, 1964.

Formulation	Active material lbs/acre	Percent Control Anthemis	Cheno-podium	Brassica	Senecio
ACP 63-303 (lithium ioxynil)	0.5	20	18	58	65
"	1.0	38	60	68	90
ACP 64-53 (sodium ioxynil)	0.5	23	25	60	73
"	1.0	43	53	65	85
NPH 1250 (sodium ioxynil)	0.5	33	78	90	80
"	1.0	50	95	100	100
NPH 1260 (potassium bromoxynil)	0.5	58	80	90	100
"	1.0	83	95	100	100
NPH 1320 (bromoxynil ester)	0.5	65	88	98	98
"	1.0	90	95	100	100
NPH 1330 (ioxynil ester)	0.5	30	83	93	75
"	1.0	30	90	95	95

Table 3. Influence of volume of carrier on ioxynil activity when applied in the spring under dry conditions.

Treatment	Active material lbs/acre	Volume of water/acre	Percent Control* Anthemis	Brassica
ACP 63-303	0.5	5	14	25
"	0.5	10	30	32
"	0.5	15	30	32
"	0.5	20	41	42
"	0.5	40	48	48
Control	0	--	0	0

* Average of four replications.

The second experiment established in early spring under dry conditions was designed to test the influence of wetting agent on ioxynil activity. Weed species present were lambsquarters, dog fennel, and mustard. Control of lambsquarters was negligible from all treatments and is not included in the table. Likewise, control of dog fennel was not satisfactory, and no differences could be noticed between treatments. Control of Brassica was definitely influenced and is reported in Table 4. As the wetting agent concentration increased, the Brassica control also increased quite markedly.

Another experiment was established in late spring under adequate moisture conditions to test the influence of various additives on ioxynil activity. Results are presented in Table 5. Again the addition of wetting agent drastically increased the control obtained from the lithium salt (ACP 63-303) on Chenopodium, Brassica, and Senecio but was not beneficial in control of dog fennel (Anthemis). The addition of sodium thiocyanate gave a slight but consistent increase in control of all species.

Table 4. Influence of wetting agent on activity of ioxynil applied in the spring under dry conditions.

Treatment	Active material lbs/acre	Wetting agent concentration	Percent control* Brassica
ACP 63-303	0.25	0	22
ACP 63-303 + ACP 64-168A	0.25	.01%	48
ACP 63-303 + ACP 64-168A	0.25	.05%	65
ACP 63-303 + ACP 64-168A	0.25	.10%	72
ACP 63-303	0.5	0	35
ACP 63-303 + ACP 64-168A	0.5	.01%	50
ACP 63-303 + ACP 64-168A	0.5	.05%	72
ACP 63-303 + ACP 64-168A	0.5	.10%	81
Control	0	0	0

* Average of four replications.

Table 5. Influence of various additives on activity of ioxynil applied in the spring under adequate moisture conditions.

Active material (ACP 63-303) lbs/acre	Additive	Dosage	Percent Control Anthemis	Cheno-podium	Brassica	Senecio
0.5	------	------	20	18	58	65
0.5	ACP 64-168A	.05%	33	83	85	95
0.5	ACP 64-168B	.05%	30	65	80	93
0.5	ACP 64-168C	.05%	30	93	95	93
0.5	Na thiocyanate	0.5 lb/A	28	30	65	73
0.5	2,4-D ester	0.25 lb/A	65	93	98	88
0.5	MCPA ester	0.25 lb/A	70	95	98	88
1.0	------	------	38	60	68	90
1.0	Na thiocyanate	1.0 lb/A	43	73	83	93

It was concluded that the addition of wetting agent to salt formulations of ioxynil can be strikingly beneficial. The oil-soluble amine is also an effective formulation. Increase in volume of carrier can improve weed control, but variation in species is involved. Very poor control, particularly of lambsquarters, has been obtained under dry soil conditions. (Dept. of Farm Crops, Oregon State University, Corvallis).

Comparison of simazine, atrazine, and bromacil for weed control in established alfalfa. Swan, Dean G. Three rates, 0.8, 1.2, and 1.6 lb/A of simazine, atrazine, and bromacil were applied in mid-winter to dormant alfalfa. Applications were made on different soil types at four locations.

Weed control was evaluated prior to first cutting, and the plots were harvested at each alfalfa cutting so the summer production could be determined.

The treatments gave complete control of downy brome, wall barley (Hordeum murinum), tansymustard shepherdspurse, 50-100% control of perennial ryegrass, and 20-80% control of quackgrass. Simazine gave poorest control of the latter two species. Redstem filaree, common mallow, and dandelion were not controlled by these treatments.

Alfalfa injury, caused by some treatments, was evident by a yellowing of some alfalfa leaves. Where injury was severe, increased yellowing with a reduction in plant size was observed.

Hay yields for the four locations are shown in the table. At the Duff plot, the check averaged 58% weeds, Mann plot 30%, McCarty plot 22%, and the Umatilla Station plot was weed free. Greatest yield reductions were measured at the first hay cutting. At the second and third cuttings both visual injury and yield reductions, caused by the treatments, were less. Yield differences were not significant at the second cutting of the Duff, Mann, and McCarty or third cutting of Umatilla Station plots.

Alfalfa yields* in T/A of air dry hay for 1964 at four Umatilla County, Oregon, locations.

			Location and soil type			
No.	Treatment	Rate lb/A	Duff Yakima loam	Mann Onyx loam	McCarty Ritzville sandy loam	Umatilla Branch Expt. Sta. Ephrata loamy sand
1	Simazine	0.8	7.59 ab	9.51 ab	5.11 ab	7.43 abc
2	Simazine	1.2	7.24 bc	8.87 bc	4.99 abc	6.98 bcd
3	Simazine	1.6	6.54 c	7.34 c	4.32 cdef	6.69 cd
4	Atrazine	0.8	7.29 bc	8.71 bc	4.83 bcd	7.04 bcd
5	Atrazine	1.2	6.90 bc	8.48 bc	4.52 bcdef	6.34 de
6	Atrazine	1.6	6.64 bc	7.76 c	4.07 ef	5.06 f
7	Bromacil	0.8	6.66 bc	8.68 bc	4.67 bcde	7.69 ab
8	Bromacil	1.2	6.75 bc	8.10 bc	3.89 f	7.36 abc
9	Bromacil	1.6	6.44 c	7.97 c	4.09 de	5.58 ef
10	Check		8.40 a	10.35 a	5.63 a	8.20 a

* Means within a column sharing the same letter are not significantly different at the 5% level.

Thus, it is evident that the alfalfa does tend, later in the summer, to recover from injury caused by the higher rates of these materials. However, initial injury caused by these higher rates did reduce summer alfalfa production at all locations. (Oregon Agricultural Expt. Sta., Pendleton).

Combining herbicides for post-emergence weed control in sugar beets. May, J. W. and Fults, Jess L. Dipotassium salt of endothal (TD-273)*, dalapon**, and pyrazon*** were selected for a preliminary post-emergence test for weed control in sugar beets under greenhouse conditions where neither moisture nor temperature were limiting factors. Flats were planted with monogerm beet seed, green bristlegrass (*Setaria viridis*), kochia (*Kochia scoparia*), and pigweed (*Amaranthus retroflexus*). Chemicals were applied, both alone and in various combinations, 21 days after planting when beets had well developed primary leaves, and evaluation was made 30 days later. The TD-273 was applied alone at rates of 1, 2 and 4 lbs/A; dalapon alone at 3, 5 and 7 lbs/A; and pyrazon alone at 2, 4 and 6 lbs/A. TD-273 and dalapon were combined at rates of 4-3, 2-5 and 1-7 lbs/A. TD-273 and pyrazon were combined at rates of 4-2, 2-4 and 1-6 lbs/A. Dalapon and pyrazon were combined at rates of 7-2, 5-4 and 3-6 lbs/A. TD-273, dalapon and pyrazon were combined at 2-2-2 lbs/A.

Flats were watered as needed daily. The daily temperature ranged from 75°F at night to 85°F during the day. Evaluation was made on the 51st day after planting, which was 30 days after chemical application. Comparisons were made on the basis of plant counts and the total weed weights. The best combination proved to be dalapon and pyrazon at 3 plus 6 lbs/A. This combination controlled pigweed 100%, kochia 36%, and bristlegrass 56%. The next best control came with the same chemicals combined at 5 plus 4 lbs/A. Neither combination retarded beet development or stand. Applications where dalapon was used at 7 lbs/A caused some marginal burning and whitening in beet foliage. In all tests, the beets were significantly larger than in controls where there was no weed control. (Botany and Plant Pathology Section, Colorado Agricultural Expt. Sta., Fort Collins, Colorado.)

Weed potential in sugar beets related to temperature and soil moisture. May, J. W. and Fults, Jess L. A field study was made to determine the dominant weeds associated with the sugar beet crop on a clay loam soil near Fort Collins, Colorado. The four most frequent weed species were found to be pigweed (*Amaranthus retroflexus*), green bristlegrass (*Setaria viridis*), kochia (*Kochia scoparia*), and lambsquarters (*Chenopodium album*). High quality seeds of each species were planted in flats where soil had been previously brought to a specified condition of soil moisture stress. This was done by mixing weighed soil and water in a twin-shell soil blender according to a sorption curve established for the soil using pressure plates. Flats were covered with Saran Wrap and closed with a rubber band, then placed in a Percival growth chamber for 10 days in an environment of "low" temperature (8 hrs with light at 55°F and 16 hrs dark at 40°F daily). At the end of 10 days, plant counts were recorded and flats were brought back to the original soil moisture condition. The flats were then placed back in the growth chamber with an environment of "warm" temperature (8 hrs light at 90°F and 16 hrs dark at 60°F) and allowed to incubate for an additional 14 days. At the end of 24 days a second set of plant counts was made. The data are presented in Tables 1 and 2.

* endothal = 7-oxabicyclo(2,2,1)heptane-2,3-dicarboxylic acid.

** dalapon = 2,2 dichloropropionic acid.

*** pyrazon = 1-phenyl-4-amino-5-chloropyridazone-6.

Table 1. The interaction of soil moisture stress and "low" temperature on the germination of 4 weed species common to sugar beet fields in northern Colorado.

Weed	Relative soil moisture stress % germination*				
	Saturated Soil	.35 bar	1.0 bar	5 bars	10 bars
Lambsquarters	5	52	55	46	1
Pigweed	5	7	3	1	0
Kochia	5	62	52	21	0
Setaria	0	1	1	0	0

* Data taken 10 days after planting with "low" temperature.

Table 2. The interaction of soil moisture stress and "high" temperature following a "low" temperature period on the germination of 4 weed species common to sugar beet fields in northern Colorado.

Weed	Relative soil moisture stress % germination*				
	Saturated Soil	.35 bar	1.0 bar	5 bars	10 bars
Lambsquarters	10	53	70	83	2
Pigweed	12	20	21	34	0
Kochia	27	83	77	42	0
Setaria	14	28	48	37	1

* Data taken 14 days after "low" temperature period or 24 days after planting.

Summary of results: Lambsquarters and Kochia germinated well at the lower temperatures at moisture tension between 0.35 to 5.0 bars, whereas pigweed and setaria did not. Best germination for both species was under a moisture stress of between 0.35 and 1.0 bar. Germination for all 4 species was very low under saturated soil conditions possibly because oxygen was limiting. When the tests were moved to a higher temperature regime, there was additional germination of lambsquarters and pigweed at all moisture stresses except at 10 bars, and in addition, pigweed, and expecially setaria, increased in germination. Best pigweed germination was at 5 bars and best setaria germination was with 1.0 bar tension at the higher temperatures. (Botany and Plant Pathology Section, Colorado Agricultural Expt. Sta., Fort Collins, Colorado.)

Pre-plant chemical combination tests for annual weed control in sugar beets. Alley, H. P. Chemical combination tests were established at the Torrington Agricultural Experiment Station April 28-29, 1964. The experiments were of the randomized-block design with treatments being replicated four times. The plots were 2 rows wide, with 22-in. spacing, 75 ft. long, in each replication. One row of the 2-row paired plot was treated with the respective chemical or combination and incorporated into a 7-in. band, 1 in. deep. The adjacent untreated row permitted direct comparison of sugar beet stand and percentage weed control with the paired treated row.

The equipment used for preparing the beds and applying the pre-plant treatments consisted of Eversman bedding unit and necessary adaptations whereby the chemical was applied in a 7-in. band, incorporated with a Flexi-planter unit altered to include finger-weeder incorporation devices and the sugar beet seed planted all in one operation.

The chemicals were incorporated in the soil pre-plant in amounts equivalent to recommended rates when used separately. The rates were diallate 2 lb/A, PEBC 2 lb/A, pyrazon 5 lb/A, EPTC 3 lb/A, TCA 6 lb/A, and TD-282 3 lb/A. Rates are expressed as the rate applied on an acre basis incorporated into a 7-in. band. One quarter of these amounts of the chemicals, two at a time, were pre-plant incorporated at ratios of 0:4, 3:1, 2:2, and 1:3, or 4:0, which is implied to represent one toxic unit.

The plant population was classified as to (1) sugar beets, (2) grass weed species, green foxtail (Setaria viridis (L.) Beauv.), and (3) broad-species, rough pigweed (Amaranthus retroflexus L.) and black nightshade (Solanum nigrum L.).

Non-orthogonal comparisons were made with each individual grouping of the chemical combinations with every other general grouping of chemical combinations and with each individual toxicant comprising the specific combination (attached table). It was necessary to group the ratios because of not having statistical significance within ratios.

Combinations definitely hold promise as a means of increasing the spectrum of weed control in sugar beets. From the results of this research it is evident that each of the combinations resulted in satisfactory control of certain weed species but were not as effective on other species.

Pyrazon:PEBC combination appeared to be the best overall treatment of the combinations. The sugar beet stand was not reduced below the other treatments and the sugar beet yield was not reduced. This treatment resulted in the lowest percent control of green foxtail - 64.1 percent. However, pyrazon:TCA was the only treatment significantly better. Pyrazon: TD-282 paralleled the pyrazon:PEBC combination but seemed to be considerably weaker on green foxtail control.

When pyrazon was present as one of the chemicals included in the mixture, there was a tendency for sugar beet seedling stimulation. Observations recorded at counting time indicated that the sugar beet seedlings present in the treated area where pyrazon was present did not show the typical physiological damage that was present in the other treated plots. (Wyoming Agricultural Expt. Sta., University of Wyoming, Laramie).

Non-orthogonal comparison of each chemical group of combinations with every other combination within the field evaluation experiment.

Treatment[1]				% 2/ Sugar Beet Stand		Sugar Beet Yield T/A		Percent Control Green Foxtail		Rough Pigweed		Nightshade	
			Pyrazon + Diallate	(38.0)		(13.2)		(53.3)	11.07**	(77.6)		(93.5)	
PEBC +	SBS	(39.2)	Pyrazon + TD-282	(59.9)	3.93*	(15.0)	6.99**	(62.3)	4.66*	(81.9)		(87.6)	
Diallate	SBY	(9.8)	Pyrazon + TCA	(57.2)		(12.9)		(83.7)		(80.9)		(76.3)	12.3**
(1 Toxic	GF	(77.9)	Pyrazon + PEBC	(55.8)		(16.5)	11.7**	(64.1)		(91.1)		(88.9)	
unit)	RP	(86.6)	Pyrazon + EPTC	(34.0)		(11.3)		(68.4)		(84.5)		(87.6)	
	N	(89.7)	PEBC 3 lb/A	(57.3)		(13.7)		(70.2)		(75.9)		(89.0)	
			Diallate 2 lb/A	(25.2)		(11.8)		(68.3)		(81.2)		(95.5)	
	SBS	(38.0)	Pyrazon + TD-282	(59.9)	5.82*	(15.0)		(62.3)		(81.9)		(87.6)	-
Pyrazon	SBY	(13.2)	Pyrazon + TCA	(57.2)	4.45*	(12.9)		(83.7)	15.95**	(80.9)		(76.3)	19.95**
+	GF	(52.3)	Pyrazon + PEBC	(55.8)	3.86	(16.5)		(64.1)		(91.1)	5.26*	(88.9)	-
Diallate	RP	(77.6)	Pyrazon + EPTC	(34.0)		(11.3)		(68.4)	4.34*	(84.5)		(87.6)	-
	N	(93.5)	Pyrazon 5 lb/A	(72.4)	5.78*	(15.9)		(17.8)	11.15**	(77.5)		(72.4)	13.0**
			Diallate 2 lb/A	(25.2)		(11.8)		(68.3)		(81.2)		(95.5)	-
	SBS	(59.9)	Pyrazon + TCA	(57.2)	-	(12.9)	-	(83.7)	8.79**	(80.9)	-	(76.3)	8.62**
Pyrazon	SBY	(15.0)	Pyrazon + PEBC	(55.8)	-	(16.5)	-	(64.1)	-	(91.1)	-	(88.9)	
+	GF	(62.3)	Pyrazon + EPTC	(34.0)	8.12**	(11.3)	-	(68.4)	-	(84.5)	-	(87.6)	
TD-282	RP	(81.9)	Pyrazon 5 lb/A	(72.4)	-	(15.9)	-	(17.8)	24.67**	(77.5)	-	(72.4)	6.22*
	N	(87.6)	TD-282 3 lb/A	(56.2)	-	(7.7)	-	(52.0)	-	(62.6)	-	(92.7)	
	SBS	(57.2)	Pyrazon + PEBC	(55.8)	-	(16.5)	-	(64.1)	7.33**	(91.1)	-	(88.9)	10.76**
Pyrazon	SBY	(12.9)	Pyrazon + EPTC	(34.0)	6.49*	(11.3)	-	(68.4)	4.50*	(84.5)	-	(87.6)	8.58**
+ TCA	GF	(83.7)	Pyrazon 5 lb/A	(72.4)	-	(15.9)	-	(17.8)	43.26**	(77.5)	-	(72.4)	-
	RP	(80.9)	TCA 6 lb/A	(54.5)	-	(15.9)	-	(93.5)	-	(89.4)	-	(68.2)	-
	N	(76.3)											
	SBS	(55.8)											
Pyrazon	SBY	(16.5)	Pyrazon + EPTC	(34.0)	5.77*	(11.3)	7.03**	(68.4)	-	(84.5)	-	(87.6)	-
+	GF	(64.1)	Pyrazon 5 lb/A	(72.4)	-	(15.9)	-	(17.8)	28.10**	(77.5)	-	(72.4)	10.07**
PEBC	RP	(91.1)	PEBC 3 lb/A	(57.3)	-	(13.7)	-	(70.2)	-	(75.9)	-	(89.0)	-
	N	(88.9)											
	SBS	(34.0)											
Pyrazon	SBY	(11.3)	Pyrazon 5 lb/A	(72.4)	7.17**	(15.9)	-	(17.8)	30.67**	(77.5)	-	(72.4)	6.12*
+	GF	(68.4)	EPTC 3 lb/A	(24.2)	-	(8.9)	-	(97.3)	6.40*	(93.8)	-	(95.2)	-
EPTC	RP	(84.5)											
	N	(87.6)											

F difference between
F value averages needed for .05 = 3.93*
significance .01 = 6.87**

1 Preplant treatments were mzde at the Torrington Experiment Station in sandy loam soil. SBS = Sugar beet stand, SBY = sugar beet veild, GF = green foxtail, RP = rough pigween, N = nightshade for respective grouping of chem combinations.

Effects of various methods of mechanical incorporation on the phytoxicity of pyrazon. Lee, Gary, and Alley, H. P. The study was conducted to determine the effects of four methods of mechanical incorporation on the activity of pyrazon. Treatments consisted of no chemical, pyrazon 5 lb/A, pyrazon 3 lb/A, and PEBC at 3 lb/A. PEBC was included in the study as an additional comparison. Each of the herbicides were mechanically incorporated into the soil with a Finger weeder, Roto-tiller, Sinner-weeder, and Rotary Hoe - to soil depth of 1 to 1.5 inches.

Plots were four rows 100 ft. long, with each treatment replicated 6 times.

Weed and beet population counts were taken from an area 10 ft. long and 3 in. wide, 1.5 in. on either side of the beet row. The plant population was classified as to (a) sugar beets, (b) broadleaved weeds, and (c) grass weeds. Broadleaved weeds most common to the experimental area were rough pigweed (*Amaranthus retroflexus* L.), black nightshade (*Solanum nigrum* L.), kochia (*Kochia scoparia* L.), and lambsquarters (*Chenopodium album* L.). Grass species most common were green foxtail (*Setaria viridis* L. Beauv.) and barnyardgrass (*Echinochloa crusgalli* L. Beauv.).

The plots were irrigated one week following treatment and planting. Plots were harvested and sugar beet weight (tonnage) and sugar analysis obtained at the termination of the growing season.

Conclusions drawn were:

(1) The use of the sinner-weeder, which applied the chemicals on a flat surface and covered the chemicals with a layer of soil, was the most toxic to the sugar beet stand, significantly reducing the sugar beet stand with all chemicals and rates used.

(2) Percent control of grass species was consistently higher, where the sinner-weeder was used, than the other three methods of soil incorporation.

(3) The pyrazon applications incorporated by the roto-tiller unit, resulted in significantly higher control of broadleaved weeds than all other methods and rates except PEBC which was incorporated with the sinner-weeder.

(4) The sugar beet yields were higher in the plots that were treated with pyrazon and incorporated with the rotary-hoe than with the other methods of incorporation. The use of the sinner-weeder resulted in the lowest yields.

(5) In general, the best weed control was obtained where the sinner-weeder was used to incorporate the chemical. The toxicity to sugar beet stand and yield was also the highest.

See table on next page.

	No Chemical				Pyrazon 5 lb/A				Pyrazon 3 lb/A				PEBC 3 lb/A			
	FW	RT	SW	RH	FW	RT	SW	RH	FW	RT	SW	RH	FW	RT	SW	RH
Percent Control of Grasses	0	0	0	0	68.04	76.13	80.71	69.64	1.46	3.47	42.69	7.36	26.92	37.84	85.05	47.26
Percent Control of Broadleaves	0	0	0	0	44.61	90.54	78.94	73.50	44.80	77.51	72.87	71.59	76.47	85.98	97.44	89.09
Percent Stand of Sugar Beets	100	100	100	100	92.13	81.88	80.78	88.85	90.16	83.42	84.26	85.45	92.45	100+	72.39	92.54
Tonnage/acre of Sugar Beet Roots	19.23	17.55	16.94	16.39	18.76	17.96	14.63	19.21	18.19	17.14	15.52	19.04	18.86	20.53	17.23	16.61
Sucrose Content of Sugar Beets	15.43	16.28	15.17	15.04	14.98	14.94	14.48	15.45	14.74	14.57	15.79	14.69	15.53	14.98	15.30	15.10

FW = finger weeder, RT = roto-tiller, SW = sinner weeder, and RH = power driven rotary hoe method of incorporation.

Chemical weed control in winter flax (linum usitatissimum Var. Linore). Fechtig, A. D., Burrill, L. C., and Furtick, W. R. This project was primarily initiated to establish optimum rates of the potential flax herbicides, and to gain additional information concerning their activities for controlling grass species.

In the fall of 1963, four separate trials, each consisting of a randomized complete block design, were conducted in the Willamette Valley. The plots were seeded in early September with a relatively winter hardy variety of flax, Linore. The treatments consisted of pre-plant, pre-emergence, and post-emergence applications.

On well drained soils, EPTC at three pounds active per acre and incorporated by double discing controlled 95% of the annual ryegrass, wild oats, and barley without any visible injury to the flax. However, on poorly drained Dayton soil, ryegrass control dropped to approximately 65%, and flax injury was visible. These data are supported by the flax yields reported in the table.

Weed Control in Flax
Oregon Willamette Valley

Chemical	Rate lb/A	Average Yield for Four Replications Location I	Location II
Pre-plant			
1) Eptam	3	2309	1585
Pre-emergence			
2) G-34698	1.6	1915	1439
3) G-34698	2.4	2047	1658
4) Isocil	1.6	1877	1596
5) CP-31393	4.0	2140	1836
6) CP-31393	6.0	1915	2060
7) Atrazine	1.6	2291	1752
Post-emergence			
8) Atrazine	1.6	2291	1627
9) Atrazine	2.4	2178	1846
10) Atrazine	3.2	1602	1650
11) IPC (WP)	3.0	2253	1533
12) IPC (WP)	4.0	2253	1471
13) IPC (WP)	6.0	2253	1752
14) Check		1839	1486

Of the pre-emergence chemicals applied, atrazine and isocil at 1.6 lbs per acre essentially controlled all of the annual ryegrass, but only isocil gave adequate volunteer barley control. Although no visible injury was noted from atrazine and isocil treatments, plots that had been treated with atrazine gave higher yields. G-34698 (2-chloro-4-isopropylamino-6-(3 methoxy propylamino)-s-triazine) and CP-31393 (N-isopropyl-alpha-chloroacetanilide) were extremely erratic in controlling annual ryegrass at 2.4

and 6.0 pounds per acre, respectively. Neither of these compounds showed activity on barley.

Post-emergence applications of atrazine at 2.4 pounds per acre and IPC at 3 pounds per acre controlled approximately 90% of the annual ryegrass, but both proved ineffective on barley. A 3.2-pound application of atrazine caused extensive injury to the flax. However, a six-pound rate of IPC was not injurious, indicating a wide safety margin.

Chemical weed control in lentils (L. esculenta - var chilean). Rydrych, D. J. Selective control of annual weeds such as wild oats, lambsquarters, prostrate pigweed, fanweed, shepherds purse, and henbit in lentils in eastern Washington is difficult because of the poor competitive ability of the lentils. Wild oats have been fairly successfully controlled with barban and diallate but control of broadleaved weeds in this crop has been poor with most chemicals tested.

Two new herbicides show some promise when applied as pre- and post-emergence treatments.

Significant yield increases were obtained from pre-emergence applications of UC 22463 (3,4-dichlorobenzyl-N-methyl carbamate), 4 lb. ai/A; and FW 925 (2,4-dichlorophenyl 4 nitrophenyl ether), 6 lb. ai/A. Post-emergence applications of these chemicals, UC 22463 (2 lb. ai/A) and FW 925 (4-6 lb. ai/A), respectively, also gave excellent control of broadleaved weeds with increased yield of lentils.

Results to date indicate that UC 22463 will be more efficient when applied as a pre-emergence treatment and FW 925 when applied post-emergence.

Post-emergence applications were applied to the lentils in the 3-5 node stage and the weeds were in the 2-4 leaf stage. Further tests will be conducted to determine the effect of these chemicals on other weeds and the possibility of combinations of these products with wild oat herbicides. (Washington Agricultural Expt. Sta., Pullman).

Weed control in crambe (Crambe abyssinica). Rydrych, D. J. and Youngman, V. E. Crambe is currently showing promise as an oil seed crop for possible use as an alternate crop in wheatland in the Pacific Northwest. It is a member of the mustard family, therefore, it is sensitive to the phenoxy compounds and only those herbicides which are selective between mustard species are effective. Crambe has aggressive growth qualities and gives dense shade quickly. For this reason long term weed control is not necessary.

Several herbicides were screened at Pullman for the control of common broadleaved weeds in crambe; trifluralin, diallate, triallate, FW 925, R-4572 and UC 22463 (3-4-dichlorobenzyl-N-methyl carbamate).

Weed species in the plot area consisted of fanweed, (*Thlaspi arvense*), prostrate pigweed, (*Amaranthus graecizans*), henbit, (*Lamium anplexicaule*), shepherds purse, (*Capsella bursa-pastoris*). and lambsquarters, (*Chenopodium album*).

Incorporated applications of diallate and triallate (1-2 lb ai/A), trifluralin (1-2 lb ai/A), and R-4572 (5 lb ai/A) killed or stunted the broadleaved weeds but did not seriously damage the crop. Of this group, only trifluralin was effective on all the weed species in the experimental area. The other herbicides tested were not as effective on prostrate pigweed, although they did cause some suppression.

Pre-emergence applications of trifluralin (1-2 lb ai/A), FW 925 (4 lb ai/A), and UC 22463 (4 lb ai/A) also killed most weed species except prostrate pigweed, which was suppressed but not completely destroyed.

In these preliminary trials, trifluralin gave the best results of the chemicals tested based on weed control and yield from both incorporated and pre-emergence applications. In areas where wild oats are a problem, then diallate and R-4572 would probably be more effective or possibly a combination of these herbicides with trifluralin.

Further investigations are being planned. (Washington Agricultural Expt. Sta., Pullman).

Weed control in peppermint. Atkeson, George W., Burrill, Larry C., and Appleby, Arnold P. Eight experiments were established in 1964 to compare several compounds for weed control in peppermint. The compounds used were: isocil, bromacil, diuron, CP 31393 (N-isopropyl-2-chloroacetanilide), duPont 732 (5-chloro-3-*tert.* butyl-6-methyluracil), and duPont 733 (5-bromo-3-*tert.* butyl-6-methyluracil).

Isocil, bromacil, DP 732, and DP 733 gave outstanding weed control at rates of .8 pounds to 1.2 pounds per acre, depending on soil type and organic matter content. A wide range of annual grasses were controlled, as well as a variety of broadleaves, including henbit, knotweed, wild lettuce, and dog fennel. Of particular interest was the excellent control of nutsedge (*Cyperus esculentus*). This perennial weed has not been controlled by any other selective herbicidal treatment in mint. All of these materials gave 90% or better nutsedge control.

A comparison of peppermint injury caused by DP 732 and DP 733 and bromacil is given in the following table. It is quite obvious that DP 732 and DP 733 are much safer for use in peppermint than is bromacil. Isocil was less selective than bromacil. The two new uracils not only caused little or no injury at the highest rate, but apparently acted as a plant stimulant at some locations. This stimulation was observed even at locations which were essentially weed-free.

Diuron gave fairly adequate control of many annual weeds, but did not control as wide a variety of species as the uracils, and provided no control of nutsedge. CP 31393 seriously injured mint and also failed to provide nutsedge control. (Dept. of Farm Crops, Oregon State University, Corvallis).

Peppermint injury at eight locations

Chemical	Rate/A	Percent peppermint injury							
Bromacil	0.4	21	0	0	10	-	0	10	0
Bromacil	0.8	11	3	0	10	5	0	36	0
Bromacil	1.2	26	-	3	25	-	28	41	0
Bromacil	1.6	24	26	4	53	-	45	68	0
Bromacil	2.4	55	72	5	68	40	49	86	0
DP 732	0.8	10	0	-	0	0	-	5	-
DP 732	2.4	10	0	-	0	0	-	0	-
DP 733	0.8	5	0	-	0	0	-	5	-
DP 733	2.4	23	7	-	0	0	-	5	0

Stale seedbed method for forage establishment. Peabody, Dwight V. Jr. Further testing of the "stale seedbed" method for establishing new forage seedings was undertaken. Since the main detriment to this method, as observed over the past several years, has been surface soil condition at seeding time, one more operation was included in the 1964 test. This was a light scarification of the seedbed with a spike-tooth harrow immediately prior to seeding. This practice loosened enough soil for seed burial (and subsequent good germination) but did not bring undue weed seed to the surface so that weed control was maintained. As a result, the following schedule of stale seedbed preparation has shown the best results: (1) soil worked to the final stage for planting, (2) three to four week waiting period for weed seed germination and growth, (3) application of diquat or paraquat, (4) after one to three days, peg-tooth harrowing, (5) sow forage mixture with "Brillion" type seeder. (Northwestern Washington Expt. Sta., Washington State University, Mount Vernon.)

Weed control in corn. Appleby, Arnold P. and Atkeson, G. W. A wide variety of herbicides and combinations of herbicides were applied to corn in the spring of 1964. Uniform stands of the following weeds were present in the plots, either from seeding or from natural infestation: barnyardgrass, green foxtail, pigweed, lambsquarter, and yellow mustard. Several treatments gave nearly complete weed control, while others controlled one or more species in the weed complex, suggesting that further work with combinations may be profitable. A combination of EPTC with OMU or DNBP amine gave good weed control The optimum time for application of the DNBP amine, however, was at the spike stage, rather than pre-plant incorporated. The addition of a number of other herbicides with EPTC also gave reasonably satisfactory weed control. These herbicides included 2,4-D, dicamba, picloram, and ioxynil. Other excellent grass killers included R 1910 (ethyl diisobutylthiolcarbamate), CP 31393 (N-isopropyl-2-chloroacetanilide), and CP 45592. All of these materials required the addition of a broadleaf herbicide for certain broadleaf weeds. Four pounds of linuron gave outstanding weed control with no crop injury in this particular experiment. Several triazine herbicides, including atrazine gave excellent broadleaf control, but were somewhat weak on foxtail and barnyardgrass. GS 13529 (2-tert. butylamino-4-chloro-6-ethylamino-s-triazine) was superior to atrazine and GS 13528 (2-sec. butylamino-4-chloro-6-ethylamino-s-triazine) in the control of these grasses. The combination of DNBP amine and 2,4-DEP (Falone) gave outstanding weed control when applied at the spike stage, but was less satisfactory when applied pre-emergence.

Some of the more promising herbicides and herbicidal combinations are listed in the following table. (Dept. of Farm Crops, Oregon State University, Corvallis).

Selected treatments for weed control in corn

		Percent Control					
Treatment	Lbs ai/A	Fox-tail	Barn-yard-grass	Mustard	Pig-weed	Lambs-quarters	% Corn injury
Pre-plant & Incorp.							
EPTC + Picloram	2 + 1	97	99	75	100	100	3
Pre-plant & pre-emerg.							
EPTC + OMU	2 + 3	100	100	100	100	100	10
R-1910 + OMU	3 + 3	100	100	100	100	100	3
Pre-plant & Spike Stage							
EPTC + DNBP Amine	2 + 2	98	99	99	87	99	0
Pre-plant & Post-emerg.							
EPTC + 2,4-D Amine	2 + .5	96	99	99	83	99	0
EPTC + ioxynil	2 + .5	92	98	99	100	67	0
EPTC + Dicamba	2 + .25	96	99	82	92	100	3
Pre-emergence							
CP 31393	4	93	91	0	10	23	0
"	8	100	100	47	75	33	3
CP 45592	2	100	100	65	72	50	13
"	4	100	100	88	70	68	3
DNBP + 2,4-DEP	1.5 + 2	63	53	98	85	57	13
"	3 + 4	89	88	100	87	87	13
Linuron	4	100	100	100	100	100	3
Atrazine	2	58	82	100	100	100	0
GS 13528	2	35	35	100	98	100	0
GS 13529	2	99	99	100	100	100	0
Pre-emerg. & Post-emerg.							
CP 31393 + 2,4-D Amine	4 + 1	95	95	100	60	45	0
DuPont 1318 + 2,4-D Amine	6+1	100	100	100	78	88	0
Spike Stage							
DNBP + 2,4-DEP	1.5 + 2	87	88	100	82	100	0
"	3 + 4	97	96	100	99	100	0

Evaluation of several herbicides for the control of wild buckwheat in Compana Barley. Guenthner, H. R. Fifteen chemical treatments were applied when the barley was in the three-leaf stage and the wild buckwheat had three true leaves. The temperature and humidity at the time of application was 61^{o} and 58%, respectively. When the barley was fully tillered and the wild buckwheat had four true leaves, the remainder of the treatments were applied with a 12-foot boom sprayer in 19.6 GPA of carrier.

Many of the treatments resulted in 100% control of the wild buckwheat present. Ioxynil and combinations of ioxynil plus 2,4-D were more effective at the three-leaf stage than when applied on barley that was fully tillered. This difference appears to be a result of volume of carrier for in another test volumes of 40 GPA provided 100% control of weeds of the size. A combination of ioxynil at 4 oz./A and 2,4-D ester at 4 oz./A applied at the three-leaf stage was the most effective of the ioxynil treatments evaluated.

Picloram provided excellent wild buckwheat control at the rates evaluated. At the three-leaf stage (barley) picloram caused less crop injury when applied alone. When the treatments were applied the barley was fully tillered, a combination of picloram and 2,4-D ester resulted in increased barley yields. Dicamba and combinations of dicamba and 2,4-D ester were effective at both dates of application; however, higher yields were obtained from the early application. Dacamine and TD-440 did not provide any better control of wild buckwheat than the 2,4-D treatments.

Results obtained from this test would indicate that in order to control a broad spectrum of weeds and to provide optimum weed control at reduced rates that a combination of 2,4-D with ioxynil, picloram, or dicamba will effectively control wild buckwheat in barley.

See table on the next page. (Montana Agricultural Expt. Sta., Central Montana Branch, Moccasin, Montana).

Seed Longevity of Downy Brome. Guenthner, H. R. In September of 1962, a series of plots were established on an area which previously had a serious infestation of downy brome (Bromus Tectorum). Each plot was framed and covered with window screening. Five cultural practices were employed. Seed left on soil surface; seed left on soil surface and mixed into the top two inches of the soil in May - 1963; seed buried one-half inch deep; seed mixed in the top two inches of the soil; and seed mixed in top two inches of the soil and remixed in May and August - 1963.

Plant counts were made in 1963 and 1964 and are presented in the table. In October of 1964 no downy brome plants were observed in any of the plots. Due to abundant fall and spring moisture after the establishment of the plots, a high percentage of the seed germinated by May 6, 1963. When the downy brome seed was buried one-half inch deep, fewer seeds germinated than any of the other treatments evaluated. This would indicate that either there may have been a dry zone near the one-half inch depth or that the mixing of the remaining seed in the top two inches of the soil in the other treatments increased germination. (See table on page 101). (Montana Agricultural Expt. Sta., Central Montana Branch, Moccasin).

Yield, Test Weight, Percent Plump and Degree of Wild Buckwheat Control for several herbicides applied on Compana barley at two growth stages at the Central Montana Branch Station, Moccasin - 1964.

Treatment	Oz./A (active)	Stage Applied (barley)	Degree of W.Buckwheat control 1/	Percent Plump 2/	Test Weight	Ave. Bu./A
Picloram	.5	3-leaf	10	96	52.2	43.0
Picloram + 2,4-D ester	.5 + 4	"	10	90	51.8	39.3
Picloram + MCPA	.5 + 8	"	10	84	51.2	40.3
Ioxynil	4	"	8	93	52.4	44.6
Ioxynil + 2,4-D ester	4 + 4	"	9	86	49.9	47.8
Ioxynil + 2,4-D ester	4 + 8	"	10	80	50.0	38.7
Ioxynil + MCPA	4 + 8	"	9	84	50.2	42.9
Dicamba	2	"	9	88	50.8	42.6
Dicamba + 2,4-D ester	2 + 4	"	9	85	51.0	45.3
Dicamba + 2,4-D ester	1 + 8	"	9	83	50.2	46.8
Dicamba + 2,4-D ester	2 + 8	"	10	80	50.0	41.8
Dicamba + MCPA	2 + 8	"	10	83	50.2	43.2
2,4-D ester	8	"	4	91	51.8	36.9
2,4-D amine	8	"	2	85	50.2	41.5
Dacamine	8	"	3	84	50.3	39.6
Picloram	.5	fully tillered	10	96	52.1	38.7
Picloram	1	"	10	94	52.0	46.5
Picloram + 2,4-D ester	.5 + 4	"	10	94	52.0	46.7
Picloram + 2,4-D ester	.5 + 8	"	10	93	51.6	45.5
Picloram + 2,4-D ester	1 + 4	"	10	94	52.2	36.7
Picloram + ioxynil	.5 + 4	"	10	90	51.3	45.5
Ioxynil	4	"	5	96	52.4	44.6
Ioxynil	8	"	6	91	50.6	41.6
Ioxynil	12	"	8	88	49.9	39.3
Ioxynil + 2,4-D ester	4 + 4	"	7	86	50.7	40.8
Ioxynil + 2,4-D ester	4 + 8	"	8	83	50.4	42.3
Ioxynil + MCPP	4 + 8	"	8	90	51.2	41.6
Ioxynil + 2,4-DP	4 + 8	"	8	91	51.5	40.6
Ioxynil + 2,4-DP	2 + 8	"	6	94	51.9	36.4
Dicamba	3	"	10	95	51.8	42.0
Dicamba + 2,4-D ester	2 + 4	"	10	90	51.5	35.1
Dicamba + 2,4-D ester	1 + 8	"	9	96	52.1	41.0
Dicamba + 2,4-D ester	2 + 8	"	10	93	52.4	34.5
Dacamine	8	"	3	97	52.3	36.6
TD-440	8	"	3	93	51.9	40.9
2,4-D amine	16	"	3	90	51.4	36.7
2,4-D ester	12	"	4	90	51.6	33.9
Weedy Check	-	-	1	94	52.1	35.1

1/ Weed control rating of 1 to 10 with 10 representing complete control.
2/ Barley remaining on top of 5/64 inch sieve.

Area harvested: 16 sq. ft. Mean Yield = 41.0 bu./A
Date harvested: 8-14-64 S.E.$\bar{x}$ = 5.215 bu./A

Seed longevity of downy brome (Bromis tectorum) using several cultural treatment, Central Montana Branch Station - Moccasin.

Treatment		Date of Observation 7/6/63	7/16/63	10/1/63	6/22/64	Tota
Seed on soil surface	Ave. plants	578	13	24	5	620
	% of Total	93	2	4	1	100
Placed on soil surface-mixed on top 2" in May 1963	Ave. plants	646	30	40	7	72[illegible]
	% of Total	89	4	6	1	100
Buried 1/2" deep	Ave. plants	286	33	17	3	339
	% of Total	94	10	5	1	100
Mixed in the top 2"	Ave. plants	538	13	21	9	581
	% of Total	92	2	4	2	100
Mixed in top 2", remixed in May and August, 1963	Ave. plants	622	38	42	9	711
	% of Total	88	5	6	1	100
Precipitation from Sept. 1, 1962 to		4.72	10.83	17.92	30.46	

Evaluation of crops grown on plots chemically fallowed in 1963. Guenthner, H. R. On April 30, 1963, several chemical treatments were applied with a variable rate sprayer on barley stubble. The soil was a Danvers clay loam. Plot size was 12 feet by 65 feet with a half dosage distance of 20 feet. Cultivation was preformed on the portion of each plot where no vegetation control was observed.

At the time winter wheat was seeded in the fall of 1963, a total of 11.31 inches of precipitation had been received after the date of chemical application. When the spring barley was seeded, 15.68 inches of precipitation had been received since the date of chemical application.

The percent stand of winter wheat and barley is presented in the table. Of the chemical treatments evaluated, isocil had the most residual present. Picloram did not reduce the stand of winter wheat and barley as was anticipated. (Montana Agricultural Expt. Sta., Central Montana Branch, Moccasin).

Percent stand of winter wheat and barley grown on plots chemically fallowed in 1963 at the Central Montana Branch Station, Moccasin - 1964

Treatment	Lb./A (Active)		Rate for veg. control	Percent stand winter wheat				Percent stand barley			
	Logged rate	Constant rate		Full rate	1/2	1/4	1/8	Full rate	1/2	1/4	1/8
Shell - 7961 1/	6		3	40	90	87	93	50	90	93	100
Dichlobenil 1/	6		3	17	17	70	90	40	70	87	97
Isocil	3		.5	0	10	50	77	0	13	60	90
OMU-EC	6		2/	97	97	100	100	97	100	100	100
Stauffer 3446	10		2/	97	97	100	100	97	100	100	100
Isocil +	3		.5 + 1	0	13	63	83	0	13	70	93
TBA		1									
Fenuron +	3		1.5 + 1	93	97	87	100	83	100	100	100
TBA		1									
Picloram	2		.5	70	90	100	100	60	93	100	100
Weedy check			-	40	46	53	57	50	60	60	67
Cultivated check 3/			-	97	100	100	100	97	100	100	100
Chemical weed-free check 4/			-	100	100	100	100	100	100	100	100

1/ Incorporated with one operation of a double disk immediately after chemical application.

2/ Treatment not effective at rates evaluated.

3/ Cultivated five times during summer fallow season.

4/ Treated with Paraquat at 2 lb/A as needed for vegetation control.

Plant pathogens as a possible factor in unexpected preplant herbicide damage in sugarbeets. Altman, Jack and Ross, Merrill. Soil-borne plant pathogens were suspected of being contributing factors in excessive injury to sugarbeets when normally safe rates of preplant herbicides were used under field conditions. Preliminary greenhouse experiments were undertaken to check this possibility.

Treatments included PEBC at 4.5 lbs/A, Rhizoctonia solani, PCA at 6.5 lbs/A, PEBC plus Rhizoctonia, PCA plus Rhizoctonia. These treatments were applied to both steamed greenhouse soil mix and unsteamed soil from a sugarbeet field. On steamed greenhouse soil, PEBC and PCA caused slight stunting of sugarbeets shortly after emergence without stand reduction. The Rhizoctonia caused appreciable reductions in numbers of sugarbeets. The Rhizoctonia in combination with the herbicides caused even larger stand reductions. In soil from a sugarbeet field the Rhizoctonia was not as pathogenic as in the greenhouse soil mix.

Careful consideration may be warranted when using preplant chemicals on soils known to be heavily infested with soil-borne pathogens. (Dept. of Botany and Plant Pathology, Colorado State University, Fort Collins.)

Table 1. Effect of preplant herbicides and Rhizoctonia on sugarbeets.

	Numbers of Sugarbeets			
	Check	Rhizoctonia	PCA @ 6.5 lb/A	PCA + Rhizoctonia
Untreated field soil	32	19	19	16
Steamed greenhouse soil	30	17	24	7
	Check	Rhizoctonia	PEBC	PEBC + Rhizoctonia
Untreated field soil	55	38	48	34
Steamed greenhouse soil	55	16	45	6

chemicals for

Evaluation of preplant/weed control in field corn. Ross, Merrill. Chemicals for preplant weed control were evaluated in 1962, 1963, and 1964 at Ft. Collins, Colorado. In all tests chemicals were applied broadcast to each plot. One-half of the rows in each plot was incorporated 1.5 to 2 in. deep using a ByeHoe. The chemical on the other half of the plot remained on the surface of the soil. Corn was planted immediately and the plots were watered within three days by furrow irrigation.

EPTC at 2 to 4 lbs/A, EPTC at 2 lbs/A plus 2,4-D at 1 lb/A (Knoxweed), CDAA plus trichlorobenzyl chloride (Randox T) 4 to 8 lbs/A, R-1910, 4 to 8 lbs/A and DATC, 1.5 to 3 lbs/A have performed consistently well for two or more years as preplant soil-incorporated herbicides in corn. Knoxweed, Randox T, and atrazine proved effective against both broadleaf and grass species. R-1910 and EPTC were effective against grasses and redroot pigweed but ineffective against kochia and Russian thistle. DATC was effective against grasses, particularly wild oats.

Chemicals which have not proven consistently effective as preplant soil-incorporated herbicides include CDAA, 2,4-DEP, DCPA, linuron, and 2,4-D.

Dicamba, fenac, and amiben have shown good preemergence activity in the range of 1 to 3 lbs/A against broadleaved weeds without injuring corn. Combinations of these materials with G-14260, R-1910, EPTC, DATC and atrazine in a preliminary test were very encouraging. This year's testing indicates that 2,4-DEP plus dinitro (Falodin) and G-14260 merit further evaluation as preplant soil-incorporated herbicides. Linuron at 2 to 4 lbs/A has proven effective as a directed postemergence material if used when the weeds are less than five inches tall. (Colorado Agricultural Expt. Sta., Colorado State University, Fort Collins.)

PROJECT 6. AQUATIC AND DITCHBANK WEEDS

D. E. Seaman, Acting Project Chairman
(for W. B. McHenry)

Four reports were received, and all were related to control of submersed aquatic weeds.

The first two reports concern low-rate applications of aquatic herbicides to flowing water. Acrolein applied at 1 ppm for 48-hour periods to recirculated water in a test flume facility reduced subsequent growths of treated sago and American pondweeds and the amount of sago pondweed tubers, when compared with untreated control plants. Somewhat similar low-rate applications of the mono-N,N-dimethylalkylamine) salt of endothall gave practical control of sago, leafy, and horned pondweeds in an Idaho irrigation canal. Furthermore, the endothall residue data indicate that the chemical stayed mainly with the treated volume of water, which became spread out and more dilute as it flowed along the canal. While the acrolein tests were conducted on a laboratory scale, actual control of submersed weeds in large canals has been demonstrated with low rates of acrolein applied over long contact periods (personal communication, V. F. Bruns, 1964). We need more work with such practical usage of time vs. concentration relationships, because the low-rate, long-time treatments offer advantages of economy, ease of application, and reduced hazards to fish, wildlife, and irrigated crops.

The contribution regarding evaluation of herbicides in rice fields describes a convenient method for getting performance data for control of some common submersed weeds under field conditions. The results provide information on some new chemicals and formulations which may have application to other aquatic weed problems aside from those in rice fields.

Influence of low-rate acrolein applications on growth and propagule production of pondweeds. Otto, N. E. Greenhouse experiments were conducted to study the influence of low-rate, long contact period treatments on the growth and propagule production of sago pondweed, *Potamogeton pectinatus* L., and American pondweed, *P. nodosus* Poir. Potted cultures of sago and American pondweed were grown, treated, rinsed, and held for observation under flowing water conditions in a test flume facility located in a greenhouse. Water was recirculated through the flume at a rate of 195 gallons per minute from an outside ponded water source, and water temperatures were maintained within a range of 21° to 24°C. Plants were treated at ages of 2, 4, and 6 weeks. Herbicidal treatments consisted of a continuous application of acrolein by a gravity feed system at a rate of 1.0 ppm for a period of 48 hours. Treated water was wasted from the treatment channel, and plants were rinsed for 2 hours following herbicide exposure. Plants were subjected to weekly observational injury ratings for 4 weeks, at which time fresh and dry weights were determined. Determinations were made of number of propagules produced and their fresh and dry weights. Estimates were made of rates of plant regrowth during the course of the study. Untreated plants were utilized for comparative standards. Resulting data were analyzed for statistical significance.

Dry weight determinations given in Table 1 indicate a significant difference between treated and untreated plants, but the weight varied with respect to plant age at treatment. Tested American pondweed exhibited an increase in plant weight with increased age; whereas, treated sago pondweed showed no significant change in plant dry weight with increased age.

Table 1. Mean dry weights (grams) of pondweeds 4 weeks after low-rate acrolein treatment *

Plant age at treatment	Sago pondweed		American pondweed	
	Untreated	Treated	Untreated	Treated
2 weeks	0.553	0.251	0.674	0.106
4 weeks	0.611	0.232	0.779	0.163
6 weeks	0.855	0.198	0.935	0.425

* Mean dry weights of treated and untreated plants are significantly different at the 1% level on 15 d.f. All other differences are significant at the 5% level, excepting the age comparisons of treated sago pondweed.

Sago pondweed tuber production was significantly reduced by the low-rate acrolein treatments, as compared to that produced by untreated plants. An age relationship was apparent, as shown in Table 2. Plants treated at the 2-week stage produced no propagules, while a continued increase was evident as the plants aged. Propagule production data on American pondweed were not obtained due to lack of propagule development. Observational injury and regrowth estimate ratings obtained over the 4-week rating period, combining 2-, 4- and 6-week plants, showed that maximum injury was evident on sago pondweed during the first week following treatment with a slight negative regression as time progressed. American pondweed showed a steady increase of injury symptoms up to the 4-week harvest period. Regrowth rate estimates of both species indicate a curvilinear regression trend with a sharp upturn at the 3- to 4-week period.

Table 2. Sago pondweed tuber production of plants harvested 4 weeks after low-rate acrolein treatment.

Plant age at treatment	Mean number of tubers per culture pot		Mean dry weight per tuber, mg	
	Untreated	Treated	Untreated	Treated
2 weeks	6.0	0.0	0.045	0.0
4 weeks	8.0	1.0	0.043	0.008
6 weeks	9.5	4.2	0.044	0.013

* Means differ significantly at the 5% level, excepting mean dry weight of untreated tubers.

Additional greenhouse studies are underway to further assess and describe the influence of low-rate treatments of acrolein and other contact herbicides in suppressing the growth of pondweeds. (Contribution of Division of Research, Office of Chief Engineer, Bureau of Reclamation, U.S. Dept. of the Interior, in cooperation with the Crops Research Division, Agricultural Research Service, U.S. Dept. of Agriculture, Denver, Colorado.)

Hydrothol 191 as an aquatic herbicide in flowing water. Bowles, E. J., Keckemet, O., Boyle, W. D., and Finkelnburg, D. E. Troublesome submersed aquatic weeds, particularly *Potamogeton pectinatus*, *P. foliosus*, and *Zannichellis palustris*, were controlled in Idaho with Hydrothol 191 from a single point of application in an irrigation ditch 24 miles long. Two applications were made in the summer of 1964 in the same canal under similar conditions. In the first application Hydrothol 191 (mono-N,N-dimethylalkylamine salt of endothall) was applied to a 106 cfs canal at 15 ppm for 1 hour on June 16; the water was flowing approximately 1 mile per hour. Immediate control was observed in the first 10 miles, while the lower half of the canal did not exhibit control until after about 21 days.

By August 7, seven weeks later, control measures were necessary in the upper 10 miles, while the lower half was still showing good control. Because of the better control observed from longer exposure to a lower concentration in the lower half of the canal, the second application was made at 3 ppm for 3 hours to a flow of 97.6 cfs. This effected good control for the remainder of the season in the upper half while little or no change was observed in the lower half where little regrowth had occurred.

Samples for residue analysis were taken during the second application at 5-mile intervals downstream from the point of application; they were timed to begin approximately one hour prior to the arrival at each point of the dye marking the application. (Southwestern and Northwestern Technical Supervisors, Pennsalt Chemicals, Fresno, California, and Tacoma, Washington, and Bureau of Reclamation, Boise, Idaho, respectively.)

Concentration of Hydrothol 191 (ppm ae) in canal at milepoints downstream

Hours after arrival of dye	Location					
	Head	1 mi	5 mi	10 mi	15 mi	20 mi
0	0.25	1.50	0.25	0.25	2.00	0.04
1	4.00	1.75	0.25	1.00	1.00	0.10
2	2.00	1.50	1.50	1.50	0.20	0.40
3	1.50	1.00	1.00	2.00	0.10	1.00
4	1.50	1.75	1.00	1.50	0.01	1.00
5		0.04	0.60	0.30	0.01	3.00
6		0.02	0.10	0.10		1.00
7			0.02	0.10		0.50
8						0.10
9						0.02
10						
11						0.01
12						0.007

Evaluation of aquatic herbicides in rice fields. Seaman, D. E. A program was initiated in 1963 to evaluate a number of herbicides for control of submersed aquatic weeds in rice. A handy small plot technique was developed to conduct these tests under rice field conditions. Sheet aluminum rings, 3 ft in diameter and 14 in high, were placed among uniform stands of submersed weeds (southern naiad, American pondweed, or chara) to enclose 8 sq ft plots of both rice and weeds in flooded (4 to 10 in deep) fields. Treatments were made 30 to 40 days after the rice was sowed when most of the weeds were mature. Granular formulations were applied by hand, and liquid or powdered formulations were applied as aqueous sprays by hand sprayer at 10 gpa to simulate aerial applications. Visual ratings of weed kill were made at two-week intervals for at least 6 weeks after treatment. In areas where the rice was uniform enough to give meaningful data, rice injury ratings were also made, and the rice was harvested at maturity for yield data as well.

Among the 23 formulations tested in 1963, the following gave good control of southern naiad at 2 or 4 lb/A without injuring rice: granular mono-(N,N-dimethylalkylamine) salt to endothall, granular di-(N,N-dimethylalkylamine) salt of endothall, granular sodium salt of endothall, a granular mixture of the potassium salts of endothall and silvex, and a powdered copper salt of endothall. Corresponding liquid formulations of the granular endothall formulations, as well as diquat and mono-(N,N-diethylalkylamine) ester of MCPA, gave good weed control but injured the rice. The others, including many that performed well against similar weeds in previous jar tests, gave inconsistent results or were ineffective, presumably because their activities were affected by environmental factors that may have been different or absent during the jar tests.

The granular mono-(N,N-dimethylalkylamine) salt of endothall was reevaluated together with 30 new herbicides in 1964. This formulation again gave outstanding control of southern naiad as well as of American pondweed, which was the main weed in two of the 1964 test areas (Table 1). Among the others tested, a new copper salt of endothall; 2-amino-3-chloro-1,4-naphtho-quinone (I); 4,5,7-trichlorobenzthiadiazole-2,1,3 (II); and chloroxuron were particularly promising, since they affected both of the vascular submersed weeds and chara. Control of chara at 2 or 4 lb/A (1 to 3 ppm in the water) is remarkable with any herbicide, and these also appeared to kill nitella, another stonewort alga that was present in one of the tests. Fenac injured the rice severely at 4 lb/A, but it gave slow but excellent control of the vascular weeds at both 2 and 4 lb/A with no effects on chara. Several of these herbicides also reduced the formation of American pondweed winter buds in the soil as shown in Table 2.

Also tested, but not shown in Table 1, were granular 2,4-dichlorophenyl-4-nitrophenyl ether (III); two algicides, dehydroabietylamineacetate (IV) and a 40:10 mixture of methyldodecylbenzyl- and methyldodecylxylene-bis-trimethylammonium chlorides (V); seven fungicides (dichlone, difolatan, maneb, nabam, thiram, zineb, and ziram); and 13 experimental chemicals. Granular III gave partial and belated control of southern naiad at 4 lb/A. Algicide IV was ineffective on American pondweed and chara, but it injured rice slightly at 3 lb/A, and algicide V was totally ineffective. All the fungicides were harmless to both weeds and rice at 2 and 4 lb/A, as were most of the experimental chemicals. Three of the latter (CIBA C-2059, CIBA C-3126, and Ortho 831) severely injured rice at 3 lb/A, but Velsicol OCS-21799 gave good control of American pondweed without injuring rice at 3 lb/A.

Further work is in progress with the granular mono-(N,N-dimethylalkylamine) salt of endothall, I, II, and chloroxuron to develop safe and effective procedures for their use in rice fields, reservoirs, and other ponded waters. (Department of Botany, Univ. of California, Davis.)

Table 1. Partial summary of 1964 aquatic herbicide test results

Herbicide	Rate lb/A	Percent weed control American pondweed	So. naiad	chara	Percent rice injury	Rice yield (cwt/A)
Mono-(N,N-dimethylalkyl-	2	100	90	0	0	51
amine salt of endothall	4	100	100	0	0	52
Copper salt of endothall	2	100	100	0	0	45
	4	100	100	70	0	45
2-amino-3-chloro-1,4-	2	50	-	90	0	49
naphthoquinone	3	80	100	100	0	46
	4	70	-	100	0	50
4,5,7-trichlorobenzthia-diazole-2,1,3	3	70	70	100	0	48
Chloroxuron	2	90	-	-	-	-
	3	100	100	100	10	47
Sodium salt of fenac	2	90	90	0	20	40
	4	90	90	0	80	13
Untreated check	-	0	0	0	0	36

Table 2. Reduction of American pondweed winter bud formation

Herbicide	Rate lb/A	Percent Control 2-wk	7-wk	Buds per sq.ft.	Percent reduction
Mono-(N,N-dimethylalkyl-	2	100	90	2	97
amine salt of endothall	4	100	90	3	95
Copper salt of endothall	2	100	90	3	95
	4	100	90	1	98
Chloroxuron	3	100	100	1	98
Sodium salt of fenac	2	10	100	2	97
	4	30	100	0	100
Untreated check	-	0	0	58	0

Preliminary results of dormant cane spray treatment for control of saltcedar (Tamarix pentandra Pall.) on ditchbanks. Hughes, Eugene E. Applications of 4, 8, and 16 lb/aehg of the PGBE ester of silvex in diesel oil were made to 30-ft-long plots of dormant saltcedar on January 28, 1964. A high-pressure sprayer with an orchard gun nozzle was used, applying the spray to one side of the trees as the vehicle moved parallel to the plot. Two spraying pressures, 100 psi and 200 psi, were compared; all treatments were replicated twice. Evaluations were made on September 27, 1964, in two successive 4-ft bands, measured from the point of application. Actual amount of oil and herbicide used, percentage of plants killed by replication, and of cost per mile of 100% dense trees are shown in Tables 1, 2, and 3.

Statistical analysis showed no significant difference in percentage of effectiveness as a result of spraying pressure. The 8- and 16-lb/aehg rates were significantly better than 4 lb/aehg. Very few dead plants were noted past the 8-ft distance. Results indicate that 8 lb/aehg of silvex PGBE ester at 100 psi spraying pressure will control saltcedar on ditchbanks effectively at a cost of approximately $117.00 per mile of 100% dense trees.

The lower cost of treatments at 200 psi at 8 lb/aehg versus 100 psi, as contrasted with higher costs at 200 psi at the 4- and 16-lb rates, was probably due to the thick stand on the 200-psi plots, which required less spraying for coverage than the thinner stand on the 100-psi plots. (Crops Research Division, Agricultural Research Service, U.S. Dept. of Agriculture and New Mexico Agricultural Expt. Sta., cooperating, Los Lunas, New Mexico)

Table 1. Actual output of diesel oil and herbicide at different rates and pressures as applied to saltcedar plots for control.

Feet out of 60 ft 100% dense trees	Rate lb aehg	Spraying pressure psi	Application time min:sec	Output of oil* gal	Output of herbicide cc
45	4	100	2:06	2:10	79.8
37	4	200	2:02	2.96	112.5
41	8	100	2:27	2.45	186.2
53	8	200	2:09	3.14	238.6
54	16	100	2:08	2.13	323.8
49	16	200	2:15	3.29	427.1

* 100 psi - 1.0 gal/min; 200 psi - 1.46 gal/min.

Table 2. Results of dormant cane spraying with the PGBE ester of silvex for control of saltcedar. Plots were sprayed January 28, 1964, and results evaluated September 27, 1964.

Rate lb aehg	Spraying pressure psi	Percentage of plants killed Rep 1 1st 4 ft	2nd 4 ft	Rep 2 1st 4 ft	2nd 4 ft	Average
4	100	87.5	84.0	79.6	41.5	73.1
4	200	75.0	71.4	84.2	80.3	77.7
8	100	100.0	100.0	100.0	80.0	95.0
8	200	92.8	93.3	81.8	80.0	87.0
16	100	94.4	87.5	100.0	94.6	91.6
16	200	100.0	100.0	88.9	93.7	95.6

Table 3. Cost of dormant cane treatments, excluding labor, for control of saltcedar.

Rate lb aehg	Spraying pressure psi	Cost of diesel oil*	Cost of herbicide**	Total cost	Feet of plot treated	Cost per mile of 100%
4	100	$0.273	$0.25	$0.52	45	$ 61.01
4	200	0.273	0.36	0.74	37	105.60
8	100	0.318	0.59	0.91	41	117.19
8	200	0.408	0.76	1.17	53	116.56
16	100	0.106	1.03	1.19	54	116.36
16	200	0.428	1.35	1.78	49	191.80

* Diesel oil at $0.13/gal.
** Herbicide at $12/gal.

PROJECT 7. CHEMICAL AND PHYSIOLOGICAL STUDIES

L. S. Jordan, Project Chairman

Summary

Abstracts were received from several experiment stations for publication in this Section. A wide range of subjects is covered. Results are briefly summarized as follows: 1. Distribution of C^{14} from labeled herbicides in Canada thistle was: a) 2,4-D-C^{14} and 2,4-DB-C^{14} move primarily toward the roots; b) amitrole-C^{14} accumulated in young leaves, shoots, and root tips; c) dicamba-C^{14} was evenly distributed, accumulated in growing point and adjacent leaves, and leaked into nutrient solution; d) roots and shoots of susceptible ecotypes were more heavily labeled with 2,4-D-C^{14}. 2. The presence or absence of sucrose in nutrient media did not affect uptake of 2,4-D in leaf discs of Canada thistle but had a marked influence on the extractability of the herbicide. 3. Tritac, dicamba, picloram, and 2,4-D reduced stem tissue growth more than root tissue growth of bindweed, but 2,4,5-T was more effective on the root tissue. 4. The C^{14} from 2,4-D-1-C^{14} was not found in microsomes of bindweed plants. 5. Dicamba undergoes an extensive metabolism in wheat plants which is more than simple conjugation. Fifty percent was altered in two days, with little or no unaltered herbicide remaining after two weeks. 6. Protein synthesis in barley and sesbania was inhibited by CDAA and CIPC. Amino acid uptake was inhibited by PCP, ioxynil, and endothal. 7. Carrot tissues, in amiben-C^{14} solutions, altered 81.3 percent of the herbicide in six days. Four percent was released as $C^{14}O_2$, 64.3 percent was in a compound which may contain a sugar moity, and 11.8 percent was in 4 other unknown compounds. 8. Volatility of isopropyl 2,4-D under field conditions decreased with time after treatment because the remaining herbicide was in a more strongly bound state. 9. High rates of herbicides were found to increase or decrease oxygen uptake of a mixed microbial culture growing on extract similar to soil. 10. PCP influenced the ATP levels in cichlids and goldfish. Changes in ATP level varied with exposture, preconditioning, and exercise schedule. 11. Investigations, *in vitro*, of factors responsible for initiation of shoot primordia from undifferentiated tissue of woody plants are being started in the Agronomy Department of the University of California..

<u>The distribution pattern of 2,4-D-C^{14}, 2,4-DB-C^{14}, amitrole-C^{14} and dicamba-C^{14} in four ecotypes of Canada thistle.</u> Smith, Leon W. Four ecotypes of Canada thistle, YM, AI, G4 and FM obtained from Montana were established from root cuttings and when 2 to 3 inches tall were transferred to quart Mason jars containing IX Hoaglands solution. The plants were grown for 2 to 3 weeks and when the tallest plant (G4) was 6 to 8 inches high applications of 2,4-D-C^{14}, 2,4-DB-C^{14}, amitrole-C^{14} and dicamba-C^{14} were made in lanolin rings on the fourth fully developed leaf of each plant. After 4 days the plants were harvested, freeze-dried and subsequently mounted on paper, pressed and exposed to x-ray film by established methods.

The autoradiographs obtained, showed the following visual distribution patterns of C^{14} from applications of the various herbicides.

2,4-D-C^{14}. The distribution pattern observed was similar to that in many other plants. The major movement was towards the roots but slight movement to the shoot did occur. The roots and shoot of the ecotype FM were more heavily labeled than the G4 ecotype, YM and AI being intermediate. This observation is in agreement with susceptibility ratings established for these ecotypes in greenhouse trials at Davis.

2,4-DB-C^{14}. Translocation and distribution of the C^{14}-label was accumulation of C^{14}-label in young leaves, shoots and root tips, however, no differences were observed between the four ecotypes.

Dicamba-C^{14}. The C^{14}-label was evenly distributed throughout the whole plant except in the growing point and adjacent leaves where accumulation had occurred. Leakage of dicamba-C^{14} was indicated by the presence of C^{14} in the nutrient solution. No differences in distribution was observed between the 4 clones.

A similar trial using amitrole-C^{14} and dicamba-C^{14} was carried out using a droplet of benzyladenine solution placed in a lanolin ring three leaves removed from the herbicide treatment. There was no evidence of preferential movement towards or accumulation in, the benzyladenine treated spot. (Department of Botany, University of California, Davis.)

The influence of sucrose on the release of 2,4-D from leaf discs of Canada thistle. Whitworth, J. W., and Tolman, K. B. Leaf discs were cut from three strains of Canada thistle, those susceptible, intermediate, and resistant in their reaction to the herbicide. The discs were incubated in Bonner's Improved Nutrient Solution containing 2,4-D-1-C^{14}. Two solutions were run in parallel, one being mixed with and one without sucrose. After incubation, the discs were removed and extracted with ethanol. The uptake of herbicide was measured by counting the residual radioactivity left in the nutrient and by counting the ethanol extracts of the leaf discs.

The nutrient showed a loss in activity ranging from 30 to 60%; there were no significant differences in uptake between the strains. The ethanol extractions of the leaf discs which had been incubated in solution containing sucrose showed a percentage uptake of 5 to 15%. The extractions of the discs incubated in solution without sucrose showed no activity. In both cases, the leaf discs after removal from ethanol showed definite radioactivity indicating the continued presence of the herbicide or its metabolized by-products. Further attempts were made to extract the radioactive material with acetone and dimethylsulfoxide; there were unsuccessful.

The presence of absence of sucrose in the nutrient did not affect the uptake of the herbicide, but showed a marked influence on the extractibility of the herbicide from leaf tissue. (New Mexico State University, Agricultural Expt. Sta., University Park, New Mexico.)

Toxicity of herbicides to isolated bindweed root and stem tissue. Whitworth, J. W., and Welsh, Mary Anne. Five herbicides were tested against bindweed stem and root sections growing separately in a nutrient solution containing the herbicides--Banvel D, Tritac, 2,4-D, Tordon, and 2,4,5-T. Rates of concentration used were 0.1, 0.5, and 1.0 ppm with untreated checks included for each herbicide at each rate. The data for the 0.1 and 0.5 ppm concentration are reported in Table 1.

Table 1. Stem and root growth of isolated bindweed tissue cultures expressed as a percentage of the untreated check.

	0.1 ppm		0.5 ppm	
Herbicide	Stem	Root	Stem	Root
2,4,5-T	100	19	29	8
Tritac	82	83	57	39
Dicamba	15	72	0	50
Tordon	15	61	0	7
2,4-D	15	26	0	7

(New Mexico State University, Agricultural Expt. Sta., University Park, New Mexico.)

Radioactivity from foliar applied 2,4-D-1-C^{14} not associated with microsomes. Whitworth, J. W., McCaw, L. B., and Welsh, Mary Anne. In last year's report, water extracts of bindweed plants treated with foliar application of 2,4-D-1-C^{14} showed the highest radioactivity in the centrifuged fraction containing microsomes and cell spun out at 90,000 x g. With the acquisition of a higher speed centrifuge, the microsomes were spun out at 100,000 x g. Radioactivity was not associated with the microsomes, but remained with the supernatant fluid and cell sap. Other workers have shown that the supernatant fractions centrifuged from homogenized apple leaves at 105,000 x g. were high in RNAase, an enzyme thought to be important in the formation as well as the degradation of RNA. (New Mexico State University, Agricultural Expt. Sta., University Park, New Mexico.)

The metabolism of dicamba (2-methoxy-3,6-dichlorobenzoic acid by wheat plants. Montgomery, M. L., Freed, V. H., Broadhurst, N. and Holcombe, E. The metabolism of dicamba by wheat plants was investigated to determine if the tolerance of this plant to dicamba might be due to detoxification of the compound. Wheat plants were exposed to C^{14}-labeled herbicide through a nutrient medium for four days. After this exposure, the plants were transferred to non-treated nutrient and extracted with 95% ethanol after varying periods of time. Chromatography of the extracts indicated rapid metabolism of the herbicide was occurring. Two days following removal of the treated nutrient, approximately 50% of the C^{14} label was in compound other than free dicamba. At the end of fourteen days following exposure there was little, if any, unaltered herbicide in the plants

Since organic acid herbicides such as 2,4-D are known to be conjugated by plants, the first attempt to characterize the metabolite was by hydrolysis to release any complexed herbicide. Thus, the alcohol extracts were hydrolyzed under alkaline or acid conditions and extracted with benzene to remove liberated herbicide. Analysis of the extracts showed that dicamba does undergo conjugation. However, after two to three weeks, very little herbicide is released by hydrolysis, showing that the metabolism of this compound is more than simple conjugation. The R_f value of the metabolite does change after hydrolysis, which indicates the metabolite is susceptible to degradation by the hydrolysis treatment, or that the metabolite is also conjugated by the wheat plant. The unextractable radioactivity in the wheat plant also demonstrates extensive metabolism of the herbicide. Twenty-four days following treatment, twenty percent of the radioactivity in the plants is insoluble in 95% ethanol. (Oregon Agri. Expt. Sta., Oregon State University, Corvallis.)

Inhibition of protein synthesis by several herbicides. Mann, Jay D., Jordan, L. S., and Day, B. E. By use of radioactive leucine-1-C^{14}, the rate of protein synthesis was measured in excised barley coleoptiles and Sesbania stems. Twenty-two herbicides were tested at 2 and 5 ppm levels. Protein synthesis was meaningfully inhibited only by 5: pentachlorophenol, ioxynil, endothal, CDAA, and CIPC (plus related carbamates). The inhibition of synthesis caused by the first 3 herbicides was, however, due to inhibition of amino acid uptake. CDAA and CIPC inhibited protein synthesis much more than they inhibited amino acid uptake. (Dept. of Horticultural Science, University of California, Riverside, California.)

Fate of amiben-C^{14} in carrots. Ashton, Floyd M. Carrot seeds were planted in soil treated with amiben-C^{14} at the rates of 3 and 6 lb/A. Plants were harvested after 69, 103, and 191 days. These plants were autoradiographed and the amount of radioactivity present was determined in an 80-percent ethanol extract and in the nonsoluble fraction. The autoradiographs showed that the highest concentration of radioactivity was on or very near the surface of the roots, however, some radioactivity was found distributed uniformly throughout the leaves and roots. The quantitative data indicated that the concentration of radioactivity decreased with time in the extract and residue fraction of the root; whereas, it decreased in the residue fraction and increased in the extract fraction of the leaves.

Disks of carrot root tissue were placed in an aerated solution of amiben-C^{14} and after 6 days the amount of $C^{14}O_2$ released and other compounds formed was determined. Only 18.7 percent of the applied amiben was unaltered during this period. About 4 percent was released as $C^{14}O_2$, 64.3 percent was present in an unknown compound which may contain a sugar moiety, and the remaining 11.8 percent was distributed between 4 additional unknown compounds. (Department of Botany, University of California, Davis.)

The volatility of isopropyl 2,4-D under field conditions. Vernetti, J. B., and Freed, V. H. One hundred acres of sagebrush was sprayed with two pounds of isopropyl ester per acre to determine the relative rate of air contamination due to volatilization of this herbicide. Air samplers were located on the sprayed area and downwind from the treated area to determine dilution of the vapors with air movement. The concentration of ester was measured at a height of three feet above the ground. A four-day sampling program was started the morning following a late afternoon application of ester.

Analysis of the air samples revealed the presence of the ester in the air at all stations downwind from the spray site. The distances of the samplers were 3/4 to 1-1/2 miles from the site as determined by the wind course. Examination of data showed that the dilution (reduction of concentration of ester in the air) was 20%/mile for a 10 m.p.h. and 13%/mile for a 6 m.p.h. wind. The dilution was found to be increased 2 to 6% for a 1-1/2 mile distance due to higher vertical displacement of air caused by striking a bluff 80 feet high, 1/2 mile downwind from the spray site. Inversion effects were not investigated due to adverse weather conditions and lack of means to measure the effect.

The relative rate of evaporation from the field was calculated from the spray-site air samples and corrected to zero wind velocity. The rates are shown in the following table:

Days after spraying	Ave. soil temp. ^{o}F	% soil moisture	Mg. ester/hr/100 M^3 air at 0 wind velocity
1	72	6.7	106.0
2	59	18.5	58.5
3	84	12.0	18.7
4	79	7.2	14.5

A heavy rain fell during the late afternoon and night of the first day's sampling so that the chemical was most likely washed off the sagebrush and onto the soil. Since the soil was found to be highly adsorbent to the ester and thus would lower the rate of volatility, it was concluded that the diminishing concentration of ester in the air for the second and third days were due to this factor. The apparent slower rate of decline indicated by the fourth day shows the effect of vaporation from soil colloids and pores since there would be a higher proportion of the chemical left in this more strongly bound state than the more loosely bound ester evaporated in the first two days. The effect of steam distillation and higher soil temperatures on the third day did not produce an increased rate of volatility as would be expected. This latter indicates again the effect of soil porosity on volatility. (Oregon Agricultural Expt. Sta., Oregon State University, Corvallis, Oregon.)

The influence of herbicides on soil metabolism. Whitworth, J. W., Garner, W., and Williams, B. C. Professor Clark of New Mexico State University has developed a method for determining the oxygen uptake of large inhomogenous biological samples. This method was used in determining the effect of environmental contaminants such as herbicides on the oxygen metabolism of a native, mixed microbial culture growing on an extract similar to that found in enriched soil. The effects of Atrazine, diuron, picloram, Prefar and trifluralin were tested on the extract. In addition, trifluralin was tested on Amarillo fine sandy loam.

At 80 ppm (approximately equal to 8 times normal field use), Atrazine and diuron caused a slight depression of oxygen uptake. Picloram at 240 ppm increased oxygen uptake approximately 20 percent and at 480 ppm caused a 60 percent decrease. Prefar at 240 - 960 ppm showed an ultimate increase of 200 percent; even at a low rate of 48 ppm, an increase of 20 percent was apparent. Trifluralin at 480 and at 960 ppm showed an initial sharp increase in oxygen uptake followed by a sharp depression to more than 40 percent below the check.

When applied to Amarillo fine sandy loam, trifluralin at 150 ppm caused a depression of approximately 20 percent in oxygen uptake whether or not cellulose was added as a substrate.

Further tests should establish if the Clark method can be used as a rapid test to determine the influence of herbicides on gross metabolism in soils. (New Mexico State University, Agricultural Expt. Sta., University Park, New Mexico.)

Biochemical effect of pentachlorophenol in fish. Freed, V. H., Cheng, J. T., and Lu, S. D. Pentachlorophenol (PCP) is widely used both as a pesticide and as a preservative. The nature of its use is such as to raise the possibility of its contamination to water.

Since PCP is known as a strong uncoupler of oxidative phosphorylation, it was decided to study the effects of the chemical on energy relationship and on selected enzymes in the fish tissue. Fish were exposed to varying sublethal and lethal levels of PCP, as the potassium salt, under normal and stressed conditions for varying lengths of time. Fish then were taken, sacrificed, scales and fins removed and analyses for ATP performed. For the analyses on selected enzymes, the fish tissues were prepared as an acetone powder.

In these studies, the juvenile stage cichlids *Cichlasoma bimaculatum* and 6" - 7" long goldfish *Carassius auratus* were used as the experimental subjects.

The fish after 24 hours' exposure to a sublethal concentration, 0.2 ppm (7.5×10^{-7} M) of PCP had an ATP level slightly higher than the controls and after 48 hours' exposure, the ATP level dropped 18%. After 25 days exposure at 0.2 ppm, the surviving fish had only 45% as much ATP as the control. The fish surviving 24 hours' exposure to a lethal dosage of 0.24 ppm (9.0×10^{-7} M) or 0.3 ppm (1.1×10^{-6} M) of PCP had a much depressed ATP level. Cichlids were exposed to 0.1 ppm (3.8×10^{-7} M) PCP for 30 and 60 days. At both times, their ATP levels were depressed. The ones at 60 days exposure showed only 19% less of ATP and 30 days exposure displayed 46% less of ATP when compared to normal fish. It indicated that upon longer exposure, the enzyme activity established an adaptation to the environmental insult.

Unexposed fish, exercised a few minutes at high speed, displayed no appreciable change in ATP level. However, when the unexposed fish performed under high speed over a long period of time, there was a drop of 30% in ATP level. When the untreated fish, acclimatized over night, were required to swim at high speed for 3 hours, the ATP level was 48% higher than the short term exercised ones. This suggested that the organism adapted its metabolism to provide a higher energy supply under exercise conditions.

Under 30 days exposure to 0.1 ppm PCP, the exercised fish showed 136% increase of ATP compared to the non-exercised ones. At the same concentration with 60 days exposure, the exercised fish had only 60% increase of ATP. At 0.1 ppm of PCP without exercise, exposed for 60 days, exhibited 51% increase of ATP compared to those having 30 days exposure. There was no difference in the amount of ATP when both 30 and 60 days exposure at 0.1 ppm were all exercised 3 hours in full speed.

The effect of KPCP on enzymes; aldolase, lactic dehydrogenase (LD), glutamic-oxaloacetic transaminases (GOT), glutamic-pyruvic transaminase (GPT) and isocitric dehydrogenase (ICD) in fish tissue were studied, both in vivo and in vitro. In vitro studies revealed that these enzymes were highly susceptible to inhibition by high concentrations of PCP. In vivo, the activity of aldolase and GOT were stimulated at 0.1 ppm KPCP with 24 hours exposure and for GPT at 0.1 ppm KPCP with 96 hours exposure. The activity of aldolase was rapidly decreased at 0.2 ppm KPCP with increasing time of exposure. Aldolase showed 53.1% inhibition at 96 hours exposure while the activities of GOT and GPT reached maximum inhibition of 30.6% at 24 hours exposure and 34% at 48 hours exposure respectively. For LD, an inhibition of 7% was found at 0.1 ppm KPCP upon 24 hours exposure and a maximum inhibition of 17.4% was found at 0.2 ppm KPCP with 48 hours exposure.

In goldfish muscle, at 0.1 ppm KPCP, the percentage of stimulation was 6.4% for aldolase, 28.2% for GOT and 8.6% for LD. The percentage of inhibition was 40.0% for aldolase, 49.3% for GOT and 29.5% for LD when fish were exposed to 0.4 ppm KPCP. For GPT, the percentage of inhibition was 9.7 at 0.1 ppm and 70.9 at 0.4 ppm KPCP. They were all exposed for 4 days.

The results showed that there was a dual effect of KPCP, producing both stimulation and inhibition on these enzymes. (Oregon Agricultural Expt. Sta., Oregon State University, Corvallis.)

Studies in the physiology of sprouting in undesirable woody plants. Goodin, J. R. Experimentation has been initiated to study the fundamental processes leading to organ differentiation and subsequently to the initiation of sprouting following cessation of top growth in woody plants. The objective of these studies is to investigate in vitro those factors responsible for the initiation of shoot primordia from an undifferentiated tissue growing on sterile medium. Most of our experiments have been involved in attempting to develop a suitable medium for growth of the callus culture of *Salvia mellifera*, *Salvia apiana*, *Quercus dumosa*, *Adenostoma fasciculatum*, *Artostaphylos glauca*, and *Arctostaphylos glandulosa*.

Primary emphasis is being devoted to hormonal and environmental relationships. Several experiments have emphasized light-kinetin interactions; *Salvia mellifera* callus tissue can tolerate a higher concentration of kinetin in darkness than in light.

It would appear that explants taken from field conditions have the greatest capacity for achieving an optimal growth rate and differentiating organs at the height of the growing season. Later in the season, this capacity decreases and we have not been able to differentiate shoots or roots on tissues obtained during the dormant season (summer and fall in the Mediterranean climate). (Dept. of Agronomy, Univ. of California, Riverside.)

Morphological responses of barnyardgrass and rice to ethyl-1-hexamethyleneiminecarbothiolate. Chen, T. M., Seaman, D. E., and Cutter, Elizabeth G. Ethyl-1-hexamethyleneiminecarbothiolate (I) is a very promising new herbicide for control of grassy weeds in rice. Other workers have found that pre- and post-flooding applications of granular I at 3 lb/A have given excellent control of barnyardgrass and red sprangletop, and applications at rates as high as 12 lb/A did not injure rice.

In greenhouse studies, time of application was very important to the performance of the herbicide. Barnyardgrass was killed in flooded pots of soil by granular I at 3 lb/A applied 3 or 8 days after sowing, when the plants were 0.5 and 3 cm high, respectively. Similar applications when the plants were larger (after 13 and 18 days) were ineffective, and rice was not affected at any of the treatment times under similar conditions. Foliar applications of the liquid formulation of I to 12-day old barnyardgrass caused no injury at 0.5 lb/A, but injury symptoms increased with higher rates from 1 to 8 lb/A. Typical symptoms were longitudinal rolling of emerged leaves, and deformed growth of new leaves whose expansion was restricted by the older leaves. Affected plants remained green without further growth for nearly two months.

Barnyardgrass planted in soil containing 3 ppm of I developed different injury symptoms. Seedlings sprouted, but they did not grow more than 2 or 3 cm high. Separations of the primary leaf inside the coleoptile were typically observed as were lateral ruptures of the coleoptile by deformed green tissues. Histological examination of treated seedlings revealed that these leaf separations occurred 3 or 4 days after sowing, and that the breakage was localized in the zone of the shoot apex. The breakage appeared like a transverse tear resulting from the continued elongation of the coleoptile, to which the leaf tip adhered, after the apical meristem had ceased to grow. If the leaf broke above the shoot apex, continued growth of the leaf intercalary meristem ruptured the side of the coleoptile, but if the break occurred below the shoot apex, this structure became separated from the rest of the seedling and no further growth occurred.

These morphological responses are being studied in relation to physiological effects of I to get a better understanding of its mode of action and basis of selectivity in control of barnyardgrass in rice. Comparisons will be made with the somewhat similar effects of EPTC. (Dept. of Botany, Univ. of Calif., Davis.)

Accurate application of granular aquatic herbicides. Culver, Andrew J. The increased manufacture and use of granular aquatic herbicides necessitated development of an accurate application system for use in testing these materials. A boat-mounted, draper-type spreader was developed and used for 2 years in aquatic herbicide tests.

The system consisted of 3 parts. (1) A vehicle suitable for carriage of the equipment, i.e. a boat, (2) a device capable of pulling the boat along a cable through and across the area to be treated, and (3) a spreader with a positive delivery which would accurately meter the granular herbicide onto the treated area.

The basic and most important idea espoused by this paper is that of establishing with the pulling cable an artificial ground by which the spreader could be driven. Thus, when the boat pulls itself along the cable, the spreader is operated with a mechanical link to the area covered, eliminating any guess-work as to the amount of herbicide applied per unit area treated. (Plant Pathologist, USDA, ARS, Pesticides Regulation Div., Cordley 116, Corvallis, Oregon.)

AUTHOR INDEX

AUTHOR INDEX (continued)

Page No.

CHEMICAL INDEX

HERBACEOUS WEED INDEX

HERBACEOUS WEED INDEX (continued)

Page No.

* Tansy ragwort is included in this group; however, the correct scientific name should be *Senecio jacobaea*.

WOODY PLANT INDEX