RESEARCH PROGRESS REPORT

AND ABSTRACTS

Western
Weed Control
Conference

1966

Research
Committee

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PREFACE

This is the 1966 Annual Progress Report of the Research Committee of the Western Weed Control Conference. It includes abstracts and summaries of research conducted throughout the conference area the past year or two. There also is a section "Abstracts of Papers Presented."

The Research Committee is organized into seven projects each having a Chairman. Due to the limited time available for compiling the Progress Report it was impossible for authors, Project Chairmen, and the Secretary to consult. Questions of clarity and context, assembly of reports, and summaries were taken care of by the respective Project Chairman.

The cooperation of the Project Chairman and research workers of the Western Weed Control Conference, in making this report possible, is greatly appreciated.

Harold P. Alley
Secretary, Research Committee
University of Wyoming
Laramie

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PROJECT 1. PERENNIAL HERBACEOUS WEEDS

D. E. Bayer, Project Chairman

SUMMARY

Nineteen reports were submitted on fourteen perennial weed species from four states. Major emphasis was on Canada thistle, field bindweed, and leafy spurge. Picloram and dicamba received considerable testing. Increasing emphasis was placed on soil residual characteristics of the herbicides used in these studies.

Briefly the reports are summarized as follows:

Canada thistle (Cirsium arvense). Colorado and Wyoming reported picloram gave excellent control. Emphasis was given to soil residual problems.

Field Bindweed (Convolvulus arvensis). Several herbicides were tested with varying results. Picloram showed extreme promise.

Leafy spurge (Euphorbia esula). Evaluation on several herbicides were made for the control of leafy spurge and their effect on associated grass species was noted.

Milkweed (Asclepias sp.). Reports indicated that these species may have some resistance to picloram and dicamba but repeated treatments may hold some promise. Several soil sterilants were evaluated.

White top (Cardaria draba) and Perennial peppergrass (Lepidium latifolium). Picloram, dicamba, and 2,4-D were not effective for the control of these species.

Field Horsetail (Equisetum arvense). Dichlobenil and bromocil gave good control of field horsetail but had high soil residual.

False Hellebore (Veratrum californicum). Of the several herbicides tested 2,4-D gave the best control.

Russian knapweed (Centaurea repens), Povertyweed (Franseria sp.), and Toadflax (Linaria sp.). These three species were included in one report that summarized the effects of picloram, dicamba and several soil sterilants on these species. Good control was reported with several herbicides.

Common Tansy (Tanacetum vulgare). Field screening trials indicated several herbicides showed promise for the control of this weed.

Fall treatment of Canada thistle (Cirsium arvense L.) in small grain. Alley, H. P. and G. A. Lee. Picloram at ½, 1, 2, and 3 lb/A and dicamba at 1, 2, 3 and 4 lb/A were applied September 24, 1964, to Canada thistle regrowth in cultivated land. The chemicals were applied in 40 gpa. Each plot was .2 acres in size. The air temperature was 35° F and the Canada thistle was covered with frost at the time of application. Trebi barley was planted in the treated areas the first week in May, 1965. Evaluations were made approximately one year after the chemicals were applied.

Picloram at all rates resulted in complete eradication of Canada thistle. The ½ lb/A rate caused slight prostration of the barley plants and some of the heads emerged from the sheath. Picloram at 1, 2 and 3 lb/A showed more toxicity to barley. The plants were prostrate, malformed and the heads did not emerge from the boot. Yields ranged from 245 lb/A to 65 lb/A of grain on the ½ lb/A and 3 lb/A picloram, respectively. Percent germination tests indicate that picloram may have slightly reduced viability of barley seed.

Dicamba at 1 lb/A gave 70 percent control of Canada thistle. The barley plants appeared to be erect and normal. The plot yielded 1260 lb of grain per acre with 75 percent viable seed. Dicamba at 2 and 3 lb/A resulted in 80 percent control of the thistle. Slight prostration was observed, but the barley plants headed out. Yields from the 2 and 3 lb/A plots were 955 lb and 505 lb of grain per acre, respectively. Germination tests of seed from the 2 lb/A plots showed 62 percent and 3 lb/A plot 66 percent of the barley seed germinating. Dicamba at 4 lb/A gave 90 percent control of Canada thistle. The barley was prostrate, slightly malformed and still in the boot stage.

The plot yielded 800 lb. of grain per acre and 62 percent germination of seed.

Picloram at all rates and dicamba at 4 lb/A caused prostration of barley plants. Picloram and dicamba reduced yields and percent viable seed when compared to the check. Picloram at all rates resulted in complete eradication of Canada thistle. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Fall treatment of Canada thistle

Chemical	Rate	% Control Canada thistle	Yield lb/A	% Germination[1] Barley Seed
Picloram	½ lb/A	100	245	61
Picloram	1 lb/A	100	155	70
Picloram	2 lb/A	100	95	46
Picloram	3 lb/A	100	65	61
Dicamba	1 lb/A	70	1260	75
Dicamba	2 lb/A	80	955	62
Dicamba	3 lb/A	80	505	66
Dicamba	4 lb/A	90	800	62
Check		--	--	81

[1] % germination determined by Wyoming Department of Agriculture, State Seed Laboratory.

<u>Control of Canada thistle (Cirsium arvense L.) in green needlegrass and Russian wildrye seed production fields with 4-amino-3,5,6-trichloropicolinic acid.</u> Alley, H. P., and Lee, Gary A. Two fields, one green needlegrass and the other Russian wildrye, had previously produced grass seed which contained

in excess of 100 Canada thistle seeds per pound. The fields were sprayed, June 21, 1965, with the potassium salt of 4-amino-3,5,6-trichloropicolinic acid (picloram) at the rate of 1½ lb/A.

Observations during the growing season showed a considerable reduction in the overall height of both grass species where picloram had been applied. The grass plants, other than the height reduction and prostrate growth, showed no other toxicity symptoms.

At time of harvest, August 30, 1965, the treated areas were completely free of Canada thistle plants; hence, no weed seed contamination. Seed production from the Russian wildrye was 484.9 lb/A, as compared to an adjacent area treated with 2,4-D which yielded 446.3 lb/A.

Seed collected from the treated areas were supplied to the Wyoming State Seed Laboratory for germination studies. Since green needlegrass has to go through a period of vernalization, germination percentages are not available for this report. The Russian wildrye, germination report, showed an 85 percent germination of grass seed from the picloram treated area as compared to 84 percent where 2,4-D had been used. The seed analyst also noted a reddish colored coleoptile on many of the grass seeds from the 2,4-D treated grass and the seedlings appeared weak at point of emergence. Plumules were normal although the radicles were short. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Woollypod milkweed control in California. Bayer, D. E., C. Schoner, and K. Glenn. July, 1963, four herbicides, picloram, dicamba, amitrole, and 2,4,5-T were sprayed on woollypod milkweed plants in the 1/2-bloom stage. Evaluations were made in June 1964 and certain plots were retreated July 1964. Evaluation on the retreated plots were made in August 1965. Repeat treatments of picloram are showing promise for the control of woollypod milkweed. (Department of Botany, University of California, Davis.)

Evaluation of amount of regrowth of woolypod milkweed.

Herbicide	lb/A ai	Percent control 1964	 1965
Picloram	1	15	50
	2	40	85
	4	75	98
	8	95	--
Dicamba	2	10	--
	4	20	45
Amitrole	4	75	--
2,4,5-T	2	15	--
Control	--	0	0

Chemical control of Canada thistle (Cirsium arvense L.) second year after chemical application. Alley, H. P. and Lee, G. A. Further evaluation of treatments applied October 11, 1963, to Canada thistle which had been previously mowed and regrowth present, showed that after two years, picloram at all rates resulted in 100 percent control. Annual broadleaved weeds and grasses were invading the plots in 1965, except for picloram 2% Gran. at 1 lb/sq. rod which was void of all vegetation. Benzabor at 1½ lb/sq. rod, dicamba at 10 lb/A and 2,3,6-TBA 20 lb/A which gave 95, 98 and 95 percent, respectively in 1964, showed 100 percent control in 1965. Fenac granular at ½ and 1 lb/sq. rod and fenac liquid at 10 lb/A resulted in 96, 97 and 95 percent control in 1965, respectively, which was an increase over the previous year. The plots, for the most part, contained no vegetation. ACP 63-35 (Fenac + 2,4-D) at 3 and 7 gal/A showed residual control in 1965. Both treatments were void of vegetation. The treatments, 2,4-D amine at 40 lb/A, tritac-D at 4, 8 and 12 gal/A showed a decrease in control the second year after application. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Chemical control of Canada thistle

Chemical	Rate	% Control[1] 1964	% Control[1] 1965
Picloram	1 lb/A	100	100
Picloram	2 lb/A	100	100
Picloram	4 lb/A	100	100
Picloram 2% Gran.	1 lb/sq. rod	100	100
Benzabor	1½ lb/sq. rod	95	100
2,3,6-TBA	20 lb/A	95	100
Tritac-D	4 gal/A	80	75
Tritac-D	8 gal/A	98	90
Tritac-D	12 gal/A	100	96
Fenac Gran.	½ lb/sq. rod	80	96
Fenac Gran.	1 lb/sq. rod	90	97
Fenac Liquid	5 lb/A	80	80
Fenac Liquid	10 lb/A	90	95
Dicamba	5 lb/A	90	96
Dicamba	10 lb/A	98	100
ACP 63-35 (Fenac + 2,4-D)	3 gal/A	60	70
ACP 63-35 (Fenac + 2,4-D)	7 gal/A	75	99
2,4-D amine	40 lb/A	80	55

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[1] Percent control is an average of three replications.

Chemical control of common milkweed (Asclepias speciosa Torr.). Alley, H. P. and Lee, G. A. Common milkweed was treated with several rates of picloram on June 7, 1964. The plots were established in a field containing intermediate wheatgrass seedlings which were in the 3-5 leaf stage of growth at time of treatment. Picloram at ½ lb/A resulted in 95 percent control, and visual observations indicated that a residual damage to milkweed was occurring. Rates of 1 lb/A, 1½ lb/A and 2 lb/A gave 99 percent control. Residual damage to milkweed was also observed. Picloram at 2½ lb/A and 3 lb/A gave complete eradication of the milkweed plants. Grass seedlings were damaged by picloram at rates above 1½ lb/A. At the time of evaluation, one year after plots were established, there were intermediate wheatgrass plants growing in all plots. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Lepidium latifolium--perennial peppergrass control in California. Elmore, C. L. and Buschmann, L. L. In areas susceptible to overflow or in non-cropped areas an extremely tolerant weed *Lepidium latifolium* perennial peppergrass is becoming established in California. In some areas this plant has been called *Cardaria Draba*. From three experiments conducted in California it has been found that picloram applied in the fall or spring has not controlled this weed. Rates of 1, 2, 4 and 8 pounds actual granular and liquid materials were used. The ester formulation of 2,4-D at rates of 2 and 4 pounds per acre was also ineffective. The addition of a surfactant to dicamba at 4 pounds per acre and picloram at 1 and 2 pounds per acre gave no control one year after application. A combination mixture of 3/4 pound picloram, 2 pounds 2,4-D; and 1.5 pounds picloram, 4 pounds 2,4-D was also tested without control.

From these tests it is apparent that the weed *Lepidium latifolium* is tolerant to a number of common hormone type herbicides. (University of California, Davis).

Chemical control of leafy spurge (Euphorbia esula L.). Alley, H. P. and Lee, G. A. Plots 9 x 30 feet, replicated twice, were established along a railroad right-of-way on May 15, 1964.

Amine of 2,4-D at 40 lb/A resulted in 90 percent control with no damage to associated grass species. Dicamba at 5, 10 and 15 lb/A gave 97, 100 and 100 percent control, respectively. Rates of 10 lb/A and above did, however, cause damage to grass growing in the plots. The leafy spurge was completely eradicated with all rates of TBA. Severe grass damage was observed with rates above 10 lb/A. Fenac liquid at 10 lb/A was required to give satisfactory control but also was toxic to grass. Fenac granular at ½, 1 and 1½ lb/sq. rod gave excellent control but showed residual damage to grass. Tritac-D at 12 and 16 lb/A, toxic to associated vegetation, resulted in 100 percent control of leafy spurge. Rates of 2 lb/A or more of picloram was required to give 100 percent control. Grass in the plots showed residual damage at rates of 2 lb/A and above. Benzabor at 3/4 and 1½ lb/sq. rod gave 100 percent control and caused less damage to the grass than picloram at 4 lb/A. Excellent control was obtained with picloram + 2,4-D (Tordon-101) although associated grass species exhibited toxic damage. High rates of liquid dinoben-by product and fenac + liquid dinoben-by product were required to get 100 percent control. One application of 2,4-D LVE (PGBE), with and without X-77, resulted in unsatisfactory control and recovery of leafy spurge.

This series of plots will be evaluated for 3-5 years to determine the residual control which may be obtained with the chemicals tested. (Wyoming Agricultural Experiment Station, Univ. of Wyoming, Laramie.)

Chemical control of leafy spurge

Chemical	Rate	% Control 5/26/65	Remarks
2,4-D amine	6#/A	75	
2,4-D amine	20#/A	85	Good grass.
2,4-D amine	40#/A	90	Good grass.
Dicamba	5#/A	97	
Dicamba	10#/A	100	Hurt grass, fair stand.
Dicamba	15#/A	100	Hurt grass, fair stand.
TBA	10#/A	100	Hurt grass slightly, Death camas hurt.
TBA	15#/A	100	Grass severely damaged.
TBA	20#/A	100	Grass severely damaged. Residual damage to L.S.
Fenac Liq.	5#/A	75	
Fenac Liq.	10#/A	99	Hurt grass.
Fenac Liq.	15#/A	100	Hurt grass.
Fenac Gran.	½#/sq.rod	99	Residual, hurt grass.
Fenac Gran.	1#/sq.rod	100	Residual, hurt grass.
Fenac Gran.	1½#/sq.rod	100	Residual, hurt grass.
Tritac-D	8#/A	80	Residual, fair grass.
Tritac-D	12#/A	100	Hurt grass, fair stand.
Tritac-D	16#/A	100	Hurt grass.
Benzabor	3/4#/sq.rod	100	Hurt grass - less than 4# Picloram.
Benzabor	1½#/sq.rod	100	Hurt grass - less than 4# Picloram.
Picloram	1#/A	96	Good grass.
Picloram	2#/A	100	Hurt grass.
Picloram	3#/A	100	Hurt grass.
Picloram	4#/A	100	Hurt grass.
Amitrole-T	8#/A	50	Plants in plot are yellow.
Tordon-101 (Picloram + 2,4-D)	1.3 gal/A	99	Hurt grass, sick L.S.
Tordon-101 (Picloram + 2,4-D)	2.6 gal/A	100	Hurt grass.
Tordon-101 (Picloram + 2,4-D)	3.9 gal/A	100	Hurt grass.
Tordon-101 (Picloram + 2,4-D)	5.2 gal/A	100	Severely damaged grass.
Picloram Gran.	.3125#/sq.rod	97	Grass OK.
Picloram Gran.	.6125#/sq.rod	100	Hurt grass.
Picloram Gran.	.9375#/sq.rod	100	Hurt grass, many bare areas.
Picloram Gran.	1.25#/sq.rod	100	Badly damaged grass.
ACP 63-35 (Fenac+2,4-D)	3.3 gal/A	45	Healthy L.S.
ACP 63-35 (Fenac+2,4-D)	6.6 gal/A	80	Grass hurt.
ACP 63-35 (Fenac+2,4-D)	10 gal/A	99	Grass hurt.
GC-7887 (Hexaflouroacetone trihydrate)	10#/A	60	
GC-7887 (Hexaflouroacetone trihydrate)	20#/A	80	Residual, hurt small L.S.

Continued

Chemical	Rate	% Control 5/26/65	Remarks
Liq. Dinoben-by prod.	25#/A	80	Some small plants.
Liq. Dinoben-by prod.	50#/A	95	Residual to L.S.
Liq. Dinoben-by prod.	75#/A	100	Fair grass.
Fenac + Liq. Dinoben-by prod.	5-25#/A	95	
Fenac + Liq. Dinoben-by prod.	5-50#/A	99	Hurt grass.
Fenac + Liq. Dinoben-by prod.	10-25#/A	100	Fair grass.
Fenac + Liq. Dinoben-by prod.	10-50#/A	100	Fair grass.
Dinoben-by prod. Gran.	1.56#/sq.rod	75	
Dinoben-by prod. Gran.	3.2#/sq.rod	95	Hurt grass.
Dinoben-by prod. Gran.	4.68#/sq.rod	98	Residual, hurt grass.
2,4-D LVE (PGBE)	2#/A	20	
2,4-D LVE (PGBE)	4#/A	20	
2,4-D LVE (PGBE)	6#/A	60	Slowed down recovery.
2,4-D LVE (PGBE) + X-77	2#/A	30	Slowed down recovery.
2,4-D LVE (PGBE) + X-77	4#/A	70	
2,4-D LVE (PGBE) + X-77	6#/A	80	Small L.S. recovering.
Dacamine (oil soluble 2,4-D amine)	6#/A	65	Small L.S. recovering.

Evaluation of herbicides for the control of certain perennial noxious weeds. Heikes, P. E. Plots established during the 1962, 1963 and 1964 seasons were observed and evaluated in 1965. Similar treatments were made in both fall and spring at most locations. Plots were established with a power sprayer, at selected locations in the state under different soil and climatic conditions. Most herbicides reported promising by either industry or other research personnel, were included. Evaluations were made on Canada thistle (Cirsium arvense), field bindweed (Convolvulus arvensis), Russian knapweed (Centaurea repens), leafy spurge (Euphorbia esula), povertyweed species (Franseria sp.), toadflax species (Linaria sp.), and whorled milkweed (Asclepias subverticillata).

Conclusions: The temporary soil sterilant herbicides (2,3,6-TBA, 2,3,6-TBP, dicamba, fenac, picloram and borate-TBA) have continued to control a high percentage of weeds after three seasons.

One or 2 applications of 2,4-D in any formulation did not eradicate the weeds, where tested, but gave only seasonal control. However, repeated applications of 2,4-D for 2 or 3 seasons has eliminated Canada thistle. There was little difference between formulations.

There was more variation in per cent control and effect on grasses, with 2,3,6-TBA, 2,3,6-TBP, dicamba, fenac and borate-TBA than with picloram. There was less variation in per cent eradication with picloram considering all locations; also dates of application did not seem to affect results with picloram. Fall treatments were as effective as spring or summer treatments. At rates used, picloram did not cause appreciable grass injury at any of the locations. This is desirable as it is important to retain as much vegetative cover and grass competition as possible. Although 1 lb/A of picloram has in several locations given 100 percent eradication, it is likely that 1½ to 2 lbs/A will be necessary as a general recommendation.

Dicamba has continued to look promising, but due to its short residual life in the soil, it appears to have the greatest advantage in cropped areas, applied in the fall after harvest. A small grain crop, corn or sorghum can be grown in treated soil 8 to 9 months after application with little or no crop injury. (Extension Service, Colorado State University, Fort Collins, Colorado).

Chemical control of white top (Cardaria draba L.). Alley, H. P. and Lee, G. A. Plots, 22 x 25 feet, were established using picloram at 1, 2 and 3 lb/A, 2,4-D LVE (PGBE) at 2, 4 and 20 lb/A and amitrole at 8 lb/A. Evaluations one year after application indicate the picloram was not effective in controlling White top.

Picloram at 1, 2 and 3 lb/A gave 40, 60 and 70 percent control, respectively. The grass was injured in all plots. Ester formulations of 2,4-D at 2, 4 and 20 lb/A resulted in 70, 95 and 100 percent control with no toxic effect to the grass. Amitrole at 8 lb/A showed 90-95 percent control but the plants which remained were vigorously growing. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Chemical control of common tansy (Tanacetum vulgare). Alley, H. P. and Lee, G. A. Tansy, which is an introduced garden plant, has escaped into pasture and waste land in western Wyoming. Several chemicals at different rates were applied on June 22, 1964, when the plants were in the 18-24 inch stage of growth. Picloram at 2 lb/A, 3 lb/A and 4 lb/A; benzabor at 1½ lb/sq. rod; dicamba at 10 lb/A; 2,3,6-TBA at 20 lb/A all resulted in 100 percent control of the tansy. Fenac liquid at 15 lb/A and 2,4-D LV ester at 4 lb/A gave 50 percent control. Fenac granular at 1 lb/sq. rod, tritac-D at 6 gal/A and 2,4-D LV ester showed no toxicity to tansy. Picloram at 4 lb/A did cause damage to the associated grass species growing in the plot. The 2,3,6-TBA treatment killed all vegetation leaving the ground bare. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Control of Equisetum arvense (field horsetail) with herbicides. Peabody, Dwight V., Jr. Dichlobenil (incorporated) and bromacil at rates of 20 pounds per acre eliminated field horsetail the year after treatment. However, at this rate these compounds are still present in the soil in high enough amounts to seriously interfere with crop growth the year after treatment. Amitrol-T gives almost as good horsetail control but does not persist in the soil so that any crop can be grown the year following treatment.

Dichlobenil when applied in mid-winter at lower rates (4 and 8 pounds active ingredient per acre) is still present in high enough amounts to interfere seriously with growth of peas planted the following spring; control of field horsetail even at 8 pounds per acre is not adequate when the treatment is not incorporated soon after application. (Northwestern Washington Research & Extension Unit, Washington State University, Mount Vernon)

Chemical control of field bindweed (Convolvulus arvensis L.). Alley, H. P. and Lee, G. A. Square rod plots, replicated three times, were established on field bindweed September 19, 1963. Evaluations one and two years after chemical application (following table) shows the percent control obtained.

Picloram at all rates resulted in 100 percent control the second year after application. Kochia was growing in plots treated with 2, 3 and 4 lb/A. Benzabor at 3/4 and 1½ lb/sq. rod gave 100 percent control with the higher rate killing all vegetation. Tritac-D at 8 gal/A, 2,4-D amine at 40 lb/A and 2,3,6-TBA at 20 lb/A showed excellent residual control the second year. Kochia and other annuals were growing in the plots treated with 2,4-D amine. Fenac granular at ½ and 1 lb/sq. rod resulted in 95 and 99 percent control respectively. Plots treated with 1 lb/sq. rod of fenac granular were void of all vegetation. Fenac liquid at 10 lb/A gave an increase in control from 70 to 98 percent the second year. Dicamba at all rates showed a decrease in control two years after application. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Chemical control of field bindweed

Chemical	Rate	% Control 1964	% Control 1965
Fenac Gran.	½ lb/sq. rod	85	95
Fenac Gran.	1 lb/sq. rod	90	99
2,4-D amine	2 lb/A	60	80
2,4-D amine	40 lb/A	96+	100
Fenac Liquid	5 lb/A	40	50
Fenac Liquid	10 lb/A	70	98
2,3,6-TBA	20 lb/A	90	100
Picloram	1 lb/A	99	100
Picloram	2 lb/A	100	100
Picloram	3 lb/A	100	100
Picloram	4 lb/A	100	100
Picloram 2% Gran.	1 lb/sq. rod	100	Destroyed
Tritac-D	4 gal/A	90	85
Tritac-D	8 gal/A	96	100
ACP 63-35 (Fenac + 2,4-D)	2 gal/A	85	70
ACP 63-35 (Fenac + 2,4-D)	4 gal/A	80	70
Dicamba	2 lb/A	75	45
Dicamba	4 lb/A	85	65
Dicamba	8 lb/A	88	75
Benzabor	3/4 lb/sq. rod	90	100
Benzabor	1½ lb/sq. rod	95	100
Dinoben by-Prod. Liq.	40 lb/A	10	50
Dinoben by-Prod. Liq.	80 lb/A	20	Destroyed
Dinoben by-Prod. Gran.	6.25 lb/sq. rod	60	Destroyed
Picloram pellets	¼ lb/sq. rod	97	100

Control of false hellebore (Veratrum californicum Durand) with herbicides.

Street, J. E., Bayer, D. E., Brooks, W. H. False hellebore is a common native of meadow and moist areas of mountain grazing lands in western United States. The plant contains various related alkaloids toxic to livestock and honeybees, although in some instances it is considered desirable forage. Ingestion of false hellebore has caused Cyclopian-type congenital malformations in lambs.

On June 12, 1964, various herbicides were applied to essentially monospecific stands of false hellebore in Mendocino County, California. The plants were prebloom and averaged 2 feet in height. Three replications of all materials were applied in a randomized block, each plot being 16-½ feet square. Spray of total volume of 80 gallons per acre was applied by three nozzle hand boom and knapsack sprayer. Adjuvant, X-77, at 30 ounces per 100 gallons was added to all treatments. Names and rates of herbicides are in the table.

On June 9, 1965, visual estimates of control were recorded on a scale of 1 to 10, ten being complete control.

Chemical control of false hellebore

Herbicide	Lbs per acre	Control Rep I	Rep II	Rep III	Avg.
2,4-D ester	2	9	9	6	8
Silvex ester	2	8	6	7	7
Dicamba	4	7	3	3	4
Dicamba	2	3	1	2	2
Picloram	1	5	1	1	2
Picloram	2	1	1	1	1
Picloram	4	1	2	1	1
Amitrole-T	4	1	2	1	1
2,4,5-T ester	2	1	1	1	1

2,4-D, the best material, effected rather good control considering a single application on a perennial. On June 24, 1965, the 2,4-D and silvex treatments were reapplied to the above experiment in identical fashion as before except diesel oil was added at 2 qt. per 100 gallons of spray.

Also on June 24, 1965, another experiment was initiated nearby, using two herbicides in three replications. 2,4-D and silvex esters at 2 lbs. per acre were applied with 160 gallons of water per acre and 2 qts. of diesel per 100 gallons. (University of California, Davis.)

PROJECT 2. HERBACEOUS RANGE WEEDS

M. C. Williams, Project Chairman

SUMMARY

Nine abstracts covering research on 11 weeds were submitted. While most abstracts dealt with weed control investigations, two papers discussed seed dormancy and buffalograss introduction. The reports are summarized below.

Plains larkspur in Wyoming was effectively controlled by picloram at rates of ½ to 2 lb/A. Rates of 1½ to 2 lb/A picloram caused moderate injury to associated grass species.

In Washington, a single combination of picloram and silvex indicated an additive effect between the two herbicides on Dalmatian toadflax.

Clubmoss was effectively controlled by ammate and monuron in Montana. Spring treatments gave better control than fall treatments. Nitrogen fertilization and additional moisture increased yield of grasses and forbs in clubmoss infested areas.

Larvae of the leafy spurge hawkmoth were found to provide good biological control of leafy spurge in Montana. Since many infestations of leafy spurge occur where spraying is difficult or undesirable, this insect may offer a promising solution to the leafy spurge problem.

Italian thistle was controlled in California with 0.5 lb/A paraquat in April. Spraying green plants with paraquat preserved protein content without reducing its palatability to sheep.

Seed dormancy in three larkspurs and western false hellebore was found to be 3½ months under natural conditions. Dormancy can be broken in the laboratory by keeping seeds saturated at 34 degrees F for 3½ months.

Buffalograss is being studied as a possible replacement for medusahead in Idaho. Once buffalograss dominance has been established, more desirable forage species may be introduced to replace buffalograss.

Chemical control of plains larkspur (*Delphinium geyeri*). Alley, H. P. and G. A. Lee. Exploratory plots established in 1963 showed that picloram at 1, 2 and 3 lb/A gave 100 percent control of plains larkspur. To determine what rate of picloram was necessary for satisfactory control, plots were established in 1964 using several rates of application of picloram in addition to other chemicals which were included in the test plots. All chemicals were applied in 40 gpa of water and replicated three times.

Results from two locations are presented in the following table. Picloram at all rates of application, ¼ to 2 lb/A, resulted in 98 to 100 percent control except at one location where picloram at ¼ lb/A gave 80 percent.

Rates of 1½ to 2 lb/A of picloram caused moderate damage to the associated native grass species, mainly buffalograss and blue grama.

Although 1 gal/A of tordon-101 (picloram + 2,4-D) was required for 100 percent control, lower rates of application looked very promising. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Comparison of control with various treatments on larkspur

Chemical	Rate	% Control Location I	% Control Location II
Picloram	¼ lb/A	98	80
Picloram	½ lb/A	100	100
Picloram	1 lb/A	100	100
Picloram	1½ lb/A	100	
Picloram	2 lb/A	100	
Tordon 101 (Picloram + 2,4-D)	1/8 gal/A		55
Tordon 101 (Picloram + 2,4-D)	¼ gal/A	96	85
Tordon 101 (Picloram + 2,4-D)	½ gal/A	98	
Tordon 101 (Picloram + 2,4-D)	1 gal/A	100	
Dicamba	¼ lb/A		0
Dicamba	½ lb/A	35	
Dicamba	1 lb/A	30	
Dicamba	2 lb/A	65	
Silvex + X-77	2 lb/A	55	
2,4-D LVE + X-77	2 lb/A	55	

Chemical control of plains pricklypear (Opuntia polyacantha) by aerial application. Alley, H. P. and G. A. Lee. Plains pricklypear was treated by aerial application on June 18, 1963. Silvex at 4 lb/A was applied in 4 gpa of diesel oil and 2 lb/A was applied in 2 and 4 gpa of diesel oil. The following table gives percent control after two years evaluation.

Percent control of plains pricklypear when aerial applying silvex at 2 and 4 lb/A in low volumes of diesel oil as a carrier.

Chemical and Volume/A	Rate	% Control 1964	% Control 1965
Silvex in 2 gal. of diesel oil	2 lb/A	75-80	100
Silvex in 4 gal. of diesel oil	2 lb/A	80-85	100
Silvex in 4 gal. of diesel oil	4 lb/A	98	100

One year after application, silvex at 2 lb/A in 2 and 4 gpa of diesel oil resulted in comparable control of 75-80 percent and 80-85 percent, respectively. Silvex at 4 lb/A applied in 4 gpa of diesel oil gave 98 percent control after one year. Two years after application, all treatments showed 100 percent control.

There was an increase in control the second year after spraying without additional chemical application. These plots will be evaluated for the next 3-5 years to determine the longevity of control and determine the rate of reinfestation of the cactus on the sprayed areas. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Biological control of leafy spurge. Baker, Laurence O. The leafy spurge hawkmoth is a native of Europe and Asia. The larvae feed on certain members of the Euphorbiaceae family. The adults which are quite colorful, have a wing span of two to two and one-half inches and are short lived. They feed on the nectar of several different flowers.

Eggs of the hawkmoth were supplied by Dr. Peter Harris, Canada Department of Agriculture.

In the greenhouse, at 80° F, eggs hatch in about five days. The larva grow rapidly, doubling in size the first 24 hours. They strip the leaves from leafy spurge and in 14-16 days are about two and one-half inches long. They pupate in the soil. This stage lasts for about two weeks except that they overwinter as pupa. Diapause is induced by short days.

Growth is much slower at lower temperatures and it is unlikely that more than one generation will be completed in the field in Montana. However, the adults do not emerge at the same time so that various stages of developing insects will be present during much of the summer.

Since leafy spurge infestations occur on many areas where spraying is undesirable or difficult, the leafy spurge hawkmoth offers a promising solution. (Montana Agricultural Experiment Station, Bozeman.)

Replacement control of medusahead in Idaho. Hironaka, M. and E. W. Tisdale. Practicability of introducing buffalograss (Buchloe dactyloides) into non-tillable medusahead ranges is being investigated. The primary purpose of introduction would be to alter the moisture depletion regime from what it is under medusahead to one that is more favorable for establishment of perennial grass seedlings and at the same time supply forage for livestock. An aggressive stoloniferous species as buffalograss would have a decided advantage over species that reproduce exclusively by seed. It is with the ultimate objective that after buffalograss dominance is established, other more desirable forage species could be introduced and replace buffalograss. The immediate objective is to find out whether buffalograss is adapted to the growing conditions found in southern Idaho.

Seed samples have been obtained from Colorado, Kansas and South Dakota. Seedling characteristics are being studied under growth chamber conditions. Rooted stolons, established seedlings and seed burs will be planted in the field during early spring. Rate of stolon production and elongation under field conditions will be followed. (Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow, Idaho.)

Enhancement of effect of a mixture of silvex and picloram on Dalmatian toadflax. Robocker, W. C. Results of a single combination of picloram and silvex in 1964 indicated an additive effect between the two herbicides on Dalmatian toadflax (Linaria dalmatica Mill.). On June 6, 1965, 4 replicates of 8- by 18-ft. plots were treated with picloram or silvex or combinations of the 2 in water at a volume of 20 gpa. Plant counts per plot, made on September 23 (as indicated in the table) show an additive, if not synergistic, effect from the combinations. The response of the Dalmatian toadflax in the 1964 trial indicates that the kill 1 year after treatment will be greater than that shown by fall evaluation following the June treatment.

Cost of treatment with 2 lb/A of silvex, plus 0.25 lb/A of picloram, is approximately 40 percent more than treatment with 3 lb/A of silvex, although the 1964 results show that the combination should give excellent control. Final results appear to be dependent in part on age of stand at the time of treatment. None of the treatments with picloram at rates up to 1.5 lb/A in 1964 were effective in preventing a heavy reinvasion by Dalmatian toadflax seedlings in 1965. (Crops Research Division, Agricultural Research Serfice, U. S. Department of Agriculture and the Washington Agricultural Experiment Station, Pullman, cooperating.)

Average number of Dalmatian toadflax plants per plot surviving from treatments on 6-7-65, counted 9-23-65

Herbicide	Rate, lb/A	Plants per plot[a]
None	--	60
Picloram	0.5	13
	1.0	4
	1.5	1
Silvex	2.0	6
	3.0	2
Silvex + picloram	1.0 + 0.25	5
	1.0 + 0.5	2
	2.0 + 0.25	1
	2.0 + 0.5	Tr

[a] Crowns or adventitious stems from roots

Control of Italian thistle (Carduus pycnocephalus L.) with herbicides. Kay, Burgess L., A. H. Murphy, and W. H. Brooks. Italian thistle is a common weed on sheep bedgrounds and road shoulders in rangelands of the north coast counties of California. Interest in control stems mainly from its aggressive nature, obnoxious appearance, and prickly characteristics.

Trials were conducted on the UC Hopland Field Station to determine the optimum timing of 2,4-D applications. 2,4-D butoxy ethanol ester at 1.0 lb/A was applied at approximately 2 week intervals from February through April.

Thistles appeared to be killed by this herbicide at all dates of application. However, new thistles were observed to germinate throughout this period, and only the latest application was successful in preventing seed formation.

In a logarithmic trial established March 10, 1965, a variety of materials at a range of rates was tested. 2,4-D butoxy ethanol ester at 1.75 lbs/A, picloram at 1/8 lb/A, and paraquat at 1.0 lb/A gave control for the rest of the season, probably due to the residue of these herbicides either in the soil or on the remaining dead plant material. Silvex at 1.0 lb/A and 2,4,5-T butoxy ethanol ester at 4.0 lb/A were not effective.

Paraquat applied April 8 and April 27 gave lasting control at 0.5 lb/A. Spraying with paraquat in April or May before seed is set appears to be a possible treatment. Other experiments (unpublished) have shown that spraying green plants with paraquat preserves the protein level and results in their being more palatable in the dry state. As thistles have been known to contain toxic levels of nitrates, samples of Italian thistle in the bloom stage were tested for nitrate. No nitrate nitrogen was found within the limits of the test. The protein content was 11 percent. Sheep were observed to readily eat Italian thistle in the dry state whether it was "cured" with paraquat or left to mature naturally. (University of California, Department of Agronomy, Davis.)

Seed dormancy in three native larkspurs and western false hellebore. Williams, M. Coburn. Seed dormancy was investigated in four poisonous range plants: low larkspur, *Delphinium nelsonii* Greene; tall larkspur, *Delphinium barbeyi* (Huth) Huth; duncecap larkspur, *Delphinium occidentalis* S. Wats.; and western false hellebore, *Veratrum californicum* Durand. Seeds were placed in plastic screen bags. In late October, the bags were laid on the forest floor in the Cache National Forest. The seeds were recovered biweekly from February 3 to March 20, 1965. Snow depth during the collection period was 10 feet. Soil temperature was 33 to 34° F.

Seeds of all species began germinating under the snow about February 15. By March 20, the majority of all species had germinated. Roots penetrated the soil as much as ½ inch or more. Under natural conditions, dormancy is about 3½ months for these species. This time is computed from the first permanent snowfall. By late March the majority of the viable seeds have both germinated and produced a well-developed root. The seedling resumes active growth after snow melt in late May or early June.

We have duplicated these results in the laboratory by holding seed in saturated white sand at 34° F for 3½ months. Once dormancy is broken, larkspurs germinate best at 50° F, while western false hellebore seed germinates well from 40 to 70° F. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture and the Utah Agricultural Experiment Station, Logan, cooperating.)

Chemical control of clubmoss (Selaginella densa Rydb.). Stroud, Don and Laurence O. Baker. Five of the most promising chemicals selected from previous tests (W.W.C.C. Research Report, p. 25, 1965) were applied to native rangeland at three widely separated locations for control of clubmoss

(Selaginella densa). These treatments were applied in triplicate to half-square-rod plots, or larger, with a knapsack sprayer in late fall 1964 and spring 1965.

All vegetation, except clubmoss, was clipped at ground level, separated by species, dried and weighed. The major species present were Stipa comata, Bouteloua gracilis, Agropyron smithii, Koeleria cristata and Carex eleocharis. Their prevalence varied with location. Other species found were grouped into miscellaneous grasses, forbs, and shrubs.

Estimated percent clubmoss control and yield data are presented in the following table. Results from certain treatments made in the spring of 1964 are also given; however, they represent data from only two locations. Fall treatments were generally less effective than those applied in the spring. (Montana Agricultural Experiment Station, Bozeman.)

Effect of several chemical treatments on clubmoss control and yield of vegetation at three locations, 1965

		Percent clubmoss control*			Yield of total vegetation expressed as percent of check**		
	Rate	Spring		Fall	Spring		Fall
Chemical	lbs./A.	64[2]	65	64	64[2]	65	64
Ammate	5		54	44		132	113
Ammate	10		91	43		126	125
Ammate	20	98	100	61	134	122	109
Atrazine	1	71	33	25	108	140	112
Atrazine	2	83	86	83	122	91	104
Monuron	1	81	31	48	139	122	141
Monuron	2	99	98	96	142	109	117
Paraquat + X-77	1 + ½%		53			83[1]	
Paraquat	2	90		39[1]	132		199[1]
Picloram	½	49		8	93		95
Picloram	1	65		12	110		108

* Sept 1965 - average of the three locations.
** Based on the 1965 harvest - total yield from the three locations.
[1] One location only
[2] Two locations

Response of clubmoss (Selaginella densa Rydb.) infested rangeland to nitrogen and water. Stroud, Don and Laurence O. Baker. Control of clubmoss results in an immediate increase in growth of associated grasses and forbs. Tests conducted by the Montana Agricultural Experiment Station have shown that reduced competition for moisture does not seem to be the principal reason for this increased growth. Because clubmoss does not shade the other plants, competition must be for nutrients. In an effort to define more clearly these relationships, nitrogen (0, 50, 100 and 150 lbs. per acre) and water (natural precipitation + supplemental water to make ½, 1 and 2 inches per week) were applied in a split plot design.

At the time the supplemental water was applied each week the precipitation received during the preceeding seven days was deducted from the total water desired. During the duration of the test 2.93 inches of rainfall were recorded. Total supplemental water added amounted to 1.07, 5.07 and 13.07 inches for the .5, 1.0 and 2.0 inch per week treatments.

This test was carried out on a native range during the summer of 1965. Clubmoss provided about 70 percent ground cover. Stipa comata, Carex eleocharis, Bouteloua gracilis, Agropyron smithii, Koeleria cristata and Poa secunda were the other principal plant species present in decreasing order of prevalence. Nitrogen treatments were applied to triplicated rod square plots. Water treatments, comprising the sub-plots, were made each week, adding sufficient water to supplement the natural precipitation to the rates desired. The water was confined to the plots by metal rings driven into the soil.

All vegetation, except clubmoss, was clipped in August to ground level, separated by species, dried and weighed. The total yield of vegetation expressed in grams from 18.85 square feet follow (Montana Agricultural Experiment Station, Bozeman.)

Total water - inches per week	Nitrogen in lbs. per acre			
	0	50	100	150
Precipitation	79.25	139.79	160.16	172.33
.5	84.37	111.60	177.01	214.68
1.0	106.96	149.47	200.10	273.79
2.0	107.09	160.62	328.79	362.14
	337.62	561.48	866.06	1,022.94

PROJECT 3. UNDESIRABLE WOODY PLANTS

M. Newton, Project Chairman

SUMMARY

This year's abstracts continue to illustrate the shift in emphasis from simple chemical screening to development of woody plant control science for support of land management objectives. Fifteen abstracts were submitted from four states, with eight from Oregon, three from Wyoming and two each from Arizona and California. Forestry and range management objectives received roughly equal emphasis.

Physiology of herbicide action is approached from three directions by workers in different regions. Studies of bud dormancy are reported by Goodin and Becker, from Riverside, while influence of plant water relations in juniper control is discussed in a report from Arizona by Johnsen. Norris, at Oregon State University, provides insight into the metabolic differences between phenoxy acetic and butyric compounds.

Ecological studies were reported in three abstracts. McKell and Goodin found important moisture conservation implications in brush control timing with respect to grass seeding. Gratkowski has contributed further data on causes of brush encroachment in southwest Oregon; while Newton has found that condition of forest regeneration may be of substantially greater importance than degree of brush control in release treatments.

Dominating reports of herbicide experiments are results of picloram on a wide variety of species. General effectiveness of picloram is apparent in most studies, but several reports indicate that mixtures with other herbicides may improve performance of picloram for control of some species, while other compounds may provide the same or slightly better control at lower cost on some picloram-resistant plants. Residues and root grafting may present problems in forestry work. A high standard of results per dollar of chemical outlay is still maintained by 2,4-D and 2,4,5-T.

Herbicide residue in streamflow was discussed in two papers. Norris et al, found amitrole contamination to be of short duration, and probably negligible hazard, in Oregon aerial brush treatments; Johnsen and Warskow found little picloram in streamflow after broadcast chaparral treatment.

Response of irrigated one-seed juniper (Juniperus monosperma) to foliage applications of 2,4-D. Johnsen, Thomas N., Jr. This study was done in an attempt to separate soil moisture from active plant growth effects upon the response of one-seed juniper to foliage applications of 2,4-D. Generally, junipers have a large variation in resistance to 2,4-D application made during the spring and summer growing seasons. Treatments were made during the spring droughts of 1962 and 1963. The springs of 1964 and 1965 were too wet to repeat these tests. Isolated, 4-foot-tall, one-seed junipers at Deadman Flats, Arizona, were treated in a randomized block design with five replications each time. Irrigated trees were flood irrigated with 1 inch of water impounded under the tree canopy at the start of the tests. The PGBE ester of 2,4-D was applied to wet the foliage with a concentration of 8 lb. aehg at various intervals following irrigation. Responses to the 1963 treatments are shown through 1965 in the accompanying table. Responses to the 1962 treatments were similar. The initial soil and foliage moistures were lower in June than in May, 1963. It appears that maximum response is obtained with 2,4-D applications made 2 or 3 days following irrigation. This is also the time it takes for the foliage moisture content to rise following irrigation. These data offer a possible explanation of the cause of variations in the response of junipers to summer applications of 2,4-D in Arizona. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, For. Sci. Lab., A. S. C., Flagstaff, Arizona.)

Response of irrigated and non-irrigated one-seed junipers to foliage applications of 2,4-D

Treatment	Percent aaparent top kill after indicated time					
	1 mo.	2 mo.	4 mo.	6 mo.	1 yr.	2 yrs.
5/63						
Irrigated,[1] 29th	83	83	82	69	54	46
Irrigated, 31st	79	78	85	74	65	69
Unirrigated, 29th	54	73	62	65	56	46
Check	0	0	0	5	0	0
6/63						
Irrigated,[1] 17th	72	75	64	68	59	52
Irrigated, 19th	88	82	83	83	82	78
Irrigated, 21st	72	89	82	81	85	77
Unirrigated, 17th	42	54	51	54	46	40
Check	0	0	0	0	0	0

[1] All irrigations were made on the initial date of the trial. The soil was then allowed to dry naturally with no further irrigation.

Stream contamination with amitrole following brush control operations with amitrole-T. Norris, Logan A.; Michael Newton and Jaroslav Zavitkavoski. Amitrole-T is often employed for the control of salmonberry on forest lands in western Oregon. As part of a continuing investigation of environmental contamination resulting from chemical brush control operations, a study of the levels of stream contamination following application of amitrole-T was made.

The study area included treated portions of several small watersheds near Hebo, Oregon on the Siuslaw National Forest in the Coast Range. A total of 12 sampling points were established ranging from immediately below the treated areas to points which were more than a mile down stream. The results of analysis of samples from five sampling points are reported here.

Sampling point 1 was located immediately below the boundary of a 21 acre unit. Sample points 2, 3, 4 and 5 are located in a different watershed.

Point 2 was just below a 14 acre treated unit, and point 3 was just below a portion of a 52 acre unit. Point 4 was about 400 yards below sampling points 2 and 3 and sampled effluent from both of these points as well as from another treated area. The total treated acreage upstream from point four was 106 acres. Point five was about one mile downstream from point four and also sampled effluent from 106 treated acres.

All the areas were treated on July 19 with 2 lb/A of amitrole-T in 10 gpa of water. The applications were made by helicopter. Several check samples were collected prior to spraying and numerous samples were collected from these various points the first 3 days after application with additional samples being taken at intervals for several weeks.

The analytical method involved the removal of the amitrole from three liter aliquots of stream water with Dowex-50 ion exchange resin. After several clean up steps, the amitrole was determined colorimetrically with a Klett colorimeter at 445-505 mu. N-naphthylethylenediamine dihydrochloride was used for color development. The check samples had an "amitrole" background of 1.6 ppb which was very consistent from sample to sample. Recoveries of amitrole from spiked checks was reasonably consistent at 70%. The method described permitted levels of amitrole in stream water as low as one ppb to be determined with a high degree of confidence.

The data obtained were graphed as a function of time after treatment, and the data reported here were interpolated from that graph. The data were corrected for background and percent recovery and are expressed as ppb of amitrole in the stream.

Parts per billion of amitrole in stream water

Time after treatment (hours)	Sampling point				
	1	2	3	4	5
5 min.	400	30	0	0	0
1 hour	91	17	90	0	0
2	35	20	35	40	0
5	15	8	14	11	0
10	4	2	3	2	1
15	2	1	2	1	0
24	15	6	8	3	2
36	3	2	1	1	0
48	2	2	3	0	0
72	0	0	0	0	0

No detectable quantities of amitrole were found in samples collected between three and five days after treatment.

In all of the situations sampled in this study the streams were included within the boundaries of the treated areas. We believe this to be one of the major reasons why the concentrations of chemical are generally higher in this study than those found in other areas of the Coast Range treated with phenoxy herbicides. It is interesting to note the lack of amitrole at point five which is only one mile below point four. It is apparent that dilution through downstream movement and absorption of the chemical on colloids and organic matter has substantially reduced the level of contamination in a short distance. Similar situations were found in all cases where the sampling point was located some distance downstream from the treated area. The concentrations of herbicide and the length of persistence found in this study are not believed to represent dangerous levels of contamination to fish in the treatment areas or to downstream water users.

This investigation was supported by Public Health Service Research Grant WP 00477, from the Division of Water Supply and Pollution Control. (Oregon Agri. Exp. Sta., Oregon State University, Corvallis.)

Chemical control of canyon live oak. Gratkowski, H. Tordon 101 (a mixture of 0.54 lb/gal. of picloram plus 2 lb/gal. of the triisopropanolamine salts of 2,4-D) and picloram were no more effective than low volatile esters of 2,4-D when applied as foliage sprays on canyon live oak (*Quercus chrysolepis* Liebm.) in the Siskiyou Mountains. Twenty numbered shrubs were sprayed to drip point with each of five different formulations of the herbicides in water carriers on July 22, 1964. Results were rated in September, 1965. Means of response for the 20 plants in each treatment were:

Chemical	Rate -ahg-	Shrubs dead --%--	Top kill --%-	Defoliation -----%-----
Tordon 101	0.5	0	0	0
Tordon 101	1.0	0	45	96
Tordon 101	2.0	0	54	97
Picloram	2.0	0	36	89
2,4-D	2.0	0	52	97

Picloram was less effective than either 2,4-D or Tordon 101. Although shrubs sprayed with 2.0 ahg Tordon 101 produced a smaller number of basal sprouts than those sprayed with 2,4-D, the difference was not great enough to be of practical value. (Pacific N. W. Forest and Range Expt. Sta., Forest Service, U. S. Department of Agriculture, Roseburg, Oregon.)

Heated soils induce germination of mountain whitethorn ceanothus seeds. Gratkowski, H. A laboratory-greenhouse experiment has shown that dormant seeds of mountain whitethorn (*Ceanothus cordulatus* Kell.) in forest soils are induced to germinate when forest sites are exposed to slash fires.

Seeds were buried in fine sand heated to soil temperatures of 30°, 45°, 60°, 75°, 90°, 105°, 120°, and 135° Centigrade for periods of 4, 13, 22, 31, and 40 minutes. Each treatment was replicated four times in a 5 x 7 factorial experiment in a randomized block design. Thermocouples and a recording potentiometer were used to control soil temperatures during treatment.

The 30° and 45° C. soil temperatures failed to induce germination. Some seeds germinated after being subjected to the 60° C. soil temperature, but maximum germination was not obtained until seeds were exposed to the 90° and 105° C. soil temperatures. Duration of exposure from 4 minutes (minimum) to 40 minutes (maximum) had no effect at soil temperatures up to 105° Centigrade. Only a small percentage of the seeds germinated after exposure to 120° C. soil temperatures, and germination tended to decrease with increasing duration of exposure at this temperature. The 135° C. soil temperature was lethal to mountain whitethorn seeds.

Soil temperatures that will induce germination of mountain whitethorn seeds within 1½ inches of the surface are developed during broadcast burning of logging slash. Light accumulations of logging slash are most apt to produce germination-inducing temperatures at depths from which mountain whitethorn seedlings are most likely to emerge. Similar soil temperatures also undoubtedly occur during wildfires. (Pacific N. W. Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture, Roseburg, Oregon.)

Chemical control of golden evergreenchinkapin. Gratkowski, H. Effectiveness of a potassium salt of picloram was compared to that of propylene glycol butyl ether esters of 2,4,5-T when applied as foliage sprays on large, mature shrubs of golden evergreenchinkapin (*Castanopsis chrysophylla* var. *minor* (Benth.) A. DC.) in the Siskiyou Mountains of southwestern Oregon. Both herbicides were applied in water carriers using a knapsack sprayer, and 20 shrubs were sprayed to drip point with each formulation. Date of spraying was August 1, 1963; effects were rated in October 1964. Results were:

Chemical	Rate ahg	Shrubs dead %	Top kill %	Defoliation %
Picloram	0.5	0	13	57
Picloram	1.0	0	37	77
Picloram	1.5	15	47	83
2,4,5-T	1.5	0	59	95

Although the 1.5 ahg rate of 2,4,5-T did not kill any shrubs, percentage of top kill was much more uniform than that obtained with 1.5 ahg picloram. This result plus less damage observed on intermingled conifers indicates that 2,4,5-T would be preferable to the potassium salt of picloram in broadcast foliage spraying of chinkapins with intermingled conifers. (Pacific N. W. Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture, Roseburg, Oregon.)

The decarboxylation of 2,4-DB in woody plants. Norris. Logan A. Earlier studies have resulted in speculation that the superior translocation characteristics of 2,4-DB in plants is directly related to the low degree of conversion of 2,4-DB to 2,4-D which has been found in the stem phloem of one species. Equally important, however, from the standpoint of herbicidal effectiveness is the ability of the roots to make this conversion. Experiments were performed to (1) test the hypothesis that different tissues vary in their ability to beta-oxidize 2,4-DB to 2,4-D and (2) to determine if the same type of tissue from several different woody species vary in their ability to make the conversion.

Leaf, stem phloem and root tissues were taken from red alder, vine maple, varnish leaf ceanothus, Douglas-fir and ponderosa pine seedlings grown in sand in the greenhouse. Tissue was collected after the plants had been washed for five minutes in 5 percent Clorox followed by washing with distilled water. The desired tissue was stripped from the plant, weighed, and placed in 125 or 250 ml erlenmeyer flasks equipped with a removable center well. The tissue was incubated for 24 hours at 25° C in the dark with 10 ml of 2.56×10^{-2} M phosphate buffer (pH 6.95) containing 2.47 ppm 2,4-D-1-C^{14}. One ml of 1 percent Pluronic L-62 was added to the leaf tissue medium to aid in wetting waxy surfaces. The removable center well contained 3 to 5 ml of 0.5 N low carbonate NaOH.

The reaction was stopped with 10 ml of 1 N. H_2SO_4, and thirty minutes later the carbon dioxide trapping solution was removed from the center well and barium carbonate prepared and collected in the usual manner and counted in a G. M. Counter.

The uptake of 2,4-DB by the tissue was determined by difference from the activity remaining in the medium after incubation. The medium was extracted with benzene which was counted with a liquid scintillation counter.

Each species was replicated five times except ceanothus where only enough material was available for three replications. Each replication represents a different plant from which experimental material was collected. Included in each run of this experiment was a control flask containing only the incubation medium.

The carbonate counting data were corrected for small differences in respiration rates which were observed among reaction flasks. The average respiratory rate was 7.45 mg CO_2 per 24 hours. The data are expressed as a percentage of the absorbed activity which was recovered as $C^{14}O_2$ in 24 hours. The data were subjected to analysis of variance following log. transformation.

Mean Percent of the Absorbed Activity Recovered as $C^{14}O_2$ in 24 Hours

	Plant Tissue		
Species	Leaves	Stem Phloem	Roots
Alder	4.0	5.3	32.7
Vine maple	2.8	2.1	12.1
Ceanothus	0.4	2.6	36.3
Ponderosa pine	1.0	2.3	9.3
Douglas fir	1.5	1.3	4.6

Analysis of data show that there is no difference in percent conversion between leaves and stems, but the roots of all species converted a greater percentage than either the stems or leaves of any given species. With respect to differences in recovery from root tissue, there is no significant difference between alder and ceanothus, or between vine maple and ponderosa pine. All other differences are significant at the five percent level.

These results confirm the hypothesis that tissue types vary in their ability to convert 2,4-DB to 2,4-D. Some important differences are seen among species for 2,4-DB conversion in the roots. To some extent this can be correlated with the effectiveness of 2,4-DB in screening tests. However, factors other than the ability to make the conversion are also involved in determining the effectiveness of 2,4-DB, although the ability to alter 2,4-DB to 2,4-D is vitally important in the action of this herbicide.

This investigation was supported by Public Health Service Research Grant WP 00477, from the Division of Water Supply and Pollution Control. (Oregon Agric. Exp. Sta., Oregon State University, Corvallis.)

Chemical control of black sagebrush (Artemisia nova). Lee, G. A. and H. P. Alley. This study was conducted to compare the activity of Dacamine (N-oleyl 1, 3-propylene diamine salts of 2,4-D) with other formulations of 2,4-D over extended periods of application. Black sagebrush was treated on five different dates in 1964. The first date of application was May 14 and the last was July 11. The butyl ester of 2,4-D and 2,4-D ester (PGBE) with and without X-77, were also applied as a comparison for dacamine.

The percent control for each chemical at the five dates of application is presented in the following table. Dacamine at 2 and 3 lb/A applied on May 14 resulted in unsatisfactory control of black sagebrush. All the 2,4-D butyl ester and 2,4-D LV ester treatments gave 80 percent or more control on the same treatment date except for 2,4-D butyl ester at 2 lb/A + X-77 which resulted in 76 percent control. Control with dacamine improved on the May 24 treatment date, but 2,4-D butyl ester and 2,4-D LV ester resulted in a higher percent control. Dacamine at 2 and 3 lb/A applied on the June 4 and June 16 treatment dates, the period when sagebrush is actively growing and a majority of spraying is done, gave satisfactory control. All chemical treatments showed a reduction in percent control on the July 11 treatment date. Although no treatment gave 70 percent control, dacamine at 2 and 3 lb/A resulted in 48 percent and 32 percent control respectively, which were the lowest for the treatment date.

Plains larkspur (*Delphinium geyeri* Green) and death camas (*Zygadenus venenosus* Wats.) were prevalent in the area when the plots were established. All formulations of 2,4-D at 2 and 3 lb/A on the five dates of application resulted in good control of these poisonous plants. There was no apparent damage to associated native grasses growing in the sprayed areas.

Conclusions drawn were:

(1) Dacamine does not give satisfactory control over a longer spraying period than other formulations of 2,4-D.

(2) **Dacamine did, however, give satisfactory control during the period when the sagebrush was actively growing and corresponds very closely to the better application dates for the other 2,4-D formulations.**

(3) Dacamine controlled plains larkspur and death camas on all five dates of treatment.

(4) Dacamine caused no apparent damage to associated native grasses. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Percent control of Black sagebrush using Dacamine; 2,4-D butyl ester, with and without X-77 and 2,4-D LVE, with and without X-77, on five different treatment dates.

		Treatment Date				
Chemical*	Rate	May 14	May 24	June 4	June 16	July 11
		Percent Control				
2,4-D butyl ester	2 lb/A	84	83	89	81	62
2,4-D butyl ester	3 lb/A	82	85	85	75	46
2,4-D butyl ester + X-77	2 lb/A	76	82	87	68	63
2,4-D butyl ester + X-77	3 lb/A	84	83	89	78	55
Dacamine	2 lb/A	40	69	87	84	48
Dacamine	3 lb/A	58	57	87	83	35
2,4-D LVE	2 lb/A	88	79	90	56	67
2,4-D LVE	3 lb/A	84	76	76	77	58
2,4-D LVE + X-77	2 lb/A	88	83	68	88	53
2,4-D LVE + X-77	3 lb/A	87	90	74	80	68

* All chemicals were applied in 40 gpa of water. X-77 spreading agent was applied at 1 pt/100 gallons water.

Chemical control of snakeweed (Gutierrezia sarothrae). Alley, H. P. and G. A. Lee. Snakeweed has invaded rangeland in many sections of Wyoming to such an extent that some means of control will be necessary to regain full productivity of the land. Exploratory plots were established with several different chemicals and three different dates of treatment in 1964. The results, one year after application, are presented in the accompanying table.

Picloram at ½ lb/A was the only treatment which gave 100 percent control on all three treatment dates. The amine of 2,4-D at 2 lb/A resulted in 100 percent control in the 1st and 2nd series while picloram + 2,4-D (Tordon-101) at 1 qt/A gave 100 percent control in the 2nd and 3rd series. GC-7887 (hexaflouroacetone trihydrate) at 5 lb/A and picloram + 2,4-D (Tordon 101) at 1 pt/A were not highly effective until the July 25 date of application. Silvex or 2,4,5-T did not give satisfactory control at any rate of application or date used in this experiment. The spreading agent X-77 did not seem to enhance control. In general, the best overall control was obtained on the June 23 treatment date when the snakeweed plants were actively growing. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Percent control of snakeweed using several chemicals applied on three different dates.

		Treatment dates		
Chemical	Rate/A	1st series May 19, 1964	2nd series June 23, 1964	3rd series July 25, 1964
2,4-D amine	1 lb	80	100	85
2,4-D amine	2 lb	100	100	90
2,4-D amine + X-77	1 lb	80	90	80
2,4-D amine + X-77	2 lb	90	100	95
2,4-D LVE	1 lb	75	90	60
2,4-D LVE	2 lb	95	100	95
2,4-D LVE + X-77	1 lb	70	100	70
2,4-D LVE + X-77	2 lb	95	100	90
2,4-D Butyl ester	1 lb	80	70	60
2,4-D Butyl ester	2 lb	75	100	80
2,4-D Butyl ester + X-77	1 lb	70	70	70
2,4-D Butyl ester + X-77	2 lb	80	100	80
2,4,5-T	½ lb	30	30	20
2,4,5-T	1 lb	40	40	30
Silvex	½ lb	30	30	50
Silvex	1 lb	60	50	60
Picloram	¼ lb	90	90	90
Picloram	½ lb	100	100	100
Dicamba	¼ lb	20	20	20
Dicamba	½ lb	70	75	70
GC-7887 (hexaflouro-acetone trihydrate)	2½ lb	40	60	60
GC-7887 (hexaflouro-acetone trihydrate)	5 lb	80	85	100
Tordon-101 (picloram + 2,4-D)	1 pt	80	80	100
Tordon-101 (picloram + 2,4-D)	1 qt	90	100	100

<u>Chemical control of green sagebrush (*Artemisia dracunculus*).</u> Alley, H. P. and G. A. Lee. Green sagebrush has become a problem in many areas throughout Wyoming. Several chemicals at various rates (following table) were applied on May 7 and June 18, 1964. Picloram at ½ lb/A resulted in 95 percent control for the May treatment and 100 percent control for the June treatment. 2,4-D LVE (PGBE) at 3 lb/A and 2,4,5-T at ½ lb/A showed 90 percent control on the earliest treatment date with some reinvasion by green sagebrush. Observations indicate that the picloram and picloram + 2,4-D

treatments resulted in a higher percentage control on the June 18 date while 2,4-D LVE (PGBE), 2,4-D butyl ester and 2,4,5-T resulted in greater control on the May 7 treatment date. Evaluations show a great deal of variation between replications and dates of treatments. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Chemical control of green sagebrush

		Treatment Dates	
Chemical	Rate	May 7, 1964 Ave. % Control[1]	June 18, 1964 Ave. % Control
2,4-D amine	½ lb/A	35	40
2,4-D amine	1 lb/A	40	60
2,4-D amine	2 lb/A	50	65
2,4-D amine	3 lb/A	65	70
2,4-D LVE (PGBE)	½ lb/A	65	40
2,4-D LVE (PGBE)	1 lb/A	75	65
2,4-D LVE (PGBE)	2 lb/A	85	85*
2,4-D LVE (PGBE)	3 lb/A	90*	70*
2,4-D Butyl	½ lb/A	50	20
2,4-D Butyl	1 lb/A	75	25
2,4-D Butyl	2 lb/A	75	40
2,4-D Butyl	3 lb/A	75*	40*
2,4,5-T	½ lb/A	90*	20
2,4,5-T	1 lb/A	65*	25
2,4,5-T	2 lb/A	60	60
Silvex	½ lb/A	55	45
Silvex	1 lb/A	60	55
Dicamba	¼ lb/A	50	40
Dicamba	½ lb/A	50	55
Picloram	¼ lb/A	70	95
Picloram	½ lb/A	95	100
Tordon-101 (picloram + 2,4-D)	1 pt/A	65	85
Tordon-101 (picloram + 2,4-D)	1 qt/A	70	95

* Green sagebrush seedlings growing in treated plots.

[1] Percent control is an average of three replications.

Picloram plus 2,4-D treatment of chaparral in Arizona. Johnsen, Thomas N., Jr. and William L. Warskow. Various rates of a combination of the potassium salt of picloram and alkanolamine salts of 2,4-D were applied by helicopter to wet site chaparral at El Oso, Tonto National Forest, on June 18, 1965. Vegetation responses and picloram residue in forage, soil, ground water, and surface runoff are being determined. This is a report of the initial results. The results of previous tests indicated that picloram plus 2,4-D may more effectively control shrub live oak (Quercus turbinella) than picloram alone. Applications of 2,4-D alone only killed the leaves.

The treatment rates used are shown in the accompanying table. Applications were made at a volume of 10 gpa with a water carrier. Plots varied in size from 1.3 to 7.2 acres; a total of 31.1 acres were treated with herbicides. The plots are on the top of the main ridge in the area, so that the three springs which arise in the treated area probably originate there also.

The initial responses of shrub live oak were promising 4 months after application. Treatment with 1½ lb/A picloram plus 3 lb/A 2,4-D killed 90 percent of the tops of alligator juniper (Juniperus deppeana). The same herbicides at 1 plus 2 lb/A, respectively, killed 65 percent of the tops. Too few juniper trees were treated at the other rates to give reliable data. The control of manzanita (Arctostaphos pringlei) and emory oak (Q. emoryi) were variable in all treatments. Killing of tops of pinyon (Pinus edulis) and ponderosa pine (P. ponderosa) ranged from 70 to 100 percent at both the 1 lb. picloram plus 2-lb. 2,4-D/A and 1½ lb. picloram plus 3-lb/A 2,4-D treatment rates.

Dow Chemical Company is determining the picloram residue. Determinations have been completed only for the water samples collected during the initial 3 months following application. Small amounts of picloram, 0.018 to 0.031 ppm. were present in the overland flow samples. Picloram was present in the spring water only in the samples taken immediately after treatment, and once following a heavy storm in August. At other times spring flows contained no picloram residue. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Forestry Sciences Laboratory, A.S.C., Flagstaff, Ariz., and Salt River Project, Phoenix, Arizona.)

Preliminary response of shrub live oak to applications of picloram plus 2,4-D applied June 18, 1965, at El Oso, Arizona. Observations made on October 19, 1965

Treatment (lb/A)		Top kill (%)	
Picloram	2,4-D	Mature plants	Sprouts
None		0	0
3/4	1½	--[1]	24
1	2	40	24
1½	3	82	64
3½	7	90	80

[1] No mature bushes in these plots

Physiology of bud dormancy in chaparral. Goodin, J. R. and F. L. A. Becker. To determine those factors which control bud dormancy and activation in woody plants, it is necessary to obtain more insight into the nature of growth and development of each species. The fact that brush control involves not only a once-over-lightly clearing of the land but also an expensive maintenance program to control resprouting has led us to a more careful study of those chaparral species which develop large underground crown reserves and are relatively insensitive to herbicides. Our efforts to date have concentrated on two species, scrub oak (*Quercus domosa*) and black sage (*Salvia mellifera*). We are attempting to study (1) physiological and biochemical factors leading to organ differentiation from a relatively undifferentiated tissue mass in sterile culture, and (2) environmental influences on bud dormancy and activation.

We have successfully cultured a number of chaparral species on sterile medium. The auxin-kinetin balance has been investigated in great detail in an attempt to find the optimum concentration combination not only for a maximum growth rate of parenchyma cells, but also for shoot and root differentiation. To date shoot differentiation has not been achieved from an undifferentiated callus mass; however, bud primordia have been activated in tissue explants taken from the nodal region of *Salvia*. The ultimate objective in this experimentation is to initiate buds from an undifferentiated callus, which we believe will provide insight for control of bud dormancy and will eventually relate to field conditions. (Department of Agronomy, University of California, Riverside, California.)

The influence of vegetation manipulation on soil moisture. McKell, C. M. and J. R. Goodin. Soil moisture at the time of range seeding is so critical in areas of limited rainfall as to determine the difference in success and failure. We have established field plots in dense chaparral at two Southern California locations. Replicated treatments consist of (1) all brush removed by hand clearing, (2) brush sprayed with 2,4-D and left standing, (3) brush sprayed with 2,4-D, left standing, and perennial ryegrass sown when the canopy is open, and (4) a control plot left untreated. Soil moisture blocks were placed at 12", 24", and 36" depths at the time that treatments were established.

We have now accumulated soil moisture data for three growing seasons. As anticipated, soil moisture consumption is much higher under a dense cover of chaparral than when the plot is cleared or sprayed with 2,4-D. As soon as regrowth begins, soil moisture begins to fall and continues to do so until growth of the new shoots is once again interrupted. As long as the soil is kept relatively free of top growth, that moisture which does accumulate appears to be stored in the soil. Proper timing of brush control coupled with grass seeding can lead to much greater success in grass seedling establishment than has heretofore been possible. (Department of Agronomy, University of California, Riverside, California.)

Control of gorse and associated species with picloram and 2,4-D. Newton, M. Resistance of gorse to herbicides is a major obstacle to reclamation of some 170,000 acres of land in southwest Oregon. Profuse sprout development and seed germination nullify gains from most spray operations. Preliminary evidence of the effectiveness of picloram on gorse and other legumes suggested continued efforts with this compound.

Fourteen aerial spray plots of four acres each were treated in July, 1964, with picloram and 2,4-D to determine dosage rates acceptable for minimum control. Dosages were 0, 2, 4, 8, and 16 ounces of picloram in combination with four pounds of 2,4-D per acre, replicated; two plots of a commercial preparation of picloram and 2,4-D (tordon 101) applied at the rate of one gallon per acre, and one plot each of picloram only, at rates of eight and 16 ounces per acre. All treatments were applied with a helicopter at the rate of ten gallons per acre. Water only was used as a carrier.

After one and one-half years, the following degrees of kill are noted, according to the Dow Rating System, based on ten observations per treatment:

Treatment		
picloram	2,4-D	Condition class
0	4#	1.4
2 oz.	4	2.4
4	4	1.9
8	4	3.0
16	4	3.8
8	2	3.5
16	0	2.7
8	0	2.5 (approx. poor sample)

Despite the general presence of aerial sprouts on some of the higher application rates, sprouts exist on a relatively small proportion of the shrubs, and there has been substantial improvement in the over-all land reclamation picture. Seeds were found to be germinating in all plots, but it is too early to determine if these will develop further, since there is evidence of picloram activity in soil at this time.

Regarding effectiveness of both chemicals for gorse control, it is concluded at this time that picloram by itself will not give as good control as the mixture of picloram and 2,4-D, despite the general ineffectiveness of 2,4-D alone. Synergistic relationships may be indicated.

Tordon 101 at the one-gallon per acre rate appears to do a reasonable job of control, probably sufficient for re-forestation with vigorous planting stock. There is some evidence, however, that residual picloram in the soil may damage planted Douglas-fir and Monterey pine. Douglas-fir in the plots at the time of treatment was badly damaged but seldom killed by any of the treatments, while lodgepole pine was virtually undamaged by any treatment. Rhododendron was not affected by any treatment, but salal, resistant to most herbicides, was moderately damaged. Bristly manzanita and Pacific madrone appeared to be damaged almost as much by 2,4-D alone as by mixtures with picloram. (Oregon State University School of Forestry, Corvallis.)

<u>Dormant spray requirements for release of Douglas-fir and grand fir.</u> Newton, M. Selective brush control in young stands of conifers in the Pacific Northwest is a well-established practice. Treatments in common use involve two or more pounds of phenoxy herbicides in five to 20 gallons of oil or water-oil emulsion per acre. Applications are made during spring or fall when no visible signs of brush or conifer growth are evident. Treatments used most widely today were developed on the basis of empirical observations of brush kill on widely scattered plots throughout the region.

This report describes results of a factorial dormant spray experiment in terms of five-year growth of released conifers.

In April, 1961, twelve six-acre plots in the vicinity of Corvallis, Oregon, were sprayed with four combinations of two and four pounds of 2,4,5-T in five and ten gallons of total diesel oil solution per acre. Plots were satisfactorily stocked with Douglas-fir and grand fir, but fifty percent of the area was completely dominated by vine maple, hazel brush and many other shrubs and small hardwoods, and relatively few of the conifers could have reached salable size without release.

One year after treatment, evaluation of kill on all brush species indicated little difference between two and four pounds of herbicide, but that ten gallons per acre resulted in substantially better control than five gallons. No effect on conifers was noted at any dosage of chemical or volume of carrier. Three commercial preparations of low-volatile esters gave near-identical results. These initial observations supported completely existing practices.

Four years after the initial observation kill of brush was still relatively the same in the various treatments, and over-all brush cover was still far less than at the time of spraying. Moreover, it will be several more years before the sprouting species will have recovered to their original size. Conifer performance was not consistent with brush kill. Only one variable in the spray treatments had any influence on growth, In the test of five versus ten gallons per acre, five-gallon treatments resulted in growth very close to normal for Douglas-fir, while there was about a twenty percent reduction of growth by ten gallons, despite improved kill of brush. Height of surrounding brush at the time of treatment, herbicide dosage and interactions of all treatment considerations and brush conditions had no influence on growth. Grand fir responded very poorly to release, although a few individuals grew very well.

These results suggest that all treatments provided acceptable control of all brush species for the release of established conifers, despite sprouting of most shrubs and poor kill on some larger trees. Very few conifers more than three feet in height were re-suppressed even with the low-volume treatments, and high volume applications caused growth depression despite a lack of outward damage symptoms.

It is concluded that any spray treatment that will reduce canopy level to a point equal in height or slightly above existing conifers will release the conifers, but that overdosage may depress growth over a period of five years or more. (Oregon State University, School of Forestry, Corvallis.)

Influence of season and dosage on effectiveness of injections for control of Douglas-fir. Newton, M. Recent successes with injections of conifers for thinning and right-of-way maintenance have led to speculation that control measures could be applied throughout the year, with resultant utilization of slack season labor. This report summarized preliminary observations of an experiment to determine minimum dosage requirement for six herbicide preparations on Douglas-fir.

Treatments were applied over an eleven-month period to complete the annual cycle. The six herbicide preparations were: picloram (tordon 22K); picloram and 2,4-D (tordon 101); 2,4-D amine; 2,4-D, 2,4,5-T & TBA amines (ACP63-102); cacodylic acid, 2#/gal.; cacodylic acid, 2.67#/gal. neutralized. Dosage rates were regulated by cut spacing, with one-half milliliter undiluted material placed in cuts spaced at three, six and nine-inch intervals at breast height.

Results given in the accompanying table were responses developed over a period of two to thirteen months, and seasons are listed chronologically in order of time of application. Numerical ratings are based on the following system:

Crown condition	Rating
Healthy	1
Slight discoloration	2
Branch terminals dead, leader and top whorls dead	3
Most of crown dead, few green needles	4
Dead	5

Inasmuch as there is a systematic decrease in effect noted with decrease in time between treatment and observation, (observed in August, 1965) it is suspected at this time that true seasonal differences are unimportant. Dosage differences definitely favor the closer cut spacings, but much of the difference between three and six-inch spacings is contributed by the relatively ineffective 2,4-D and mixture of 2,4-D, 2,4,5-T and TBA, and six-inch spacing with picloram and cacodylic acid consistently providing ratings of 3.4 or higher. This degree of injury is sufficient to remove Douglas-fir from a competitive position in the stand, hence is considered satisfactory control.

Problems of thinning involving insects have not materialized, but root grafting with picloram only has caused mortality of adjacent dominant trees in about one treated tree out of every twenty. No root graft mortality has become evident as the result of treatment with any of the other compounds. (Oregon State University, School of Forestry, Corvallis.)

Response of 25-year-old Douglas-fir to injection according to date of application, dosage (cut spacing), and chemical.

Season	Space between cuts Inches	Tor 22K	Tor 101	2,4-D amine	ACP 63-102	Caco 2#/gal.	Caco 2.67#/gal.	Means
	3	4.8	5.0	2.6	3.0	3.8	---	3.84
June	6	4.2	4.8	2.6	1.6	3.8	---	3.40
	9	4.8	4.6	3.8	1.2	3.4	---	3.56
								3.60
	3	4.6	3.4	2.2	3.0	4.6	4.4	3.70
Sept	6	4.4	3.8	1.4	1.8	3.5	4.4	3.22
	9	3.8	3.6	2.0	2.2	3.6	4.0	3.20
								3.37
	3	5.0	4.4	1.5	2.0	4.5	2.5*	3.32
Nov	6	4.4	3.8	2.4	2.0	4.5	3.8	3.48
	9	4.6	4.2	1.0	1.2	3.6	3.6	3.03
								3.28
	3	4.8	4.8	2.4	1.5	4.2	4.2	3.65
Jan	6	4.0	4.0	1.2	1.0	4.2	3.5	2.98
	9	4.8	4.4	1.4	1.2	2.6	3.5	2.98
								3.20
	3	4.8	3.4	2.6	2.2	4.0	4.6	3.60
March	6	4.2	2.8	2.4	1.3	3.4	3.8	2.98
	9	3.8	4.0	1.5	1.2	3.0	2.6	2.68
								3.09
	3	3.8	3.4	1.8	1.8	3.8	3.8	3.07
May	6	3.4	3.4	1.8	1.4	3.8	4.0	2.97
	9	3.6	3.0	2.8	1.2	3.8	3.2	2.93
								2.99
		4.32	3.95	2.06	1.71	3.78	3.73	
								3.26

Means for spacings:		
	Three-inch	3.53
	Six-inch	3.17
	Nine-inch	3.06

* During the November application, it was found that the hatchet malfunctioned, giving a reduced volume of chemical in each cut, this treatment only.

PROJECT 4. WEEDS IN HORTICULTURAL CROPS

Roman R. Romanowski, Project Chairman

SUMMARY

Five states submitted a total of 18 reports which included observations on vegetable crops, strawberries, ornamental bulbs and turf.

Direct seeded broccoli: A report from Washington indicates that herbicides as trifluralin and CP 31393 will play a key role in establishing completely mechanized broccoli production.

Cantaloupes: Researchers in Texas reported that R-4461 was an outstanding herbicide for possible use with cantaloupes. DCPA, R-4461 and NPA controlled weeds more effectively when incorporated at a 2-inch depth rather than 3/4 inches.

Spinach: Norea has performed well in Washington when used on spinach planted in soils of high fertility with a pH range above 6. This herbicide may alleviate the need of inter-row tillage for processing spinach.

Lettuce: CDEC still appears a favorite in Hawaii for lettuce along with the suggested use of a broadcast application of DCPA after the CDEC is no longer effective at 4 to 5 weeks. Unlike Texas, poor results were obtained with R-4461, but this may be due to a high soil organic matter content in the Hawaii trials.

Celery: Two celery trials conducted in Hawaii indicate that this crop is very tolerant to some excellent herbicides. Prometryne and FW-925 were of special interest.

Tomatoes: PEBC and R-4461 provided excellent weed control with tomatoes in Texas. Diphenamid controlled only barnyard grass in a mixed weed population.

Carrots: Trifluralin and R-4461 were exceptional for weed control in carrots on a sandy clay loam in Texas. Linuron 2 lb/A and prometryne 1½ lb/A reduced yields when used as surface applications as compared to no yield reduction when incorporated.

Onions: With furrow-irrigated onions in Texas, DCPA and R-4461 controlled common purslane, but with rain neither herbicide controlled the weed selectively in onions--CP-31393 had no effect on weed or onion growth. Trials in California indicated that only DCPA gave acceptable weed control and acceptable onion tolerance in preplant soil incorporated trials. In post-plant pre-emergence trials, DCPA, linuron, prometryne 1 lb/A, R-4461, CDAA and CP-31393 exhibited satisfactory onion tolerance. Weed control was marginal at 30 days with prometryne 1 lb/A and R-4461. DCPA, CP-31393 and prometryne 2 lb/A provided 70% or better control 60 days following treatment.

Peas: Of 32 herbicides evaluated in Washington, six showed encouraging results.

Table Beets for seed: Some promising results were obtained by mixing pyrazon with three new herbicides so as to obtain more effective grass control.

Strawberries: Washington reports encouraging results with 3/[(p-(p'chlorophenoxy)-phenyl)]/-1,1-dimethylurea.

Ornamental bulbs: Simazine and linuron are definite candidates for use with iris and daffodils but not with tulips in Washington.

Turf: Four reports were received from Colorado describing results with turfgrass. Dicamba appeared to be more effective than 2,4-D and 2,4,5-T in controlling harebell (*Campanula rapunculoides*), black medic (*Medicago lupulina*) and yarrow (*Achillea lanulosa*). Results are reported for the comparison of five new herbicides for pre-emergence crabgrass control to standards as DMPA, trifluralin, DCPA and Bandane. A three-year study showed that cumulative amounts of Bandane up to 120 lb/A showed no adverse effects on bluegrass. Interesting results were reported for the successful removal of bentgrass from bluegrass with high rates of ammonium sulfate and potassium cyanate. Scientists from Washington state reported that methylol urea and liquid calcium cyanamide were very effective in reducing weed populations in six weeks with no adverse effects on crops sown at six weeks after treatment.

Annual weed control in direct-seeded broccoli. Peabody, Dwight V., Jr. Five, pre-plant soil incorporated, herbicides (bromoxynil, 2-bromo-6'-*tert*-butyl-N-(methoxy-methyl)-O-acetotoluidide, CP31393, 4,5,7-trichlorobenzthiadiazole-2,1,3 and trifluralin) showed activity with good selectivity in direct-seeded broccoli. CP31393 looked especially promising as a new selective herbicide in this crop.

Dependent upon variety, growth, and maturity characteristics, it is now feasible to direct-seed broccoli in rows of close spacing, control weeds with pre-emergence or pre-planting herbicidal treatments, never cultivate and mechanically harvest center heads only in one cutting. Although total yield of marketable broccoli will probably be less from a single harvest of center heads than from a multiple harvest of center heads and side shoots over a period of time, costs of all phases of broccoli production from planting through harvest will be greatly decreased. The key to this completely mechanized method of broccoli production is elimination of annual weed competition with chemical herbicides. Under the right conditions, trifluralin closely approaches this ideal. (Northwestern Washington Research & Extension Unit, Washington State University, Mount Vernon.)

The effects of soil incorporation and time of treatment on the performance of herbicides in cantaloupes. Menges, Robert M. and J. L. Hubbard. Soil-incorporated and unincorporated herbicides and polyethylene film were studied for weed control in furrow-irrigated cantaloupes. With little rainfall, warm temperatures, and significant evaporative losses of soil moisture from Hidalgo sandy clay loam all herbicides controlled Palmer amaranth (*Amaranthus palmeri* S. Wats.) and barnyardgrass (*Echinochloa crusgalli* (L.)

Beauv.) more efficiently when soil-incorporated. Polyethylene film controlled weeds and provided suitable conditions for growth of cantaloupes.

R-4461 was the outstanding herbicide. The herbicide selectively controlled all weeds at 4 or 8 lb/A when soil-incorporated.

DCPA, R-4461, and NPA controlled weeds more effectively when incorporated within the surface 2 in. rather than 3/4 in. of soil whereas CDEC was unaffected by differential depth of incorporation. DCPA selectively controlled weeds at 8 lb/A incorporated 3/4 in. and at 4 lb/A when incorporated 2 in. but reduced the yield at 8 lb/A regardless of the planting date.

CDEC controlled weeds selectively at 6 lb/A incorporated 3/4 in. but when incorporated 2 in., a delay of 10 days in planting was required for selectivity. The rate of water evaporation from soil may be an important consideration with soil-incorporated CDEC. Incorporated CDEC persisted longer in soil than did unincorporated CDEC. (USDA, ARS, CRD, Weed Investigations in Horticultural Crops and Lower Rio Grande Valley Research and Extension Center, Texas Agri. Exp. Sta., Texas A & M Univ., Weslaco, Texas.)

Annual weed control in spinach. Peabody, Dwight V., Jr. Further field testing of norea as a pre-emergence herbicide under managerial practices differing from those accepted as standard has indicated that processing spinach may be grown in rows of close spacing with no inter-row tillage and without hand cultivation. In addition, there is a possibility that under the climatic and edaphic conditions in the Puget Sound region, processing spinach may be over-wintered (fall planted and harvested in early spring) with marked increases in yield. Both of these altered procedures, i.e., fall-planted and/or "close-planted," depend mainly upon the virtual elimination of annual weeds by means of herbicides. The use of norea as a pre-emergence selective herbicide in "close-planted" as well as "over-wintered" spinach has resulted in control of a wide range of common annual weed species with little or no injury to spinach. However, there are two major factors which influence the selective activity of norea in spinach: (1) Weed species of the genus *Polygonum*, namely, *P. persicaria*, *P. convolvulus* and *P. aviculare* exhibit a marked tolerance to the activity of norea - these species are prevalent and common in soils and sites where spinach may be grown, (2) Under marginal or poor conditions of soil acidity for good spinach growth (pH at 5.8 and less), pre-emergence norea applications cause a reduction in the stand of seedling spinach and a severe stunting and leaf chlorosis of those plants that do emerge. Spinach planted in soils of high fertility and pH of 6.0 and higher exhibited no injury symptoms. (Northwestern Washington Research & Extension Unit, Washington State University, Mount Vernon.)

Secondary lettuce herbicide screening trials in Hawaii. Romanowski, R. R., P. J. Ito and J. S. Tanaka. The lettuce growers in Hawaii are still in need of effective long lasting herbicides for use in lettuce culture. CDEC has been very helpful during the first 3 to 4 weeks of lettuce growing, but its effectiveness seldom lasts more than 5 weeks in most areas. Three secondary screening trials were conducted to evaluate some of the newer herbicides for use with lettuce. Two experiments were conducted at the Lalamilo Branch Station on a Waimea fine sandy loam (8 percent organic matter) and a third experiment on a Manoa silty clay loam (2 percent organic matter). All spray mixes were applied at the rate of 40 gpa and 30 p.s.i. of pressure. The experimental results are contained in the following three tables.

CDEC, CIPC, IPC, R-4461, benefin, diphenamid and DCPA (applied at 2 weeks after sowing) all appeared relatively safe on lettuce under the test conditions. Trifluralin was not phytotoxic on the high organic matter soil, but injury was incurred on the Manoa soil. DCPA and FW-925 applied immediately after sowing resulted in severe crop phytotoxicity. It appears that CDEC applied at sowing followed by DCPA applied as an over-the-plant spray at 3 to 5 weeks to a weed free soil should be considered for further experimentation and trial use by growers in Hawaii. The soil residual of DCPA under a continuous cropping cycle will have to be evaluated. (University of Hawaii, Department of Horticulture, Honolulu, Hawaii.)

Lettuce tolerance and weed control response to the herbicides, Lalamilo Station, Experiment No. 1[1]

	July 24, 1964 (4 weeks)			
	Crop Rating[2]	Weed Rating		
Treatment (lb active/acre)	Early Great Lakes	*Portulaca oleracea*	*Amaranthus* spp.	*Coronopus didymus*
1. Check, late cultivation	1.3	1.0	1.0	1.0
2. Check, cultivated	1.8	4.5	4.8	4.8
3. CDEC 4#	2.0	4.8	4.0	2.8
4. CDEC 6#	2.0	4.8	4.5	3.3
5. IPC 6#	2.0	4.0	2.0	2.5
6. DCPA 6#	3.0	5.0	4.3	2.8
7. DCPA 10.5#	3.8	5.0	4.5	3.8
8. FW-925 6#	4.3	5.0	4.8	4.5
9. Diphenamid 6#	2.0	2.8	4.0	3.5
10. R-4461 4# (soil incorporated)	1.0	1.0	1.0	1.0
11. IPC 6# (soil incorporated)	1.0	5.0	1.5	2.5
12. Trifluralin 2# (soil incorporated)	1.0	4.5	4.0	2.0
13. Trefmid W-50 7# (soil incorporated)	1.5	4.3	4.3	4.0
14. Trifluralin 4#	2.8	4.8	4.8	2.3
L.S.D. 5% (1%)	1.0(1.4)	0.9(1.2)	1.1(1.5)	1.5(2.0)

[1] Field preparation June 22, 1964; Trts. 10-13 soil incorporated June 24; seed sown June 24; all other Trts. applied on June 25; Experimental design - Randomized complete block with 4 replicates.

[2] Weed Rating: 1 - no control, 2 - slight, 3 - fair, 4 - good (commercially acceptable), 5 - complete.
Crop Rating: 1 - no injury, 2 - slight, 3 - moderate, 4 - severe, 5 - dead.

Lettuce tolerance and weed control response to the herbicide, Lalamilo Branch Station, Experiment No. 2[1]

	July 2, 1965 (5 weeks)			
	Crop Rating[2]	Weed Rating		
(lb active/acre)	Early Great Lakes	Portulaca oleracea	Amaranthus spp.	Coronopus didymus
1. Check, late cultivation	1.0	1.0	1.0	1.0
2. Check, cultivated	1.0	4.0	4.3	4.3
3. Benefin 1#)	1.0	1.5	1.5	1.5
4. Benefin 1¼#) soil	1.0	1.5	1.8	1.0
5. Benefin 2½#) incorporated	1.0	3.5	3.3	1.8
6. Benefin 2½#	1.0	2.8	3.0	1.5
7. Trifluralin 3/4#)	1.0	3.3	3.0	1.3
8. Trifluralin 1#) soil	1.0	2.5	2.5	1.8
9. Trifluralin 2#) incorp.	1.0	4.0	4.0	2.5
10. Trifluralin 2#	1.8	3.8	3.8	1.8
11. CDEC 6#	1.0	3.8	3.5	2.5
12. CIPC 6# (soil incorporated)	1.0	3.5	2.0	1.8
13. CIPC 6#	1.5	4.5	3.0	2.5
14. R-4461 8# (soil incorporated)	1.0	1.3	1.3	1.0
15. DCPA 10.5#	4.0	5.0	5.0	1.8
16. DCPA 10.5# at 2 weeks	1.3	4.0	3.5	1.5
L.S.D. 5% (1%)	0.2(0.3)	0.8(1.1)	0.8(1.1)	1.1(1.4)

[1] Field preparation May 24, 1965, soil incorporated trts. applied May 24; seed sown May 25; pre-emergence sprays applied May 26; Trt. No. 16 over-the-plant spray on June 10; Experimental design - Randomized complete block with 4 replicates.

[2] For rating scale, see footnote No. 2, preceeding table.

Lettuce tolerance and weed control response to the herbicides, Manoa Campus Farm, Experiment No. 3[1]

	Crop Rating 7 weeks[2]	Weed Response - 4 weeks (No. of weeds/sq. ft.)		
Treatment (lb active/acre)	Green mignonette	Eleucine indica	Portulaca oleracea	Amaranthus spinosus
1. Check, late cultivation	3.3	38.0	73.0	9.0
2. Check, cultivated	1.7	0	0	0
3. CDEC 6#	1.3	4.0	4.3	2.3
4. Benefin 1#)	1.7	2.6	7.6	1.3
5. Benefin 1¼#) soil incorporated	1.3	2.1	4.6	0
6. Benefin 2½#)	1.7	1.3	1.3	0
7. Benefin 2½#	1.3	0.3	2.0	0.6
8. Trifluralin 1#) soil	2.7	0	0	0
9. Trifluralin 2#) incorp.	3.3	0	0	0
10. Trifluralin 2#	2.7	0	0.6	0
L.S.D. 5% (1%)	0.9(1.3)	3.6(4.9)	7.8(10.7)	1.7(2.4)

[1] Field preparation July 26, 1965; soil incorporated Trts. July 26; lettuce sown July 26, pre-emergence treatments applied July 27; lettuce resown on Aug. 2.

[2] For rating scale see footnote No. 2, first table.

Celery herbicide screening trials in Hawaii. Romanowski, R. R., P. J. Ito and J. S. Tanaka. Two celery trials were conducted at the Lalamilo Branch Experiment Station located on the island of Hawaii at an elevation of 3,200 feet. The soil type is a Waimea fine sandy loam and rainfall is rather sparse during the summer months, hence overhead irrigation was applied as needed. The herbicides were applied either as "preplant soil incorporated" treatments or as "over-the-plant" spray immediately after transplanting and again in some treatments two weeks after transplanting. Back-mounted fiberglass tanks were used to apply a total of 40 gpa spray mix at 30 p.s.i. of pressure.

The results (following tables) show that prometryne and FW-925 exhibited excellent weed control under the test conditions. These two herbicides look especially promising in that they both removed small existing weeds at the time of treatment at two weeks. From all indications the celery plants are able to withstand the application of a broad spectrum of herbicides which are of interest for weed control in vegetable crops. (University of Hawaii, Department of Horticulture, Honolulu, Hawaii.)

Celery tolerance and weed control response to the herbicides, Experiment No. 1[1]

	Oct. 1		July 24 (Weed Rating)[2]			
	Av. Wt./Stalk (lb)					
Treatment (lb active/acre)	Utah 15	Tall Utah 52-70	Portulaca oleracea	Amaranthus spp.	Coronopus didymus	Pennisetum clandestinum
1. Check, late cultivation	0.9	1.0	1.0	1.0	1.0	1.5
2. Check, cultivated	1.0	1.1	3.8	3.3	4.0	4.0
3. CDEC 6#	0.9	1.1	5.0	3.8	4.3	1.3
4. Prometryne 4#	1.0	1.0	5.0	5.0	5.0	4.8
5. Amiben 4#	0.9	1.2	5.0	4.8	5.0	5.0
6. Chloroxuron 6#	0.9	1.2	5.0	5.0	5.0	3.0
7. DCPA 10.5#	0.8	1.0	5.0	4.3	2.3	2.3
8. Diphenamid 6#	0.9	1.3	4.0	4.5	4.0	4.8
9. Norea 2#	0.9	1.1	5.0	3.8	5.0	4.0
10. R-4461 4# (soil incorp.)	0.9	1.1	1.5	1.0	1.0	2.8
11. Trifluralin 2# (soil incorporated)	0.8	1.1	4.8	4.0	3.5	5.0
12. Stoddard Solvent 80 gals/A at 2 weeks	0.8	1.0	5.0	5.0	5.0	5.0
13. FW-925 6# at 2 weeks	1.0	1.1	5.0	5.0	4.8	5.0
14. Prometryne 4# at 2 weeks	1.0	1.2	5.0	5.0	5.0	5.0
L.S.D. 5% (1%)	n.s.	n.s.	1.0(1.4)	0.9(1.2)	1.2(1.6)	1.4(1.8)

[1] Field preparation June 24, 1964; R-4461 and trifluralin incorporated into soil June 24; all other initial over-the-plant sprays June 25. Trts. 12, 13 and 14 applied over-the-plants on July 7; Experimental design - Randomized complete block with 4 replicates.

[2] Weed Rating: 1 - no control, 2 - slight, 3 - fair, 4 - good (commercially acceptable), 5 - complete control.

Celery tolerance (cv. Spartan) and weed response to the herbicides, Experiment No. 2[1]

Treatment (lb active/acre)	July 2	July 2 (Weed Rating)	
	Celery Rating[2]	<u>Portulaca oleracea</u>	<u>Amaranthus spp.</u>
1. Check, late cultivation	1.0	1.0	1.0
2. Check, cultivated	1.0	3.3	3.3
3. CDEC 6#	1.0	1.0	1.0
4. CIPC 6#	1.0	2.8	2.8
5. CDEC 4# + CIPC 3#	1.0	5.0	5.0
6. Prometryne 2#	1.0	5.0	5.0
7. Prometryne 4#	1.0	5.0	5.0
8. Benefin 2½# (soil incorporated)	1.0	2.3	2.3
9. R-7465 6#	1.0	4.0	4.8
10. FW-925 6# at 2 weeks	1.0	5.0	5.0
11. Stoddard Solvent 80 gal/A at 2 weeks	1.0	4.5	4.3
12. Prometryne 4# at 2 weeks	1.0	5.0	5.0
L.S.D. 5% (1%)	n.s.	0.8(1.1)	1.1(1.5)

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[1] Field preparation May 24, 1965; Benefin incorporated May 26; field transplanting May 26; all other initial over-the-plant applications May 26; Trts. 10, 11 and 12 sprayed over-the-plants on June 10; Experimental design - Randomized complete block with 4 replicates.

[2] Crop Rating: 1 - no injury; 2 - slight; 3 - moderate; 4 - severe; 5 - dead.

<u>Preplanting and pre-emergence weed control in tomatoes.</u> Menges, Robert M. and J. L. Hubbard. Herbicides were soil-incorporated to study their effectiveness in the control of Palmer amaranth (<u>Amaranthus palmeri</u> S. Wats.) and barnyardgrass (<u>Echinochloa crusgalli</u> (L.) Beauv.) in furrow-irrigated tomatoes. Under relatively low soil temperatures, little rainfall and high evaporation in the Hidalgo sandy clay loam, PEBC and R-4461 controlled all weeds at 5 lb/A whereas diphenamid controlled only barnyardgrass at 10 lb/A. No herbicide treatment decreased the yield of tomatoes, although weeds competed for yield. (USDA, ARS, CRD, Weed Investigations in Horticultural Crops and Lower Rio Grande Valley Res. and Ext. Center, Texas Agri. Exp. Sta., Texas A & M University, Weslaco.)

<u>Effects of soil incorporation and time of seeding on the performance of herbicides in furrow-irrigated carrots.</u> Menges, Robert M. and J. L. Hubbard. Soil surface and soil-incorporated applications of herbicides were studied for control of barnyardgrass (<u>Echinochloa crusgalli</u> (L.) Beauv.) in carrots field-grown in cool, wet Hidalgo sandy clay loam.

Trifluralin, 3/4 lb/A, and R-4461, 4 lb/A, were outstanding for selective weed control with rain regardless of soil incorporation or the time of planting with incorporation.

Linuron controlled grass selectively at 1 lb/A without incorporation and 2 lb/A with incorporation; carrots were injured only with the 2 lb/A surface application.

Prometryne controlled grass at 1½ lb/A regardless of soil incorporation and reduced the yield only in surface applications; 3 lb/A reduced yield regardless of incorporation. (USDA, ARS, CRD, Weed Investigations in Horticultural Crops and Lower Rio Grande Valley Res. and Ext. Center, Texas Agric. Exp. Sta., Texas A & M Univ., Weslaco.)

Effect of depth of soil incorporation and time of seeding on the performance of herbicides in furrow-irrigated onions. Menges, Robert M. and J. L. Hubbard. Soil-incorporated and unincorporated herbicide applications were compared for weed control in furrow-irrigated onions. DCPA and R-4461 controlled common purslane (Portulaca oleracea L.) but with rain neither herbicide controlled the weed selectively in onions, regardless of incorporation depth or time of planting.

CP-31393 had no effect on weed or onion growth regardless of method or rate of application.

Temperatures ranged from 64 to 95° F at the ½-in. depth in the Hidalgo sandy clay loam. (USDA, ARS, CRD, Weed Investigations in Horticultural Crops and Lower Rio Grande Valley Res. and Ext. Center, Texas A & M Univ., Weslaco.)

Effects of several herbicides on southport white globe onions grown under furrow and sprinkler irrigation. Agamalian, H. and A. H. Lange. Preplant soil incorporated, post-plant surface, and post-emergence applications were made on two soil types. Plot treatments were 2 rows, 50 feet in length with 4 replications.

Preplant, soil incorporated: Herbicides were incorporated at the 2-3 inch depth of a Metz fine sandy loam. The onions were seeded following treatment and furrow irrigated. The following weeds were present in the control: Amaranthus retroflexus L., Solanum sarachoides, Sendt., Chenopodium album L., Portulaca oleracea L., and Capsella Bursa-pastoris L.

Data presented in the following table indicated that only DCPA at 6 and 12 lb/A gave acceptable weed control and crop tolerance. The stand reduction observed at the 12 lb/A rate did not affect yields due to the larger bulb size resulting from the wider spacing. The larger bulbs are not desired by the dehydrator-processor. All other herbicides provided excellent weed control, but limited onion tolerance resulted in excessive stand reductions.

Postplant pre-emergence, non-incorporated: Herbicide treatments were made to the surface of a Salinas clay loam. A 2 in. sprinkler irrigation was applied 4 hours following treatment. Weed species present in the control were Urtica urens L., Chenopodium album L., Stellaria media L., Amaranthus retroflexus L., Senecio vulgaris L., Malva parviflora L. and Solanum sarachoides, Sendt.

With the exception of prometryne 2 lb/A (following table) all herbicides tested in this experiment provided accepted onion tolerance. Weed control 30 days following planting was marginal with prometryne 1 lb/A (no control of Malva sp.) and R-4461 at 6 and 12 lb/A (poor control of Urtica sp.). All others were acceptable. DCPA 6 and 12 lb/A, CP 31393 6 lb/A and prometryne 2 lb/A continued to provide 70% or better weed control 60 days following treatment.

Post emergence: Herbicides were sprayed on the onions at the 2-3 true leaf stage. The following weed species varied from 1 to 3 in. in height at time of treatment: Portulaca oleracea L., Capsella Bursa-pastoris L., Urtica urens L., Chenopodium album L., Stellaria media L., Amaranthus retroflexus L., Senecio vulgaris L., Malva parviflora L., and Solanum sarachoides Sendt.

Linuron at 1 lb/A (following table) when applied in this manner did not control Senecio sp. Initial crop symptoms were evident by a decombent growth and this symptom was not evident 4 weeks following treatment. Linuron at 2 lb/A provided excellent weed control, but caused some stand reductions.

The bromoxynil ester and potassium formulations are extremely weak on Urtica urens and Portulaca oleracea, resulting in poor weed control in this test. Potassium formulations possessed a greater onion tolerance than the ester. (University of California Agriculture Extension Service, Salinas, California.)

Preplant, soil incorporated

Herbicide	Lb/A	% Weed Control	Phytotoxicity	Per Cent Yield of Control
DCPA	6	82	1	101
DCPA	12	86	4	101
CDAA	4	75	1	95
CDAA	6	81	3	89
IPC	4	98	8	10
CIPC	3	97	9	5
R-2063	4	99	6	50
R-2063	6	94	8	10
control	0	--	0	100

* 10 = completely dead

Post-plant, pre-emergence, non-incorporated

Herbicide	Lb/A	% Weed Control 4/24/65	% Weed Control 5/24/65	Plants/2 ft. of row	toxicity	Per Cent Yield of Control
DCPA	8	95	70	15	0	100
DCPA	12	100	88	14	1	100
Linuron	1	85	47	16	0	100
Linuron	2	92	65	18	1	100
Prometryne	1	65	33	14	0	100
Prometryne	2	100	91	5	5	60
R-4461	6	62	27	16	0	100
R-4461	12	60	22	13	0	100
CDAA	4	100	40	15	0	100
CP 31393	2	78	18	14	0	100
CP 31393	4	100	41	15	1	100
CP 31393	6	100	80	16	1	102
Control						

Post-emergence on the onions

Herbicide	Lb/A	% Weed Control	Phytotoxicity	Per Cent Yield of Control
Linuron	1	83	1	100
Linuron	2	100	2	80
Potassium cynate	12	90	0	100
DNBP	3/4	70	0	100
Bromoxynil ester	3/4	70	3	90
Bromoxynil potassium	¼	1	0	100
Bromoxynil potassium	½	2	0	100
Bromoxynil	3/4	20	2	90
Control	0	0	0	100

Herbicide evaluation field test in processing peas. Peabody, Dwight V., Jr. Of the 32 different herbicides evaluated as pre-planting soil-incorporated treatments in processing peas, six showed high promise as selective herbicides in this crop: 1,1-dimethyl-3-((3-(N-*tert*-butylcarbamyloxy)phenyl))urea, 5-chloro-3-*tert* butyl-6-methyluracil, 5-bromo-3-*tert* butyl-6-methyluracil, N-(p-bromophenyl)-N'-methyl-N-methoxyurea, 3-(m-trifluoromethylphenyl)-1, 1-dimethylurea, and 1-phenyl-3-methyl-5-allyl-hexahydro-1, 3,5-triazinone-2. Almost as effective and selective were 4,5,7-trichlorobenzthiadiazole-2,1,3, "BV 201," 2-chloro-N-isopropylacetanilide, norea and

1-(3,4-dichlorophenyl)-3,5-dimethylhexahydro-1,3,5-triazinone-2. Some of these materials (1,1-dimethyl-3-((3-(N-tert-burylcarbamyloxy)phenyl))urea, 5-chloro-3-tert butyl-6-methyluracil and 5-bromo-3-tert butyl-6-methyluracil) demonstrated high activity (with selectivity) at 0.5 lb ai/A. The activity of most of these promising compounds had not been completely dissipated almost five months after application as determined by bioassay. (Northwestern Washington Research & Extension Unit, Washington State University, Mount Vernon.)

Annual weed control in table beets for seed. Peabody, Dwight V., Jr. Pyrazon has continued to show a high degree of selectivity in beets grown for seed. However, the two principal disadvantages to its wide-spread acceptance are high cost (due to the necessity of two applications in one growing season) and low activity on grassy weeds. This year's results indicate that these disadvantages might be overcome by combining pyrazon with any one of three new herbicides, 2-chloro-N-isopropylacetanilide, 2-bromo-6'-tert-butyl-N-(methoxymethyl)-O-acetotoluidide, and bromoxynil. These compounds, when combined with pyrazon at "half-rates" and applied soon after planting, resulted in better weed control for a longer period of time than the presently recommended pyrazon treatment. This year's results also show that beet stecklings planted in "close" (20 in.) row spacings and treated with pyrazon mature earlier and yield more seed than beets planted in the conventional manner. A combination of these techniques is indicated, namely, pyrazon at a low rate plus a grass killer applied soon after planting to beets in row spacings of approximately 20 in. (Northwestern Washington Research & Extension Unit, Washington State University, Mount Vernon.)

Selective weed control tests with 3-[(p-(p'chlorophenoxy)-phenyl)]-1,1-dimethylurea in strawberry plantings. Peabody, Dwight V., Jr. Repeated applications of 3-[(p-(p'chlorophenoxy)-phenyl)]-1,1-dimethylurea at low rates did not replace all cultivation and hand-hoeing. Resistant weed species, necessary mechanical management techniques (row trimming, fertilizer side-dressing, etc.) and soil tilth, are factors which contribute to the poor growth and lower yield of strawberries managed without cultivation. Although chemicals will probably not eliminate mechanical methods of weed control in strawberry plantings, selective herbicides should reduce the number of cultivations and perhaps eliminate hand-weeding and hoeing.

Tests undertaken at off-station sites in northwestern Washington under conventional managerial practices further demonstrated the effectiveness and safety of 3-[(p-(p'chlorophenoxy)-phenyl)]-1,1-dimethylurea as a selective herbicide in strawberry plantings. A wide range of weed species were controlled under many different environmental conditions. This herbicide caused little or no strawberry injury even at rates in excess of those prerequisite for good weed control. (Northwestern Washington Research & Extension Unit, Washington State University, Mount Vernon.)

Annual weed control in ornamental bulbs (bulbous iris, daffodils, and tulips). Peabody, Dwight V., Jr. Results of the 1964-65 field tests of pre-emergence selective herbicides in ornamental bulbs were greatly influenced by two factors: (1) high water with actual flooding of part of the test area for more than two weeks in late winter and (2) a drastic change in plot technique, i.e., planting a very small number of bulbs in small wire-bottomed trays. As a result of these conditions, experimental error was increased with a concomitant loss of some information. Nevertheless, some general trends were indicated: (1) simazine, contrary to results of previous years, seems to be safe and effective for use as a pre-emergence herbicide in bulbous iris and King Alfred daffodils (but not in tulips); (2) pre-emergence application of linuron also exhibits good selective weed control in iris and daffodils, but not tulips, substantiating previous work; (3) although dichlobenil seems to be fairly safe in ornamental bulbs, it does not perform at the level of annual weed control obtained with simazine and linuron applications.

In a test comparing combinations of post- and pre-emergence application of different substituted-urea herbicides, it appears that the earlier post-emergent applications are causing less bulb yield reduction and resulting in better season-long annual weed control. Further experimentation is needed to determine the best combination of pre- and post-emergent substituted-urea applications.

Off-station testing of linuron and dichlobenil indicated that linuron resulted in excellent annual weed control and dichlobenil greatly reduced field horsetail infestations in bulb fields at rates which caused no obvious signs of injury to ornamental bulbs. (Northwestern Washington Research & Extension Unit, Washington State University, Mount Vernon.)

Recent work in controlling hard-to-kill weeds in turfgrass. May, J. W., H. M. Hepworth and Jess L. Fults. Experimental plots treated on August 3, 1965, and evaluated on September 14, 1965, comparing dicamba and 2,4-D for the control of creeping harebell (*Campanula rapunculoides*) in bluegrass turf showed considerable promise in favor of dicamba with respect to eliminating this persistent perennial weed.

Dicamba applied at ½ and 1 lb/A gave 95 percent top kill of harebell. 2,4-D alone at 2 lb/A resulted in only 50 percent control of the weed, and 1 lb 2,4-D plus 1 lb 2,4,5-T had little effect on harebell.

All chemical applications considered above completely controlled dandelions, kochia, and knotweed present in the treated plots, and there was no visual damage to bluegrass turf. Experiments were conducted in Fort Collins, Colorado, and represent only one season's observations. Final evaluation will be made during the spring and summer of 1966.

2,4-D, 2,4,5-T and dicamba were applied to plots in Denver, Colorado, for the control of black medic (*Medicago lupulina*). Applications were made August 16, 1965, and evaluations were made on September 15, 1965.

This data indicates control may be obtained with dicamba at considerably lower rates than with the phenoxy compounds for eradication of black medic in bluegrass-fescue turf.

Dicamba at 2 lb/A was compared to 2,4-D plus 2,4,5-T at 1 plus 1 lb/A for the control of yarrow (*Achillea lanulosa*) in bluegrass-bent turf in Denver, Colorado. Application was on August 16, 1965 and evaluation was made September 15, 1965. Results showed 100 percent initial top kill with dicamba and 40 percent control with the 2,4-D plus 2,4,5-T combination.

Final evaluations will be made in the spring and summer of 1966. (Botany and Plant Pathology Section, Colorado Agri. Expt. Sta., Colorado State University, Fort Collins.)

Chemical control of black medic

Treatment	Rate - lb/A	% control of black medic
1. Dicamba	½	98
2. Dicamba	1	96
3. 2,4-D	1	55
4. 2,4-D	2	90
5. Dicamba + 2,4-D	½ + 1	97
6. Dicamba + 2,4-D	¼ + 1½	100
7. 2,4-D + 2,4,5-T	2	100
8. Dacamine (oil soluble 2,4-D amine)	2	100

Comparison of nine pre-emergence crabgrass herbicides for use in bluegrass turf. May, J. W., H. M. Hepworth and Jess L. Fults. Nine compounds were evaluated for pre-emergence crabgrass control in Greeley, Colorado during 1965. Four of these materials, DMPA, trifluralin, DCPA, and bandane have been previously recommended for use as pre-emergence crabgrass herbicides in Colorado; five were newer compounds included on an experimental basis. The new compounds were Azak (2,6-di-tert-butyl-p-tolyl-methylcarbamate), Sindone 296-B (1,1-dimethyl-4,6-diisopropyl-5-indanyl ethyl ketone), R-4461 (N-(beta-O,O di-isopropyl di-thiophosphoryl ethyl)-benzene sulfonamide), SD-11831 (aniline, 4-(methylsulfonyl)-2,6-dinitro-N,N-dipropyl), and tupersan (1-(2-methylcyclohexyl)-3-phenylurea).

Chemicals were applied on April 21, 1965, and evaluation was on August 21, 1965. All materials were applied pre-emergence to crabgrass by mixing with 2 qts. of water and sprinkling over 25 sq. ft. plots with an ordinary sprinkle can. Three replications of each treatment were used. The experimental design was a systematic block arrangement. Three blocks were used and within each block there were 9 treatments and one control systematically arranged.

The method of evaluation was based on the use of a 5' x 5' quadrat covering the entire 25 sq. ft. for any one treatment. The quadrat was divided into 9 equal sub-units and in every case each of the 9 sub-units was observed for the presence of crabgrass. An arbitrary visual rating of "0" was given to sub-units with no crabgrass, "1" for units with 1 or 2 crabgrass plants, "2" for units with 2 to 10 crabgrass plants, "3" for units with 10 to 50 plants, and "4" for units with over 50 crabgrass plants. In this manner both density and distribution within the whole quadrat unit were considered.

Comparison of nine pre-emergence crabgrass herbicides

	Compound	Rate Lb/A a.i.	Rating*
1.	Azak	10.0	0.00
2.	DMPA	15.0	0.00
3.	Trifluralin	1.5	0.00
4.	296-B	12.0	0.00
5.	296-B	10.0	0.00
6.	296-B	8.0	0.03
7.	DCPA	10.0	0.03
8.	Bandane	35.0	0.03
9.	DCPA	8.0	0.10
10.	R-4461	10.0	0.10
11.	SD-11831	1.0	0.27
12.	SD-11831	2.0	0.37
13.	Tupersan	20.0	0.43
14.	DCPA	6.0	0.63
15.	SD-11831	0.5	1.13
16.	Bandane	15.0	1.23
17.	Control	--	2.14

* A rating of "0" is equal to complete control of crabgrass; a rating of "4" is equal to heavy infestation with no control. In this case control plots averaged a rating of 2.14.

One factor contributing to the low density of crabgrass this year may have been the occurrence of unusually cool-wet conditions in June and July. The average daily temperature for June was -1.7° F and July -0.6° F. The total precipitation for June was +2.41 inches and July +2.20 inches above the long time average. This year no germinating crabgrass was observed until May 26, 14 days later than on the average year for the period 1959-1965. This late germination of crabgrass plus the wet and cool conditions of June and July were correlated with almost complete replacement of crabgrass by white clover in bluegrass turf on our test area at Luther Park, Greeley, Colorado. (Botany and Plant Pathology Section, Colorado Agri. Expt. Sta., Fort Collins.)

Selective removal of bentgrass from bluegrass turf with potassium cyanate and nitrogen fertilizers--a progress report. Hepworth, H. M., J. W. May, and Jess L. Fults. The use of potassium cyanate and high rates of nitrogen fertilizers as selective herbicides for removal of bentgrass from bluegrass turf has been explored during the growing seasons of 1963, 1964 and 1965. Results from 1963 and 1964 indicated that a concentrated water solution of aqueous ammonia (NH_4OH) applied at 20.7 lb of N/1000 sq. ft. was the most promising of five chemicals tested. Treatment in early August followed by reseeding with bluegrass seven days later appeared to be the most successful treatment. During the 1965 season this technique was used on several home owners' lawns in south Denver where bentgrass in bluegrass turf is a wide-spread problem. Although an aqueous ammonia solution was again highly effective as a selective contact herbicide it proved to be too hazardous for use under home owner conditions. Even in rather still air the unpleasant ammonia fumes could not be controlled. Severe irritation to the nose and eyes of the applicator and burning of nearby trees, shrubs and flowers resulted. These features would make the practice generally unacceptable to the average home owner.

As an alternative to using aqueous ammonia, two other chemicals have been tested. They were ammonium sulfate at 100 lb/1000 sq. ft. and potassium cyanate at 20 lb/1000 sq. ft. applied in water solution. These rates are equivalent to 20 lb of N/1000 sq. ft. for the ammonium sulfate and 4 lb of N/1000 sq. ft. for the potassium cyanate. Both of these materials produced excellent contact top-kill of the mixed turf. Bluegrass shows considerable ability to recover while bent does not. Neither material produced objectionable fumes or caused any damage to adjacent trees or flowers. Reseeding wtih bluegrass seed in late August at a rate of 3 lb/1000 sq. ft. resulted in well-established seedlings by November 1, except under conditions of excessive bentgrass thatch. Removal of excessive thatch before seeding seems desirable. Use of this practice may require considerable judgement on the part of the home owner. Treatment of small "spots" of bentgrass in bluegrass may not be objectionable provided the remaining turf is fertilized with the equivalent of 2 lb N/1000 sq. ft, concurrent with the selective herbicide treatment to reduce the growth differential turf color resulting from the high "N" application. When the bentgrass "spots" are large or the infestation occurs throughout the turf, treatment of the whole area may be advisable. One such trial is in progress. Observations and measurements will be continued during 1966. (Botany and Plant Pathology Section, Colorado Agri. Expt. Sta., Fort Collins.)

Toxicity study of bandane used over three-year period for control of crabgrass in bluegrass turf. May, J. W., H. M. Hepworth and Jess Fults. Tests in Luther Park located in Greeley, Colorado, were conducted to determine any detrimental effects associated with repeated applications of high rates of bandane (polychlorocyclo pentadiene isomers).

Bandane was applied in the granular form beginning in 1962. A second application was made in 1963, and a third in 1965. Cumulative amounts of bandane at the end of the third treatment were 0, 60, 80, 90 and 120 lb/A.

	1st year	2nd year	3rd year	Total
A	30 lb/A	15 lb/A	15 lb/A	60 lb/A
B	30 lb/A	30 lb/A	30 lb/A	90 lb/A
C	40 lb/A	40 lb/A	40 lb/A	120 lb/A
D	40 lb/A	20 lb/A	20 lb/A	80 lb/A
E	Control	Control	Control	0

Effect of methylol urea and liquid calcium cyanamide on weed seed viability. Peabody, Dwight V., Jr. Methylol urea at 200 and 400 gpa and liquid calcium cyanamide at 100, 200 and 400 gpa were highly effective in reducing the annual weed population to insignificant amounts six weeks after applications.

At this time crop plants could be planted and subsequently grown with no injury in soil treated at rates of 200 gpa of methylol urea and 100 gpa of liquid calcium cyanamide. These materials in addition to having activity as fumigants (killing soil-borne insects, pathogens and weed seed) are fertilizers containing relatively high percentages of nitrogen that are available as plant nutrients. (Northwestern Washington Research & Extension Unit, Washington State University, Mount Vernon.)

PROJECT 5. WEEDS IN AGRONOMIC CROPS

W. E. Albeke, Project Chairman

No Summary Submitted by the Project Chairman

Evaluation of ioxynil and bromoxynil formulations for selective control of fiddleneck (Amsinckia intermedia) in winter wheat. Rydrych, D. J. and D. G. Swan. Fiddleneck control has been difficult using the various 2,4-D formulations because early treatments or fall treatments would injure wheat and later treatments failed to control the weeds. Ioxynil and bromoxynil were found to be highly selective in cereal grains and treatments could be made early without injury. In addition, the two compounds were effective in controlling fiddleneck. Several formulations of each compound were tested in 1965.

Weed species in the area included tumbling mustard (Sisymbrium altissimum) and fiddleneck (Amsinckia intermedia). Ioxynil (ACP 63-166A and ACP 64-53), and bromoxynil (ACP 64-255, M&B 100731, M&B 10064, and M&B 11641), were applied at .25 - 1 lb/A. Treatments were applied in March when wheat was in the 3 leaf stage. Tumbling mustard was .5 inch in diameter and fiddleneck was 1-2 inches in diameter.

Ioxynil (ACP 64-53) was only 50-60% effective on fiddleneck and 30-40% effective on tumbling mustard. Ioxynil (ACP 63-166A) was 100% effective on both weed species but only at the high rate (1 lb/A).

Bromoxynil (ACP 64-255, M&B 100731, M&B 10064, and M&B 11641) were all 100% effective on fiddleneck and tumbling mustard when applied at high rates (1 lb/A). When lower rates (.25 lb/A) of bromoxynil were used, formulations of ACP 64-255, M&B 100731, and M&B 10064, were slightly more effective than M&B 11641.

In general all bromoxynil formulations were superior to ioxynil for fiddleneck and tumbling mustard control. There were no differences between bromoxynil formulations when compared at high rates (1 lb/A). However, bromoxynil formulations were more variable when tested at .25 lb/A and ACP 64-255 and M&B 100731 were 20% more effective on fiddleneck than the other bromoxynil formulations. (Oregon Agricultural Expt. Sta., Pendleton.)

Blue mustard (Chorispora tenella) control in winter wheat. Rydrych, D. J. and D. G. Swan. Blue mustard is a tenacious broadleaved annual belonging to the cruciferae family. This weed has been responsible for severe yield reductions in winter wheat because the standard 2,4-D treatments have not been effective. Extensive tests have been conducted in eastern Oregon to select a herbicide that is selective on wheat and effective on blue mustard.

Post-emergence applications of diuron, linuron, GS 13528, GS 13529, and prometryne all at .8 - 1.6 lb/A, and ioxynil - ACP 63-166 (.5 lb/A), ioxynil - ACP 63-166 plus 2,4-D (.5 + .25 lb/A), ioxynil - ACP 63-166 plus dicamba (.5 + .12 lb/A), and picloram plus 2,4-D (.025 + .25 lb/A), were applied in February 1965. Blue mustard was 1 inch in diameter and wheat was in the 3 leaf stage with 1 tiller.

Bromoxynil - M&B 10064 (.5 lb/A) and 2,4-D plus dicamba (.75 + .12 lb/A) were applied in April when the blue mustard was 3-4 inches in diameter and wheat had 5-6 leaves and 3-4 tillers.

Diuron, linuron, GS 13528, and GS 13529 (.8 - 1.6 lb/A) gave 90-100% blue mustard control. Prometryne (1.6 lb/A) was 90% effective. Ioxynil, ioxynil plus 2,4-D and ioxynil plus dicamba were 90-100% effective. None of the treatments injured the wheat. Picloram combinations were not effective on this weed.

Bromoxynil (.5 lb/A) was 90% effective on blue mustard. Dicamba plus 2,4-D (.12 + .75 lb/A) was 70% effective. No wheat injury was recorded in these treatments.

Several of these compounds and/or mixtures show excellent selectivity in wheat and blue mustard control is effective. Further trials are planned. (Oregon Agricultural Exp. Sta., Pendleton.)

Downy brome (Bromus tectorum) control in winter wheat. Rydrych, D. J. and D. S. Swan. Downy brome continues to be a serious weed problem in the dryland wheat areas of eastern Oregon. A selective herbicide is needed which (a) will provide downy brome control (pre or post-emergence) and (b) will be safe and selective in winter wheat. New herbicides are continually being screened for possible use in this area.

Thirteen herbicides were tested in 1965 for the selective control of downy brome in winter wheat. EH 52445 (1 - 6 lb/A), GS 14253 (1 - 2 lb/A), TH 052-H (1 - 3 lb/A), Bay 43975 (2 - 6 lb/A), Bay 56250 (2 - 4 lb/A), OCS 21799 (2 - 6 lb/A), TH 073-H (2 - 4 lb/A), CP 45592 (1 - 4 lb/A), CP 45592 plus diuron (2 + 1.5 lb/A), and linuron (.8 - 1.6 lb/A) were applied pre-emergence in October 1964. Atrazine and potassium azide, prometryne, GS 14253, and Bay 56250 were applied post-emergence (February 1965) when downy brome was in the 2 leaf and wheat was in the 3 leaf stage.

TH-073-H (2-4 lb/A), EH 52445 and Bay 43975 each at 6 lb/A were effective on downy brome but wheat injury was severe. A combination of CP 45592 plus diuron (2 + 1.2 lb/A) was effective on cheatgrass and wheat injury was slight. Linuron (1.6 lb/A) was 50-70% effective on downy brome and wheat injury was minor. OCS 21799, Bay 56250, and GS 14253, and TH 052-H were not effective on downy brome when applied pre-emergence.

Atrazine (.6 lb/A), Prometryne (1 - 1.5 lb/A) and GS 14253 (2 lb/A) were active on cheatgrass with minor injury to wheat when applied post-emergence but GS 14253 was superior to the other compounds. Potassium azide (10-20 lb/A) was not effective on downy brome. (Oregon Agricultural Exp. Sta., Pendleton.)

Control of annual broad-leaved weeds in barley with aircraft applications of bromoxynil and ioxynil. Foy, Chester L. and Orris W. Gibson. Present 2,4-D recommendations in cereal grains, although used effectively for many years, have two important limitations as follows: (1) certain species are difficult to wet or for other reasons are somewhat tolerant to 2,4-D (2) for reasons of crop safety, treatment with 2,4-D should normally be delayed until the grain is well established and tillered (the need for weed control may often occur earlier).

Based on a preliminary study in 1962, 7 replicated tests in 1963, and 11 more experiments in 1964, certain benzonitrile compounds have shown exceptional promise for use instead of or in addition to 2,4-D in California cereal grains. Ioxynil was tested most extensively during 1962-64 (rates, volumes, formulations, residues, combinations with other herbicides, timing, etc.). During 1965 similar emphasis was given primarily to bromoxynil which proved even more effective against several major weed species in California, e.g. Amsinckia spp. tarweeds, mustards, etc. Early tests in 1966 tend to confirm the previous findings.

Excellent weed control performance (with few exceptions), high crop tolerance, and no detectable herbicide residues in either crop or soil, combined, appear to justify the following recommendation in barley and wheat: bromoxynil ester, 6-8 oz/A (1 1/2-2 pints of 2 lb/gal formulation), 10-20 gpa spray volume (5-10 by air), apply when crop is in the 2-leaf to boot stages and weeds are in early seedling stages. The above treatment has repeatedly given excellent control of many common annual broad-leaved weeds. Bromoxynil has proven equal to, or in most cases, more effective than ioxynil, however exceptions have been observed. Ioxynil appears more effective than bromoxynil against chickweed and scarlet pimpernel. The more "tolerant" or "resistant" species to bromoxynil observed in California are filaree, bur clover, strawberry clover, chickweed, spurry and scarlet pimpernel. The lower rate (6 oz/A) should be used on very young seedlings (less than 3-4 leaf stage); the 8 oz/A rate, on more resistant species and on more advanced weeds up to 6-8 inches tall but before flowering. Early application is preferred.

Almost all reported studies with bromoxynil have involved application by ground rig, using 15 gpa spray volume, or more. Less information was available on its effectiveness at lower gallonages applied aerially. On January 22, 1965, bromoxynil ester and ioxynil amine (1/2 lb/A) and 2,4-D amine (3/4 lb/A) were applied by fixed-wing aircraft (9 gpa spray volume) to Arivat barley, 5-7 inches tall and well tillered. Soil moisture was near field capacity at the time of treatment. There was a very heavy infestation of Amsinckia spp. in the 6-inch rosette stage. Other weeds present were stinging nettle, common chickweed, filaree, miner's lettuce, milk thistle, mustards, pineapple weed, prickly lettuce, common sow thistle, shepherds purse, Malva sp., curly dock (seedlings) and bur clover.

Untreated checks were provided by covering several random areas with plastic sheets during spraying, then removing the sheets immediately thereafter.

No toxicity symptoms on the barley were observed with either of the three herbicides. Bromoxynil caused a rapid contact injury to all weeds except common checkweed, stinging nettle and filaree which showed only chlorosis and stunting. Even these more resistant species, however, were soon understoried by vigorous growth of the barley and offered only slight competition (mostly where barley lodged). Overall weed control at harvest was rated 99%.

Herbicidal response was slower with ioxynil than bromoxynil and finally less complete. Chlorotic spots over stems and leaves were observed at first; necrosis followed several days later. Total weed control at harvest was rated at 70%.

Combine-harvested yields were compared with those from plots receiving the standard 2,4-D treatment (see table).

Treatment	Grain Yield (lb/A)	% of standard 2,4-D treatment
1. bromoxynil ester (1/2 lb/A)	2134	126
2. ioxynil amine (1/2 lb/A)	1924	113
3. 2,4-D amine (3/4 lb/A)	1691	--
4. untreated check	0	0

Several annual species were adequately controlled by 2,4-D. Amsinckia sp., the principal weed problem, was stunted but not killed and apparently still offered considerable competition. Untreated portions of the field were so foul that no mature grain was produced. (Department of Botany, University of California, Davis.)

Weed control in spring wheat with several post-emergence herbicides. Appleby, Arnold P., Larry C. Burrill and W. R. Furtick. Beaver spring wheat was seeded on April 3, 1965, and herbicides were applied on April 29. At the time of application, the wheat had 3-4 leaves and 1-2 tillers. Most of the weeds were very small, 2 inches tall or less. The major weed species were dog fennel (Anthemis cotula), bachelor's button (Centaurea cyanus) and lambsquarters (Chenopodium album). Weed control was evaluated on June 28 and wheat was harvested on August 16. Treatments were replicated 4 times in a randomized block design. Plot size was 10' x 50'. Results are given in the following table.

Bromoxynil caused slight temporary chlorosis. K azide caused severe foliage damage, but considerable regrowth occurred. Diquat gave complete wheat kill.

It should be pointed out that the rates of bromoxynil used in this trial were higher than normally needed for commercial weed control, in order to determine the safety factor of bromoxynil on spring grain. (Department of Farm Crops, Oregon State University, Corvallis.)

Weed control and yield of Beaver spring wheat

Treatment	Lbs/A	% Control Dog fennel	 Bachelor's button	 Lambs-quarters	Wheat Yield Lbs/A
1. NC 3363	1	93	80	64	3004*
2. NC 3363	1 1/2	96	99	51	3052*
3. Ortho 407	1	93	70	20	2944*
4. Ortho 745	1	89	50	28	2752
5. Ortho 831	1	95	88	95	2752
6. Diquat	1	98	99	79	0*
7. G-12133	1	56	75	63	2788
8. G-12133	1 1/2	69	83	73	2559
9. Bromoxynil ester	1	100	100	100	2848*
10. Bromoxynil ester	2	100	100	100	2680
11. Bromoxynil ester + dicamba	1/2 + 1/8	100	100	99	2776
12. 2,4-D amine + dicamba	1/2 + 1/8	91	100	100	2812*
13. K azide + X-77	20 + 0.1%	100	100	100	2043*
14. Check	0	0	0	0	2547

* Significantly different from check at 5% level
LSD 5% = 250 lbs/A
C.V. = 6.9%

<u>Herbicides for broadleaf weed control in spring wheat and barley.</u> Cords, H. P. In the spring of 1965 a number of herbicides were applied to wheat and barley for broadleaf weed control. In the wheat trials, the principal weed present was wild buckwheat (*Polygonom convolvulus*). Also present were wild mustard (*Brassica* sp.), dwarf mallow (*Malva rotundifolia*), redstem filaree (*Erodium cicutarium*), lambsquarters (*Chenopodium album*), and prostrate knotweed (*Polygonum acivulare*). Of these, mallow and filaree were resistant to the herbicides applied. Overall weed control and crop injury were rated about three weeks after application, which was in the fully tillered stage of the wheat. Results are summarized in the following table.

Effect of ioxynil and bromoxynil on wheat and weeds

Herbicide	Rate/A oz.	Weed control ratings[1]	Crop injury rating[1]
Ioxynil	8	4.8	0
Ioxynil	16	6.0	0
Bromoxynil	8	8.0	0
Bromoxynil	16	8.8	tr

[1] 0 = no plant injury; 10 = completely killed.

In the barley trials, the principal weed present was prostrate knotweed. Also present were wild mustard, flixweed (Descurainia sophia), various smartweeds (Polygonum spp.), lambsquarters, and dwarf mallow. The smartweeds and mallow were not controlled by any of the treatments. As in the previous trial, application was at the fully tillered stage with evaluation about three weeks later. Results are given in the following table.

Effect of herbicides on weeds and barley

Herbicide	Rate, oz/A	Weed control rating[2]	Crop injury rating[2]
Bromoxynil	8	7.3	0
Bromoxynil	16	7.3	1.3
Bromoxynil + 2,4-D	8 + 8	8.2	1.7
Bromoxynil + 2,4-D	16 + 8	9.2	2.3
Ioxynil	8	6.0	0.7
Ioxynil	16	5.0	1.0
Ioxynil + 2,4-D	8 + 8	9.0	1.7
Ioxynil + 2,4-D	16 + 8	9.2	2.0
Dicamba	2	3.8	1.0
Dicamba	4	5.0	2.5
Dicamba + 2,4-D	2 + 8	7.3	2.8
Dicamba + 2,4-D	4 + 8	7.5	3.7
Picloram	0.5	2.7	0
Picloram	1	4.5	1.0
Picloram + 2,4-D	0.5 + 8	8.0	1.5
Picloram + 2,4-D	1 + 8	7.2	2.3
2,4-D	12	7.0	1.8

[2] 0 = no plant injury; 10 = completely killed

Heavy rains just prior to harvest caused severe shattering. Consequently, no yields were taken. At harvest time there were no obvious treatment effects on the barley. Weed control persisted to harvest in successful treatments. (Nevada Agri. Exp. Sta., University of Nevada, Reno.)

The effect of herbicides on the control of wild buckwheat and cow cockle in small grains. Guenthner, H. R. Twenty-six treatments were applied to wild buckwheat and cow cockle in winter wheat, two dates in barley, and in spring wheat. The following summary could be made from these treatments:

Bromoxynil - rates of 5 to 6 oz/A of bromoxynil ester applied at the three-leaf stage to jointing stage will effectively control wild buckwheat and cow cockle in wheat and barley. A combination of 4 oz/A of bromoxynil ester with 2,4-D ester at 4 to 6 oz/A could be applied after the five-leaf stage.

Picloram - applied at 5/16 to 3/8 oz/A with MCPA at 4 to 6 oz/A at the three-leaf to 5-leaf stage of growth or applied with 2,4-D at 4 to 6 oz/A applied at the five-leaf to tillering stage effectively controlled most annual broadleaf weeds in wheat and barley.

Dicamba at rates of 2 oz/A has been an effective treatment for wild buckwheat control in small grains. Due to the narrow spectrum of weeds controlled with dicamba, the following treatments can be made: 1) a combination of dicamba at 2 oz/A with MCPA at 4 to 6 oz/A applied at the three-leaf to five-leaf stage; and 2) a combination of dicamba at 2 oz/A with 2,4-D ester at 4 to 6 oz/A applied at the five-leaf to tillering stage. These treatments can be used in wheat or barley. In oats, dicamba may be applied alone or in combination with MCPA. (Montana Agricultural Experiment Station, Central Montana Branch, Moccasin.)

Weed control in Gaines Wheat. Meyer, R. W. and T. J. Muzik. Herbicide trials in Gaines wheat were conducted primarily to investigate control of coast fiddleneck, *Amsinckia intermedia*; blue mustard, *Chorispora tenella*; gromwell, *Lithospermum arvense*; dog fennel, *Anthemis cotula* and henbit, *Lamium amplexicaule*. The trials were in 14, 16, 20 and 22 inch precipitation areas. Harvest data were obtained from tests on gromwell and coast fiddleneck.

Bromoxynil was the outstanding material under test. This product became available too late for timely application but even the late applications gave excellent control of weeds and very good yields were obtained. Control of gromwell, fiddleneck and blue mustard at the flowering stage ranged from 90 to 100%. Dog fennel was effectively controlled and henbit was appreciably reduced with control varying from 40 to 90%. The degree of control of henbit appeared directly proportional to the size of the plants with the best control on young plants. Mixtures of bromoxynil and phenoxy compounds controlled mustards more effectively than bromoxynil alone but control of gromwell, fiddleneck and blue mustard was reduced. Yields were also consistently lower from the mixtures. Both weed control and yield were somewhat superior from mixtures with MCPA and MCPP than from mixtures with 2,4-D. Bromoxynil produced no visible damage to winter wheat and yields were consistently near those of hand-weeded plots in spite of the lateness of the applications.

The lithium salt of ioxynil produced extremely variable results, from 0 to 80% control at both 1/2 and 1 lb/A rates. The ester formulation gave much better and more uniform weed control than the lithium salt in all trials. A combination of 1/2 pound of the ester with 1/2 pound of 2,4-D gave the best control of gromwell, dog fennel and henbit and the highest yield in one trial.

Among the phenoxy compounds, butoxy ethanol ester of 2,4-D applied in the fall at 1/2 or 1 lb/A gave 50% control of gromwell but did not control henbit. Results from spring application varied more with date of application than with rate. Wheat infested with fiddleneck and gromwell sprayed in March with 1 lb/A yielded 10 bushels per acre more than wheat sprayed in April although there was obviously more damage to the crop from the earlier application. Application of 1 lb/A on blue mustard in

March resulted in 80% control. Dacamine at 1 lb/A gave erratic control of gromwell when applied in either spring or fall. MCPA and MCPP gave about 75% control and no wheat damage when applied in April at 1 lb/A.

Diuron was the only substituted urea tested in 1965. Applications of 0.8 and 1.2 lb/A in the fall and spring gave good control of gromwell in the 22-inch precipitation area. Spring applications in the drier areas resulted in poor control.

Dicamba alone or in mixtures with 2,4-D produced variable results in controlling weeds in wheat.

These results suggest that bromoxynil may be superior for control of 2,4-D resistant species, especially in areas of 20 inches or less of average annual precipitation. The soil residual effects of diuron appear to make it the material of choice for early fall application in areas of high rainfall, drainage-ways and seep areas where late fall, winter and early spring applications cannot be made. (College of Agriculture Research Center, Washington State University, Pullman.)

Herbicides or mixtures tested in 1964-1965 on Gaines wheat

Herbicide	Rate/A Applied
Dacamine	1/2, 1
Emulsamine	1/2, 1
2,4-D amine	1/2, 1
2,4-D isopropyl ester	1/2, 1
2,4-D butoxy ethanolester	1/2, 1, 2
MCPA	1
MCPP	1
ACP-63-303 (ioxynil, Li. salt)	1/2, 1
M & B 8873 (ioxynil, ester)	1/8, 1/4, 1/2, 1
M & B 10064 (bromoxynil, ester)	1/8, 1/4, 1/2
Diuron	1/2, 8/10, 1, 2/10, 1.5
Dicamba	1/4, 1/2
ACP 63-303 + 2,4-D	1/2 + 1/2
ACP 63-303 + MCPP	1/2 + 1/2
M & B 8873 + 2,4-D	1/8 + 1/2, 1/4 + 1/2, 1/2 + 1/2
M & B 8873 + MCPP	1/8 + 1/2, 1/4 + 1/2, 1/2 + 1/2
M & B 10064 + MCPP	1/8 + 1/2, 1/4 + 1/2, 1/2 + 1/2
M & B 10064 + MCPA	1/8 + 1/2, 1/4 + 1/2, 1/2 + 1/2
M & B 10064 + 2,4-D	1/8 + 1/2, 1/4 + 1/2, 1/2 + 1/2
Dicamba + 2,4-D	1/4 + 1/2, 1/2 + 1/2

Response of cotton to soil incorporated herbicides. Anderson, W. P., and J. W. Whitworth. Five herbicides were applied as preplant soil incorporated treatments at four rates on cotton sown in clay loam soil. The herbicides were applied as a broadcast spray in 40 gallons water/A and immediately disked into the soil. Beds were then listed on 40" centers and the preplant irrigation followed. At the proper time as to moisture and temperature, the beds were harrowed and 1517-D Acala cotton was seeded at a rate of 30 lb/A. Cotton emerged to a uniform stand but the weed seed population was somewhat sparse. All treatments gave satisfactory control of the annual morning glory and annual grasses that emerged.

The effect of the herbicides on yield is shown in the following table.

Relative yield of cotton from plots treated with preplant applications of herbicides incorporated by double disking (4 inches)[1]

Rates	Treflan	Prefar	Diuron	Dacthal	Caparol
I	86	95	96	107	89
II	108	90	95	96	108
III	86	93	91	99	109
IV	79	101	-	111	110
			Rates - lb/A		
I	1/2	4	3/4	6	1/2
II	3/4	6	1	9	1
III	1	8	1½	12	1½
IV	1½	10	-	18	2

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[1] Yields expressed as a percentage of the untreated check plots, average yield of check = 2.29 Bales of Lint/A.

Statistically, none of the yields from the herbicide treated plots were higher or lower than the hoed check plots. However, the trend toward lower yields somewhat correlates with inhibition of plant height, following table.

Yield of cotton from plots treated with preplant applications of Treflan soil-incorporated by double disking (4 inches)

Treflan lb/A	% Inhibition of plant height	Bales of Lint/Acre
0	0	2.07
1/2	5	1.78
3/4	22	2.23
1	24	1.78
1½	37	1.64

Since many acres were treated with treflan this past year and the cotton trade people were complaining of low quality cotton from this area, data were also taken on fiber properties, following table.

Quality of cotton from plots treated with preplant applications of treflan soil-incorporated by double disking (4 inches)

Treflan lb/A	"Mike"	Strength	Stretch	Upper 1/2 Mean
0	3.6	236	7.2	113
1/2	3.6	230	7.7	114
3/4	3.8	233	7.4	111
1	3.8	220	7.9	106
1½	3.5	232	7.8	111

There were no adverse affects of treflan on cotton quality. (New Mexico State University, Agricultural Experiment Station, University Park.)

Combinations of preplanting and layby applications of herbicides in irrigated cotton. Hamilton, K. C. and H. F. Arle. Research on herbicide combinations for season-long control of annual weeds in cotton was continued in Arizona during 1965. Two tests were conducted at the Cotton Research Center in Phoenix where N-(2-mercaptoethyl)benzenesulfonamide S-(O,O-diisopropyl phosphorodithioate) (bensulide), DCPA, prometryne, and trifluralin were applied to the soil on March 8, before furrowing for the preplanting irrigation. Treatments were replicated 4 times on plots 4 rows wide, 43 feet long. Deltapine Smooth Leaf cotton was planted in moist soil under a dry mulch on March 31. Two weeks of cool weather and rain followed, so the tests were replanted on April 20.

Directed applications of DCPA, diuron, monuron, prometryne or trifluralin covered the entire furrow and base of the cotton plants before the first (June 2) and second (June 30) postemergence irrigations. Layby applications contained 1/2% nonionic surfactant. Treated plots were cultivated within one hour.

The surface soil averaged 48% sand, 35% silt, 17% clay, and 1% organic matter. Weeds present included Panicum fasciculatum Swartz, Echinochloa colonum (L.) Link, Leptochloa filiformis (Lam.) Beauv., Physalis wrightii Gray, and Amaranthus palmeri S. Wats. The test area was cultivated three times. Percent broadleaved and grassy weed control was estimated on October 13. The center rows of each plot were handpicked in November. Rates of application, percent grass control, and cotton yields are shown in the table.

Cotton seedlings were temporarily stunted by preplanting applications of trifluralin. Postemergence applications of diuron and monuron caused temporary chlorosis of cotton foliage. Prometryne caused severe chlorosis, and some cotton plants were killed.

There was little difference in weed control when layby applications were made before the first and second irrigation. Combinations of herbicides gave 94 to 100 percent control of broadleaved weeds. Control of annual grasses was less satisfactory, averaging 61 to 95%. The combination of bensulide and diuron gave the best grass control and combinations containing prometryne the poorest.

Combinations containing bensulide and DCPA resulted in the highest yields of hand-harvested seed cotton. Combinations containing prometryne and monuron gave the lowest yields. Machine picking would have been possible on all treated plots. Ground harvest was possible only on the plots treated with bensulide-diuron. (Cooperative investigations of Crop Research Division, Agricultural Research Service, U. S. Dept. of Agriculture and Arizona Agric. Expt. Sta., University of Arizona, Tucson.)

Grass control and cotton yield following preplanting and layby applications of herbicides.

Treatment Preplanting Herbicide	lb/A	Layby Herbicide	lb/A	Grass control Percent estimated October 13 Date of layby treatment June 2	 June 30	Yield[1] as percent of DCPA checks June 2	 June 30
Trifluralin	0.75	diuron	1.25	67	84	92abc	107
Trifluralin	0.75	monuron	1.25	69	76	80 bc	92
Trifluralin	0.75	prometryne	2.00	64	69	68 c	91
Trifluralin	0.50	trifluralin	0.50	69	78	80 bc	90
		and diuron	1.25				
Bensulide	5.00	diuron	1.25	94	95	120a	100
Prometryne	2.00	diuron	1.25	61	73	89abc	89
DCPA	8.00	diuron	1.25	73	78	101ab	103
DCPA	16.00	DCPA	8.00	80	88	100abc	100

[1] Yield of seed cotton on DCPA checks was 2,070 and 2,350 lb/A.

Preplanting applications of bensulide in cotton. Arle, H. F. and K. C. Hamilton. Research with preplanting applications of *N*-(2-mercaptoethyl)benzenesulfonamide *S*-(*O,O*-diisopropyl phosphorodithioate) (bensulide) to control annual grasses in irrigated cotton was continued in 1965 at the Cotton Research Center, Phoenix, Arizona.

Preplanting applications of bensulide were: 2, 4, and 6 lb/A, on March 8, to the flat soil surface before furrowing for the preplanting irrigation; 4 lb/A, on March 10, as a broadcast application after furrowing before the preplanting irrigation; and 2, 4, and 6 lb/A, on March 31, as a broadcast application before harrowing for the final seedbed preparation. DCPA at 8 lb/A was also applied after furrowing before the preplanting irrigation. Treatments were replicated 4 times on plots 4 rows wide, 43 feet long.

Deltapine Smooth Leaf cotton was planted in moist soil under a dry mulch on March 31. Two weeks of cool weather and rain followed, and the cotton was replanted on April 22. The surface soil of the test area was 38% sand, 40% silt, 22% clay, and 1% organic matter. Weeds present included Panicum fasciculatum Swartz, Echinochloa colonum (L.) Link, Leptochloa filiformis (Lam.) Beauv., Physalis wrightii Gray, and Amaranthus palmeri S. Wats. The test area was cultivated three times. On June 29, 1 lb/A of diuron was applied on the plot area as a directed spray covering the entire furrow. This rate of diuron will not control annual grasses but usually controls broadleaved weeds. Percent weed control was estimated on October 13. The center rows of each plot were hand-picked in November. Grass control and cotton yields are shown in the table.

Cotton emergence and seedling growth were not affected by preplanting herbicide applications. Best control of annual grasses was obtained with preplanting applications before furrowing for the preplanting irrigation. All preplanting applications of bensulide gave better grass control than DCPA. Preplanting application of bensulide did not alter cotton yields. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U. S. Dept. of Agriculture, and Arizona Agric. Expt. Sta., University of Arizona, Tucson.)

Grass control and cotton yield following preplanting applications of bensulide and DCPA

Herbicide	Treatment method	lb/A	Grass control percent estimated	Yield[1] as percent of DCPA check
bensulide	before furrowing	2	96	107
bensulide	before furrowing	4	99	103
bensulide	before furrowing	6	100	99
bensulide	before irrigation	4	91	99
bensulide	before harrowing	2	84	102
bensulide	before harrowing	4	90	103
bensulide	before harrowing	6	95	108
DCPA	before irrigation	8	81	100

[1] Yield of seed cotton on DCPA checks was 2,700 lb/A.

Repeat directed applications of low rates of herbicides in cotton. Arle, H. F. and K. C. Hamilton. Single applications of herbicides to the soil for control of annual weeds in cotton have sometimes resulted in soil residues of herbicides which affect subsequent crops. The evaluation of repeated applications of low rates of herbicides to the foliage of small weeds was continued in 1965 at the Cotton Research Center, Phoenix, Arizona. This was an attempt to control annual weeds with a minimum residue in the soil.

On June 2 when Deltapine Smooth Leaf cotton was 4 to 6 inches high, overall applications were made as follows: 2, 4, and 8 oz/A of diuron, 3 lb/A of DSMA, and 0.67 lb/A of prometryne. Directed applications, covering the entire furrow and base of the cotton plants, were made on June 23 (cotton 8 to 10 inches), July 17 (cotton 18 inches), and August 3 (cotton 24 inches). MSMA at 3 lb/A and paraquat at 0.2 lb/A were applied as directed sprays on June 23, July 17, and August 3. Herbicides were applied in 40 gal/A of water which contained 0.5% nonionic surfactant. Treatments were replicated 4 times on 4 row plots, 43 feet long. The test area was cultivated three times.

Small weeds were present on all plots at each date. Weeds present included Panicum fasciculatum Swartz, Echinochloa colonum (L.) Link, Leptochloa filiformis (Lam.) Beauv., and Physalis wrightii Gray. Percent weed control was estimated on October 13. The center rows of each plot were harvested in November.

Overall applications of diuron and prometryne caused severe chlorosis of cotton foliage. Prometryne and the high rate of diuron caused stunting of cotton plants. Prometryne reduced cotton stands. Later directed applications had little effect on cotton plants and gave excellent control of broadleaved weeds. Control of annual grasses ranged from 83 to 95% with the repeated applications of herbicides as compared to 15% on the cultivated checks. All herbicide treatments, except prometryne, resulted in significant increases in cotton yield as compared to the cultivated check. Prometryne also delayed maturity. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U. S. Dept. of Agriculture, and Arizona Agric. Expt. Sta., University of Arizona, Tucson.)

Early postemergence applications of herbicide combinations in cotton. Hamilton, K. C. and H. F. Arle. Interest in early postemergence applications of herbicides to the soil has increased because of injury to seedling cotton from preplanting applications and inadequate weed control with later layby applications. Where mixed weed infestations occur, herbicide combinations might perform best. During 1965, the effects of diuron in combination with three herbicides were evaluated on cotton and weeds at the Cotton Research Center, Phoenix, Arizona.

When Deltapine Smooth Leaf cotton was 4 to 6 inches tall (June 2) herbicides were applied as a directed spray covering the soil of the entire furrow and as little as possible of the cotton plants. All combinations were applied in 40 g.p.a. of water with 1/2% nonionic surfactant. All combinations contained 1.25 lb/A of diuron. Combinations also contained; 3, 6, 9, or 12 oz/A of trifluralin; 2, 4, or 6 lb/A of N-(2-mercaptoethyl) benzenesulfonamide S-(O,O-diisopropyl phosphorodithioate) (bensulide); or 6 lb/A of diphenamid. Treatments were replicated 4 times on plots 4 rows wide, 43 feet long.

Herbicides were incorporated immediately with a ground-driven, sectioned, rolling cultivator and the area was furrow-irrigated 2 days later. The surface soil contained 37% sand, 39% silt, 24% clay, and 1% organic matter. Weeds present included Panicum fasciculatum Swartz, Echinochloa colonum (L.) Link, Leptochloa filiformis (Lam.) Beauv., Physalis wrightii Gray, and Amaranthus palmeri S. Wats. The test area was cultivated 3 times. Percent weed control was estimated on October 13. The center rows of each plot were hand-picked in November.

Herbicide combinations applied early postemergence caused severe chlorosis of cotton foliage and reduced stands. Combinations including trifluralin caused more injury than combinations with bensulide or diphenamid. Injury to cotton with combinations containing trifluralin or bensulide was related to the amount of these herbicides in the combinations. Combinations of two herbicides and a surfactant caused more injury to cotton than combinations of the two herbicides without surfactant, or diuron with surfactant in adjacent tests.

Combinations of bensulide and diuron gave the best initial control of weeds. None of the combinations gave satisfactory control until harvest. There was no difference in yield of seed cotton following applications of herbicide combinations to young cotton. (Cooperative Investigations of Crop Research Division, Agricultural Research Service, U. S. Dept. of Agriculture, and Arizona Agric. Expt. Sta., University of Arizona, Tucson.)

Testing seedling grass tolerance to post-emergence herbicides. Ross, Claude C., W. R. Furtick and L. C. Burrill. Kentucky bluegrass, orchardgrass, tall fescue, red fescue, bentgrass, perennial ryegrass, and annual ryegrass were planted July 9, 1965. On July 27 and August 17, these grasses were sprayed with five herbicides to test the grasses' tolerance when sprayed at the approximate two- and four-leaf stages of growth. The compounds used were: Bromoxynil (+wetting agent) at ½ lb/A and 1 lb/A, Ortho 831 (+ wetting agent) at 1 lb/A and 2 lb/A, NC 3363 at 1½ lb/A and 3 lb/A, 2,4-D at ½ lb/A and 1 lb/A, and dicamba at ¼ lb/A and ½ lb/A. The grass species made up sub-plots within main plots of chemical application. Tolerance evaluations were made one week after each application and then again on December 20, 1965.

The first evaluation of the 2-leaf stage application showed leaf tip burning of some degree by all applications. The high rates of Ortho 831 and NC 3363 showed severe tip burning with a few dead leaves present. On the other hand, dicamba gave very little to no tip burning. The only weeds present in the trial at this application were very small pigweeds, *Amaranthus retroflexus*. Control of these was quite good in all treatments except in both rates of dicamba and the 1.5 lb rate of NC 3363 where control was from 50-75 percent. Both rates of 2,4-D gave 90-100 percent control and the rest of the treatments 98-100 percent control.

When the second application was made at the approximate 4-leaf stage, the individual growth stages were as follows: tall fescue (3-4 leaf), orchardgrass (5-leaf), perennial and annual ryegrass (6-8 leaf), bentgrass and red fescue (both had stooled and had 2-3 culms from each base), and bluegrass (3-leaf). Leaf tip burning at this application was found in both the 1 and 2 pound rates of Ortho 831 and NC 3363 at the 3 pound rate. The other applications produced no damaging effects. The pigweed was 1 to 2.5 feet tall at this application and control of this weed was very poor in all treatments.

After the evaluation of the application at the four-leaf stage, the trial was mowed to a three inch height, and the residue hauled off. This removed much of the pigweed competition in the checks, so a comparison of treated plots to check plots would be more valid at the December 20 evaluation. This last evaluation was a comparison of density between treated plots and check plots. The density of tall fescue was reduced 10 percent by the high rates of Bromoxynil and Ortho 831 applied at the 2-leaf stage. Ortho 831 was the only compound that reduced the bentgrass density, the most severe reduction coming in the 2 lb/A rate at the 2-leaf stage application. The density was only 38 percent when compared to the check plot. Red fescue, perennial ryegrass and annual ryegrass had no reduction in density. Evaluations of the Kentucky bluegrass and orchardgrass were not reliable due to erratic stands of both grasses. (Farm Crops Department, Oregon State University, Corvallis.)

Control of annual bluegrass in Kentucky bluegrass seedfields. Neidlinger, Thomas J., Floyd O. Colbert and W. R. Furtick. Merion Kentucky bluegrass was seeded in the fall of 1963, and herbicides were applied on September 18, 1964. At the time of application, no crop had been taken from the field in 1964, and the field had not been burned. The major weed species was annual bluegrass (Poa annua). Weed control evaluations were made at 11, 16, and 24 weeks after herbicide applications. Treatments were replicated 4 times in a randomized block design. Seed from the plots was harvested in June 1965. Plot size was 8' x 20', with a 3' x 17' harvested sample taken from each plot for yield analysis. Results are given as follows:

Annual bluegrass control and yield of Kentucky bluegrass

Treatment	Active lb/A	% Annual bluegrass Control weeks after application 11	16	24	Kentucky bluegrass seed yields lb/A	Rank
1. R 4461	10.0	71	97	80	853.0	7
2. R 4461	15.0	85	98	97	871.8	6
3. Diuron	2.4	43	78	54	1,095.4	3*
4. Bromacil	1.6	44	75	62	1,030.5	5*
5. Bromacil	2.4	68	87	55	1,155.2	1*
6. Simazine	2.4	85	99	100	1,068.6	4*
7. Simazine	3.2	70	99	90	1,150.0	2*
8. Check	0	0	0	0	796.5	8

* Significantly different from check at 5 percent level
LSD 5% = 157 lb/A
C.V. = 10.6%

Single applications of R 4461 at 15 lb and simazine at 3.2 lb/A, gave the highest Poa annua control. The diuron treatment indicated that a single fall application is not giving adequate Poa annua control throughout the winter months. None of the treatments in this trial showed injury to the Kentucky bluegrass. (Farm Crops Department, Oregon State University, Corvallis.)

Control of annual broadleaf weeds in grass. Guenthner, H. R. In 1964 two species of grass, Oahe intermediate wheatgrass and standard crested wheatgrass, were seeded on a Danvers clay loam soil. Four weeks after emergence and seven weeks after emergence, twenty-six treatments were applied. The primary weed species present were wild buckwheat, round leaf mallow and knotweed. The most effective treatments were: dicamba at 2 oz/A plus 2,4-D ester at 6 oz/A; picloram at ½ oz/A plus 2,4-D ester at 6 oz/A and ioxynil at 4 to 8 oz/A. Dicamba and picloram when applied alone were not effective in controlling round leaf mallow.

May yields were taken in 1965. Considerable variation in yields was noted within treatments. Statistical analysis revealed significant differences for; treatments, grass species, treatments by grass, and date of application by grass species. The most important source of variation that was significant was the differences in treatments. The highest yielding treatments were: ioxynil at 8 oz/A; picloram at ½ oz/A plus 2,4-D ester at 6 oz/A; and dicamba plus either 2,4-D or MCPA at 6 to 8 oz/A. Yields were increased from 50 to 90 percent of the weedy check which yielded 3469 lb/A. (Montana Agricultural Experiment Station, Central Montana Branch, Moccasin.)

Preplant soil-incorporated applications of benefin, trifluralin, and EPTC on seed alfalfa. Agamalian, H. Preplant applications of herbicides were made to evaluate crop tolerance and weed control. The soil was a Lockwood gravelly loam. Benefin was applied at 1, 2, and 4 lb/A, Trifluralin at ½, 1 and 2 lb/A and EPTC at 3 lb/A. Herbicide applications were immediately incorporated with power rotary equipment. Applications were made on February 16, 1965, with soil temperatures at 49° F. at the three inch depth. Plots were one row wide, 50 feet long, with five replications. The trials were planted to the Steinbach-Schmidt variety on February 17, 1965.

The trials received no mechanical cultivation. The checks were hand weeded on May 1. The field was grown under furrow irrigation with five irrigations during the course of the season. Weed species present in the control were *Chenopodium album* L., *Amaranthus retroflexus* L., *Solanum sarachoides*, Sendt., and *Brassica geniculata* (Desfontaines) J. Ball.

Benefin at 1 and 2 lb/A resulted in 90% weed control with slight suppressant symptoms on the alfalfa at the 2 lb/A rate. Harvested seed resulted in a 14% and 37% increase in yields over the hand weeded checks. Benefin at 4 lb/A resulted in maximum weed control, but crop tolerance was marginal. Yield were reduced by 24% over the hand weeded check. Trifluralin at ½ and 1 lb/A resulted in 90% weed control with a slight degree of seedling suppression. Respective yield increases were 13% and 4% over the hand weeded check. Trifluralin at 2 lb/A provided maximum weed control, but severe crop phytotoxicity was evident. A 31% yield reduction was measured over the hand weeded check. EPTC at 3 lb/A resulted in 90% weed control with a slight amount of leaf folding. Yields were increased 30% over hand weeded checks.

Results of this trial indicate the performance of Benefin at 2 lb/A was comparable to EPTC at 3 lb/A and Trifluralin at ½ lb/A. (University of California, Agricultural Extension Service, Salinas.)

Control of mixed annual weeds in established alfalfa with several preemergence herbicides. Foy, Chester L. and Orris W. Gibson. Several herbicides are in current use for controlling mixed annual weeds in established stands of alfalfa. However, as in the case of seedling stands, improvements with respect to (a) herbicidal effectiveness, (b) crop tolerance, (c) cost, (d) convenience of use, and (e) crop and soil residue problems are possible and are being actively sought in California.

During 1965, several new herbicidal chemicals were considered promising enough to warrant further testing in semi-dormant established alfalfa, pre-emergence to the weeds. Two essentially comparable experiments were conducted as follows:

(1) Broadcast sprays (55.8 gpa) were applied January 15, 1965, to semi-dormant, 2-year-old Ranger alfalfa growing on a clay loam soil near Orland, California. The field was renovated by cross-disking, and was partially recompacted by rainfall just prior to treatment. Soil moisture was near field capacity at the time of treatment, and 0.16 inch of rain fell during the week after treatment. Most weeds emerged after treatment.

(2) Repeat of (1) except chemicals were applied January 27, 1965, to 2-year-old alfalfa variety CL-35 (less dormant type) growing on a Tehama gravelly fine sandy clay loam (also near Orland, California). The field was not renovated and moderate to heavy stands of small, mixed weed species were present at the time of treatment.

Weed species present in the two experiments included the following: wild oats, annual ryegrass, yellow star thistle, mayweed, common chickweed, mouseear chickweed, common groundsel, annual bluegrass, mustards, foxtail barley, bur clover, dog fennel, wild radish, shepherds purse, prickly lettuce, volunteer ladino clover, Malva sp., sow thistle, and volunteer barley.

Because of the similarity of the results obtained in the two experiments, the chemicals, rates, and principal results (averages of the two replicated experiments) are summarized in one table (ratings made May 3, 1965).

GS-14254 provided the most outstanding combination of broad spectrum weed control and crop safety of all compounds tested. Alfalfa height at first cutting was reduced about one inch by the 4 lb/A rate of GS-14254, however no further symptoms were observed. The plots remained essentially weed-free throughout the remainder of the season.

Atrazine (1 1/2 lb/A), D-732 (2 lb/A), D-733 (1 lb/A), and bromacil (1 lb/A) provided outstanding weed control but caused more severe crop injury than GS-14254 which persisted slightly into the second cutting.

RP-11561 provided excellent grass control into the second cutting but was weak on several broad-leaved weed species. Slight initial crop stunting was observed.

Simazine, diuron, GS-14260, GS-13529, BV-201, and TOK, at various rates, provided slight to moderate crop injury and/or less than ideal season-long, (broad spectrum) weed control.

Several of the newer herbicides appear to merit more extensive study during the coming season. (Department of Botany, University of California, Davis.)

Chemical	Rate lb/A	% crop stand	Crop vigor*	% weed reduction	Weed vigor*
Simazine	3/4	99	10	27	9
Simazine	1 1/2	94	9	54	9
Simazine	3	79	7.5	88	1.5
Atrazine	1	97	8	93	8
Atrazine	1 1/2	94	8.5	98	3.5
Atrazine**	3	40	6	100	0
GS-14254	1	99	9	88	7.5
GS-14254	2	99	9.5	99	4.5
GS-14254	4	95	8	99	1
GS-14260	1	99	9.7	30	9
GS-14260	2	94	9	68	8.5
GS-14260	4	93	8	97	5.5
GS-13529	1	96	9.3	72	8.5
GS-13529	2	97	8	87	8
GS-13529	4	81	8	99	7
D-732	1/2	95	8	72	7.5
D-732	1	91	7.5	99	6.5
D-732	2	86	7	100	0
D-732	4	75	7	100	0
D-733	1/2	99	10	39	8
D-733	1	94	8.5	90	8
D-733	2	86	7	100	0
D-733	4	75	6.5	100	0
Bromacil	1	91	8	94	9
Bromacil	2	81	7	99	4.5
Bromacil	4	60	6	100	1
BV-201	3	90	10	68	8
BV-201	6	91	8.8	81	7
TOK	3	94	8	63	8
TOK	6	97	8.5	64	7
RP-11561**	2	95	9	96	6
RP-11561**	2.54	83	9	93	6
Diuron	2	100	10	38	9
Diuron	3	93	9	75	9
Diuron	4	95	9	79	9
Check	-				

* 10 = full vigor, 0 = all plants dead.
** Included in Experiment (1) only.

Evaluation of three pre-plant, soil-incorporated herbicides for control of annual weeds in seedling alfalfa. Foy, Chester L. and Orris W. Gibson. Several herbicides are currently recommended, and used successfully, for weed control in perennial legumes in California. However, improvements with respect to (a) effectiveness of weed control, (b) crop safety, (c) residues, (d) cost, and (e) convenience of use are continually being sought. Despite the existence of useful recommendations, unsolved or only partially solved annual weed problems still exist in seedling stands of alfalfa.

During 1964-1965, two promising soil-active chemicals were compared with EPTC (standard recommendation) in two uniform experiments. Broadcast sprays (55 gpa) of trifluralin (1/2, 1 and 2 lb/A), benefin (1/2, 1, 2 and 4 lb/A), and EPTC (4 lb/A) were applied to dry clay loam soil with a hand-propelled power sprayer and immediately incorporated 2 inches deep with a garden tiller prior to seeding alfalfa.

At one location (near Orland, California) the results were somewhat inconclusive because crop and weed emergence, and weed control, were erratic with all treatments. However, no crop injury symptoms were observed either, thus suggesting that the herbicides were lost in some manner. The reduced herbicidal performance was tentatively attributed to non-uniform soil-incorporation of the herbicides. The matter requires further confirmation.

In the second experiment (near Willows, California) dense stands of bur clover and mustard emerged along with the alfalfa following rainfall. Moderate stands of wild oats, annual ryegrass, pineapple weed, shepherds purse, and yellow star thistle were also present. Weed control and crop vigor ratings were made 4 and approximately 6 1/2 months after initiation of the experiment. The principal results are summarized in the following table (treated October 8, 1964; rated April 27, 1965):

Chemical	Rate lb/A actual	Crop vigor*	% grass control	Grass vigor*	% broadleaf control	Broadleaf vigor*
Trifluralin	1/2	10	98	3	80	8
Trifluralin	1	8	99	2	95	3
Trifluralin	2	7	99	4	80	9
Benefin	1/2	10	0	10	0	10
Benefin	1	10	20	9.5	0	10
Benefin	2	10	98	6	70	8
Benefin	4	10	98	3	70	8
EPTC	4	10	98	6	70	8
Check	--	10	0	10	0	10

* 10 = full vigor, 0 = all plants dead

The standard EPTC treatment was equal to or more effective than all other treatments early in the season; trifluralin provided the most outstanding season-long weed control. The crop safety margin with trifluralin used in this manner appears to be narrow, however; rates above 1/2 lb/A resulted in light to moderate losses of stand. Ample moisture throughout the early growing season probably favored alfalfa tolerance to trifluralin. Still, at all rates of trifluralin, many of the seedlings showed considerable early root injury (short club roots, etc.) and lay on the soil surface for some time before becoming effectively rooted through the treated soil.

Benefin provided greater crop safety than trifluralin but was considerably weaker in the control of several annual grasses and broadleaved species.

In this particular experiment, much of the benefit that would have been derived from the use of either of the three herbicides was obscured by a dense, fluorishing stand of bur clover which was not controlled by any treatment. Further studies with these and several promising related herbicides are considered justified, and some are already in progress. (Department of Botany, University of California, Davis.)

Herbicides for control of broadleaf weeds in new legume seeding. Stewart, Vern R. Seven herbicides were used alone and two of the seven in combination to find an effective means of controlling broadleaf weeds in sainfoin (Onobrychis viciaefolia Scop). The predominate weed species were dandelion, (Taraxavcum officinale Weber); shepherds purse, (Caspella Bursa-pastoris L. Medic); fanweed, (Thaspi arvense L.); lambsquarter, (Chenopodium album L.); red root pigweed, (Amaranthus retroflexus L.); and night-flowering catchfly, (Silene notiflora L.). Application dates, rates and time in relation to growth are found in the following table. Post emergence applications were made when the sainfoin was in the five leaf stage. Plot size was 10 x 20 feet (200 square feet). All herbicides were applied at a volume of 54.4 gpa. Eight counts of weeds and sainfoin were made in each plot, July 12, 1965.

No significant reductions in sainfoin population were found because of treatment. Trifluralin caused considerable injury to new sainfoin seedlings. Avadex in combination with 4(2,4-DB) injured young seedlings. There was no stand reduction or plant injury with ACP 63-252 and ACP 63-57.

Rates of 8 to 32 ounces of both ACP 63-252 and ACP 63-57 provided good control of the broadleaf species. Trifluralin and 4(2,4-DB) provided little or no control at any rate of application. (Northwestern Montana Branch Station, Montana Agricultural Experiment Station, Montana State University, Kalispell.)

Data from herbicide study on a new seeding of sainfoin
Northwestern Montana Branch Station 1964, Kalispell, Montana

Treatment	Application time	Rate/acre ounces	Plant counts[1] Sainfoin	Plant counts[1] Weeds	
ACP 63-57	Post emerg.	32	9.5	.6	f[2]
ACP 63-252	Post emerg.	32	8.2	.8	ef
ACP 63-57	Post emerg.	48	7.3	.8	def
ACP 63-252	Post emerg.	16	8.1	3.8	cdef
ACP 63-252	Post emerg.	8	8.4	5.9	bcdef
Check		0	9.0	7.4	abcdef
Dacthal	Post plant	128	7.5	9.1	abcd
Dacthal	Post plant	64	8.2	10.0	abcd
Trifluralin	Pre plant	32	7.3	10.1	abcd
Trifluralin	Pre plant[3]	16	7.8	10.4	abc
4(2,4-DB)	Post emerg.	24	6.5	11.0	abc
Avadex	Pre plant[3]	32	8.1	12.3	ab
Avadex	Pre plant[3]	16	8.2	12.9	ab
Avadex + (2,4-DB)	Pre plant Post emerg.	16 16	6.8	13.4	ab
Trifluralin	Pre plant[3]	48	7.4	14.2	a
4(2,4-DB)	Post emerg.	16	8.5	14.5	a
4(2,4-DB)	Post emerg.	8	6.2	15.0	a

[1] Average of 8 counts per replication, 3 replications

[2] Items having common letter are not significant one from another

[3] Pre plant and incorporate

Seeded - June 1, 1965

Pre plant	May 26, 1965	Temp 60°F Humidity 95%
Post plant	June 4, 1965	
Pre emergence	June 10, 1965	Temp 85°F Humidity 35%

Field evaluation of several pre-plant, soil-incorporated herbicides in sugar beets. Foy, C. L. and O. W. Gibson. Chemical weed control studies in sugar beets have been conducted over a period of several years in California, with varying degrees of success. Of the newer materials tested, until recently pebulate (PEBC)at 3-4 lb/A showed generally most satisfactory performance - leading to its state-wide recommendation. A continuous testing program is maintained, however, to stay abreast of rapid developments in the field that may offer improvements in weed control efficiency, selectivity, economy, and the achievement of complete mechanization in sugar beet production.

During the period 1963 to the present, some 17 experiments were conducted, employing 58 different herbicides, each in one or more tests, along with other variables. The studies included logarithmic screening trials, rates, formulations, methods of application, and combinations of herbicides. Yields and quality data were recorded in several experiments. Several of the principal results and tentative conclusions are presented below:

(1) Of all herbicides tested singly, R-2063 provided the most outstanding selective control of mixed annual grasses and broad-leaved weeds. Although similar in action to pebulate, R-2063 demonstrated a greater safety factor on beets, and more effective, longer-lasting weed control when used pre-plant, soil-incorporated (2-3" deep) at comparable rates (e.g. 4 lb/A).

(2) When used correctly, pyrazon provided excellent control of most annual broad-leaved weeds, but was consistently weaker against barnyardgrass under all conditions. Where broad-leaved weeds predominated, pyrazon proved effective by two methods of use as follows: (a) pre-plant sprays (4.0-4.8 lb/A), incorporated 1-2 inches deep with a power-driven rotary tiller device. If no rain falls within 5-10 days (depending on weed germination), the field should be irrigated to activate the chemical and germinate beet and weed seeds. (b) early post-emergence (3.2-4.0 lb/A) when beets show 2 true leaves but before weeds have more than 2 true leaves. Surface applications require rain or sprinkler irrigation (perhaps ¼" minimum) within a few days after treatment also. Used post-emergence in this manner, pyrazon still functions primarily as a soil-active herbicide. When used as described, pyrazon appears to have an adequate (approx. 2X) safety margin in beets. Under other conditions, as with pebulate, selectivity is less spectacular. Crop vigor is an important factor in the susceptibility of sugar beets to this herbicide. For safety, the rate of inactivation of pyrazon in the crop plant must be kept in reasonable equilibrium with the rate of uptake. Beets in less than the 2-leaf stage are more sensitive to pyrazon; tolerance increases with age and as root penetration into untreated soil occurs. Seedling beets weakened from other causes, e.g. disease, saline or alkaline conditions, etc. are more likely to show injury than normal vigorous beets.

(3) Most excellent broad-spectrum control of mixed annual species has been obtained with various herbicide combinations, applied simultaneously in most instances, e.g. R-2063 + pyrazon, pebulate + pyrazon, TCA + pyrazon, and others (listed in their general order of effectiveness). Also, it was observed that TCA + pyrazon gave better control of grasses than TCA alone and better control of broad-leaved weeds than pyrazon alone. Whether the effects are truly synergistic or merely additive has not been determined with certainty. Although the advantages in weed control from the use of herbicide combinations are real, further testing is required to establish the relative efficiencies of these treatments on a unit cost-per-acre basis.

(4) One "mixed blessing" of pre-plant incorporated herbicides now in use is their relatively short soil life. Various herbicide combinations, applied sequentially throughout the season in a "program approach" offer considerable promise and warrant further testing. To illustrate, after herbicide X applied pre-plant or pre-emergence becomes nearly dissipated, herbicide Y is applied at early post-emergence (e.g. post-thinning) and/or herbicide Z is applied at late post-emergence or lay-by. For example, trifluralin, benefin, or SD 11831 (at 0.75 lb/A) appears to hold promise as post-thinning or mid-season applications to provide season-long weed control following the use of a pre-plant or pre-emergence herbicide. Selectivity may be a problem, however.

(5) FW-925 (3-6 lb/A) selectivity controlled many common annual weeds in beets when applied pre-emergence and followed by rain or irrigation. Of the species observed, the mustards appeared to be among the most tolerant. Herbicidal activity was essentially lost by soil incorporation.

(6) D-1318 (1-6 lb/A) showed promise as a pre-emergence treatment against barnyardgrass and other annual grasses, but little activity against common broad-leaved species. Activity was diminished considerably by soil incorporation.

(7) Metering of pebulate into the water during furrow irrigation gave erratic and generally unsatisfactory results, presumably because of vapor loss of the herbicide and poor distribution down the rows and across the beds.

(8) In preliminary tests, with pebulate and R-2063, shank injection (4" spacings across the bed) compared favorably with the standard practice of band spraying and rotary tiller incorporation as pre-plant treatments, with respect to both weed control and crop tolerance. However, the matter requires further study under other soil and environmental conditions.

(9) Several more pre-plant or pre-emergence herbicides have shown some promise and are being investigated further, whereas others are periodically eliminated from further testing because of inadequate weed control or marginal selectivity. (Department of Botany, University of California, Davis.)

Chemical weed control in sugar beets. Alley, H. P. and G. A. Lee. Demonstration plots, ¼ to ½ acre in size, were established in six sugar beet growing areas of Wyoming. Eleven chemicals and combination of chemicals which showed promise of alleviating the weed problem in sugar beets were included in the demonstrations. The chemicals and combinations were as follows: pebulate, pyrazon, pre beta I (pebulate + diallate), pyrazon + pebulate, pyrazon + H-282, pyrazon + diallate, pyrazon + TCA, endothall + TCA, pyrazon + R-2063 and non-treated. Soil types varied between locations from a sandy loam to clay loam. Rates of application varied to fit the type of soil prevalent to the area. All chemicals were applied (pre-plant) on a 7 in. band, over the beet row, and incorporated 1-1½ in. deep.

The results obtained from the demonstrational plots afforded opportunities to compare the effectiveness of several chemicals and combination of chemicals on different soil types and upon different species of weeds. The data show rather decisively that no one chemical or combination of chemicals can be expected to obtain effective weed control for the entire state or local sugar beet growing area.

Where the density of both broadleaved and grassy weeds were prevalent individual chemical treatments were not as satisfactory as the combinations. In areas where black nightshade (Solanum nigrum) was the primary infestation, the pebulate + diallate, pyrazon + diallate, and pyrazon + R-2063 were the better treatments. Where grassy species predominated the pyrazon + pebulate, pyrazon + diallate, pyrazon + TCA, pyrazon + R-2063 and pebulate + diallate treatments resulted in over 90 percent control. In another area where buffalo bur (Solanum rostratum) comprised 96 percent of the infestation the treatment of pyrazon + diallate appeared to be the best. Herbicide-282 and pyrazon + H-282 were outstanding compounds for the control of kochia (Kochia scoparia).

Results from the demonstration plots indicate that herbicides and the combination of herbicides are available to obtain outstanding weed control in sugar beets. They will not, however, alleviate the problem unless the weed species common to the area is known and the best herbicide or combination of herbicides used. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Fall application of chemicals for weed control in sugar beets. Alley, H. P. and G. A. Lee. The sugar beet field was prepared by plowing, disking and leveling. The field was pre-bedded November 8, 1965, just prior to chemical application.

Each treatment consisted of four rows, 150 feet long. Each row was incorporated separately with one of the three soil incorporation methods used. These consisted of one row with the knotched coulter, two rows with the power units (Bye-Hoe), and one row with the sinner weeder.

All chemical treatments, excluding the granular materials, were applied in 37.5 gpa of water carrier. Treatments were applied on and incorporated into a seven inch band approximately 1-1½ inches deep. Sugar beet seed was planted April 19, 1965, without further mechanical disturbance to the soil. The plots were furrow irrigated within three days after planting.

Sugar beet stands and weed populations were based on counts taken from an area 10 ft. long and 3 in. wide, 1½ in. on either side of the sugar beet row. Six random samples were taken from each treatment. Tonnage yields are based on sugar beet roots taken from 20 ft. of row in four randomly selected areas in each treatment.

Results (table) show that seven of the treatments, pyrazon + pebulate 6 lb/A + 3 lb/A, pebulate + diallate at 3 lb/A + 2 lb/A and 6 lb/A + 4 lb/A, G-36393 at 2 lb/A, EPTC gran. at 4 lb/A, pyrazon at 10 lb/A and pyrazon + G-34690 + EPTC at 3 lb/A + ½ lb/A + 1 lb/A, gave 90 percent or more control of the broadleaved and grass species present in the sugar beet field.

Several of the fall treatments caused burned leaf margins, waxy-leaves and stunting to the sugar beet seedlings. Later in the growing season, the toxicity damage was overcome and the beets recovered.

Vapam and mylone, soil fumigants, were evidently dissipated from the soil by planting time as there was little weed control measured. Diallate + pebulate at 3 lb/A + 2 lb/A was possibly the outstanding treatment in this study. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Fall bedding and chemical treatment for weed control in sugar beets

Treatment	Rate[1] per Acre	% Sugar beet stand	% Broad-leaved weed control	% grass weed control	Yield Ton/A	% sucrose	Pound[2] sugar/A
Vapam	5 gal	113.5	43.8	2.5	13.52	16.80	4542.80
Vapam	20 gal	115.4	67.4	100.0	13.10	17.15	4493.2
Mylone	15 lb	113.9	57.0	56.0	15.92	16.25	5174.00
Mylone	45 lb	114.8	64.5	84.0	24.30	15.60	7581.60
DCU	10 lb	103.7	58.3	56.0	11.12	15.55	3458.40
DCU	20 lb	115.4	77.9	92.0	17.56	16.65	5847.40
GA-210	4 lb	84.6	93.3	99.3	14.44	15.95	4606.40
GA-210	8 lb	88.0	88.1	100.0	17.02	16.05	5463.40
GA-211	4 lb	93.8	85.3	84.0	17.69	16.15	5713.80
GA-211	8 lb	46.3	93.4	100.0	20.44	16.75	6847.40
G-36393	2 lb	54.6	94.7	92.0	17.14	16.40	5622.00
EPTC Gran.	4 lb	88.9	97.3	100.0	16.88	16.20	5789.80
Pyrazon	5 lb	92.6	88.8	80.0	15.76	16.70	5263.80
Pyrazon	10 lb	71.5	93.4	100.0	21.62	16.65	7199.40
Diallate Gran.	8 lb	76.9	68.3	72.0	12.86	16.60	4269.60
CP-15336 Gran.	4 lb	107.4	96.6	84.0	15.24	16.30	4968.20
Pyrazon +	3 lb						
pebulate	3 lb	99.4	95.8	56.0	14.55	16.50	4801.40
Pyrazon +	6 lb						
pebulate	3 lb	57.7	100.0	100.0	13.94	15.70	4377.20
Pebulate +	3 lb						
diallate	2 lb	111.1	99.3	96.0	17.13	16.85	5772.80
Pebulate +	6 lb						
diallate	4 lb	92.3	97.3	100.0	23.06	15.95	7333.00
Pyrazon +	3 lb						
G-34690 +	½ lb	107.7	96.0	96.0	15.44	16.70	5157.00
EPTC	1 lb						
Check					17.20	16.40	5641.60

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[1] Rate per acre is expressed as active material per acre on a broadcast basis incorporated into a 7 in. band 1-1½ in. deep.

[2] LSD-358 lb. sugar produced per acre.

Evaluation of preplanting herbicides in sugar beets. Schweizer, Edward E. and Dan M. Weatherspoon. In a 1965 study, 16 preplanting herbicide treatments, some of which were mixtures, were evaluated for weed control in sugar beets. All treatments were incorporated into a clay loam soil to a depth of 1 to 2 inches with a front mounted 4-row power driven Eversman incorporator. Herbicides were sprayed on a 7-inch band at a volume of 20 gpa aqueous mixture per 23,764 row feet. Row width was 22 inches. The treatments were applied on April 30 and furrow irrigated 1 week later.

The most promising herbicides were: CP31393 at 4 lb/A; R-2063 at 4 lb/A (very poor against kochia); and TD283 at about 4 lb/A. The most promising mixture was pyrazon at 3.75 lb/A plus TD283 at 4 lb/A. The weed control rating was 96% overall and 87% on kochia. Other mixtures that warranted further study were: CP31393 plus CP45592; pyrazon plus CP31393; and pyrazon plus R-2063. (Cooperative Investigations of Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and the Colorado Agri. Expt. Sta., Colorado State University, Fort Collins.)

An evaluation of sugar beet response to trifluralin when applied post-blocking. Warner, Lloyd C., Alex Lange and W. W. Carmean. Dramatic results have been obtained with the use of pre-planting and pre-emergence herbicides in sugar beets. However, the compounds now used only control the weeds for a few weeks. In order that weeds may be controlled for the remainder of the season other chemicals, mechanical or hand labor, must be used.

Trifluralin, normally a preplanting soil incorporated herbicide, has also been widely used as a post-emergence treatment in cotton. However, unlike cotton, sugar beets are sensitive to trifluralin when applied and incorporated pre-planting.

It was the purpose of this study to determine the phytotoxicity of trifluralin when applied to sugar beets post-blocking. Two locations were selected, one near Stockton, California, and the other near Ripon, California. At both locations, excessively high rates were used in order to promote possible phytotoxic effects. Weeds in both areas were controlled by mechanical as well as hand labor in order that competition would not be a factor. The treatments were incorporated immediately by using a Planet Jr. Spring Weeder mounted on the same tractor behind a Lilliston Rolling Cultivator. The Stockton soil was a loam containing 6.8 percent organic matter. The plot size was four 30" rows x 250' with four replications. The beets were treated June 10, 1965, and harvested November 12, 1965. At the Ripon location the soil was a sandy loam and contained less than 1.0 percent organic matter. The plot size was four 30" rows x 650' with three replications. Treatments were made June 9, 1965, and harvested November 13, 1965. An analysis of the data show no significant difference in yields between treatments even at the excessively high rate of 3.0 lb/A. The percent sucrose or gross sugar was also not adversely affected by the treatments at either location.

At the probable recommended rates of .75 and 1.00 lb/A a slight russetting was observed. This appeared as a band around the beets at or near the soil surface. The excessive rates resulted in a constriction of some of the beets near the soil surface. However, this injury was not consistent and did not result in a significant yield reduction. Foliar injury was not observed at any stage after treatment. (Eli Lilly and Company, 5653 North Bond, Fresno, and Holly Sugar, Tracy, California.)

Sugar beet response to trifluralin applied post-blocking at Stockton, California

Treatment	Rate lb/A	Tons/Acre	% Sucrose	Gross Sugar lbs/Acre
Trifluralin	1.0	33.22	14.48	9620
Control	0	33.18	13.89	9217
Trifluralin	.75	30.91	14.51	8970
Trifluralin	3.0	30.15	13.76	8297
LSD at 5% level		NS	NS	NS

Sugar beets were kept free of weed competition.

Sugar beet response to trifluralin applied post-blocking at Ripon, California

Treatment	Rate lb/A	Tons/Acre	% Sucrose	Gross Sugar lbs/Acre
Control	0	26.65	14.60	7782
Trifluralin	.75	25.56	15.22	7780
Trifluralin	1.50	24.80	15.53	7703
Trifluralin	1.00	25.36	14.90	7557
LSD at 5% level		NS	NS	NS

Sugar beets were kept free of weed competition.

Weed control in sugar beets with herbicides. Stewart, Vern R. Several herbicides alone and in combination were evaluated for control of weeds in sugar beets. The predominate weed species were lambsquarters, (*Chenopodium album* L); red root pigweed, (*Amaranthus retroflexus* L); and nightshade, (*Solanum nigrum* L). The study consisted of twenty-six treatments plus a check. Plots were 10 x 60 ft. Herbicides were applied at volume rate of 54.4 gpa. Incorporation of herbicides and seeding of sugar beets was done with an "Eversman" planter and incorporator, in one operation. Plots were evaluated for control by making population counts of weeds and sugar beets. Eight counts were made in each plot in an area 3" by 48" (one sq. ft.). Three groupings for weeds were made, lambsquarter, red root pigweed and other weeds, (predominantly nightshade).

Pyrazon 3 lb and pebulate 2 lb/A controlled 95.3% of all the weed population. Kochia plants were unaffected. No apparent beet damage was evident. (Following table)

CP45592 at 3 lb/A was the most effective individual product on lambsquarters and the most detrimental to sugar beets. R2063 at 3 lb/A was superior for pigweed control. R2063 4 lb/A gave the most effective control of "other weeds" in the study. (Following table)

The higher rates of pebulate, CP45592, CP31393 and the combination of diallate and CP45592 reduced sugar beet stands significantly. (Following table) (Northwestern Branch Station, Montana Agri. Expt. Sta., Montana State University, Kalispell.)

Summary of data from herbicide on sugar beets grown on the W. Glenn Kirscher farm, Stevensville, Montana 1965

Herbicide	Rate lb/A	Beet stand in % of Check	Average number of weeds per quadrant in sample[1] I	II	III	Total	% weed control	Remarks
Pebulate	2	98	57.5	--	9.8	67.3	0.0	Some beet injury
Pebulate	3	100	38.6	8.5	16.1	63.2	45.4	Limited control of lambsquarter, leaves kochia and mustard
Pebulate	4	84	23.0	18.8	52.8	17.6	54.4	Lambsquarter, kochia and mustard not controlled
R 2063	2	123	28.9	11.1	8.4	48.4	58.2	No effect on mustard and kochia
R 2063	3	117	14.8	7.0	1.6	23.4	79.8	Good on pigweed, leaves mustard
R 2063	4	96	12.4	--	1.1	13.5	74.5	Some beet injury, no control of mustard and kochia
Pyrazon	3	111	18.4	5.3	2.1	25.8	77.7	Some control of kochia
Pyrazon	4	96	21.0	--	10.6	31.6	40.2	Fair control of kochia
TD 282	3	106	22.1	7.6	1.6	31.3	73.0	Some beet injury, no control of mustard or kochia, weak on lambsquarter, some control of nightshade.
TD 283	3	104	27.8	4.3	5.1	37.2	67.9	Some beet injury, good on pigweed, poor on lambsquarter and sow thistle
Diallate	2	101	31.0	19.8	9.1	59.9	48.3	Little visual evidence of any control
CP 45592	1.5	112	17.2	--	10.0	27.2	48.5	Beet injury, no control of mustard
CP 45592	3	69	4.5	4.1	4.5	13.1	88.7	Severe beet injury, no control of kochia
CP 31393	3	78	20.4	--	14.3	34.7	34.4	Some control of nightshade some beet injury
CP 31393	5	69	8.9	11.0	7.6	27.5	76.3	Beet injury, no control of mustard
Diallate + CP 45592	1.5 + 1	48	20.8	9.4	1.4	31.6	72.7	Severe beet injury
Pebulate + diallate	2.75+1.25	107	22.9	7.0	9.3	39.2	66.1	Beet injury, no control of kochia, mustard & nightshade
Pebulate + diallate	3 + 1.5	89	11.1	5.1	3.5	19.7	83.0	Beet injury, no control of mustard, weak on pigweed
Pebulate + diallate	3.25+1.75	95	8.0	3.8	2.8	14.6	87.4	Beet injury, no control of kochia

(continued)

Herbicide	Rate lb/A	Beet stand in % of check	Average number of weeds per quadrant in sample[1] I	II	III	Total	% weed control	Remarks
R 2063 + diallate	3 + 1.5	109	36.1	21.5	10.9	68.5	40.8	Left some mustard
Pyrazon + 64-296B	3 + 1	110	20.1	10.6	5.6	36.3	68.7	No control of kochia, Canada thistle and mustard
Pyrazon + pebulate	3 + 2	97	2.9	2.5	.1	5.5	95.3	Left kochia
Pyrazon + R 2063	3 + 2	112	10.5	4.0	2.8	17.3	85.1	Weak on kochia and mustard, left some pigweed
Pyrazon + TD 282	3 + 2	111	20.0	--	2.0	22.0	58.4	Weak on lambsquarter, good on nightshade
Pyrazon + CP 45592	3 + 1	88	1.2	10.6	.3	12.1	89.6	Severe beet injury, no control of mustard and nightshade
Pyrazon + diallate	3 + 1.5	106	7.6	7.8	10.2	25.6	77.9	Beet injury, no control of mustard and sow thistle
Check	0	100	28.5	62.8	24.5	115.8	0.0	

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[1] Quadrant = 3" x 4' - 1 square foot, 8 counts per plot.

Summary of weed control data by species in sugar beet study located in Ravalli County on the Glenn Kirscher farm, Stevensville, Montana
Two replications

Herbicide	Rate lb/A	% weed control[1] Lambsquarter	Pigweed	Other[2]
Pebulate	2	37.5[3]	50.0[3]	53.9[3]
Pebulate	3	55.2	80.3	65.2
Pebulate	4	55.7	56.3	52.1
R 2063	2	74.6	64.2	70.2
R 2063	3	79.1	94.1	89.8
R 2063	4	62.5[3]	50.0[3]	98.2[3]
Pyrazon	3	86.1	91.3	90.5
Pyrazon	4	0.0[3]	0.0[3]	88.4[3]
TD 282	3	81.6	95.3	86.6
TD 283	3	54.2	92.9	87.5
Diallate	2	67.2	50.8	46.6
CP 45592	1.5	0.0[3]	0.0[3]	68.4[3]
CP 45592	3	87.6	68.5	84.3
CP 31393	3	0.0	0.0[3]	71.6[3]
CP 31393	5	83.1	73.6	60.0
Diallate + CP 45592	1.5 + 1	78.1	91.3	87.2
Pebulate + diallate	2.75 + 1.25	86.1	74.8	68.9
Pebulate + diallate	3.00 + 1.50	91.0	89.0	79.7
Pebulate + diallate	3.25 + 1.75	91.0	90.9	87.6
R 2063 + diallate	3.00 + 1.5	68.2	46.1	59.0
Pyrazon + 64-296B	3 + 1	73.1	77.2	84.3
Pyrazon + pebulate	3 + 2	92.0	99.2	96.7
Pyrazon + R 2063	3 + 2	97.0[3]	83.1[3]	91.6[3]
Pyrazon + TD 282	3 + 2	31.3[3]	50.0[3]	96.5[3]
Pyrazon + CP 45592	3 + 1	85.0	77.6	81.0
Pyrazon + diallate	3 + 1.5	84.6	69.3	76.7
Check	0	0.0	0.0	0.0

[1] Average of two replications
[2] Predominantly nightshade
[3] Only one replication

Weed control in fall planted sugar beets grown for seed. Furtick, W. R., Floyd O. Colbert and Larry C. Burrill. Trials were established on 3 locations representing 3 different soil types in the Willamette Valley in the fall of 1965. Several promising herbicides as well as EPTC were tested either as pre-plant incorporated, pre-emergence or post-emergence applications. The primary weed species were dogfennel (Anthemis cotula), mustard (Brassica campestris), and annual ryegrass (Lolium multiflorum).

Results obtained from the pre-plant incorporated treatments indicate sugar beets are most tolerant of Stauffer's R-2063 than EPTC under all conditions tested. Rates of R-2063 up to 16 lb/A were not appreciably phytotoxic to the sugar beets. It was further noted that R-2063 in combination with Amchem's pyrazon gave fairly consistent grass and broadleaf weed control. The other two compounds tested, CP 31393 and EH 52,504, were quite toxic to the sugar beets.

Pre-emergence results for all chemicals tested indicate a high degree of sugar beet injury or a rather narrow margin of safety. These compounds included the following: ACP-64-296 B, CP 31393, CP 45592, CP 50144, EH 52,504, RC 3114, RC 3215, RP 11755, and SD 11831.

Some promise with early post-emergence treatments of Spencer's S-6173 and Reichhold's RC 3215 was evident. In one trial the combination of pyrazon and S-6173 appeared safer in relation to sugar beet injury and gave better weed control than S-6173 alone. (Farm Crops Department, Oregon State University, Corvallis.)

Residual effect of Picloram on field peas and annual weeds. Rydrych, D. J. and D. G. Swan. It has been reported that picloram has varying degrees of soil persistence depending on soil type, moisture, and dosage. This study was initiated to determine the longevity of residual picloram and to observe the effect of the residues on field crops and certain annual weed species.

On November 17, 1964, several rates of picloram (.5-2 lb/A) were applied on wheat stubble. The soil was a Walla Walla silt loam and field peas were seeded in the residual area on April 5, 1965. Readings were taken on June 29, 1965.

Predominant weed species in the area included prostrate pigweed (*Amaranthus blitoides*), downy brome (*Bromus tectorum*), Russian thistle (*Salsola kali*), tumbling mustard (*Sisymbrium altissimum*), shepherds purse (*Capsella Bursa-pastoris*), prostrate knotweed (*Polygonum aviculare*), and lambsquarters (*Chenopodium album*).

Crop injury and weed control from the residual picloram are presented in the table. Field peas were completely killed by all rates of picloram. All weed species except downy brome and prostrate pigweed were controlled by picloram at .5 lb/A. The latter weed species were not controlled by less than 1 lb/A. The results show that not only are certain crops such as field peas highly sensitive to residual picloram but also many annual weed species. (Oregon Agricultural Experiment Station, Pendleton.)

Residual effect of picloram on field peas and annual weeds

	Control score[1]				
Species	Control	.25 lb/A	.50 lb/A	1 lb/A	2 lb/A
Field peas	0	10	10	10	10
Prostrate pigweed	0	0	0	9	10
Downy brome	0	0	0	8	7
Russian thistle	5	10	10	10	10
Tumbling mustard	0	9	10	10	10
Shepherds purse	0	5	9	10	10
Prostrate knotweed	0	0	10	10	10
Lambsquarters	0	8	10	10	10

[1] Control rating--10 = 100% kill; 0 = none

Weed control in peppermint with uracil herbicides. Appleby, Arnold P., Larry C. Burrill and George W. Atkeson. Research was continued on peppermint weed control with major emphasis being placed on DuPont 732 (5-chloro-3-tert. butyl-6-methyluracil) and DuPont 733 (5-bromo-3-tert. butyl-6-methyluracil). In general, weed control from both compounds has been outstanding with a wide margin of safety on mint. DuPont 732 has been slightly superior to 733 and will receive major emphasis in future work.

In Eastern Oregon, it now appears that .8 lb ai/A is sufficient to give good control in most cases. Where particularly resistant weeds are present or moisture conditions are poor, 1.2 lb may be required. In Western Oregon, a rate of 1.2 to 1.6 lb/A appears adequate.

Weeds requiring a higher rate of herbicide are pigweed (Amaranthus retroflexus), Russian thistle (Salsola kali), Canada bluegrass (Poa compressa), and salsify (Tragopogon porrifolius).

Best results have been obtained when adequate but not excessive amounts of overhead moisture have been received before weeds become well established. (Department of Farm Crops, Oregon State University, Corvallis.)

Weed control in grain sorghum. Williams, David, W. P. Anderson, and J. W. Whitworth. Preliminary screening trials at the main station were used as a basis for predicting the performance of a group of triazine herbicides and when used under grower conditions at another location and on a different soil type.

On the main station the crops and weeds were sown on the flat and the herbicides were then applied as a broadcast spray followed by a flood irrigation. Of the five herbicides shown in the following table, Propazine and GS-14260 were especially low in toxicity, and also in toxicity to johnson from seed.

Percentage reduction in stand of weeds and sorghum from pre-emergence herbicides[1]

Herbicide	Rate lb/A	Annual grasses	Pigweed	Johnson (seed)	Sorghum
Propazine	1½	13b	100	0	0a
GS-13528	2	5	97c	0a	38a
GS-13529	2	46b	100	38a	31a
GS-14253	2	97b	69b	56b	69b
GS-14260	2	100	98c	0b	0a

[1] Clay loam soil, University Park, New Mexico
Key, injury: a = light, b = mod., c = severe

Propazine was less effective on annual grasses (Erichloa gracillis and Echinochloa colonum) than GS-14260. The soil on these plots is classified as clay loam.

In the following table, the percentage control of sandbur and the yield of grain at Tucumcari on sandy loam soil is shown for only two of the herbicides.

Preplant applications of soil incorporated herbicides applied 5/12/65[1]

Herbicide	Rate lb/A	% Control of sandbur	Yield of grain sorghum, % of ck.
Propazine	1	70	148
	1½	100	161
	2	100	112 (injury)
GS-14260	1	70	148
	2	50	152
	4	90	121 (injury)

[1] Sandy loam soil, Tucumcari, New Mexico

Propazine at 1½ lb/A produced 100 percent control of the sandbur and grain yield of the sorghum amounted to 161% of the untreated check. GS-14260 at 2 lb/A gave 50% control and yields equal to 152% of the check. At the highest rate, GS-14260 was less toxic to sorghum than Propazine. These treatments were applied pre-plant, soil-incorporated. Yields for pre-emergence treatments without incorporation are not reported since all caused injury to the sorghum and reduced the yields.

The comparative toxicity of five herbicides when applied as pre-emergence sprays at the two locations is shown in the following table.

Comparative performance of pre-emergence herbicides at two locations[1]

		Percentage reduction of sorghum	
		Stand	Yield
Herbicide	lb/A	Univ. Park	Tucumcari
Propazine	2	0	20
GS-13528	2	38	49
GS-13529	2	31	100
GS-14253	2	69	100
GS-14260	2	0	16

[1] Clay loam soil at Univ. Park and sandy loam soil at Tucumcari

At both locations, Propazine and GS-14260 proved to be the least toxic to sorghum. Stands were not reduced by these treatments at the main station, University Park, and yields were reduced only 20% and 16%, respectively, at Tucumcari, New Mexico. These two herbicides, as with the other treatments, proved less toxic to sorghum at Tucumcari when soil-incorporated than when applied on the soil surface without incorporation. (Northeastern Branch Station and New Mexico State University, Agricultural Experiment Station, University Park.)

The value of preliminary screening trials. Whitworth, J. W. and W. P. Anderson. A system of preliminary field screening trials has been developed at New Mexico State University to permit a measure of the maximum toxicity of herbicides to weeds and their protoplasmic selectivity to crops. Eight to ten crops and associated weed species were drilled in dry soil in rows one foot apart. The plantings were on the flat between borders. After the planting, the herbicides were applied as broadcast sprays immediately followed by flood irrigation.

In the spring trials, the seeds were sown in the bottom of a 1-1½" depression in the row and capped with sand. The soil on these tests was a clay loam. In the fall tests the lighter soil, sandy clay loam, made direct seeding possible without capping with sand.

Percentage reduction in the stand of weeds one month after preemergence applications of herbicides[1]

Herbicide	Rate lb/A	Cupgrass	Junglerice	Lambsqtrs	Pigweed	Johngrass	A. M. Glory
Dacthal	6-9	100	100	91	89	94	50
Prefar	6-8	90	98	78	84	95	9
Treflan	1-4	100	100	99	98	100	50
Benefin	1½	100	90	80	95	88	0
Diuron	1	78	90	89	100	42	81
Caparol	2	74	81	93	78	49	78
Propazine	1½-2	18	57	100	100	0	85

[1] Average of 7 tests, 1962-65, except for Benefin which was tested once in 1965.

The preceeding table shows the average performance on weeds of some of the more effective herbicides tested from 1962-65.

In the following table, their selectivity on crops is shown for these same herbicides. The correlation between high selectivity on crops and clearance for use on these same crops by USDA is somewhat better than expected. However, it has become apparent that soil incorporation must be included as a variable to properly measure selectivity with herbicides such as Treflan which are not readily moved into the soil even by repeated flood irrigations. (New Mexico State University, Agricultural Experiment Station, University Park.)

Percentage reduction in crop stands one month after pre-emergence applications of herbicides[1]

Herbicide	Rate lb/A	Cotton	Alfalfa	Onions	Lett	Sorghum
Dacthal	6-9	9*	19*	13*	21	71
Prefar	6-8	3	48	35	8	73
Treflan	1-4	0*	65	59	64	63
Benefin	1½	8	0	11	0*	54
Diuron	1	15*	90	76	96	44
Caparol	2	48*	77	70	95	42
Propazine	1½-2	0	100	100	100	0*

[1] Average of 7 tests, 1962-65, except for Benefin which was tested once in 1965.

* Cleared

Stale seedbed method for forage establishment. Peabody, Dwight V., Jr. Mainly due to the unusually dry spring weather conditions of this year, pre-planting weed control treatments in a stale seedbed preparation technique resulted in poor control with accompanying lesser yields of good forage than did the presently recommended post-emergent DNBP treatment. Where pre-planting flame was compared to pre-planting chemical (diquat) treatments, more good forage was harvested from plots receiving diquat treatment than those that were flamed, although for the most part this difference had disappeared by the time of the second cutting. The principal hazard to the establishment of good forage stands by means of the stale seedbed method is not an adequate method of weed control, but rather weather. After the waiting period which is required for germination and early growth of weeds, soil and climatic conditions often are not conducive for germination and growth of clover and grass. (Northwestern Washington Research & Extension Unit, Washington State University, Mount Vernon.)

Weed populations in a northern Colorado beet field as influenced by herbicides, crop sequence and nitrogen fertilizer. Hepworth, H., J. May, A. D. Dotzenko and K. Storer. A cooperative study between the Colorado Agricultural Experiment Station (Agronomy, Botany and Agricultural Engineering Sections) and the Great Western Sugar Company was initiated in 1964 and continued in 1965 at the Agronomy Research Center 5 miles southeast of Fort Collins. Objectives of the 4 year study are to determine the interacting and residual effects of cropping sequence, chemical and mechanical weed control, and nitrogen application on weed populations, beet yields and sugar production. The crops in the cropping sequence are corn, beans, beets and barley. Alfalfa was not included because its use would have extended the test period too long for the probable values to be obtained.

At the beginning of the tests, the whole area was treated with an ample level of phosphate and plowed under. In all tests irrigation water was flooded on to the plots. Water was measured on each area to insure uniformity of available moisture.

The three crop sequences under study are barley, beets and corn; corn, beets and barley; and beans, beets and barley. The experimental design for the study for the 1964, 1965 and 1966 seasons involving crop sequence and fertilizer treatments are as follows:

Crop	Year	Levels of nitrogen fertilizer treatment F_1 level Lbs "N"/A	 F_2 level Lbs "N"/A	 F_3 level Lbs "N"/A
		Sequence A		
Barley	1964	0	50	50
Beets	1965	100	100	200
Corn	1966	100	200	100
		Sequence B		
Corn	1964	100	200	100
Beets	1965	100	100	200
Barley	1966	0	50	50
		Sequence C		
Beans	1964	0	50	0
Beets	1965	50	100	150
Barley	1966	50	50	50

The currently recommended herbicides as applied to each crop involved are as follows:

Sugar beets	Pre-plant, incorporated	Pyrazon + TD 282	3.75 lb/A 2.50 lb/A
	Post-emergence	Pyrazon + Dalapon + Surfactant	3.00 lb/A 3.00 lb/A
Corn	Pre-plant, incorporated	EPTC + 2,4-D	2.00 lb/A 1.00 lb/A
	Post-emergence, directed spray	Linuron + 2,4-D + Surfactant	2.00 lb/A 0.75 lb/A
Beans	Pre-plant, incorporated	EPTC + Amiben	2.00 lb/A 2.00 lb/A
Barley	Post-emergence (5 leaf stage)	2,4-D	0.75-1 lb/A

The mechanical methods of weed control are the standard tillage practices used in this areas.

The weed and stand count data were obtained from 400 inches of row per plot. Plot size was 45 ft long and 12 rows wide; rows were spaced 22 inches apart.

Results through the 1965 season indicate:

1. Herbicides greatly reduced weed populations in sugar beets as compared to standard tillage practices; chemicals caused slight stunting of beets for the first 4 or 5 weeks but thereafter was not noticeable. Yields and sugar per acre were not decreased.

2. In the crop sequence when beets followed beans there were significantly less weeds compared to beets after corn or beets after barley. Beets following corn had the most weeds per foot while beets after barley was intermediate.

3. The nitrogen fertilizer used in 1964 and 1965 had little or no direct effect on either weed populations or beet stands. Differences may appear in later years.

4. No chemical residual effects from the 1964 applications were observed in the 1965 crops.

Since these results are based on only two seasons, a longer period of test will be needed to determine year to year variation in the effectiveness of herbicides, crop sequence and nitrogen fertilizer on the solution of the weed control problem in beets in this area.

Evaluation of five herbicides in pre-plant, pre- and post-emergence applications. Reimann, James and Lambert C. Erickson. The effects of 5 herbicides at 3 rates on 4 crops, applied as pre-plant, pre-emergence, and post-emergence were studied during the summer of 1965.

The experiment began May 28 with the application of the pre-plant material. A small boom equipped power sprayer was used, delivering 38 gallons per acre. A 5% solution of surfactant was added with the azides. The varying pounds per acre rates were obtained by double etc., coverage. The pre-plant applications were soil incorporated with a tandem disc to an average 3-inch depth.

The entire pre-plant, pre-emergence, and post-emergence plot areas were seeded on May 31. The pre-emergence treatments followed immediately, and the post-emergence treatment was delayed until June 23. Observation evaluations continued until the study was terminated on August 10.

The triflüralin and Shell 11831 treatments appeared to have no influence on weed control or crop damage under the conditions of this test.

Thompson Haywards No. 164 was most effective as pre-plant and pre-emergence treatments and their toxicities were more apparent as the season progressed. Germination was not influenced and toxicity was due to root absorption. All broadleaved weeds were eliminated except for *Convolvulus arvensis* and *Cirsium arvense*. Continuous control of annual weeds prevailed all summer.

Peas was the most susceptible crop to pre-plant and pre-emergence application but it had a high tolerance to foliar applications; however, all crops were damaged by the pre-emergence treatments.

The sodium and potassium azides had herbicidal value at the 10 pound rate when applied as pre-plant and pre-emergence. When they were applied as foliar sprays, all rates were toxic and the symptoms could be detected within 2 hours. The plants first developed chlorotic spots, then wilted and eventually turned black. Crambe and flax were more susceptible than wheat or peas. Higher rates generally shortened the time interval between application and plant desication. All broadleaf weed species that were present at the time of application were killed. Plants that did survive the treatment recovered and grew vigorously and appeared normal. (Idaho Agricultural Experiment Station, Moscow.)

			Pre Plant		Pre-Emergence		Post-Emergence	
Crop	Herbicide	Rate	Crop Damage	Weed Control	Crop Damage	Weed Control	Crop Damage	Weed Control
Crambe	Trifluralin	1	0	0	0	0	0	0
		2	0	0	0	0	0	0
		3	0	0	0	0	0	0
	Shell 11831	1	0	0	0	0	0	0
		2	0	0	0	0	0	0
		4	0	15	0	0	0	0
	K azide	2.5	0	0	0	0	60	40
		5	0	0	0	0	80	50
		10	10	0	0	60	95	70
	TH 164	2	30	20	20	10	15	0
		4	50	60	40	35	25	0
		8	80	85	70	60	40	0
	Na azide	2.5	0	0	0	0	60	40
		5	0	20	0	30	80	50
		10	0	40	0	45	95	70
Wheat	Trifluralin	1	0	0	0	0	0	0
		2	0	0	0	0	0	0
		3	0	5	0	0	0	15
	Shell 11831	1	0	0	0	0	0	0
		2	0	0	0	0	0	0
		4	0	0	0	0	0	0
	K azide	2.5	0	0	0	10	0	0
		5	0	30	0	10	20	20
		10	0	80	20	10	30	40
	TH 164	2	10	15	25	20	15	35
		4	25	40	45	60	25	55
		8	40	90	75	85	50	80
	Na azide	2.5	0	0	0	10	0	10
		5	0	25	10	30	20	35
		10	0	50	30	50	65	50
Check	Trifluralin	1	0	0	0	0		
		2	0	0	0	0		
		3	0	5	0	0		
	Shell 11831	1	0	0	0	0		
		2	0	0	0	0		
		4	0	0	0	0		

Crop	Herbicide	Rate	Pre Plant Crop Damage	Pre Plant Weed Control	Pre-Emergence Crop Damage	Pre-Emergence Weed Control	Post-Emergence Crop Damage	Post-Emergence Weed Control
	K azide	2.5	0	0	0	0		
		5	0	0	0	0		
		10	0	0	0	10		
	TH 164	2	0	20	0	0		
		4	0	60	0	50		
		8	0	95	0	90		
	Na azide	2.5	0	0	0	0		
		5	0	0	0	0		
		10	0	5	0	0		
Peas	Trifluralin	1	0	0	0	0	0	0
		2	0	0	0	0	0	0
		3	0	0	0	15	0	0
	Shell 11831	1	0	0	0	0	0	0
		2	0	0	0	0	0	0
		4	0	0	0	0	0	0
	K azide	2.5	0	0	0	0	30	20
		5	0	5	10	0	55	45
		10	0	15	20	15	70	75
	TH 164	2	20	20	45	35	0	0
		4	40	60	70	65	0	0
		8	60	85	95	90	5	0
	Na azide	2.5	0	0	0	0	30	20
		5	0	0	0	0	55	45
		10	5	15	5	10	70	75
Flax	Trifluralin	1	0	0	0	0	0	0
		2	0	0	0	0	0	0
		3	10	0	0	0	0	0
	Shell 11831	1	0	0	0	0	0	0
		2	0	0	0	0	0	0
		4	0	0	0	0	0	0
	K azide	2.5	0	0	0	10	20	15
		5	0	0	0	10	35	20
		10	15	0	10	15	60	40
	TH 164	2	30	20	0	30	0	0
		4	60	70	0	60	10	10
		8	85	85	0	80	20	30
	Na azide	2.5	0	0	0	0	0	10
		5	0	15	0	40	50	25
		10	0	35	20	50	75	40

Amiben effectiveness as influenced by formulation. Dunster, K. W. In areas where precipitation cannot be predicted, Amiben must be soil incorporated for consistent weed control. Soil dilution coupled with leaching characteristics has tended to reduce weed control effectiveness in instances where rainfall occurs after incorporation.

Leaching studies indicate that amiben formulated as an ester or amide rather than the ammonium salt greatly reduces leachability. When applied to the soil surface and subjected to 3 inches of simulated rain, amiben acid leached to a depth of 12 inches. In contrast the ester and amide formulations stayed in the top 1.5 and 3.0 inches of soil respectively.

Field experiments conducted under controlled moisture conditions confirmed initial laboratory findings. Crop tolerance was improved with the ester and amide formulations as the amiben remained in the zone above the developing crop root system. (Amchem Products, Inc., Fremont, California.)

Formulation	Rate	Per Cent Weed Control ½" Rainfall	 2" Rainfall
Ammonium salt	3 lb/A	95	60
Methyl ester	3 lb/A	90	90
Amide	3 lb/A	80	95

Crambe: weed control trials in 1965. Youngman, Vern E., D. J. Rydrych and T. J. Muzik. Crambe (Crambe abyssinica) is under investigation as an alternate crop in the Palouse area of the Pacific Northwest. Unknown in the United States 6 years ago, the oil derived from the crambe plant now shows promise in industrial applications where other U. S. farm products are not used. The purpose of this research was to study the effect of selected herbicidal applications on the growth and development of the crambe plant as well as the yield of seed.

Ten herbicides were field tested for selective weed control in crambe. Trifluralin, diallate, R-4572, ACP 64-296 B, SD 11831 and tupersan were incorporated prior to seeding of crambe. Barban, UC 22463, TOK-25, and bromoxynil were applied when the crambe was in the three to four leaf stage.

Weed species in the experimental area were wild oats (Avena fatua) which was seeded in a single row across all plots, field pennycress (Thlaspi arvense), lambsquarters (Chenopodium album), henbit (Lamium amplexicaule), shepherds purse (Capsella bursa-pastoris) and cow cockle (Saponaria vaccaria). One set of plots was weeded by hand hoeing. Weeds, on the average, reduced yield 17 percent.

Trifluralin at 0.75 lb/A incorporated in the soil before planting satisfactorily controlled broadleaved weeds with no measurable injury to the crambe plant. Diallate incorporated into the soil at 1.5 lb/A satisfactorily controlled wild oats and similarly did not injure the crambe. Plots treated with a mixture of the two chemicals incorporated prior to planting at the rate of 0.75 lb/A of trifluralin and 1 lb/A of diallate produced yields as good as the hand-weeded check plots.

R 4572 effectively controlled wild oats but injured the crambe. Of other chemicals tested only ACP 64-296 B shows promise for wild oats control with little injury to crambe.

Barban at the rate of ½ lb/A shows promise for wild oat control by post-emergence application without damage to crambe. TOK-25 at the rate of 2 lb/A resulted in some reduction in wild oats and broadleaf weed growth with treated plots producing yields that were as good as the hand-weeded controls. Bromoxynil severely injured crambe and resulted in lower yields.

Further trials are planned. (Department of Agronomy, Washington State University, Pullman.)

PROJECT 6. AQUATIC AND DITCHBANK WEEDS

D. E. Seaman, Project Chairman

Summary

Three reports were received from one contributor and his coworker, and two reports were contributed by the chairman of this project. In spite of the obvious quality of these reports, the lack of contributors to this project is very disappointing. However, perhaps the dearth of reports means that the WWCC aquatic weed scientists are busy gathering data to contribute to next year's Project 6 research progress report.

The reports concerning low rate, long term applications of the mono-(N,N-dimethylalkylamine) salt of endothall show encouraging results in control of sago pondweed, but the necessity of using concentrations higher than 1 ppm may be a disadvantage in areas where fish toxicity is important. Perhaps later uptake studies will reveal some ways of making endothall amine more effective at rates that are safer to fish. The suggestion that leaves of submersed weeds expand energy during absorption of herbicides from dilute solutions in a manner similar to that of inorganic ion uptake by roots is intriguing, and there may be possibilities of enhancing uptake and kill through use of underwater surfactants or adjuvants.

It appears that soil applied fenac and dichlobenil still has some promise for control of submersed weeds in canals, but the timing of the applications and subsequent fates of the herbicides are important factors requiring further investigation.

The report concerning the control of submersed weeds in rice by 2-amino-3-chloro-1,4-naphthoquinone is a pleasing pay-off after three years of ring testing about 80 formulations. The use of this fish toxic chemical with relative safety in rice fields shows that we need not be too alarmed by aquarium toxicity data when conducting tests in the field where numerous factors affect herbicides and usually render them less harmful.

The success of repeated applications of systemic herbicides for control of reed canarygrass further emphasizes the necessity of multiple applications for perennial grass control. Those who object to the expense of multiple applications must choose between the total waste of time and effort spent on one shot applications and the possibility of killing the weeds with several well timed treatments.

Mono-N,N-dimethylalkylamine salt of endothall for control of sago pondweed. Hollingsworth, E. B. The mono-N,N-dimethylalkylamine salt of endothall (known commercially as Hydrothol 191), in a previous study, provided control of sago pondweed (Potamogeton pectinatus L.) for 6 to 8 weeks when applied at 15 ppm for 1 hour. The present test utilized two separate applications to explore the use of lower concentrations of the herbicide.

In the first application, Hydrothol 191 was applied on July 22, 1965, at a concentration of 6.5 ppm for 1 hour to 11 cfs of water in a canal 5½ miles long. The water was clear with a temperature of 57° F. The required amount of herbicide was mixed with water in a 55-gallon barrel and metered into the stream. The development of the weed growth ranged from early bud to early bloom stage.

The second application of Hydrothol 191 was made in the same canal, 5 weeks after the first treatment. The herbicide was applied at 11 ppm for 90 minutes to 9 cfs of water flow. The water was clear with a temperature of 56° F. Pretreatment weed data and the weed response after each application are shown in the following table. Observations were taken at five stations at 1-mile intervals. The weed conditions 5 weeks after the first treatment prevailed at the time of the second treatment.

Weed data	Distance downstream from point of application (miles)				
	1	2	3	4	5
Pre-treatment					
Infestation (percent)	85	90	85	80	80
Weed density (percent)	15	60	80	50	60
Max. weed length (inches)	24	30	40	20	18
2 weeks after first treatment					
Weed slumping (percent)	95	90	30	95	90
Stem kill (percent)	0	10	5	25	0
Leaf kill (percent)	60	80	40	98	20
5 weeks after first treatment					
Infestation (percent)	30	50	80	70	75
Weed density (percent)	5	20	60	7	20
Weed slumping (percent)	75	60	0	90	84
Max. weed length (inches)	24	24	36	18	12
3 weeks after second treatment					
Infestation (percent)	40	60	80	60	60
Weed density (percent)	5	15	60	5	10
Weed slumping (percent)	90	85	10	90	50

The marked difference in plant response at the 3-mile station merits some explanation. The cross-sectional area of the stream is larger in this vicinity for approximately 1 mile. The water velocity is less and silt deposition more pronounced. These conditions were more favorable for pondweed growth as reflected in the pre-treatment weed length and density for the 3-mile station. The dense heavy growth was conducive to "channeling" in which the treated water by-passes the weed infestation instead of flowing through it. Other portions of the stream had less dense growth which was more susceptible to treatment. The 3-mile station will be omitted from the following discussion.

The 6.5 ppm concentration of Hydrothol 191 was effective in reducing the pondweed obstruction to flow, as indicated by the percentage slumping 2 weeks after treatment and the reduced weed density after 5 weeks. Slumping was caused by a reduced buoyancy of the weed, due to treatment, causing it to sink toward the bottom. The more slumping the greater the release of water flow.

Good response to the 6.5 ppm treatment persisted for about 4 weeks. Stem kill of the pondweed was not good and the leaf kill was only fair, but unobstructed flow of water was established. At the end of 5 weeks, plant regrowth was occuring and the weed recovering its buoyancy. At that time the 11 ppm concentration of herbicide was applied to maintain weed control for the remainder of the season. The overall weed density and infestation were reduced during the experimental period.

Results of this test indicate that Hydrothol 191 at 6 to 10 ppm can cause slumping of sago pondweed and provide a satisfactory increase of water flow in irrigation canals. The weed response is temporary and not so severe as when higher rates of application are used. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture and the Wyoming Agricultural Experiment Station, Laramie.)

Absorption of endothall and diquat by submersed aquatic weeds. Seaman, D. E. and T. M. Thomas. The use of the mono-(N,N-dimethylalkylamine) salt of endothall (MDMA-endothall) for control of submersed weeds in moving water seems very intriguing because of the simple method of applying this herbicide, its low cost, and its probable lack of hazards to fish and to irrigated crops. Unfortunately, some problems were encountered in our field tests with MDMA-endothall during the summer of 1965. An application at 1 ppm for 10 hours gave only partial control of American pondweed, with no apparent effects on fish, in a ditch flowing at 2 cfs. A repeated application to the same ditch at 3 ppm for 5 hours killed about 80 percent of the weeds, but numerous minnows, green sunfish, and tadpoles were also killed. On the other hand, satisfactory control of sago pondweed with no fish injury resulted in a similar ditch treated with MDMA-endothall at 1 ppm for 6 hours. These limited trials indicated that an important advantage of MDMA-endothall (that of not injuring fish) might be negated by the necessity of using concentrations higher than 1 ppm to control American pondweed and other weeds that are more resistant than sago pondweed.

Some absorption experiments were conducted with excised leaf segments of American and sago pondweed and trifoliate nodes of American elodea to learn more about the nature of their absorption of herbicides from dilute solutions over long periods of time. Leaf samples were allowed to absorb C^{14}-labeled diquat, disodium endothall, or a simulated MDMA-endothall formulation containing disodium endothall-C^{14} and dimethylalkylamine from solutions of these herbicides in 250 ml Erlenmeyer flasks on a rotary shaker. Following the absorption periods, the samples were transferred and rinsed for an hour in an equivalent concentration of the same but non-radioactive herbicide. The samples were then blotted with absorbant tissue, wrapped in pre-weighed ashless black paper, weighed (for fresh weights), dried at 50 C for 12 hours, weighed again (for dry weights), and assayed for total radioactivity by a modified Schoniger oxygen flask combustion technique (Olivero et al., Anal. Biochem., 4:188-189, 1962). The amount of herbicide absorbed by the sample was based on the total radioactivity and expressed as micrograms uptake per gram fresh weight, which is equivalent to ppm of herbicide in the living leaves.

The leaves of both sago and American pondweed were found to absorb more than twice as much endothall-C^{14} from 0.1 ppm solutions as did elodea leaves during 48 hour runs. Internal concentrations of endothall-C^{14} as high as 1.2 ppm were found in pondweed leaves, but a maximum of only 0.4 ppm was found in elodea leaves. The differences in accumulation may be related to the greater susceptibility of the pondweeds to endothall compared with elodea as numerous field tests have shown. Similar uptake experiments showed that elodea leaves accumulated diquat-C^{14} from 0.05 ppm solutions up to 24 times the external concentration in 10 hours, while an 8-fold concentration of this herbicide resulted in sago pondweed leaves.

The uptake of both diquat-C^{14} and endothall-C^{14} by elodea leaves was greatly reduced by pretreatment with 0.01 molar NaN$_3$ or KCN and by 2,4-DNP at 0.001 molar. The reduction in uptake caused by all three of these respiratory inhibitors is strong evidence that the accumulation of these herbicides occurs by processes requiring metabolic energy. The 95 percent reduction in endothall-C^{14} uptake by the inhibitors suggested that this compound was absorbed almost entirely by metabolic processes, while a 38 to 48 percent reduction in the uptake of diquat-C^{14} by the inhibitors showed that more than half of the uptake of diquat may be by means of nonmetabolic processes such as physical adsorption to plant surfaces.

Although MDMA-endothall is usually lethal to elodea, the trifoliate nodes of elodea absorbed only 65 percent as much MDMA-endothall-C^{14} as they did disodium endothall-C^{14} during a 48 hour run. This indicates that some factor other than absorptivity is responsible for the greater herbicidal action of MDMA-endothall on elodea. These studies will be continued to find a means for making low rate, long term applications of MDMA-endothall, and possibly other herbicides as well, more effective for control of submersed weeds without accompanying hazards. (Dept. of Botany, Univ. of California, Davis.)

Soil-application of fenac and dichlobenil for control of sage pondweed. Hollingsworth, E. B. The response of sago pondweed (*Potamogeton pectinatus* L.) to soil applications of 2,3,6-trichlorophenylacetic acid (fenac) and 3,6-dichlorobenzonitrile (dichlobenil) has varied from poor to excellent in the past few years. The differences are presumed to have been due to the variation in moisture associated with previous applications. In an effort to test this presumption, fall and spring applications of fenac and dichlobenil were made in ponded water of a canal.

The test was conducted in the Rock Ranch Canal near Torrington, Wyoming, after the waterflow had been cut off for the season. The plots were 100 feet long and 15 feet wide with 25-foot untreated areas between plots. A low dam was installed at the ends of each plot to confine the herbicides in the treated area. Fenac and dichlobenil were both applied at rates of 15 and 20 lb/A. The required amount of granular herbicide was weighed and applied to each plot with a cyclone-type distributor. The fall treatments were on October 18, 1964, and the spring treatments on June 17, 1965. Standing water ranged from 1 to 4 inches deep over the plots. The results from all treatments are shown in the following table.

Treatment	Rate lb/A	Date applied	Percent pondweed control 6-10-65	8-10-65	10-19-65
Dichlobenil	15	10-18-64	10	0	0
Dichlobenil	20	10-18-64	20	0	0
Fenac	15	10-18-64	70	30	40
Fenac	20	10-18-64	70	30	30
Dichlobenil	15	6-17-65	-	100	95
Dichlobenil	20	6-17-65	-	100	95
Fenac	15	6-17-65	-	100	82
Fenac	20	6-17-65	-	100	85

The fall applications of dichlobenil were unsatisfactory. Early spring observations revealed only slight pondweed control that might be attributed to the material. During the remainder of the summer there were 100 percent infestations in the fall-treated dichlobenil plots. Fenac, applied in the fall, produced good weed control early in the spring which rapidly declined to less than satisfactory control during the summer. Both materials provided excellent pondweed control throughout the season when applied on June 17.

The results of this test indicate that fall treatments with fenac and dichlobenil are poor risks for weed control in irrigation ditches the following summer. Frozen soil and water conditions during the fall and winter are detrimental to the best incorporation of soil-applied materials. In previous experiments fenac has shown good residual tendencies when the application was followed by sufficient moisture. Probably the 1 to 4 inches of ponded water in this test was insufficient to carry the entire herbicidal dose into the soil. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture and the Wyoming Agricultural Experiment Station, Laramie.)

Control of submersed weeds in rice with 2-amino-3-chloro-1,4-naphthoquinone. Seaman, D. E. Submersed aquatic weeds have largely been ignored by California rice growers in favor of the more obvious emersed weed problems (arrowhead, barnyardgrass, burhead, etc.), although the growers have recognized that submersed weeds such as American pondweed, chara, horned pondweed, and southern naiad may interfere with rice production in a number of ways. They may compete with rice for space and nutrients, they impede water flow making water management difficult, and they retard pre-harvest draining and drying of the fields delaying harvest schedules and sometimes causing losses during harvest. These weeds also harbor mosquito larvae and thereby contribute to mosquito abatement problems.

2-amino-3-chloro-1,4-naphthoquinone (06K) was introduced by the Chemical Division of the U. S. Rubber Company in 1958 as a possible algicide and aquatic herbicide. It was essentially abandoned later when its high fish toxicity became known. However, 06K was among the four most promising herbicides tested for submersed weed control in rice in 1963 and 1964 (Seaman, D. E., WWCC Res. Prog. Rpt., 1965, pp. 108-109). The present report concerns two large scale evaluations of 06K conducted in 1965.

Aerial applications of a 10 percent granular formulation of 06K were made on July 14 at 3 lb/A to 20-A portions of two flooded seed rice fields planted 55 days previously with Calrose variety rice. Field A was densely infested throughout with chara as well as some southern naiad, and Field B also contained mainly chara with some horned pondweed and southern naiad scattered throughout its area. The irrigation water was diverted around the fields and their outlets were closed to provide static water conditions for five days after application, and water samples were collected frequently for 06K residue analysis. In addition to visual performance ratings, the weeds were gathered by hand from five random square meter plots in each of the treated and untreated portions of the fields to determine the extent of control a month after application. The rice was hand harvested at maturity from five random 16 sq. ft. plots in each of the treated and untreated areas of the fields and the rough rice yields (14 percent moisture) were calculated in hundreds of pounds per acre (cwt/A). The results are shown in the accompanying table.

Initial dipped water samples from Field A contained as much as 1.25 ppm of 06K while those from Field B contained no more than 0.6 ppm. The 06K concentration of all succeeding samples decreased rapidly with time while the water was held static as well as after the water was allowed to flow again, and the chemical was indetectable (less than 20 ppb) in the effluents of both fields 13 days after application. Caged mosquitofish (Gambusia affinis), which are now being tested by state and county agencies for control of mosquitoes in rice fields, survived the treatment at all water sampling stations of Field A except at the station where 1.25 ppm of 06K was found, but even at that accidentally high initial concentration only 28 percent mortality resulted. Numerous small carp (Cyprinis carpio) were seen in open water areas of Field B, and a few of these were killed during the first two days after treatment. We suspect that it was not the dissolved 06K that killed these carp, because numerous other healthy ones were present. These bottom feeders probably obtained lethal amounts of 06K by eating the bright red granules before they slaked after falling into the water. No other fish mortalities occurred in the fields or in their drainage ditches as a result of the 06K applications.

The excellent control of the weeds in each field is reflected in the remarkable increases in yield. The 26.2 cwt/A increase in Field A was highly significant (1% level), but the 10 cwt/A increase in Field B was only significant at 10% because of some variability among samples due to the lack of uniform rice stand caused by excessive growths of emersed weeds. This is the first time a profitable yield increase has ever been demonstrated as a result of submersed weed control in rice. In fact, these mean yield increases are greater than those usually given by effective control of emersed weeds in rice with herbicides such as propanil, molinate, and MCPA. Perhaps the death and decay of the submersed weeds provided additional nitrogen fertilization of benefit to the rice in addition to the prevention of competition for space and nutrients as is usually attributed to the effect of emersed weed control in rice.

Since 06K is deemed not to be unduly hazardous to fish, it is highly promising for effective and economical control of chara, horned pondweed, and southern naiad (but not American pondweed) in rice at 2 or 3 lb/A. Yield returns in excess of 10 times the cost of the treatment appear possible, and this should interest rice growers in California as well as in other rice growing areas of the world such as in India where two million acres of paddy rice are reported to be infested with chara. (Department of Botany, University of California, Davis.)

Performance of 06K-10G applied by aircraft to rice at 3 lb/A. (Data are means of five replicate harvests.)

	Weeds (chara)		Rice	
	Dry wt (lb/A)	Control (%)	Yield (cwt/A)	Increase (cwt/A)
Field A				
Treated	62	90	81.3	26.2
Untreated	579		55.1	
Field B				
Treated	134	80	62.1	10.0
Untreated	677		52.1	

Control of reed canarygrass. Hollingsworth, E. B. and R. D. Comes. In 1963 we tested the effect of repeated applications of several herbicides on canarygrass (*Phalaris arundinacea* L.), which is becoming an important weed pest in irrigation and drain ditches in Wyoming. Two replications were applied to both banks of a small combination drain and delivery canal, and the third to the north side of a large drain ditch nearby. Plots were approximately 1 sq. rod in area. The herbicide was first applied on May 18, 1963, when reed canarygrass plants were in the pre-boot stage. Retreatments were made in July 1963; on May 25 and July 22, 1964; and on June 5, 1965. At the time of each retreatment, surviving plants had attained near normal vigor and were 10-16 inches tall. All treatments were in a total volume of 120 gpa and contained a nonionic water soluble surfactant at a rate of 7.5 ml./gal. Experimental data are summarized in the following table.

Treatment	Rate lb/A	Percent topkill 8-23-63	Percent stand reduction 5-27-64		
			5-27-64	7-22-64	8-4-65
Amitrole	4	68	35	20	53
	8	88	22	43	87
	12	95	45	66	96
Amitrole-T	2	77	19	23	63
	4	83	29	45	82
	8	90	50	63	96
Dalapon	15	90	37	34	60
	20	93	39	54	65
	25	93	44	65	78
Control	-	0	0	0	0

The degree of weed control observed varies widely between and within replications, but the average readings show rather consistent trends. With one exception (amitrole, May 1964), all materials provided better control as the dosage increased. Amitrole-T was more effective than amitrole at equivalent rates, and twice as effective per pound at the two lowest rates tested. The trend was also toward increased control with each additional treatment. The percent stand reduction at all rates following five applications of amitrole and amitrole-T compares favorably with the estimated topkill after only two treatments in 1963. Dalapon, which killed more topgrowth in 1963, reduced stands somewhat less by 1965.

Plant succession following control of the canarygrass favors the use of the triazole compounds. Canada thistle, kochia, and foxtail barley invaded the dalapon-treated plots, while redtop and scattered Kentucky bluegrass plants developed on several plots receiving amitrole-T. Control of reed canarygrass tended to be much better on the south side of the channel than on the north side, and less at the waterline than on the upper portion of the slope. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture and the Wyoming Agricultural Experiment Station, Laramie.)

PROJECT 7. CHEMICAL AND PHYSIOLOGICAL STUDIES

Reed A. Gray, Project Chairman

SUMMARY

Thirteen research progress reports were received for inclusion in the chemical and physiological section. Six of these reports were presented as papers and are published in the back of this booklet, so only the titles are reported here. A short summary of each report follows:

In studies on the persistence of picloram in Wyoming, Alley and Lee observed severe injury to soybeans, field beans, peas and potatoes that were planted in plots one year after treatment with picloram at ½, 1, 1½, 2 and 3 lb/A. In another study in grass nurseries by Alley, Lee and Powell, one application of picloram at 1 lb/A eradicated Canada thistle and white-leaved franseria with very little or no injury to orchardgrass, meadow foxtail, reed canarygrass, timothy and wheatgrasses, but some varieties of smooth bromegrass were severely injured. Kreps, Alley and Lee found that picloram caused swelling, splitting and deterioration of the root tissue of Canada thistle while 2,4-D caused swelling with a minimal amount of splitting and deterioration.

Pennington and Erickson in Idaho tests found that the addition of 10 lb of DMSO to 2 lb of dicamba in 50 gpa of spray solution enhanced the kill of common mullein from 50% to 100%. Lower levels of DMSO (½-1 lb/A) also increased the activity of dicamba at ¼-3/4 lb/A. The herbicidal activity of 2,4-D at 2 lb/A on mullein was increased from 0% to 62% control by 10 lb/A of DMSO.

In studies in Oregon on the effect of four surfactants on the uptake of radioactive 2,4-D by bean leaves, Norris found that Sarkosyl NL-30 and WK surfactant caused about twice as much uptake as Pluronic L-62 and X-77. Pretreatment of leaves with each surfactant prior to application of 2,4-D, failed to promote uptake in all cases except with WK surfactant. In another report from Oregon, Morris demonstrated the appearance of several new cytoplasmic proteins in pea roots 48 hours after treatment with 2,4-D. The nuclear histones were also altered within a few hours after treatment with 2,4-D.

Smith, Foy and Bayer in California showed that amitrole-C^{14} was metabolized faster by bean leaves than leaves of Canada thistle. Of the three Canada thistle ecotypes studied, the most susceptible one to amitrole showed the least conversion of amitrole-C^{14} to metabolites.

In Arizona, Hull and Shellhorn showed that leaves of mesquite that developed on branches enclosed in a glass chamber outdoors had thinner cuticles than adjacent leaves on the same tree in the direct sunlight. However, cuticles were the same on seedlings grown outdoors in vermiculite irrigated with nutrient as in the greenhouse, but seedlings grown in soil outdoors had thicker cuticles. The parenchyma tissue of greenhouse plants was injured more by oils and surfactants than outdoor plants.

Soil injection tests by Gray, Arneklev and Weierich in California showed that EPTC gave wider bands of weed control than five other thiocarbamate herbicides tested. In addition to the thiocarbamates, only a few other herbicides including bromacil, dicamba and fenuron worked well by injection into the soil. Gray demonstrated that nutgrass could be killed by applying a light spray of technical EPTC to the foliage or by applying a single drop in the center whorl of leaves. Gray, Arneklev and Baker introduced R-7465, a new type of napthoxy herbicide which appears promising for controlling weeds in tomatoes, cotton and cole crops and for controlling perennial grasses in non-crop areas.

Whitworth et al. (New Mexico) showed that after foliar application of 2,4-D-1-C^{14}, the roots of resistant strains of Canada thistle exuded radioactivity into the nutrient solution much sooner than susceptible strains at 80° F. The radioactivity of the cell sap of treated plants was primarily in the nucleic acid fraction. Anderson and Richards (New Mexico) found that MSMA was more effective than DSMA for controlling purple nutsedge. About 10 mg of MSMA per plant was required to completely kill the top and prevent regrowth when applied to the crown of the plant.

Crop tolerance to picloram residual. Alley, H. P. and G. A. Lee. This study is being conducted to determine the longevity of picloram residual sufficiently toxic to cause damage to crops commonly grown in Wyoming. Picloram at ½, 1, 1½, 2 and 3 lb/A was applied to plots 9 x 200 feet on July 9, 1964. Sorghum sudangrass cross, soybeans, field beans, peas, corn, potatoes, oats, barley, and wheat were cross planted, June 1, 1965, across the treatments so that each crop was planted in each rate of application. Visual observations, approximately one year after treatment, indicated that the picloram residual in all plots was extremely toxic to soybeans, field beans, peas, and potatoes. Wheat, oats and barley grew in all treated plots, but showed an increase in prostration and malformation as the picloram rate increased. Wheat showed the least toxic effect and oats showed the most of the small grains tested. Corn and sorghum sudangrass cross exhibited the least residual damage of all the crops grown. This study will be continued until the crops grown show no residual toxicity. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Preliminary trials to determine the activating effects of DMSO on the phytotoxicity of dicamba and 2,4-D to mullein. Pennington, Lawrence R. and Lambert C. Erickson. One early study by others indicated that DMSO (dimethyl sulfoxide) had facilitated the translocation of 2,4,5-T in mesquite when DMSO constituted approximately 50% of the diluent and thus enhanced 2,4,5-T toxicity.

Common mullein (Verbascum thapsus) has usually shown little response from 2,4-D treatments. Preliminary trials established in mid-July, 1965, demonstrated that 10 pounds equivalent of DMSO added to 2 pounds of dicamba equivalent per acre, diluted in water approximating 50 gallons per acre of total solution, killed 100% of the mullein, whereas, 2 pounds of dicamba alone killed only 50% of the mullein plants.

Additional trials established in mid-August applying dicamba at rates of 1/4, 1/2 and 3/4 lb/A in DMSO equivalent to 0, 1/8, 1/4, 1/2, 3/4 and

1 lb/A revealed that over 70% of the mullein plants survived regardless of dicamba rate in the absence of DMSO, and only 33% of the mullein plants survived when all the dicamba rates were pooled within the DMSO rates. No significant differences in toxicity were obtained among the 1/8 to 1 lb DMSO and three dicamba rates.

However, pooling the DMSO rates (1/8 to 1 lb/A) within the dicamba rates revealed that dicamba at 1/4, 1/2 and 3/4 lb/A reduced mullein by 55, 67 and 68% respectively.

The activating effect of DMSO in combination with dicamba was discernible within 2 weeks after application. Similar treatments using DMSO and 2,4-D as the herbicide produced no early apparent effects. However, 2 months following treatment, the following results were obtained:

A. 2,4-D at 2 lb/A gave 106% mullein survival.

B. 2,4-D at 1 lb/A plus 10 lb/A DMSO gave 84% mullein survival.

C. 2,4-D at 2 lb/A plus 10 lb/A DMSO gave 38% mullein survival.

Although practical mullein control was not obtained, the results suggest that DMSO aids as a vehicle in facilitating the penetration of these two herbicides through materials, cells and tissues that otherwise restrict the mobility of these two herbicides. (Plant Sciences Department, University of Idaho, Moscow.)

The influence of some surfactants on foliar uptake of 2,4-D. Norris, Logan A. The effectiveness of four surfactants in aiding the uptake of 2,4-D by bean foliage was determined in these experiments. In one experiment the foliage was treated with solutions of surfactant and herbicide to compare the effectiveness of two newer surfactants with two older ones in promoting 2,4-D absorption in terms of their influence on the surface tension of the treatment solution. In a second experiment the foliage was pretreated with surfactant solution, followed later by rinsing and then treatment with a solution containing only herbicide to determine the influence of previously absorbed surfactant on herbicide uptake.

In the first test, nearly fully expanded primary leaves of bean plants were treated with 25 ul of a 2000 ppm solution of the triethanol amine salt of 2,4-D-1-C^{14} in water containing 0.1% surfactant. The surfactants tested were Pluronic L-62, X-77, Sarkosyl NL-30 and WK surfactant. Twenty-four hours after treatment the leaves were rinsed with 25 ml of 50% isopropyl alcohol. The leaf washings were saponified, acidified, extracted with benzene and counted in a G. M. counter. Two primary leaves from a single plant constituted a replication, and each treatment was replicated three times. The data are presented as a percentage of the applied activity which was not recovered in the leaf washings.

The surface tension of similarly prepared but nonradioactive treatment solutions was determined with a stalagometer. The determinations were repeated several times and the surface tension reported in dynes/cm.

Mean percent 2,4-D absorption in 24 hours

Surfactant	Surface tension of treatment solution (dynes/cm)	Absorption (percent)
0.1% Pluronic L-62	43.9	30.0
0.1% X-77	34.6	23.5
0.1% Sarkosyl NL-30	56.8	50.0
0.1% WK Surfactant	29.7	60.5
No Surfactant	70.2	--

These data indicate a marked influence of different surfactants on the absorption of this particular herbicide by bean foliage. The two newer surfactants, Sarkosyl and WK seem particularly effective in this test. It is apparent however that reductions in surface tension alone are not sufficient to explain the differences in 2,4-D uptake found here.

In the second experiment the primary leaves of bean plants were pretreated with water or 0.1% water solutions of Pluronic L-62, X-77, Sarkosyl NL-30 or WK surfactant applied as a fine mist to the drip point. After 24 hours the leaves were rinsed with 30 to 50 ml of distilled water. Removal of the surfactant was verified by checking the surface tension of the last portions of the rinse water. Three hours after washing the treatments were applied.

Each primary leaf received 25 ul of a 2000 ppm water solution of the triethanol amine salt of 2,4-D-1-C^{14} in the mid portion of the blade extending along either side of the midrib. Twenty four hours later the leaf surface was washed with 25 ml of 50% isopropyl alcohol. The leaf washings were handled as before.

Two primary leaves from one plant constituted one replication, and three replications of each treatment were included. A laboratory accident resulted in the loss of the 2,4-D treatment solution after the treatments had been applied but before it could be counted, and thus a measure of the percent uptake is not possible. However all plants were treated with the same solution, and the results are reported in terms of the total activity which was recovered in the leaf washings. It is important to remember that the greater the activity recovered the less uptake which took place.

Total CPM recovered in leaf washings from bean foliage pretreated with various surfactants and treated with 2,4-D-1-C^{14}

Pretreatment	Total CPM recovered
0.1% Pluronic L-62	89,58[illegible]
0.1% X-77	82,558
0.1% Sarkosyl NL-30	72,457
0.1% WK Surfactant	69,570
Water only	72,078
No pretreatment	83,947

It is assumed that pretreatment with water will give a measure of the mechanical effects of pretreatment. From this data it appears that only the WK surfactant had a positive pretreatment effect. The other surfactants either had no effect or appeared to actually inhibit the uptake of 2,4-D applied later. It would appear from this that with the exception of the WK surfactant the presence of the surfactant in the leaf prior to the application of the herbicide failed to promote 2,4-D uptake over that of the controls.

This investigation was supported in part by Public Health Service Research Grant WP 00477, from the Division of Water Supply and Pollution Control. (Oregon Agricultural Exp. Sta., Oregon State University, Corvallis.)

Changes induced by 2,4-D in the macromolecular constituents of pea seedlings. Morris, R. O. Changes induced by 2,4-D in the nature of the cytoplasmic and nuclear proteins of pea seedling roots were studied, using the technique of acrylamide gel electrophoresis.

Cytoplasmic protein patterns from whole roots 48 hours after 2,4-D treatment show striking deviations from control patterns. Specifically, the appearance of several new protein bands was demonstrated. Studies with C^{14}-labeled 2,4-D indicated that these proteins were in fact new, and that they were not artefacts arising from combination of the herbicide with pre-existing tissue components. The effect was caused specifically by 2,4-D since the analog 2,6-D, which at the level used has no growth regulating properties, was not capable of inducing changes in the tissue proteins.

By taking serial 1 mm sections from normal tissue, it was established that differences exist between mature and meristematic regions of the root. In contrast, patterns obtained by sectioning treated roots were all very similar. In addition, patterns from previously mature regions now resembled those from normal meristematic tissue.

Prior to the induction of changes in cytoplasmic protein and subsequent cell proliferation, it was found the electrophoretic patterns of the nuclear histones altered markedly (changes were seen within a few hours of treatment). These changes were followed within 24 hours by a large increase in the total tissue RNA content. Again, 2,6-D was not active in this respect. (Oregon Agriculture Experiment Station, Oregon State University, Corvallis.)

Metabolism of amitrole-C^{14} by three ecotypes of Canada thistle. Smith, L. W. C. L. Foy and D. E. Bayer. The metabolism of amitrole-C^{14} was examined in excised leaves of three ecotypes of Canada thistle and the trifoliate leaves of the red kidney bean. Thistle leaves of a similar age were used, but because of the wide variation in leaf shape and size among the three species, similar leaf sizes were only possible within the same ecotype.

A time series trial which involved harvesting at 0, 6, 12, 24, 48, 96, and 144 hours after treatment with 1 uc of amitrole-C^{14} was carried out.

Other trials involved treatments of light and dark and feeding sucrose. The presence of amitrole and its metabolites was determined by thin-layer chromatography on cellulose and by autoradiography and liquid scintillation counting of paper chromatograms.

Amitrole-C^{14} was readily metabolized in this system and several differences were seen among the thistle ecotypes and between bean and thistle, as well as between light and dark treatments. Bean leaves metabolized amitrole-C^{14} faster than thistle leaves and also converted it into products Unknown I and Unknown II (R. A. Harrett and W. P. Bagley, J. Agr. Food Chem. 12, 17-20. 1964) in a different proportion.

The thistle ecotype YM, which is the most susceptible to amitrole, was the least efficient in metabolizing amitrole to its supposed detoxication products. On a dry weight basis of the leaves used the ecotype G1 metabolized amitrole to a greater extent than the other ecotypes.

Percent of total C^{14} recovered on paper chromatogram.

C^{14} composition of plant extract	Bean	YM ecotype	FI ecotype	Gl ecotype
Amitrole-C^{14}	14.5	54.0	37.0	43.1
Unknown I	11.2	18.1	30.0	27.0
Unknown II	59.3	16.7	21.0	14.1
Other	15.0	11.2	12.0	15.8
Conversion Rate of Amitrole-C^{14} (uM/g dry weight/48 hours)	9.6	2.8	4.2	9.0

The results are in close agreement with the relative susceptibilities of these three ecotypes to amitrole. (University of California, Davis.)

The influence of temperature on response of Canada thistle to 2,4-D-1-C^{14}. Whitworth, J. W., W. P. Anderson, Larry MacCaw, Mary Anne Welsh and Katherine Tolman. Plants of susceptible, intermediate and resistant strains of Canada thistle were grown in nutrient solution. At 60° F, there was root exudation of radioactivity into the solution two hours after foliar application of 2,4-D-1-C^{14}. At 80° F, the interval for root exudation was two hours for the intermediate and resistant strains and eight hours for the susceptible strain. Cyclic appearance and disappearance of radioactivity in the nutrient solution was noted at 80° F.

Fractional centrifugation of water extracts of 2,4-D-1-C^{14} treated plants of the susceptible strain showed the main site of labelling to be in the cell sap remaining after removal of the microsomes at a force of 100,000 x g. Electrophoretic separation of the cell sap showed activity primarily in the nucleic acid fractions. Further analysis using thin layer chromatography indicated that this radioactivity was not due to the presence of free unmetabolized 2,4-D. (New Mexico State University, Agricultural Experiment Station, University Park, New Mexico.)

Amount of methanearsonates required to control purple nutsedge, *Cyperus rotundus* L. Anderson, W. P. and Anna Beth Richards. Greenhouse experiments were conducted with purple nutsedge to determine the amount of disodium (DMSA) and monosodium (MSMA) methanearsonates required to kill this persistent pest. Plants of nutsedge were established from tubers planted in 7" pots, one tuber per pot. They were planted August 31, 1965, and treated October 23, 1965, by direct pipette application to the crown of each plant. An average of six to seven plants had developed from each tuber by the time the treatments were applied. The results are shown in the following tables. (New Mexico State University, Agricultural Experiment Station, University Park, New Mexico.)

Top kill and regrowth from nutsedge tubers four months after treating foliage with disodium methanearsonate (DSMA)[1]

DSMA micrograms per plant	% top kill of original plants	Number of plants growing from original tuber including resprouts
0	0	6
10	0	7
50	0	8
100	25	8
500	33	8
1000	40	8
5000	89	5
10000	100	3

[1] One nutsedge tuber planted in each 7" pot August 31, 1965, and treated by direct pipette application to crown of each plant October 23, 1965.

Top kill and regrowth from nutsedge tubers four months after treating foliage with monosodium acid methanearsonate (MSMA)[1]

MSMA micrograms per plant	% top kill of original plants	Number of plants growing from original tuber including resprouts
0	0	6
10	17	5
50	17	5
100	43	4
500	60	3
1000	97	1
5000	93	2
10000	100	0
24000	100	0

[1] One nutsedge tuber planted in each 7" pot August 31, 1965 and treated by direct pipette application to crown of each plant October 23, 1965.

Metabolism of 2 Methoxy-3,6-Dichlorobenzoic acid (dicamba) by bluegrass plant in the presence of various pesticides. Broadhurst, Norman A., Marvin L. Montgomery and Virgil H. Freed. (Late Report) It has been established that dicamba is metabolized by wheat and bluegrass plants primarily to 5-hydroxy-2-methoxy-3,6-dichlorobenzoic acid together with small amounts of 3,6-dichlorosalicylic acid.

Bluegrass plants were treated with C^{14} dicamba in the presence of each of five pesticides to ascertain whether the same metabolic products would be produced. The pesticides used were mylone, malathion, 2,4-D, sevin and D.D.T. The first four pesticides were used at 2 ppm and 50 ppm levels while the D.D.T. was at saturation level.

The plants apparently produced the same metabolic products as gauged by relative Rf values, but it appears that the rate of metabolism is affected by the presence of the other pesticides. (Oregon Agricultural Experiment Station, Oregon State University, Corvallis.)

Dormancy, growth inhibition and tuberization of nutsedge (Cyperus rotundus L.) as affected by photoperiods. Berger, Gideon, and Boysie E. Day. (Late Report) Nutsedge has highly developed underground rhizomes and tuber chains, which in temperate zones remain mostly dormant throughout the year. A study of the phases of dormancy and tuberization of nutsedge was undertaken in the belief that an increased understanding of the life cycle of the plant might eventually provide knowledge which will increase the effectiveness of its eradication.

The internal and external factors controlling dormancy of nutsedge were studied. A number of growth inhibitors were isolated from growing tubers and foliage, but none from dormant tubers. The major inhibitor was isolated from foliage. This inhibitor was identified as salicylic acid (O-hydroxy benzoic acid). All the other isolated growth inhibitors performed less inhibition and were not studied.

Salicylic acid was isolated from foliage by extractions with 80% methanol. The crude extract was purified by carrying the residues through numerous solvents. The separation of the organic acids was based on partition between aqueous solutions and organic solvents in different pH values. The final acidic residue was further separated by ascending paper chromatography. The identification of the acidic growth inhibitor (salicylic acid) was based on color reactions with diazotized sulfanilic acid (D.S.A.) and diazotized P-nitro aniline (D.N.A.), ultraviolet fluorescent properties, activation and fluorescence wave lengths and R.f. values in numerous solvent systems. Relative fluorescence intensity (R.F.I.) was used for qualitative determination of salicylic acid in the extracts.

Bioassay studies were performed to demonstrate growth inhibitory properties of salicylic acid. Dormant tubers were emersed in different concentrations of pure salicylic acid, and salicylic acid isolated from foliage. It was found that growth initiation was delayed in both cases.

Short (10 hours) and long (18 hours) photoperiods were applied to nutsedge. Short photoperiods induced flowering and tuber production, stimulated formation of salicylic acid, inhibited bud growth of tubers, reduced foliage growth and caused it to grow horizontally. Long photoperiods inhibited flowering, reduced tuber production and formation of salicylic acid, bud growth of tubers was enhanced, foliage growth was induced and the foliage grew vertically.

Salicylic acid is suggested to be the major mechanism associated with the seasonal dormancy of nutsedge. (Department of Horticultural Science, University of California, Riverside.)

Research Progress Reports submitted to this section which were presented as papers are published in the back of this booklet. The abstracts are not duplicated here, but the titles are listed below.

Cuticle development in the field and greenhouse and its relationship to herbicidal response. Hull, H. M. and S. J. Shellhorn.

Soil injection tests with thiocarbamates and other herbicides. Gray, R. A., D. A. Arneklev and A. J. Weierich.

Nutgrass control with foliage sprays of technical EPTC. Gray, R. A.

R-7465, 2-(α-naphthoxy)-N,N-diethyl propionamide, a new preemergence herbicide. Gray, R. A., D. R. Arneklev and D. R. Baker.

Comparison of the phytotoxicity and histological effects of picloram and 2,4-D on Canada thistle. Alley, H. P., L. B. Kreps and G. A. Lee.

Tolerance of several grass species and varieties to picloram. Lee, G. A., H. P. Alley and L. M. Powell.

AUTHOR INDEX

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AUTHOR INDEX (Continued)

AUTHOR INDEX (Continued)

CHEMICAL INDEX

Nomenclature is based on the report of the Terminology Committee of the Weed Society of America (Weeds 14, 1966). Herbicides are indexed according to the common name available. If no common name is available, herbicides are indexed by temporary designation, appropriate code designation or by chemical name, in that order of priority. Names beginning with numerals are indexed as if the names are spelled out.

CHEMICAL INDEX (Continued)

CHEMICAL INDEX (Continued)

CHEMICAL INDEX (Continued)

CHEMICAL INDEX (Continued)

CHEMICAL INDEX (Continued)

CHEMICAL INDEX (Continued)

HERBACEOUS WEED INDEX

HERBACEOUS WEED INDEX (Continued)

HERBACEOUS WEED INDEX (Continued)

WOODY PLANT INDEX

CROP INDEX

Research Committee Meeting
Albuquerque, New Mexico
March 17, 1965

The meeting was called to order by Bob Schieferstein. The first order of business was the selection of a meeting place for the 1965 Research Section meetings.

Harold Alley stated that the W-77 Regional Technical Committee were meeting in Reno prior to the Research Section and expressed the desire to have the Research group consider Reno for their 1966 meeting place also.

Lewis Jensen reported that facilities and service would be improved over 1964 if the group desired to return to Salt Lake City in 1966.

Howard Cords assured the group that adequate facilities would be available in Reno.

Harold Alley moved and Dean Swan seconded that the Research Section hold their meeting in Reno, Nevada, in 1966. Passed.

Bob Schieferstein read the proposed constitution and By-Laws of the Research Committee of the WWCC. (Appended to these minutes.) Considerable discussion followed.

A question was raised pertaining to the section on membership which reads "members of the conference actively engaged in Weed Control Research." Bob Shieferstein stated that the membership has not been restrictive but there may be a possibility of such. He explained that anyone who showed interest in weed control should possibly be considered as "actively engaged."

President Hodgson read the section from the WWCC Constitution and By-Laws which reads "actively engaged." Jess explained his interpretation of "actively engaged" in research.

The concensus of opinion following the discussion was that membership into the Research Committee would in no way be restricted.

It was moved and seconded that the proposal be accepted as read. Passed.

The Acting Chairman of Project 6, Aquatic and Ditchbank Weeds, raised the question of changing the title as some papers overlap and are reported or could be submitted to other project areas. Dr. Timmons explained that the WSA project is entitled Aquatic and Marginal Weeds and felt that in the Western Region Aquatic and Ditchbank go together. The Research Committee was opposed to separating Project 6 and felt that individuals could report research in the project area where it best fitted.

Gene Heikes, Chairman of Project 8, Economic Studies, stated that there were no research papers submitted, no members to the sectional meetings and suggested that Project 8 be disbanded; however, he encouraged submission of economic studies.

Meeting adjourned.

Officers and Program Chairman 1966

President - Bob Shieferstein
Secretary - Harold Alley
Program Chairman - Dave Bayer
Local Arrangement Chairman - Howard Cords

Sub Committee Chairman

Project I Perennial Herbaceous Weeds - Dave Bayer
Project II Herbaceous Range Weeds - Coburn Williams
Project III Undesirable Woody Species - H. Gratkowski
Project IV Weeds in Horticultural Crops - R. Romanowski
Project V Weeds in Agronomic Crops - E. Albeke
Project VI Aquatic and Ditchbank Weeds - D. Seaman
Project VII Chemical and Physiological Studies --Reed Gray
Project VIII Disbanded - report to sub-committee to which the study applies.

Respectfully submitted,

Harold Alley
Secretary, Research Committee

THE RESEARCH COMMITTEE OF THE WWCC
First draft March 10, 1965

Purpose: 1. To help coordinate research activities in the WWCC.
2. To help disseminate information on results of research, development of new techniques and procedures in research, and new equipment.

Membership: The Committee shall be composed of "members of the conference actively engaged in Weed Control Research". These members shall be the voting membership - to determine policy and settle issues and elect officers of the Committee.

Officers: Chairman and Secretary. The Secretary shall be elected for a 2-year term, and shall succeed to Chairman the second year of his term.

The Chairman shall organize and preside at Research Committee Meetings.

The Secretary shall assemble and publish the Research Progress Report and record minutes of Research Committee Meetings.

Meetings: Meetings may be held annually. During a year that Conference meets, a session of the Conference shall be designated as the Research Committee Meeting.

During a year that Conference does not meet the Research Committee Chairman will obtain approval of the Executive Board of the Conference for a meeting and establish dates of meetings and locations at least 6 months prior to the meeting.

Research Progress Report: Shall consist of Abstracts of Research from research workers throughout the Conference. It shall be prepared according to instructions from the Chairman and mailed to the Researchers 5 months before the meeting. A record of minutes of the meeting shall be kept and printed. Following the meeting it shall be made available to those attending and a copy shall be mailed to each of the Executive Board of the Conference within 2 months after the meeting.

Finances: Finances for publication of the Research Progress Report and the expenses incident to meetings shall be obtained by the Sale of Research Progress Reports and registration fees at the meetings.

It shall be the responsibility of the Committee Chairman and Secretary to determine and collect these moneys and to pay all costs of the Committee operations.

The Conference will not assume any financial responsibilities for the Committee unless they have been agreed upon by the Executive Board of the Conference in advance of the committment.

PROGRAM ABSTRACTS

Research Committee, Western Weed Control Conference
Reno, Nevada March 16, 17 and 18, 1966

D. E. Bayer, Program Chairman

Wednesday Afternoon - March 16, 1966

The Plant Epidermis . . . . C. E. Crisp

Cuticle Development in the Field and Greenhouse and its Relationship to Herbicidal Response . . . . H. M. Hull and S. J. Shellhorn

An Electron Microscopic Study of Gilson Diffusion Patterns in Plantago Major . . . . C. E. Crisp, D. A. Fisher and D. E. Bayer

The Possible Mode of Action of Nonionic Surfactants in Herbicide Solutions . . . . C. E. Smith and C. L. Foy

Comparison of the Phytotoxicity and Histological Effects of Picloram and 2,4-D on Canada Thistle . . . . . H. P. Alley, L. B. Kreps and G. A. Lee

Morphological and Anatomical Effects of Picloram on Phaseolus Vulgaris . . . . D. A. Fisher and D. E. Bayer

Anatomical Studies on Cotton Roots Treated with Trifluralin . . . . T. E. Mallory and E. G. Cutter

Thursday Morning - March 17, 1966

Changes Induced by 2,4-D in the Histones and Cytoplasmic Proteins of Pea Seedlings . . . . R. O. Morris

The Metabolism of Dicamba (2-methoxy-3,6-dichlorobenzoic acid) by Wheat and Bluegrass Plants in the Presence of Other Pesticides . . . . . N. A. Broadhurst, N. A. Montgomery and V. H. Freed

Thursday Afternoon - March 17, 1966

Medusahead Investigations in Nevada . . . . R. A. Evans, R. E. Richard, Jr. and J. A. Young

Grass Tolerance and Seed Production as Affected by Picloram Treatments . . . . G. A. Lee and H. P. Alley

Bindweed Control and Cropping Sequence with Picloram . . . .
. . . . L. S. Jordon, W. A. Evans, J. R. Goodin and B. E. Day

Soil Injection Tests with Thiocarbamates and Other Herbicides . . . . .
. . . . R. A. Gray, D. R. Arneklev and A. J. Weirich

Factors Influencing the Effective Use of Sindone (D-263) in Sugar
Beets . . . . R. A. Fosse and K. W. Dunster

R-7465, 2-(α-naphthoxy)-N,N-diethyl propionamide, a New Pre-emergence
Herbicide . . . . R. A. Gray, D. R. Arneklev, and D. R. Baker

Friday Morning - January 18, 1966

Drift Characteristics of Invert Emulsion and Particulate Sprays . . . .
. . . . C. R. Kaupe

Chemical Brush Control and Contamination in Forest
Watersheds . . . . . L. A. Norris, M. Newton, J. Zavitkovzki and D. Griener

Forest Regulation with Chemicals . . . . M. Newton

Experiments with Cacodylic Acid as a One-Shot Silvicide for Thinning
Conifers . . . . R. W. Smith

A Progress Report on the Control of Persistent Perennial Broadleaf
Weeds by Borolin . . . G. K. Harris, V. W. Woestermeyer and R. H. Cooper

Nutgrass Control with Foliage Sprays of Technical EPTC . . . . R. A. Gray

Johnsongrass Control in California Orchards . . . .
. . C. L. Elmore, L. L. Buschmann, R. B. Jeter, J. J. Smith and A. H. Lange

THE PLANT EPIDERMIS

C. E. Crisp

Polymeric cutin of Agave americana L. was degraded to its monomers and identified by GLC. Completely degraded cutin yielded a mixture of isomers of hydroxy-fatty acids ranging in chain length from tridecanoic to octadecanoic. Ninteen fractions were identified.

The fine structure of a xerophyte, mesophyte, and hydrophyte has been studied; the species were Agave americana L., Plantago major L., and Elodea densa L., respectively. The studies have revealed the presence of characteristic cuticular constituents and organizations for each type.

Agave americana L. was found to be grossly cutinized and to possess a fibrillar type of cutin on the more autoxidized surface.

Plantago major L. possessed no wax pores or ectodesmata within the cutin and cell wall, respectively.

Cutin of Elodea densa L. was found to be constituted of two layers of cutin, a sieve cutin with pores and slime cores, and a polymerized cutin void of pores. (U. S. Forest Service, Berkeley.)

CUTICLE DEVELOPMENT IN THE FIELD AND GREENHOUSE AND ITS RELATIONSHIP TO HERBICIDAL RESPONSE

H. M. Hull and S. J. Shellhorn

Greenhouse and growth chamber seedlings are often used in screening and physiological research programs because of their relatively greater uniformity in herbicidal response as compared to field plants, and because of the rapidity with which information can be obtained. Those discrepancies in response which do sometimes occur between greenhouse and field plants may be partially due to different degrees of cuticle development in the two plant groups. Evidence exists that cuticle thickness in itself does not significantly affect foliar wettability; it may also bear little relationship to water loss. However, absorption of 2,4-D and other organic substances has been shown to be markedly inhibited in mature leaves having thick cuticles. Because of these findings, we have been interested in specific environmental factors which influence cuticular development, and have been concerned as to what extent such developmental variations might influence the leaf's susceptibility to contact injury from a herbicide or herbicidal carrier.

Although some plants develop cuticle of normal thickness when grown under glass (e.g., certain species of Crassulaceae), we have observed that the cuticle of greenhouse-grown mesquite (Prosopis juliflora var. velutina) is less than 1 μ in thickness and hardly discernible under the light microscope--even in 8-month-old plants. Leaves of field plants, regardless of their age, have cuticles ranging from 8 to almost 20 μ in thickness. Supplementary irrigation during the dry spring period did not significantly alter this thickness. In order to determine whether such cuticular development results from plant maturity or whether it is more a function of simply being outdoors rather than under glass, the following experiment was devised. The terminal portion of a branch from a mature tree was placed in a ventilated glass aquarium before spring budbreak. Placement was such that all sunlight impinging on the foliage during its subsequent development would penetrate the glass. Microscopic examination of numerous mature leaves, 13 weeks after budbreak, showed that those within the chamber had a mean cuticular thickness of 5 µ, whereas those on an adjacent uncovered branch had 8 µ cuticles. Plants grown outdoors from seed in pots of vermiculite and irrigated with 65% Hoagland's solution during the same 13-week period developed no more cuticle than greenhouse plants. However, when such seedlings were grown directly in the soil and allowed to reach an age of 1 year, they did develop a 4-5 µ cuticle. Cuticular development is thus not determined by any single factor but seems to be a function of nutrition (possible microelements in the soil), plant maturity, perhaps the necessity of overwintering, and of light quality (i.e., passing through glass or not). From these preliminary experiments it is difficult to assess the relative importance of the several factors involved. It is entirely possible that humidity, which was not controlled, may also be a factor.

A subsequent experiment was designed to compare susceptibility to herbicidal carriers of leaves of field plants with those of 2-month greenhouse seedlings. Both types of leaves were treated with (1) 1% Tween-20; (2) a 1:7 aqueous emulsion of nontoxic oil (Mobilsol 100) containing 1% Tween-20; (3) straight nontoxic oil; (4) a 1:7 aqueous emulsion of diesel oil containing 1% Tween-20; and (5) straight diesel oil. Leaflets were harvested following treatment at intervals of 1 minute, 1 hour, 24 hours, and 7 days. Sections were permanently mounted and stained for microscopic examination. Briefly, the parenchyma tissue of greenhouse plants was considerably more injured than that of outdoor plants, suggesting a more rapid and more complete penetration of the toxicants. Microscopic evidence of injury included anomolous staining, cellular deformation and plasmolysis, and disorganization and clumping of the chloroplasts. Degree of injury after 7 days ranged from almost none for field plants receiving treatment 1 and both plant types receiving treatment 3, up to severe injury and death for plants receiving treatments 4 and 5. Of particular interest was the synergistic effect of the surfactant and nontoxic oil (treatment 2); this combination caused immeasurably more injury than either constituent used alone (treatments 1 and 3). The rapidity with which diesel oil penetrated was surprising. Incipient plastid disorganization was observed in greenhouse leaves only 1 minute after application. Further details and the implications of such injury, including photomicrographs, will be published. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Tucson, Arizona.)

AN ELECTRON MICROSCOPIC STUDY OF GILSON DIFFUSION PATTERNS IN PLANTAGO MAJOR

C. E. Crisp, D. A. Fisher and D. E. Bayer

Electron micrographs of the outer wall of the epidermis of *Plantago major* failed to show the presence of ectodesmata, or structures synonymous with plasmodesmata, or of a selective porous pathway for the penetration of materials from the outer environment to the internal protoplasmic system. Rather, movement of mercuric chloride through the epidermal cell wall appears to be strictly a diffusion phenomenon. (U. S. Forest Service, Berkeley and Department of Botany, University of California, Davis.)

THE POSSIBLE MODE OF ACTION OF NONIONIC SURFACTANTS IN HERBICIDE SOLUTIONS

L. W. Smith and C. L. Foy

Recent work with radiolabeled surfactants confirms the previously proposed theories that the place of surfactant action lies principally in the cuticular penetration process.

Studies on structure-activity relationships between herbicides and homologous series of surfactants indicate that definite relationships exist between the herbicide and surfactant structure for maximum herbicide penetration. The length of the molecular chains (either hydrophilic or lipophilic) of a surfactant molecule appear to have considerable influence on herbicide penetration and the surfactant concentration also influences this process markedly.

It seems reasonable that molecules of a surfactant may diffuse from the spray droplet into the cuticle of leaves via imperfections and cracks and then align themselves in monolayers with their nonpolar ends being in the cutin and wax. The polar ends will thus also form a layer the size of which depends on the length of the hydrophilic chain of the surfactant molecule. These layers or "hydrophilic channels" will presumably attract water causing swelling of the cuticle and thus channels or pores are found along which herbicide molecules can diffuse according to their various chemical properties (solubility, residual chemical charge, polar properties, etc.).

One property of the surfactant molecule recently studied in detail has been the influence of the number of moles of ethylene oxide (E.O.) in the lipophilic side chain on herbicide penetration and activity. A surfactant with a low number of moles of E.O., i.e. 1-5, or a short hydrophilic chain appears to be non-polar, whereas one with a high number of moles of E.O., i.e. 40, is too large to form layers as efficiently as those with an intermediate number of moles, i.e. 10-20.

The influence of surfactant concentration may possibly lie in the micellar structure of the solution and the adsorption of herbicide molecules into these micelles or it could also be due to the increased diffusion rate of the surfactant into the cuticle with increasing concentration and thus the satisfying of all the binding or adsorption sites within the cuticle. (Department of Botany, Univ. of California, Davis.)

References

Smith, L. W., C. L. Foy and D. E. Bayer. 1966. Structure-activity relationships of alkylphenol ethylene oxide ether nonionic surfactants and three water soluble herbicides. Weed Research 6: September 1966.

Smith, L. W., and C. L. Foy. 1966. Penetration and distribution studies in bean, cotton and barley from foliar and root applications of Tween 20-C^{14} (fatty acid and oxyethylene label. J. Ag. Food Chem. (In press)

COMPARISON OF THE PHYTOTOXICITY AND HISTOLOGICAL EFFECTS OF PICLORAM AND 2,4-D ON CANADA THISTLE

Harold P. Alley, L. B. Kreps and G. A. Lee

The study was conducted to determine the changes in the morphological and cytological structures of the underground parts of Canada thistle from applications of picloram and 2,4-D.

Of significance in addition to differences in total plant weight was the extent of root damage.

Although swelling was noted in both the picloram and 2,4-D treated plants, splitting of the root tissue accompanied the swelling of the root tissue in plants treated with picloram. Splitting and deterioration of the roots from 2,4-D treated plants was minimal and did not extend through the entire root system.

Histological studies showed the 2,4-D treated plants exhibiting little damage. A few cells had broken down in the exodermis and subexodermis areas, root sections from the picloram treated plants showed the cortical cells deteriorated and in many cases completely destroyed; the periderm and xylem were the only tissues apparently unaffected.

Picloram was translocated throughout the entire root system of Canada thistle, whereas 2,4-D moved only to the transition zone. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

MORPHOLOGICAL AND ANATOMICAL EFFECTS OF PICLORAM ON PHASEOLUS VULGARIS

D. A. Fisher and D. E. Bayer

Picloram caused severe bending and swelling of stems and petioles when applied on the leaves of beans. High concentrations caused a complete inhibition of meristems, bud initials and leaf initials. Lower concentrations caused swelling and bending of the stem, and delayed flowering.

Light microscope study of the aerial portions of the plant revealed that the initials of the vascular cambium remained meristematic and grew and divided, forcing the epidermis outwards and crushing and tearing the cortical cells in the area of growth. Phloem cells were carried outward within the meristematic area or were pushed to the side. (Department of Botany, University of California, Davis.)

ANATOMICAL STUDIES ON COTTON ROOTS TREATED WITH TRIFLURALIN

T. E. Mallory and E. G. Cutter

Microscopic observations of the development of the primary root of cotton treated with trifluralin were conducted. Comparisons were made on the effect of the herbicide at high and low concentrations on the development of the primary root. The activities of the pericyclic cells was of particular interest. (Department of Botany, University of California, Davis.)

CHANGES INDUCED BY 2,4-D IN THE HISTONES AND CYTOPLASMIC PROTEINS OF PEA SEEDLINGS

R. O. Morris

2,4-D, but not 2,6-D or 2,4,6-T induces the synthesis of new cytoplasmic proteins in pea seedling roots. The proteins are produced as the result of de novo synthesis and are not complexes of 2,4-D with pre-existing tissue proteins. They resemble proteins occurring in normal meristematic tissue.

Changes have also been observed in the histones, ribosomal proteins and in the total tissue RNA content. These changes will be discussed in detail and a working hypothesis will be outlined. (Oregon Agricultural Experiment Station, Oregon State University, Corvallis.)

THE METABOLISM OF DICAMBA (2-METHOXY-3,6-DICHLOROBENZOIC ACID) BY WHEAT AND BLUEGRASS PLANTS IN THE PRESENCE OF OTHER PESTICIDES

N. A. Broadhurst, M. L. Montgomery and V. H. Freed

Dicamba is known to be metabolized by wheat and bluegrass plants to produce mainly 5-hydroxy dicamba together with a small amount of 3:6 dichlorobenzoic acid. The effect of other pesticides on the metabolism of dicamba was studied to determine whether the metabolism pattern was altered in any way. The pesticides chosen for this study were DDT (chlorinated insecticide), Malathion (phosphate insecticide), Sevin (carbamate insecticide), mylone (fungicide) and 2,4-D (chlorinated herbicide). The concentration of dicamba was always 1 ppm but the concentrations of the pesticides varied. DDT was at saturation (1ppb) while the other insecticides were used at the 2 ppm and 50 ppm levels. The plants were exposed to the pesticides for 5 days then extracted with alcohol at certain time intervals after the exposure. The metabolic products of dicamba will be reported. (Oregon Agricultural Experiment Station, Oregon State University, Corvallis.)

MEDUSAHEAD INVESTIGATIONS IN NEVADA

Raymond A. Evans, Richard E. Eckert, Jr. and James A. Young

Medusahead (Elymus caput-medusae L.), an introduced winter-annual grass, is one of the primary range weed problems in Oregon, Idaho, California, and Washington.

Medusahead is a serious threat to the range livestock industry, both because of its aggressiveness in competition with other annuals such as downy brome (*Bromus tectorum* L.) and the low preference cattle and sheep exhibit for the grass.

A small medusahead infestation was discovered near Reno 1963 and a control and seeding program was undertaken in the spring of 1964.

In 1964, dalapon, atrazine, disk, and furrow spring treatments gave good medusahead control.

The plots were seeded in November of 1964 with Amur intermediate wheatgrass (*Agropyron intermedium* (Host) Beauv.); Standard crested wheatgrass (*A. desertorum* (Fisch.) Schult.); and Fairway crested wheatgrass (*A. cristatum* (L.) Gaertn). Excellent intermediate wheatgrass stands resulted where dalapon treatments were made at 2 and 3 lb/A and on plots which were disked. Furrowing gave good intermediate wheatgrass stands and atrazine and siduron fair to poor stands. Stands of crested wheatgrass were poor in all treatment plots. Paraquat and check treatments were seeding failures. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, University of Nevada, Reno, Nevada.)

GRASS TOLERANCE AND SEED PRODUCTION AS AFFECTED BY PICLORAM TREATMENTS

G. A. Lee and H. P. Alley

Fields of green needlegrass and Russian wildrye were treated with picloram at 1½ lb/A. Although plant height was reduced approximately 12 inches, the grass showed no other toxic effects. Canada thistle was eradicated in both fields. Seed production yields from the Russian wildrye field was 484.9 lb/A, as compared to an adjacent area treated with 2,4-D which yielded 446.3 lb/A. Germination tests show the Russian wildrye seed from the picloram treated area had 85 percent germination as compared to 84 percent viable seed on the 2,4-D treated area. Many of the seeds from the 2,4-D treated area were observed to have reddish colored coleoptiles and appeared weak at the point of emergence.

Grass nurseries, comprised of smooth bromegrass, meadow foxtail, reed canarygrass, orchardgrass, timothy and wheatgrasses, were treated with picloram at 1 lb/A. Orchardgrass, reed canarygrass, meadow foxtail, timothy and the wheatgrasses showed little toxic effect. Smooth bromegrass varieties exhibited different levels of toxicity to the picloram treatment. Sask. S-5824 and Carlton were the most resistant varieties observed. Southland, Lincoln and Lancaster were the most susceptible. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

BINDWEED CONTROL AND CROPPING SEQUENCE WITH PICLORAM

L. S. Jordan, W. A. Isom, J. R. Goodin, and B. E. Day

Picloram has been found to be effective for control of perennial bindweed. Its long residual in soil and high toxicity to some crop species must be considered in selecting crops following treatment. Plots were established at Riverside to develop: 1. A perennial bindweed control program combining low rates of Picloram and management practices, and 2. Cropping rotations and sequences following initial treatment.

In preliminary research we found that one pound per acre of picloram gave almost complete control of bindweed when cultural and competitive cropping practices were employed. Selected grass species and varieties were relatively tolerant to the herbicide. Broadleaved species in general were less tolerant but with a large variation in response.

The main plots were established by spraying strips 48 by 660 ft. with picloram at 0.5 and 1 lb/A. Subplots were established by disking a 24 by 660 ft. strip of the main plots. Three weeks later the entire field was disked to prepare a seedbed for planting grain varieties. Varieties of wheat, oats, and barley were sown in twelve foot strips perpendicular to and across the herbicide plots. The barley varieties were Rojo, Grande, California Mariout, Arivat, Tennessee Winter, and Atlas 57. The wheat varieties were Onas 53, Ramona 50, Yaqui 54, and Sentry Durum. Oat varieties included Curt, Ventura, Indio, Sierra, and Kanota. Six months after planting, the height and yield of each variety in each herbicide plot were determined. The field was then burned and disked.

Seven months after treatment the entire field was furrowed to 30 inches and each herbicide plot was planted to 13 varieties of agronomic and vegetable crops. The effect of residual picloram on the various crops was determined. Very few bindweed plants were found in the treated areas. These were spot treated with picloram at 0.5 lb/A.

One year after the initial treatment the entire field was plowed and disked and fertilized. Two months later the entire field was disked, furrowed, and planted to 22 varieties of agronomic and vegetable crops to determine their tolerance to picloram residues at this time.

There was a significant reduction in yield of all the varieties of wheat, oats, or barley planted after treatment with 0.5 or 1 lb/A of picloram. Reductions in height occurred for many varieties but the height reduction was not necessarily correlated to yield reduction. The greatest reduction in height and injury occurred with wheat varieties with the least reduction with the oat varieties. Eight months after treatment, field corn, sweet corn, sorghum and sudan grass were not injured by the residual herbicide. Crops showing slight injury were sugar beets and watermelon. Those showing moderate injury were cantaloupes and tomatoes. Crops killed or severely injured were blackeye beans, bush beans, cotton, peppers and sesbania. Evaluations of the winter planted crops are being made. (University of California, Riverside.)

SOIL INJECTION TESTS WITH THIOCARBAMATES AND OTHER HERBICIDES

R. A. Gray, D. R. Arneklev and A. J. Weierich

Four thiocarbamate herbicides were compared in greenhouse tests to determine the best one for controlling weeds in sugar beets by the soil injection method. EPTC, PEBC, R-2063 and R-1856 were each injected in two strips 1.5 inches deep in the soil at a distance 1.25 inches on each side of, and parallel to, a row of sugar beet seeds. Each compound was tested at three rates. The tests were carried out in 4" x 20" x 24" metal flats filled with loamy sand. Seeds of five different species of weeds were planted 3/8 inch deep in rows perpendicular to the injected strips. The results indicated that the best treatment with respect to safety to the crop and good weed control was PEBC injected in each strip at 17.4 mg per linear foot. The weed control lasted longer with R-2063 than with PEBC but was poorer with R-2063 in the early stages of weed growth and the sugar beets showed less growth than in the PEBC treatment. EPTC at 4.3 mg per foot did not injure the sugar beets and gave fair weed control, while 8.7 mg per foot gave excellent weed control but severely injured the sugar beets. R-1856 at 26 mg per foot controlled weeds fairly well for three weeks without injuring the sugar beets.

Similar greenhouse injection tests were run on corn with EPTC, EPTC + 2,4-D, R-1910 and R-1856. R-1910 and R-1856 caused the least crop injury. Since young corn plants have relatively long roots that pick up the herbicide from the injection strips, it was difficult to control the weeds all the way to the center of the corn row without injuring the corn. This problem was solved by injecting R-1910 at 8.7 mg per foot at a distance of 1.25 inches on each side of the corn row and EPTC at 6.5 mg per foot next to the R-1910 strips 2.5 inches further out.

In small field plots in a loam soil, EPTC, EPTC + 2,4-D, R-1607, R-1856, R-1910 and R-2063 were accurately injected 1.5 inches deep and 1.25 inches on each side of the corn row. Only EPTC + 2,4-D (2+1) at 6.5 mg per foot and R-1910 at 8.6 mg per foot, gave good control of the weeds without injuring the corn too much. Injecting EPTC at 13 mg per foot 2 inches from the corn row also controlled the weeds in the corn row without injuring the crop, but injecting the same amount 1.25 inches from the corn caused injury.

In a test where different rates of EPTC were injected 1.5 inches deep, the width of the weed control band increased from 1.4 to 4.5 inches as the rate increased from 2.2 to 13 mg per foot, but further increases in rate caused only small increases in band width. When EPTC was injected into different types of soils, the widest bands of weed control were obtained in the sandy soils. The band widths were about the same size in sandy loam, loam and clay soils and much smaller in peat. In a test on the effect of depth of injection, EPTC produced the widest bands of weed control when injected 1 inch deep. The activity was reduced slightly at the 1.5 inch depth and almost eliminated at the 3 inch depth.

In another greenhouse test, 52 commercial and developmental herbicides were tested for the control of five different weed species by injecting them in a loamy sand at a depth of 1.5 inches at a rate of 20.6 mg per foot. EPTC was the most effective of the herbicides tested by this method. Other herbicides which showed some promise by injection, in decreasing order of activity, were EPTC + 2,4-D, bromacil, R-1607, dicamba, R-1910, PEBC, fenuron and R-4572. (Stauffer Chemical Company, Agricultural Research Laboratory, Mountain View, California.)

FACTORS INFLUENCING THE EFFECTIVE USE OF SINDONE (D-263) IN SUGAR BEETS

R. A. Fosse and K. W. Dunster

The alkylated acylated indanes represent a new group of pre-emergence grass killers. Two of these, Sindone and Sindone-B, have provided annual grass control at rates well tolerated by sugar beets. Sindone-B appears more active on grassy weeds but may be less selective than Sindone on sugar beets at equal rates.

Sindone resists leaching in the soil and herbicidal effectiveness is improved by shallow incorporation. Preliminary tests indicate that Sindone is taken up by the emerging coleoptile as well as through the root zone. Placement of the material in the shallow weed seed zone seems best as deep incorporation may result in unnecessary dilution. Thorough, shallow incorporation with power driven rotary tiller type equipment will provide optimum sugar beet selectivity.

Growth chamber studies conducted in Canada indicate that temperature may be a factor in terms of sugar beet tolerance. Beet tolerance appears to increase with increasing temperature.

Soil texture may be a factor in terms of sugar beet selectivity. Greenhouse trials indicate that finer textured soils increase tolerance levels. This relationship has not been verified under field conditions. (Amchem Products, Inc., Ambler, Pa.)

R-7465, 2-(α-NAPHTHOXY)-N,N-DIETHYL PROPIONAMIDE, A NEW PREEMERGENCE HERBICIDE

R. A. Gray, D. R. Arneklev and D. R. Baker

R-7465 is a new selective preemergence herbicide developed by Stauffer Chemical Company which appears promising for controlling weeds in tomatoes, tobacco, cotton, peanuts, soybeans, cabbage and other cole crops. R-7465 is a white crystalline powder that has a very low solubility in water. It is soluble in acetone but is only slightly soluble in most organic solvents. It is formulated as a 50% wettable powder and as an emulsifiable concentrate containing 2 lb of active ingredient per gallon. R-7465 is relatively nontoxic to small laboratory animals. The acute oral LD-50 for male albino rats was greater than 5000 mg/Kg and the acute dermal on rabbits was greater than 4640 mg/Kg. It was non-irritating to the eyes of rabbits.

R-7465 is related structurally to auxins of the naphthoxy type that cause malformations on broadleaf plants similar to 2,4-D. However, R-7465 does not show these hormonal type symptoms on most broadleaf plants and is much more active in controlling grass weeds than broadleaf weeds. Crabgrass grown in soil treated with R-7465 does not emerge from the soil, but other grasses emerge, stop growing and succumb soon. Susceptible broadleaf weeds emerge normally, but soon show severe stunting, injured growing points and finally succumb. R-7465 controlled all grass weeds tested preemergence at 4 lb/A in field tests in California in a loam soil. These included watergrass (barnyardgrass), smooth crabgrass, hairy crabgrass, green foxtail, yellow foxtail, wild oats, perennial ryegrass, annual bluegrass, and others. Broadleaf weeds controlled at 4 lb/A included redroot pigweed, prostrate pigweed, lambsquarters, purslane, plantain, henbit, ragweed, carpetweed and curly dock.

Incorporation of R-7465 into the soil at a depth of 2 to 3 inches increased the herbicidal activity so that only 3 lb/A was required to give good weed control. Incorporation at 2 lb/A gave good weed control in some soils. In California field tests, R-7465 appeared outstanding for controlling weeds in direct seeded tomatoes and at least a two-fold safety margin was observed. R-7465 was also safe on transplanted tobacco. Soil incorporation at 3 lb/A controlled weeds, while no injury to tobacco was observed at rates as high as 12 lb/A. Cotton appeared tolerant to R-7465 when incorporated preplant at 3 and 4 lb/A or when applied preemergence at 6 lb/A. Other crops which showed good tolerance to R-7465 at 4 lb/A included peanuts, peas, beans, soybeans, lima beans, cabbage, broccoli, Brussels sprouts, Chinese cabbage, collards, radish, turnips, rape, sunflower, okra, eggplant and watermelons.

R-7465 also appeared promising for controlling perennial weeds including Bermudagrass, johnsongrass, quackgrass and nutgrass in areas along ditchbanks, field borders and other non-crop places. For this purpose, the material was incorporated into the soil 3 to 6 inches deep at rates of 6 to 12 lb/A, after first working the existing stands of weeds into the soil with a disc. R-7465 was also useful for selectively controlling Bermudagrass, crabgrass and other weeds in dichondra lawns when applied preplant, preemergence or postemergence.

In leaching tests run in soil columns, R-7465 moved very little in most soils. Bioassays run on soil from field plots showed that R-7465 disappeared slowly from the soil. Photodecomposition and volatility studies showed that the herbicidal activity of R-7465 was reduced only slightly after exposure to sunlight for one week on the surface of dry soil. (Stauffer Chemical Co., Agricultural Research Center, Mountain View, California.)

DRIFT CHARACTERISTICS OF INVERT EMULSION AND PARTICULATE SPRAYS

C. R. Kaupke

Applications of invert emulsion sprays were made with jet nozzles on a Stearman biplane and broadcast nozzles on ground equipment.

A particulate spray was applied with hollow-cone nozzles on a Stearman biplane. Deposits up to one-half mile downwind were analyzed for fluorescent tracer content.

Invert emulsion and particulate sprays produced significantly less downwind deposits than conventional emulsion sprays.

An invert emulsion applied by aircraft produced approximately 90 times more deposit 100 feet downwind than when applied by ground equipment. Differences in total atomization and circulation created by the aircraft wake were major contributing factors.

When applied by aircraft, the particulate spray reduced downwind deposits near the treated area more than did the invert emulsion. (Department of Agricultural Engineering, University of California, Davis.)

CHEMICAL BRUSH CONTROL AND CONTAMINATION IN FOREST WATERSHEDS: A PROGRESS REPORT

Logan A. Norris, Machael Newton,
Jaroslav Zavitkovzki and David Griener

The research presented here was designed to assess the type and magnitude of environmental contamination which results from the aerial application of herbicides to forest land. This program represents a joint effort by the Dept. of Agricultural Chemistry and the School of Forestry at Oregon State University in conjunction with the U. S. Public Health Service.

The ultimate goals of this half completed five year program are (1) to provide the land manager the data necessary for the evaluation of specific brush control operations in terms of environmental contamination, and (2) to provide the scientific basis necessary for the formulation of sound forest spray policies.

Toward this end the research effort has been directed initially at determining the levels of herbicides in streams which flow from treated areas. Additional studies have been concerned with the rates and pathways of herbicide degradation in treated foliage of woody plants, forest floor litter and stream water. While most of these studies are continuing, sufficient data has been collected to warrant a presentation of some findings and conclusions at this time.

An intensive program of stream sampling for the detection of 2,4-D, 2,4,5-T or amitrole has been carried out in three areas of the Coast Range of Oregon and in a sage brush type in eastern Oregon. The results obtained to date show some appreciable differences in the levels of contamination and the length of persistence depending on the type of area treated. Differences among chemicals are also noted but it is believed this is more a function of the type of area treated and the season of application than a function of the chemical applied.

In general where 2,4-D or 2,4,5-T have been applied as dormant season sprays in the Coast Range the levels of contamination are low and the time of persistence short. Concentrations greater than 20 ppb are uncommon. Heavy rains in the fall after application failed to introduce measurable quantities of herbicide into the streams sampled.

Concentrations of amitrole ranging from 30 to 450 ppb have been found immediately below treated areas shortly after spraying in the Coast Range. However a 10 to 100 fold decrease in concentration was observed in 10 hours. Sampling stations a mile further downstream failed to yield samples containing measurable quantities of amitrole.

In eastern Oregon concentrations of 2,4-D to 10 ppm have been found in streams flowing from treated areas. The length of persistence also tends to be longer.

Factors of topography, density and distribution of brush cover, character of the streams, season of application and the physical layout of the spray area are all factors which are believed to be important in determining the degree of contamination which will result. These factors are discussed in terms of the results presented.

Studies with 2,4-D and 2,4,5-T in forest floor litter have shown that both chemicals are degraded but at different rates. Related studies of the influence of several chemical factors on herbicide degradation in litter are nearly complete. Initial observations indicate that formulation, type of carrier, an insecticide and another herbicide may all be factors which influence the rate of degradation of 2,4-D in litter.

Experiments to determine the pathways of degradation of 2,4-D in treated foliage of bigleaf maple and red alder have shown that the rate of application and the species treated influence the proportion of the total chemical recovered which is identified as unaltered herbicide. No effect on the pathway of degradation was evident. It has been determined that the metabolites which are found in greatest quantity are herbicide-plant constituent complexes which liberate 2,4-D on acid hydrolysis. The accumulation of other metabolites has not been observed.

Another study has been concerned with the loss of several herbicides from impounded stream water. The analysis of samples is nearly complete, and the data will be ready for presentation shortly.

Studies which remain to be done are outlined. The results obtained thus far are discussed in terms of the possible hazard from chemical brush control operations on forest lands. Inferences to the more general case of the application of many different types of chemicals in the forest are considered.

This research was supported by the U. S. Public Health Service Research Grant WP 00477, from the Division of Water Supply and Polution Control. (Oregon Agri. Expt. Sta., Oregon State University, Corvallis.)

FOREST REGULATION WITH CHEMICALS

Michael Newton

Timber needs for future generations must come from depletion of virgin timber stands, and/or deliberate cropping of second-growth lands. To date, much of the harvesting of old-growth forests has resulted in second-growth stands of poor species composition and stocking. Moreover, virgin forest inventories are depletable, and have a distinctly limited future. Increasing use must be made of second-growth land to meet our timber needs, and an enormous effort is needed to bring these lands into maximum productivity. Fortunately, opportunities exist now for chemicals to replace much of the physical effort of forest improvement.

Chemical forest management begins with reforestation. Chemicals are needed for animal repellant and weed control in the field, plus fungus and insect control in the nursery. Seedlings of desirable species are often choked out by brush and cull species, and selective control of undesirable vegetation is needed on millions of acres. Dense stands must be thinned to avoid stagnation. Thinning by injection is effective and cheap. Species composition in young and mature forests can be regulated completely with low-cost injection and aerial treatments. Mature timber may be killed for seasoning on the stump to avoid high logging costs of heavy green timber. Stands may need protection against insect epidemics at any age.

Most chemicals used in forest regulation are low in toxicity. Net increases in jobs will result from chemical use simply because work may be done that has been economically unfeasible until now. Unit production costs may be reduced by chemicals at many stages in the development of most forests. The immediate task is to adapt existing technology to operational conditions throughout the world. (Oregon State University School of Forestry, Corvallis.)

EXPERIMENTS WITH CACODYLIC ACID AS A ONE SHOT SILVICIDE FOR THINNING CONIFERS

Robert W. Smith

Serious overstocking in many of the nation's young-growth coniferous forests presents one of the greatest challenges to foresters today. The magnitude of the annual losses in growth and yields due to severe competition in dense stands would stagger the imagination of any forester.

Currently, precommercial thinning of conifers is done mechanically on a relatively small scale. The costs of this work are high, ranging from $12 to $60 per acre and averaging $20 to $40 per acre in typical cases. With the increasing backlog of thinning and the trend toward maximum yield forest management, research in chemical thinning has been stimulated.

Early experiments with sodium arsenite proved that the basic concept of chemical thinning was sound (1,2,3,5). However, chemical thinning was largely discontinued because of the absence of an efficient application system and the lack of a fast acting, effective, low toxicity chemical which would not translocate through root grafts.

New Technology

During the past few years, several important breakthroughs have occurred which promise to provide a faster, less costly system of precommercial thinning.

The first report of a break-through came in 1963, when a New Zealand consulting forester, J. L. Harrison-Smith disclosed the results of his experiments with cacodylic acid and a tree boring machine on Monterey pine (Pinus radiata D. Don) (4). As a result of this work, mechanical thinning has been replaced with a low cost chemical system in New Zealand.

Exploratory tests on North American species in 1964 indicated that a solution containing 30% cacodylic acid[1] equivalent was effective as a one shot silvicide on pines and hardwoods in the Lake States (5).

The results of the early tests indicated that a more concentrated formulation of cacodylic acid might reduce the volume of chemical needed for practical field application and result in lower handling costs.

1964-1965 Field Tests

During November, 1964, tests were installed to determine the efficacy of a 50% solution of cacodylic acid[2] as a one shot silvicide on red pine (Pinus resinosa Ait.) and jack pine (Pinus banksiana Lamb.) in Wisconsin.

The jack pine were planted in 1946 at a spacing of 4 x 4. The average d.b.h. was 3.8 inches and the diameter range was 2 to 5 inches.

The red pine were planted at a 5 x 5 spacing in 1947. The average d.b.h. was 4.5 inches and the diameter range was 3 to 6 inches.

The cacodylic acid was applied to a single ½ inch diameter hole three feet above the ground with a metered syringe. Dosages were 0.5 cc. and 1.0 cc. per inch of d.b.h.

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[1] ANSAR 160 is Ansul's tradename for a sodium cacodylate solution containing the equivalent of 30 wt. % cacodylic acid or 3.25 pounds per gallon.

[2] SILVISAR 510 Tree Killer is Ansul's tradename for a solution containing the equivalent of 50 wt. % of cacodylic acid or 5.7 pounds per gallon.

No effect was noted until growth began during spring, 1965. By May, the jack pine were more than 80% crown-killed. The red pine were slower to respond, but by July practically all of the treated red pine and jack pine were dead and heavily defoliated (Table I).

Soon after death, some of the treated jack pine were moderately attacked by the bark beetle Ips pini. Close examination revealed that the attack was confined to the areas of the bole into which cacodylic acid had not diffused. There was also evidence that many of the beetles failed to complete their life cycle. This stand will be watched closely, although no insect build-up appears likely.

TABLE I

Pines treated during November, 1964, with 1 injection of cacodylic acid.[2]

JACK PINE				RED PINE			
		Ave. % Crown-Kill Days After Treatment				Ave. % Crown-Kill Days After Treatment	
No. Trees	Dosage cc/in dbh	171	283	No. Trees	Dosage cc/in dbh	171	283
8	0.5	79	99	8	0.5	6	94
8	1.0	93	100	8	1.0	24	100

A second test was conducted in April, 1965, in the same stands using the same method and dosages. Within three weeks results were evident on jack pine. Within 10 weeks both jack pine and red pine were heavily damaged. Defoliation was occurring on most of the jack pine and on many of the red pine. The results are reported in Table II. Activity of Ips pini on jack pine in this test was similar to that in the November, 1964 trial.

TABLE II

Pines treated during April, 1965, with one injection of cacodylic acid.

		Ave. % Crown-Kill Days After Treatment					Ave. % Crown-Kill Days After Treatment		
No. Trees	Dosage cc/in dbh	25	74	136	No. Trees	Dosage cc/in dbh	25	74	136
8	0.5	54	100	100	8	0.5	10	82	88
8	1.0	61	96	100	8	1.0	8	82	98

Another test was initiated June 30, using the same method and dosages. Results were apparent much earlier than in previous tests indicating more rapid uptake of the cacodylic acid during the active growing season. As in all previous tests, no translocation of cacodylic acid through root grafts (backflash) was observed. The results are reported in Table III.

Ips pini attack was extremely light during this test. Exploratory trials with cacodylic acid on jack pine during August, 1964, also resulted in no appreciable *Ips* attack. This indicates that treatment of jack pine between June and September may not cause an increase in *Ips* activity.

TABLE III

Pines treated during June, 1965, with one injection of cacodylic acid.

JACK PINE					RED PINE				
		Ave. % Crown-Kill Days After treatment					Ave. % Crown-Kill Days After treatment		
No. Trees	Dosage cc/in dbh	15	34	61	No. Trees	Dosage cc/in dbh	15	34	61
10	0.5	42	85	100	10	0.5	14	78	82
10	1.0	98	100	100	10	1.0	48	100	100

Very impressive results were reported by the Bureau of Indian Affairs at the Northern Cheyenne Agency in Lame Deer, Montana (7). The purpose of this test was to check the effectiveness of the 30% solution of cacodylic acid equivalent as a one shot silvicide on ponderosa pine (*Pinus Ponderosa Lamb.*).

Treatments began in late May, 1965 and continued until late June, 1965. A total of 200 trees ranging from two inches to nine inches d.b.h. were treated. Cacodylic acid was applied in a single hole at one foot or three feet above the ground. Dosages were 1 cc. and 2 cc. per inch of d.b.h. (7).

Results were soon visible. Within two weeks after treatment all of the trees were partially crown killed. Within four weeks, trees six inches d.b.h. and below were 80-100% killed. Within eight weeks virtually all of the trees below six inches d.b.h. were dead at both dosage levels and trees seven to nine inches d.b.h. averaged 96% dead (7).

The needles of the treated trees fell to the ground when the trees were shaken four weeks after treatment. At the end of eight weeks, the needles fell readily (7). This would greatly reduce the fire hazard compared with mechanical thinning which results in a gradual drying of the slash over a relatively long period of time.

TABLE IV

Percent crown-kill of ponderosa pine treated with one injection of a 30% solution of cacodylic acid.

Dosage cc/in dbh	Location of Application	Number Trees	% Crown-Kills Inspection Interval 2 wks.	4 wks.	8 wks.
1.0	1 foot	55	45	90	99
2.0	1 foot	48	52	91	100
1.0	3 feet	47	46	90	99
2.0	3 feet	50	59	92	100
Averages		200	50	91	99

Instead of forming a dangerous continuity of heavy fuel on the forest floor, the treated stems remain obscured from view by the expanding crowns of released crop trees.

Another less conspicuous advantage of chemical thinning is the reduction of subsequent timber losses due to infections of root rotting fungi which sometimes infect residual crop trees via severed stumps and root grafts.

New Injection Systems

As a result of the above tests and many experiments on other coniferous species not reported here, it can be concluded that the first prerequisite for a fast, low cost system of chemical thinning is a reality in that one shot of concentrated cacodylic acid quickly kills and defoliates the crowns of conifers below 10 inches d.b.h.

Another significant advance was recently reported by Michael Newton at Oregon State University. Newton disclosed his invention of an automatic injecting hatchet (Hypo-Hatchet) capable of injecting small metered dosages of chemical concentrate into the sapstream of trees. Extensive field testing since 1963, indicated that cacodylic acid was the most effective and economical silvicide for precommercial thinning ~~of~~ Douglas fir (*Pseudotsuga menziesii*).

The most recent trials with the Hypo-Hatchet and concentrated cacodylic acid solutions indicate that one whack with the hatchet set at 1.5 cc. is sufficient to kill Douglas-fir up to 4 inches d.b.h. Similar results have been observed on pines and true firs. In one test in Oregon, 500 Douglas-fir trees 4 inches d.b.h. and below were eliminated in one man-hour using one whack with the Hypo-Hatchet and

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[1] Reprinted from unpublished preliminary report 1965. Welton & Theiler, r., Forestry Branch, Bureau of Indian Affairs, Lame Deer, Montana.

concentrated cacodylic acid solution. The total cost was about $6 for labor and chemical.

During 1965, tests were conducted with a light weight (12 pound) back-pack drill (Hypo-Drill) powered by a 2 cycle gasoline engine with a flexible drive shaft and auger bit. Attached to this unit was a chemical reservoir which led to a self filling automatic syringe. Using this system one man was able to eliminate conifers at a rate of 5 to 8 trees per minute. In a typical situation, one man should be able to thin about 350 trees per hour at a total cost of about $5. The Hypo-Drill shows great promise for use on moderate terrain and on large cull conifers which would require considerable labor to eliminate with current techniques.

It is difficult to state an average cost per acre due to the variable conditions existing on the ground. However, it is now clearly evident that chemical thinning with concentrated cacodylic acid solutions and the Hypo-Hatchet or Hypo-Drill will permit foresters to vastly increase the productivity of the nation's coniferous forests in the years ahead. (Forester, Chemical Products Division, The Ansul Company, Marinette, Wisconsin.)

1. Cook, D. B. 1959. The Hatchet and Oilcan Technique for the Application of Sodium Arsenate. Journal of Forestry, 57: 845-847.

2. Cook, David B. 1963. Thinning Conifers with Sodium Arsenite, Scottish Forestry. 17: 2, 112-116.

3. Cope, J. A. and Spaeth, J. N. 1931. The Killing of Trees with Sodium Arsenite, Journal of Forestry. 29: 775-783.

4. Harrison-Smith, J. L. 1963-64. Progress in Poison Thinning. New Zealand Timber Journal. October, 1963, pp. 25-27.

5. Lexen, B. R. 1939. An Experiment in the Use of Sodium Arsenite in Thinning Ponderosa Pine. Journal of Forestry. 37: 259-262.

6. Smith, Robert W. 1965. Cacodylic Acid--A Potential One-Shot Silvicide. Proceedings, Northeastern Weed Control Conference. 19: 559-562.

7. Welton and Theiler R. 1965. Unpublished report. Bureau of Indian Affairs, Forestry Branch, Lame Deer, Montana.

A PROGRESS REPORT ON THE CONTROL OF PERSISTENT PERENNIAL BROADLEAF WEEDS BY BOROLIN ^{R}

G. K. Harris, V. W. Woestemeyer and R. H. Cooper

BOROLIN*® (Borax-picloram 2%) was introduced at the 1965 Western Weed Control Conference in Albuquerque, New Mexico. This report deals with 13 tests of BOROLIN in 1964 and 87 in 1965. The tests were located primarily in the Western and Central states, and the Prarie provinces.

The species tested were field bindweed, Canada thistle, leafy spurge, Russian knapweed, toadflax, and bur-ragweed, with the emphasis in that respective order. Soils in the studies were medium to heavy texture. The precipitation in 1965 was above normal. The plots were 10 feet square, or 16.5 feet square. BOROLIN was applied with a shaker can.

The data from the 1965 tests indicated in several instances that 50 pounds of BOROLIN was satisfactory and that, in general, 100 pounds of BOROLIN gave satisfactory control of the persistent perennial broadleaf weeds tested (Table I). Certain perennial grasses, such as bluegrass, were observed to be tolerant. Some regions appeared to require less BORALIN to give satisfactory control (Table II).

TABLE I

Control of perennial broadleaf weeds treated in spring, 1965

Species	Number of reps.	Per cent control in fall 1965			
		50 lb/A	75 lb/A	100 lb/A	150 lb/A
Bindweed	15	94	98	99	99
Canada thistle	14	85	94	84	96
Leafy spurge	10	91	99	99	99
Russian knapweed	4	63	88	96	99
Toadflax	4	48	75	97	88
Bur-ragweed	2	100	100	100	100

TABLE II

Field bindweed control with BORALIN in three regions

Location	Per Cent Control		
	50 lb/A	100 lb/A	150 lb/A
Kansas - Oklahoma - Texas	66	85	93
Prarie provinces, Nebraska, North Dakota, South Dakota	82	97	100
Intermountain states	83	92	98

Control of perennial broadleaf weeds has proved to be satisfactory through the second growing season (Table III) - an essential feature in eliminating these species. Considering this persistence, BOROLIN has

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* A registered trademark of U. S. Borax and Chemical Corp.

been cleared for spot treatment of cropland provided the production from the actual area treated is removed for as long a period as the effects of the herbicide are evident.

TABLE III

Control of field bindweed and Canada thistle with BOROLIN one and two seasons after treatment

Species	BOROLIN: Lb/Acre	Per cent Control	
		One Season	Two Seasons
Field bindweed	50	52	56
	100	77	82
	150	83	91
	200	92	94
Canada thistle	50	100	100
	100	100	100
	150	100	100
	200	100	100

Results of factorial studies showed BOROLIN (granular formulation with picloram) to be equal in performance to an equal quantity of picloram in the liquid formulation (Table IV).

TABLE IV

A comparison of the effectiveness of BOROLIN and Picloram.

Total number of comparisons	BOROLIN Lb/A	Picloram Lb/A	Effectiveness of BOROLIN control		
			More	Equal	Less
73	50	1	22	29	22
72	100	2	15	38	19
64	150	3	11	44	9
8	200	4	3	5	0

(U. S. Borax Research Corporation, 412 Crescent Way, Anaheim, California, 92803.)

NUTGRASS CONTROL WITH FOLIAGE SPRAYS OF TECHNICAL EPTC

R. A. Gray

It is well established that purple and yellow nutgrass can be controlled by working existing stands of nutgrass into the soil with a disc and then incorporating EPTC at rates of 3 to 12 lb/A.

Incorporation may be difficult around trees, on ditch banks and in certain non-crop areas, so foliage sprays of EPTC would be easier to apply if effective on nutgrass. However, foliage sprays of aqueous EPTC solutions have usually failed to control nutgrass. Preliminary tests in the greenhouse and field showed that spraying the leaves of yellow nutgrass with technical EPTC, using an atomizer, at several hundred pounds per acre resulted in complete kill of the nutgrass. None of the new shoots, that emerged after treatment from underground rhizomes and tubers, survived. When the leaves were painted with technical EPTC without letting any material run into the crown of the plant, poor control resulted. However, application of as little as one drop of EPTC into the center whorl of leaves of the nutgrass plant resulted in complete kill. When a small drop of radioactive EPTC (C-14 labelled) was applied to the center whorl of a mother plant in a pot containing several daughter plants, the radioactivity was found throughout the roots, shoots and tubers of all the plants in the pot two days after treatment. This indicated that the radioactivity was translocated to the untreated daughter plants as well as throughout all tissues of the treated mother plant.

Further tests showed that the emulsifiable concentrate (6-E) formulation containing 6 lb of EPTC per gallon, also killed nutgrass when sprayed on the foliage or applied as a single drop. The rate applied was about 10 to 40 lb/A by the single drop method depending on the number of plants per pot. A number of spray additives including oils, wetting agents and stickers were added to technical EPTC to see if any would prevent the vaporization of the EPTC when sprayed on the leaves of nutgrass. The plants were held in an upside down position while spraying to prevent the material from running down into the crown. Under these conditions, technical EPTC did not quite kill the nutgrass while adding several oils at a concentration of 25%, or using the 6-E formulation, completely killed the nutgrass.

The results of these experiments indicate that nutgrass along ditchbanks and other non-crop areas might be eradicated by using foliage sprays of undiluted EPTC. The droplet method of application appears promising for selectively controlling nutgrass in lawns and gardens. (Stauffer Chemical Company, Agricultural Research Center, Mountain View, California.)

JOHNSONGRASS CONTROL IN CALIFORNIA ORCHARDS

C. L. Elmore, L. L. Buschmann, R. B. Jeter, J. J. Smith and A. H. Lange

Johnsongrass is becoming a very serious weed in California orchards. With increased usage of annual weed control herbicides the populations will increase.

Experiments were conducted in 12 California orchards using the materials dalapon and MSMA. The material MSMA was applied at 4 week intervals at the rate of 4 pounds actual per acre for four applications; two applications of 8 pounds actual per acre; and one application of 16 pounds per acre. Dalapon was applied at 4 pounds actual per acre for four applications at 4 week intervals and at a 10 pound actual per acre rate.

In these studies it was found that MSMA at 4 pounds with repeated treatments gave better topkill control in all experiments. Two applications of 8 pounds was quite effective in some experiments however in most the regrowth was more apparent with higher rates. A single 16 pound per acre rate was virtually ineffective.

In all experiments no injury was found on the treated trees. The small amount of residue analysis that is available from fruit shows no apparent residue of the untreated checks. (University of California, Davis.)