RESEARCH COMMITTEE

RESEARCH PROGRESS REPORT

WESTERN
WEED
CONTROL
CONFERENCE

◆

PHOENIX,
ARIZONA

◆

MARCH 15-17
1967

PREFACE

This is the 1967 Annual Progress Report of the Research Committee of the Western Weed Control Conference. It consists of summaries of current research results submitted by workers throughout the conference area.

The promptness of the reports and the cooperation of the respective Project Chairmen made it possible to have this report assembled in time for distribution at the annual conference meeting.

The Research Committee is organized into seven projects each having a Chairman. Due to the limited time available for compiling the 1967 Report it was impossible for authors, Project Chairmen, and the Secretary to consult. Questions of clarity and context, assembly of the reports, and summaries were, in the main, handled by respective Project Chairmen.

Harold P. Alley
Secretary, Research Committee
Western Weed Control Conference

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

PROJECT 5. WEEDS IN AGRONOMIC CROPS
W. E. Albeke, Project Chairman

TABLE OF CONTENTS (Continued)

PROJECT 1. PERENNIAL HERBACEOUS WEEDS

D. E. Bayer, Project Chairman

SUMMARY

Eleven reports were submitted on ten perennial weed species from three states. Interest was shown in control two years following treatment. The reports are summarized as follows:

Canada thistle (Cirsium arvense). The response to environmental factors and sensitivity to amitrole and 2,4-D amine was studied using two selections of Canada thistle. Studies were also reported on the effectiveness, longevity of control and soil residual of the herbicide used. Picloram gave the most consistent control.

Dalmation toadflax (Linaria dalmatica). All herbicides used in the study were effective except 2,4-D.

Johnsongrass (Sorghum halepense). Foliar applications of MSMA or dalapon in combination with winter applied soil active herbicides, bromacil and monuron, indicated MSMA applied to plots previously treated with bromacil or monuron may have promise for controlling this weed pest where cultivation is not practicable.

Leafy spurge (Euphorbia esula). Picloram, dicamba, fenac and picloram + 2,4-D treatments resulted in good control. The presence of leafy spurge seedlings in dicamba plots was evidence of low or no residual activity.

Milkweed (Asclepias sp.). These species were effectively controlled by picloram. Intermediate wheatgrass seedlings growing in the plots showed light damage at rates of 1 lb/A and above.

Povertyweed (Iva axillaris). This weed species appears to be quite susceptible to picloram and dicamba.

Russian knapweed (Centaurea repens). Several herbicides applied in May 1964, received no moisture following application until November, showed excellent control two years later.

Tansy (Tanacetum vulgare). Longevity of control from 1964 treatments indicated fenac and Tritac-D gave better control the second year while picloram and Benzabor provided excellent control both years. Low rates of picloram appear promising for control of this weed.

Western false hellebore (Veratrum californicum). Silvex and 2,4-D ester gave the best control.

Response of two strains of Cirsium arvense L. to environmental factors and two herbicides. Erickson, Duane H. and Lambert C. Erickson. A Bozeman, Montana 2,4-D resistant strain and a Moscow, Idaho strain of unknown resistance were propagated from 3-inch root cuttings in metal containers 6 x 6 x 24 inches deep, under greenhouse conditions. Both strains were propagated in

McAvoy fine sandy loam soil containing two nitrogen levels (48 containers at 7.2% N and 48 containers at 10.4% N) totaling 192 samples.

To determine relative growth performance and nitrogen level response all containers were maintained at equal temperature, light, and soil moisture levels for 6 months. Top growth was removed and weighed three times during this interval. Short days severely inhibited growth in the Bozeman strain. This factor was largely responsible for the following average weight differentials:

Bozeman	strain	low	nitrogen	0.9 grams
Moscow	"	"	"	2.3 "
Bozeman	"	high	"	2.7 "
Moscow	"	"	"	4.7 "

The influences of subsequent moisture and temperature regimes i.e., 18.3% and 7.0% H_2O (MHC = 13.9%) and means of 87 and 68.3^{o} F., compounded with the two nitrogen levels (0 and 150 pounds N added to the initial low and high N levels respectively) were used to determine the influence of these factors on the relative toxicities of amitrole and 2,4-D amine at 2.5 lb. a.e./A. Due to uncontrollable conditions the low moisture phase was lost. Results from the high moisture phase were:

1. Statistically significant increases in root and top growth and shoot numbers at high N levels.
2. Statistically significant root and shoot deterioration from both herbicides.
3. Non-significant differences in degree of toxicity of the two herbicides as expressed by root and stem deterioration between the herbicides from differences in either temperature or nitrogen regimes or between thistle strains. (Idaho Agricultural Experiment Station, University of Idaho, Moscow.)

Chemical control of Canada thistle (Cirsium arvense L.) in Wyoming. Alley, H. P., G. A. Lee and A. F. Gale. Plots were established throughout Wyoming in the spring of 1964 to compare the effectiveness, longevity of control and soil residual of the compounds most often used for control of Canada thistle. Soil types and moisture varied between locations. The data presented in the attached table are an average of several tests.

There was considerable range in percent control of all chemical included in the plots except for picloram which was consistent throughout the state. Rates higher than 2 lb/A of picloram showed considerable toxicity to the associated grass species the first year after application. Readings 2 years after treatment showed recovery of the grass species. There was evidence of recovery where dicamba, 2,3,6 TBA and Benzabor was used. (Wyoming Agricultural Experiment Station, Univ. of Wyoming, Laramie.)

Range of control of Canada thistle, two years after application

Chemical	Rate[1]	Range of control	Remarks 1966
Dicamba	10	70-80	no residual activity - reinfestation
Benzabor	1 1/2 lb/sq. rd.	50-100	recovery
Fenac liquid	15	85-90	void of grass
Fenac granular	1 lb/sq. rd.	50-100	void of grass
Picloram	4	100	recovery of grass
Picloram	3	100	good stand of grass
Picloram	2	100	good stand of grass
Picloram	1	90-100	good stand of grass
Tritac-D	8 gal.	65-70	reduced grass stand
2,3,6 TBA	20	50-80	recovery

[1]Rate is expressed as pounds active per acre except for the granular materials and Tritac-D.

Chemical control of tansy (*Tanacetum vulgare* L.) in Wyoming. Alley, H. P. and G. A. Lee. Several chemicals at different rates of application were applied on June 22, 1964, when the plants were in the 18-24 in. growth stage. Additional applications were established on June 24, 1965, when the plants were in the pre-bud stage of growth to determine if lower rates of application of the compounds resulting in outstanding control in 1964, were feasible.

Readings for both the 1964 and 1965 plots are presented in the attached table. Picloram from 2 to 4 lb/A maintained 95 to 100 percent control over a two-year period. Benzabor at 1 1/2 lb/sq. rd. maintained 100 percent control over the two-year period. Readings obtained from the 1965 plots indicate that 3/4 lb/A of picloram may be sufficient to obtain initial 100 percent control. The 2,4-D formulations showed very little activity. (Wyoming Agricultural Experiment Station, Univ. of Wyoming, Laramie)

Tansy control - one and two years after application

Chemical	Rate[1]	1965	1966[2]	1966[3]
Benzabor	1 1/2 lb/sq. rd.	100	100	
Dicamba	10	100	50	
Dacamine	6			0
Fenac (gran.)	1 lb/sq. rd.	0	80	
Fenac	15	50	95	
Tritac-D	6 gal./A	0	90	
2,3,6 TBA	20	100	50	
2,4-D LVE (PGBE)	2	0	0	

Tansy control - one and two years after application (Continued)

Chemical	Rate[1]	1965	1966[2]	1966[3]
2,4-D LVE (PGBE)	4	50	50	
2,4-D LVE (PGBE)	6	50	50	
Weedone-638 (emulsifiable acid of 2,4-D)	6			0
Picloram granules (Tordon Beads)	1/2 lb/sq. rd.			100
Picloram granules (Tordon Beads)	3/4 lb/sq. rd.			100
Picloram	1/4			50
Picloram	1/2			80
Picloram	3/4			100
Picloram	1			100
Picloram	1 1/2			100
Picloram	2	100	95	
Picloram	3	100	98	
Picloram	4	100	100	

[1]Rate is expressed as pounds active per acre except for the granular materials and Tritac-D.

[2]Plots established June 1964, evaluated June 1965 and 1966.

[3]Plots established June 1965, evaluated June 1966.

Chemical control of dalmation toadflax (*Linaria dalmatica* (L.) Mill.) in Wyoming. Alley, H. P., G. A. Lee and A. F. Gale. Eight chemicals were applied to a heavy stand of dalmation toadflax July 21, 1965. The plants had been mowed and regrowth had started. All chemicals except the granular materials were applied in 40 gpa water. The attached table includes the average percentage control of the three replications as evaluated one year after initial treatment. All chemicals included in the test were effective except the 2,4-D formulations. It may be possible to obtain satisfactory control with lower rates than were included in the test. (Wyoming Agricultural Experiment Station, Univ. of Wyoming, Laramie.)

Chemical control of dalmation toadflax

Chemical	Rate[1]	Average Percent control[2]	Remarks
Benzabor	1 1/2 lb/sq. rd.	100	
Dacamine	6	23	
Dicamba	5	98	
Dicamba	10	100	hurt grass

Chemical control of dalmation toadflax (Continued)

Chemical	Rate[1]	Average Percent control[2]	Remarks
Fenac granules	1 lb/sq. rd.	100	hurt grass
Picloram	1/2	100	
Picloram	1	100	
Picloram	1 1/2	100	hurt grass
Picloram	2	100	hurt grass
Picloram granular (Tordon beads)	3/4 lb/sq. rd.	100	hurt grass
Picloram granules (Tordon beads)	1 1/4 lb/sq. rd.	100	hurt grass
Tritac-D	8 gal/A	100	hurt grass
2,4-D LVE (PGBE)	6	33	

[1]Rate is expressed as pounds active per acre except for the granular materials and Tritac-D.

[2]Average percent control of three replications.

Johnsongrass control combining two soil-applied herbicides with three foliage-applied herbicides. Boyd, F. M., D. E. Bayer, W. B. McHenry, N. L. Smith and J. T. Yeager. The eradication of established Johnsongrass on canalbanks and other sites where cultivation is not practicable requires high soil sterilant rates or extended retreatments with foliage-active herbicides.

An experiment was established on a canalbank to compare the effects of combining soil active herbicides applied in the winter with foliar applications during the following summer. Bromacil was applied at 8 and 16 lb and monuron at 16 and 32 lb ai/A in December, 1965. Approximately 5 in rainfall occurred following treatment. During the summer of 1966, six applications of MSMA at 4 lb ai/A, dalapon at 7.4 lb ae/A, and pyriclor at 2 lb ae/A were made using a spray volume of 100 gpa. A surfactant, Multi Film X-77, was included at a concentration of 0.5%. Retreatment intervals varied from 4 to 6 weeks.

Number of foliar applications of dalapon, MSMA, or pyriclor to effect apparend eradication*

	Bromacil 8 lb ai/A	Bromacil 16 lb ai/A	Monuron 16 lb ai/A	Monuron 32 lb ai/A	No sterilant Treatment
Dalapon 7.4 lb ae/A	>5	>5	>5	>5	>5
MSMA 4 lb ai/A	4	4	5	3	5

Number of foliar applications of dalapon, MSMA, or pyriclor to effect apparent eradication* (Continued)

	Bromacil 8 lb ai/A	Bromacil 16 lb ai/A	Monuron 16 lb ai/A	Monuron 32 lb ai/A	No sterilant Treatment
Pyriclor 2 lb ae/A	>5	>5	>5	>5	>5
No foliar treatment	(5% control)	(25% control)	(0% control)	(5% control)	(0% control)

* Foliar treatments made May 3, June 16, July 19, August 19, September 26, and October 24, 1966. Last 1966 observation made October 24, 1966, reflecting the effects of the first five treatments. A more certain appraisal to be made the spring of 1967.

From observations made during the same year of treatment, MSMA was superior to dalapon and pyriclor. MSMA had reduced the Johnsongrass stand by 97-99% following two applications where the plots had also been treated the preceding winter with bromacil at 8 or 16 lb or with monuron at 32 lb ai/A. Two applications of MSMA alone resulted in 58% stand reduction. Neither dalapon nor pyriclor alone or combined with any soil sterilant attained even 90% stand reduction following five applications. (Department of Botany, and Agricultural Extension Service, University of California, Davis.)

Chemical control of leafy spurge (Euphorbia esula L.) in Wyoming. Alley, H. P., G. A. Lee and A. F. Gale. Square rod plots were established during the 1965 growing season in several areas of Wyoming. The soil type and moisture conditions varied between locations from sandy loam to clay loam and dry to intermediate moisture conditions.

There was considerable variation in percentage control between locations. The Benzabor and 2,3,6 TBA treatments resulted in quite wide ranges of control. However, residual activity was evident and control could be expected to increase. Picloram, dicamba and picloram + 2,4-D treatments resulted in outstanding control at the rates applied. Dicamba plots had small leafy spurge seedlings coming into the treated areas with no residual activity evident. (Wyoming Agricultural Experiment Station, Univ. of Wyoming, Laramie.)

Chemical control of leafy spurge

Chemical	Rate[1]	Range of control	Remarks
Benzabor	1 1/2 lb/sq. rd.	30-100	residual damage-activity
Dicamba	5	90-95	small spurge-recovery
Dicamba	10	97-100	small spurge-recovery
Fenac (gran.)	1 lb/sq. rd.	100	reduced grass stand

Chemical control of leafy spurge (Continued)

Chemical	Rate[1]	Range of control	Remarks
Picloram	1	85-100	shows residual activity
Picloram	1 1/2	90-100	shows residual activity
Picloram	2	95-100	shows residual activity hurt grass
Picloram	3	100	shows residual activity grass damage
Picloram + 2,4-D (Tordon 101)	1 gal/A	99-100	
Picloram + 2,4-D (Tordon 101)	2 gal/A	100	hurt grass
Picloram granules (Boralin and Tordon Beads)	3/4 lb/sq. rd.	75-100	small leafy spurge, residual
Picloram granules (Boralin and Tordon Beads)	1¼ lb/sq. rd.	80-100	
2,4-D LVE (PGBE)	6	40	recovery - no residual
2,3,6 TBA	10	40-100	shows residual activity
Tritac-D	6 gal/A	60-90	hurt grass-shows little residual activity

[1]Rate is expressed as pounds active per acre except for the granular materials Tritac-D and picloram + 2,4-D mixture.

Chemical control of common milkweed (Asclepias speciosa Torr.) with picloram in Wyoming. Alley, H. P., G. A. Lee and A. F. Gale. Common milkweed was treated with several rates of picloram on June 7, 1964, when the milkweed was in the early bud-stage of growth. The plots were in a field containing intermediate wheatgrass seedlings which were in the 3-5 leaf stage of growth at time of treatment. The attached table includes readings which were made in 1965 and 1966, one and two years following establishment. One year after treatment, picloram as low as 1/2 lb/A gave 95 percent control. The rate of 1 lb/A and above resulted in 99-100 percent control. Evaluations two years after chemical application indicated that 1 1/2 to 2 lb/A may be needed to maintain 95-100 percent control. There was considerable reinfestation at rates less than 1 1/2 lb/A.

Intermediate wheatgrass seedlings were damaged above the 1 1/2 to 2 lb/A rate one year following treatment, whereas in 1965, two years following treatment, light grass damage was evident at 1 lb/A and above. (Wyoming Agricultural Experiment Station, Univ. of Wyoming, Laramie.)

Control of milkweed

Treatment	Rate/A	Percent control 1965	1966	Remarks 1966
Picloram	1/2	95	50	no damage to grass
Picloram	1	99	80	light damage to grass
Picloram	1 1/2	99	99	light damage to grass
Picloram	2	99	100	moderate damage to grass
Picloram	2 1/2	100	100	extensive damage to grass
Picloram	3	100	100	very severe reduction of grass

Woollypod milkweed (Asclepias eriocarpa Benth.) control in California. Bayer, D. E., C. Schoner, K. Glenn, J. E. Street, W. H. Brooks. In June and July of 1963, 1964 and 1965 herbicides were sprayed on woollypod milkweed plants in the 1/2 bloom stage. Two experiments are on adjacent locations in the Sacramento Valley in Yolo County, on land that is farmed in a barley-pasture-fallow-barley rotation. Although adjacent, the two experiments are on different soil types. The cultivation and soil differences probably account for changing and relatively different numbers of plants per plot in the nil or check treatment. Another experiment is in the Coast Range Mountains of Mendocino County. Materials, dates, rates and results are itemized in the following table. All materials applied in 100 gpa water with 0.5 percent by volume adjuvant, Multi Film X-77, added. Repeat treatments with picloram continue to be promising for control of this poisonous weed. In 1966 picloram and Amitrole T were again applied as retreatments and as new treatments. (Department of Botany, University of California, Davis.)

Material	Lb/A ai 1963	1964	1965	Percent 1964	Plants per plot 1965 I	II	III	IV	Avg.	Plants per plot 1966				Avg.
YOLO COUNTY, EXPERIMENT I														
Picloram	1	1	--	15	12	15	20	32	20.0	11	22	13	50	24.0
Picloram	2	2	--	40	1	7	2	7	4.3	0	2	1	7	2.5
Picloram	4	--	--	75	9	15	26	47	24.3	0	12	22	17	12.8
Picloram	8	--	--	95	--	1	3	7	2.8	0	1	1	6	2.0
Check	--	--	--	0	60	60	52	75	61.8	12	5	2	24	10.8
Picloram	--	2	2		1	3	2	8	3.5	0	0	0	0	0
Picloram	--	2	--		8	6	7	1	5.5	4	3	5	2	3.5
Picloram	--	--	4		60	45	40	60	51.3	1	0	0	0	0.3
Amitrole	4	--	--	75	40	36	45	44	41.3	4	27	--	15	15.3
Amitrole	--	4	--		22	28	14	22	21.5	45	60	14	50	52.3
Amitrole T	--	4	4		7	8	3	3	5.3	10	3	10	7	7.5
Amitrole T	--	--	6		45	60	45	74	56.0	1	0	3	7	2.8
Dicamba	2	--	--	10										
Dicamba	4	--	--	20										
2,4,5-T	2	--	--	15										

(Continued)

Material	Lb/A ai 1963	1964	1965	Per-cent 1964	Plants per plot 1965 I	II	III	IV	Avg.	Plants per plot 1966				Avg.
YOLO COUNTY, EXPERIMENT II														
Picloram	--	4	--		1	0	1	0	.5	2	0	4	0	1.5
Amitrole	--	2	--		45	21	44	31	35.1	100	17	55	46	54.5
Amitrole T	--	2	--		27	27	21	70	36.3	50	44	36	50	45.0
Check	--	--	--		63	60	37	20	45.0	40	75	50	30	48.8
MENDOCINO COUNTY EXPERIMENT					Percent Control					Percent Control				
Picloram	--	1	1		30	20	40		30	90	60	90		80
Picloram	--	2	2		10	20	30		20	85	90	95		90
Picloram	--	4	4		40	70	40		50	100	100	95		95
Amitrole T	--	4	4		30	50	70		50	80	100	90		85
Amitrole	--	--	4						70	60	20	20		50
Dicamba	--	2	2		50	30	40		40	30	20	100		50
Dicamba	--	4	4		40	40	40		40	80	60	40		60
Silvex	--	2	2		10	30	10		20	20	20	20		20
Check	--	--	--		0	0	0		0	0	0	0		0

Plots 20 ft. x 20 ft. in Yolo County and 16-1/2 ft. x 16-1/2 ft. in Mendocino County.

Povertyweed (Iva axillaris Pursh.) control in Wyoming. Alley, H. P. and G. A. Lee. Square rod plots, replicated twice, were established in July, 1965. Picloram, dicamba, Tordon-101 (picloram + 2,4-D) and Tordon beads (picloram + sodium tetraborate) were applied at various rates. The povertyweed was in the bloom stage of growth. Plots were evaluated June 1966 approximately one year after application. All treatments resulted in outstanding control. Picloram at 1/4 lb/A gave 96-100 percent control and dicamba at 2 lb/A 85-99 percent control. The combination of picloram + 2,4-D (Tordon-101) could possibly be used at a much lighter rate of application. (Wyoming Agricultural Experiment Station, Univ. of Wyoming, Laramie.)

Chemical control of povertyweed

Chemical	Rate[1]	% Control (2 reps)
Picloram	1/4 lb/A	96-100
Picloram	1/2 lb/A	100-100
Picloram	3/4 lb/A	100-100
Picloram	1 lb/A	100-100
Picloram + 2,4-D (Tordon-101)	1 gal/A	100-100
Picloram + 2,4-D (Tordon-101)	2 gal/A	100-100
Dicamba	1 lb/A	90 - one rep not treated
Dicamba	2 lb/A	85-99
Picloram granules (Tordon beads)	1/2 lb/sq. rd.	100-100
Picloram granules (Tordon beads)	3/4 lb/sq. rd.	100-100
Picloram granules (Tordon beads)	1 lb/sq. rd.	100-100

[1]Rate is expressed as pounds active per acre except for the granules and picloram + 2,4-D mixtures.

Evaluation of several soil residual compounds for the control of Russian knapweed (Centaurea repens L.). Alley, H. P., G. A. Lee and A. F. Gale. Plots were established on May 20, 1964 to evaluate the toxicity, longevity of control and soil residual to several compounds being used for control of Russian knapweed. The soil at time of treatment was dry and no moisture was received until the winter snows in early November. The only treatments showing activity the year of treatment, 1964, was the liquid formulations. As late as September the fenac granular was still on the soil surface as when applied in May. Although the liquid picloram showed good activity there was evidence of root recovery. Early the next spring, May 1965, one year after application, Russian knapweed seedlings covered the plots, two weeks later, the plots were showing outstanding control.

The attached table includes the 1965 and 1966 evaluations. All treatments, except the heavy rate of 2,4-D amine resulted in 90 percent or better control two years after treatment. The initial evaluation of the heavy rate of 2,4-D amine, one year after treatment, showed 90 percent control. (Wyoming Agricultural Experiment Station, Univ. of Wyoming, Laramie.)

Control of Russian knapweed one and two years following treatment

Chemical	Rate[1]	Percent control 1965	Percent control 1966
Fenac granular	1 lb/sq. rd.	98	98
Picloram	1	100	90
Picloram	2	100	100
Picloram	3	100	100
Picloram	4	100	100
Picloram granular (Tordon-2K)	3/4 lb/sq. rd.	99	98
Tritac-D	4 gal/A	98	96
Tritac-D	6 gal/A	100	100
Tritac-D	8 gal/A	100	100
2,4-D amine	40	90	60

[1]Rate is expressed as pounds active per acre except for the granules and Tritac-D.

Control of Western false hellebore (Veratrum californicum Durand). Street, J. E., D. E. Bayer and W. H. Brooks. Western false hellebore is a common native of meadows and moist areas of mountain grazing lands in western United States. The plants contain various related alkaloids toxic to livestock and honeybees. Although in some instances it is considered desirable forage. Ingestion of Western false hellebore has caused Cyclopian-type congenital malformations in lambs.

In June of 1964 and 1965 various herbicides were applied to essentially monospecific stands of Western false hellebore in Mendocino County, California. The plants were prebloom, had 10 leaves and averaged two feet in height.

to kill johnsongrass. Dalapon and dalapon-TCA were less effective than DSMA and there was no difference in the response of johnsongrass to these treatments. Treatments started in the fall were more effective than similar treatments started in the spring. The most economical treatment was DSMA applications started in the fall.

The strains differed in their susceptibility to herbicides. The number of plants with regrowth in mid-summer is shown in Table 2. Strain E8 was the most difficult to control and W20 was the most susceptible to herbicides. (Arizona Agric. Expt. Sta., University of Arizona, Tucson.)

Table 1. Plants with topgrowth, stems per growing plant, and cost of herbicides for repeated applications on johnsongrass

Started	Herbicide	Plants with topgrowth April, 1966	Stems per growing plant April, 1966	Cost* per acre for herbicide
Fall	DSMA 6.3 lb/eihg	1	1	$ 88.00
Fall	dalapon 10 lb-TCA 5 lb/eihg	15	28	299.00
Fall	dalapon 15 lb/eihg	14	27	242.00
Spring	DSMA 6.3 lb/eihg	1	10	116.00
Spring	dalapon 10 lb-TCA 5 lb/eihg	34	32	318.00
Spring	dalapon 15 lb/eihg	25	42	339.00

*Based on dalapon $1.00/lb, DSMA $.80/lb, and surfactant $5.00/gal.

Table 2. Plants with topgrowth after four or five applications of herbicides

Treatment		Strain				
Started	Herbicide	E8	E20	W7	W9	W20
Fall	DSMA	3*	1	2	0	1
Fall	dalapon-TCA	11	12	8	4	1
Fall	dalapon	10	11	10	6	1
Spring	DSMA	11	9	8	0	0
Spring	dalapon-TCA	12	12	12	10	2
Spring	dalapon	12	12	12	7	7

*Based on 12 plants.

PROJECT 2. HERBACEOUS RANGE WEEDS

M. C. Williams, Project Chairman

SUMMARY

Four abstracts were submitted covering research on 15 weeds. Three abstracts dealt with weed control investigations while one discussed the tolerance of certain clovers and grasses to bromoxynil. Reports are summarized below.

Two clovers and 2 grasses used in reseeding California ranges were tested for tolerance to bromoxynil. All species were injured when treated at 3/4 lb/A in mid-January. No species were injured at this rate when treatment was delayed until February or March.

Picloram plus 2,4-D (Tordon 101) at ¼, ½, and 1 gal/A gave excellent control of plains larkspur (Delphinium geyeri Greene) with little or no damage to the grasses. Picloram alone completely controlled plains larkspur but caused moderate to heavy damage to grass and required approximately twice as much picloram as when mixed with 2,4-D.

Picloram and dicamba were evaluated for control potential on 13 range weeds in Northwestern Colorado. First year results are summarized in the abstract.

Several herbicides were evaluated for control of spotted knapweed. Perennial native grasses recovered rapidly once the knapweed was controlled. Thickspike wheatgrass was useful in revegetating areas where native perennial grasses were absent.

Chemical control of plains larkspur (*Delphinium geyeri* Greene) in Wyoming. Lee, G. A. and H. P. Alley. Plots established in 1964 to determine the minimum rate of picloram necessary for satisfactory control of plains larkspur were evaluated in 1965 and again in 1966, 2 years after treatment. The average percent control for the two years is presented in the attached table.

Outstanding control of plains larkspur after two years was obtained with all picloram and picloram + 2,4-D treatments. The treatment of 1/4 gal/A of picloram + 2,4-D would be equivalent to 1/8 lb/A of picloram and 1/2 lb/A of 2,4-D. This is one-half the rate of picloram needed when applied separate from 2,4-D. This treatment gave 98 percent control two years after treatment and is of interest because of the low rate of each chemical included in the mixture. The 2,4-D LVE (PGBE), Silvex and dicamba controlled approximately 50 percent of the plains larkspur the first year; recovery and reinfestation were common two years after treatment. (Wyoming Agricultural Experiment Station, Univ. of Wyoming, Laramie.)

Chemical control of plains larkspur

Treatment	Rate[1]	Percent control 1965	Percent control 1966	Remarks
Dicamba	1/2	50	10	
Dicamba	1	30	20	larkspur seedlings in plots
Dicamba	2	65	40	larkspur seedlings in plots
Picloram	1/4	98	99+	
Picloram	1/2	100	100	
Picloram	1	100	100	moderate grass damage
Picloram	1 1/2	100	100	moderate to heavy grass damage
Picloram	2	100	100	moderate to heavy grass damage
Picloram + 2,4-D (Tordon-101)	1/4 gal/A	96	98	
Picloram + 2,4-D (Tordon-101)	1/2 gal/A	98	98	
Picloram + 2,4-D (Tordon-101)	1 gal/A	100	100	
Silvex + X-77	2	55	30	
2,4-D-LVE (PGBE) + X-77	2	55	50	

[1]Rate is expressed as pounds active per acre except for the picloram + 2,4-D mixture.

Bromoxynil on rose clover, subclover, hardinggrass, and Palestine orchardgrass. Kay, Burgess L. Coast fiddleneck and Douglas fiddleneck frequently present a weed problem in new seedings of range species in cismontane California. Bromoxynil has been suggested for control of these weeds and was tested for tolerance on four of the principal range seeding species--Wilton rose clover (*Trifolium hirtum* All.), Mt. Barker subclover (*T. subterraneum* L.), hardinggrass (*Phalaris tuberosa* L. var. *stenoptera* (Hack.) Hitch), and Palestine orchardgrass (*Dactylis glomerata* L.). Bromoxynil was applied at three growth stages as described in the table. Rates of 3/4, 1/2, and 1/4 lb/A were tested at each date in four replications. No surfactant was added. Solutions were applied at 50 gpa.

Stage of growth at bromoxynil applications

Spraying date	Rose clover	Subclover	Hardinggrass	Palestine orchardgrass
1/18/66	1 1/2 trifoliate leaves	1-2 trifoliate leaves	1 in., 3 leaves	1 in., 3 leaves
2/11/66	5 leaves, 2 1/2 in. rosette	5 leaves, 2 1/2 in. rosette	2-3 in., 5 leaves, tillering	2 in., 1-3 tillers
3/2/66	3-4 in. rosette	3-4 in. rosette	4-6 in., tillered	2 in., tillered

The 3/4 lb rate at the earliest spraying produced a severe leaf burn on both clovers, and the tips of the grass leaves were burned. The 1/2 and 1/4 lb/A rates showed a slight burn on the clovers but not on the grasses. Spraying at the later dates produced no damage even at the 3/4 lb rate. Final ratings on March 28, which is still a vegetative stage for all species, showed a slight suppression of growth of subclover by 3/4 lb/A applied at the earliest date. Plants of all four varieties had fully recovered and showed no effect from any of the other treatments. (Dept. of Agronomy, University of California, Davis.)

Picloram vs. dicamba for perennial weed control on rangeland in northwestern Colorado. May, J. W., H. M. Hepworth, and J. L. Fults. Picloram (Tordon) was compared to dicamba (Banvel-D) for treating several perennial range weeds near Steamboat Springs in Northwestern Colorado. Application of herbicides was made in mid-June, 1966, and evaluation, based on foliage reduction, was made in late July with the following results:

1. Milk Vetch (Astragalus haydenianus) was sensitive to both picloram and dicamba. 1 lb/A picloram resulted in complete foliage reduction, whereas 3 lb/A dicamba was required to achieve the same measure of toxicity.

2. Canada Thistle (Cirsium arvense) was reduced about 95% with 1 lb/A picloram and with 3 lb/A dicamba.

3. Yarrow (Achillea lanulosa) was reduced from 75 to 80% with 1 lb/A picloram, while 3 lb/A dicamba gave 95% reduction.

4. White Lupine (Lupinus argentus) was completely killed to the ground with 1 lb/A picloram and 5 lb/A dicamba, the only rates applied. This would indicate the possibility of good control at lower rates.

5. Toadflax (Linaria vulgaris) was affected very little by 1 lb/A picloram except possible retardation of flowering. No comparable dicamba treatment was applied.

6. Russian Knapweed (Centaurea repens) was reduced to the ground by both 1 lb/A picloram and 5 lb/A dicamba, the only rates applied.

7. Poverty Weed (Franseria discolor) was killed to the ground by 1½ lb/A picloram whereas 3 lb/A dicamba were required for the same results.

8. Whitetop (Cardaria draba) appeared unaffected by 1 lb/A picloram, and up to 5 lb/A dicamba. 8 lb/A amino triazole gave 100% reduction in the same tests.

9. Stinging Nettle (Urtica dioicaprocera) was killed to the ground with 1 lb/A picloram or 2 lb/A dicamba.

10. Bluebell (Campanula rapunculoides) was treated with 4 lb/A dicamba and 2 lb/A picloram. Both treatments caused 100% leaf kill.

11. Bindweed (Convolvulus arvensis) appeared to be much more sensitive to 3 lb/A dicamba than 1 lb/A picloram. The dicamba application completely killed the top growth whereas picloram gave only slight foliage retardation.

12. Wild Licorice (Glycyrrhiza lepidota) top growth was not visibly reduced with 1 lb/A picloram; whereas 2 lb/A dicamba resulted in 60% foliage kill, and 5 lb/A about 80%.

13. Skunk Cabbage (Veratrum californicum) appeared to be more susceptible to 2 lb/A dicamba than to 1 lb/A picloram, however, neither chemical reduced top growth completely. A combination of 2 lb/A of 2,4-D plus ¼ lb/A dicamba resulted in extensive foliar burning also.

Final evaluations for percent control will be made on this series of tests in the summer of 1967. (Botany and Plant Pathology Section, Colorado Agri. Expt. Sta., Fort Collins).

The effects of herbicidal control of spotted knapweed (Centaurea maculosa) and other forbs on forage production in a grassland-park type in western Montana. Ryerson, D. E. and Sonder, L. W. Deterioration is occurring in many native grasslands in grassland-park and foothill grassland types under private ownership in western Montana. In many cases economic improvement through grazing management within a reasonable time does not occur; therefore, revegetation with adapted species is desirable. Grasslands in poor condition throughout this area are being invaded by spotted knapweed, noxious weeds, numerous undesirable forbs, and annual grasses.

A study was established in the spring of 1965 in a dense spotted knapweed infested area. The feasibility of seeding desirable grasses was determined by utilizing a herbicide band treatment only as a means of seedbed preparation coupled with drilling thickspike wheatgrass (Agropyron dasystachyum) directly into the center of the sprayed band. Sprayed bands were approximately 24 inches wide and placed 48 inches apart from center to center on the contour. Seeding operations were made April 15, 1965 with a flexo type beet seeder. Spraying operations were conducted April 21, 1965, using a constant pressure, hand boom sprayer. The study area was fenced and grazing excluded. The study was in cooperation with Missoula County Extension Service staff, Soil Conservation Service, Bureau of Land Management, U. S. Forest Service-Missoula District, and local ranchers.

Herbicides used in the band spraying operation were paraquat plus 2 lb/A of 2,4-D constant at ½, 3/4 and 1½ lb/A ai; picloram at ¼, ½, and 3/4 lb/A ai; dicamba at ½, 1, and 1½ lb/A ai; and 2,4-D low volatile ester at 1, 2, and 3 lb/A ai. Treatment plots were 30' x 60' in randomized blocks with three replications.

Each treatment plot was sprayed with 1½ lb/A ai of 2,4-D low volatile ester on June 29, 1965, in 40 gal. water per acre with 0.1 percent X-77 surfactant. Spotted knapweed was in the bud stage. On May 18, 1966, all of the treatment plots were again sprayed with 2 lb/A ai of 2,4-D low volatile ester. Treatment was made in 20 gallons of water per acre with 0.1 percent X-77 surfactant. Spotted knapweed was in the rosette stage.

Evaluation of treatment effects were made in August, 1966, utilizing clipped forage production estimates with three, 5.42 sq. ft. circular samples per treatment plot.

Establishment of thickspike wheatgrass in all herbicide-banded strips was rated poor. We attributed this primarily to competition from existing perennial grasses. We observed, however, that where perennial grasses were not present--establishment of thickspike wheatgrass was good to excellent. Further investigations of the herbicide band technique with seeding will be required before any conclusions can be drawn.

Recovery of the existing perennial grasses on the treatment plots following the additional applications of 2,4-D is shown in the accompanying table. From the perennial grass recovery that has occurred through the control of spotted knapweed, further investigations are justified to determine the effect of its control without interseeding on ranges in poor to low fair conditions. (Cooperative Extension Service, Montana State Univ., Bozeman, Montana.)

Effects on average perennial grass and forb production following control of spotted knapweed and other forbs in western Montana

	Rates[1]						Treatment means	
	1		2		3			
	grass lb/A	forbs lb/A	grass lb/A	forbs lb/A	grass lb/A	forbs lb/A	grass lb/A	forbs lb/A
Paraquat + 2,4-D constant	859	68	771	89	667	19	766	59
2,4-D	846	161	833	45	861	127	847	112
Picloram	831	68	1178	29	1183	65	1102	54
Dicamba	684	74	1287	29	986	48	694	50
Check	8	865	65	927	5	1558	26	1118

[1]paraquat 1/2, 3/4, 1-1/2 lb/A
picloram 1/4, 1/2, 3/4 lb/A
dicamba 1/2, 1, 1-1/2 lb/A
2,4-D 1, 2, 3 lb/A

PROJECT 3. UNDESIRABLE WOODY PLANTS

M. Newton, Project Chairman

SUMMARY

Fifteen reports were submitted by fourteen authors from five states. Three abstracts reported on progress in range weed research, one dealt with control of phreatophytes, one discussed physiology of herbicide movement, and ten were oriented toward forestry. Most of the current reports are concerned with development of field practices and identification of hazards resulting therefrom.

Range shrubs were treated successfully with both phenoxy herbicides and picloram in both Wyoming and Montana. Alley and Lee showed that picloram was effective on snakeweed at rates of down to one-quarter pound per acre, while Ryerson and Sonder eradicated fringed sagewort with their lowest rate of picloram, at one-half pound per acre. Both studies showed that good control of these species could be obtained with moderate rates of 2,4-D, and the Montana work indicated that degree of control was important for grass production, regardless of method. Continued progress was reported by Plumb regarding control of sprouting oak stumps in southern California. He found that season was important in selection of herbicides for effective control, and rounded out the general picture of effectiveness of picloram as a woody plant killer throughout the year.

Saltcedar was the only phreatophyte for which research was reported this year. Hughes found that high rates of Silvex were effective during the dormant season. Mowing in mid-summer prior to winter herbicide treatment enhanced effectiveness.

Glenn and Leonard are gaining insight regarding the role of assimilate sinks in determination of direction and amount of herbicide translocation. Implications of this work extend far beyond those species on which work was conducted, acacia and mesquite.

Forestry reports were all from Oregon, and ranged from ecological studies pertaining to origin of brush problems to estimation of environmental contamination from herbicide use. Gratkowski contributed further insight into the role of high temperatures at the soil surface in establishment of sclerophyllous brush species in the area of southern Oregon and northern California. He found that one member of this group, squawcarpet, was resistant to some herbicide treatments that have been successful on other species of *Ceanothus*. Basic to evaluation of success for forestry applications, Gratkowski expressed success of several methods of varnishleaf ceanothus control in terms of growth of released Douglas-fir, with the conclusion that maximum release is provided by complete removal and stump treatment.

Manipulation of existing forest stands was discussed by Newton and Holt. Progress is reported in a search for herbicides that will provide acceptable

control of conifers and hardwoods alike without consideration of species composition. Season and dosage studies for lodgepole and ponderosa pines indicate comparable results for the pines as has been reported for Douglas-fir with cacodylic acid. Insects, one of the major stumbling blocks of the concept of chemical thinning, have largely been eliminated or repelled by this arsenical.

Residues from broadcast herbicide usage in forests have been reported by Norris et al. In one exploratory study of deer whose entire habitats had been treated with atrazine, residues were found in several tissues at low levels. Stomach contents contained sufficient atrazine to indicate that substantial degradation occurs as deer metabolize this compound. This information may be of considerable importance, since domestic ruminants frequently share treated ranges with deer at comparable or lower exposure levels.

Soil and water contamination were reported also by Norris et al. Degradation of 2,4-D was influenced by formulation and litter composition, with highly nitrogenous litter contributing to fast decomposition, and pure acid formulation appearing most susceptible to degradation. Addition of DDT was associated with significant increases in rate of degradation. Further evidence of rapid degradation or absorption of amitrole in strems was reported. Failure to find amitrole roughly one mile downstream from a point with a substantial concentration points up the clean-up capacity of some stream bottoms, and also illustrates the need for insight as to what mechanisms or organisms are active in this role.

Application of herbicides to scrub oak stumps to prevent sprouting. Plumb, T. R. Studies were started in southern California to test the effectiveness of stump applied herbicides in preventing sprouting of scrub oak (*Quercus dumosa* Nutt.) following clearing. The three herbicides used in an initial test were: (1) undiluted dimethyl amine salts of 2,4-D painted on the cut surface of the stump, (2) a 50-50 brushkiller mixture of low volatile esters of 2,4-D and 2,4,5-T at a concentration of 16 lb aehg of non-phytotoxic oil sprayed over the entire stump, and (3) AMS (ammonium sulfamate) at 4 lb per gal of water also sprayed over the entire stump. Herbicide was applied either at the time of cutting or 2 weeks later on plants cut each month for 13 consecutive months beginning in March 1961. The stumps were prepared for treatment by cutting them close to the ground with a chain saw and then by clearing litter and soil from around the base of the stump to further expose the root crown bud zone.

Plant kill was highly seasonal and good results were obtained only between November and March. However, even during this period plant kill from the different herbicides was erratic. Both brushkiller and 2,4-D amine gave over 70 percent kill in November and brushkiller gave similar results in January as did 2,4-D in February. AMS generally gave unsatisfactory results with the outstanding exception of the February application when a 95 percent kill was obtained. Brushkiller gave at least a 10 to 20 percent plant kill each month while 2,4-D amine and AMS gave little or no kill during late spring and summer. Immediate application of 2,4-D and AMS was important, and on the average resulted in at least twice as much kill as that obtained with the delayed application. No clearcut advantage for either the immediate or delayed application was obtained with brushkiller.

A subsequent stump treatment test was started in 1964 with cutting dates of November, January, March, and July. Chemicals used in the first test plus picloram at 8 lb aehg nontoxic oil and undiluted weed oil (Annalos 11) were also sprayed over the entire stump and exposed root crown. Stumps receiving weed oil were hacked with an ax immediately prior to spraying. An additional test in January with the brushkiller formulation compared litter removal vs. no litter removal. Fourteen months after cutting, a follow-up foliage application of brushkiller at 4 lb aehg of water was sprayed on all plants which sprouted after stump treatment. This test is to be carried on for 3 consecutive years.

Results 14 months after cutting (Table) indicated that good plant kill was obtained with brushkiller and especially 2,4-D amine in November through March but not in July. Plant kill with AMS was satisfactory only in January and weed oil was essentially ineffective at any time. Picloram, which was effective in January and March, was the only herbicide that gave good kill in July. In contrast to 2,4-D, delaying application of picloram was consistently more effective than applying immediately at cutting. Litter removal to expose more of the bud zone was definitely worthwhile in this test. A 65 percent plant kill was obtained with this treatment compared to only 17 percent kill when no litter was removed. Based on the first year results of this test, it seems possible that a treatment combining 2,4-D amine and picloram may give good results in any season. (U.S. Dept. of Agriculture, Forest Service Fire Laboratory, Riverside, Calif.)

Percent of dead plants 14 months after stump treatment

Chemical	Application time	Date of Cutting November	January	March	July	Average
2,4-D amine	Immediate	72	98	68	21	65
	Delay	58	11	13	8	22
Brushkiller	Immediate	25	63	18	19	31
	Delay	74	54	43	17	47
AMS	Immediate	28	61	7	19	29
	Delay	16	40	8	27	23
Picloram	Immediate	17	44	52	8	30
	Delay	36	81	69	61	62
Annalos 11	Immediate	3	3	0	0	1
	Delay	3	39	0	13	14

Chemical control of fringed sagewort (Artemisia frigida). Ryerson, D. E. and L. W. Sonder. Fringed sagewort is a half-shrub commonly found in varying degress of abundance on deteriorated grasslands in the foothill and plains type in Montana. This half-shrub has increased in number rapidly following mechanical treatments for range renovation and improvement, and curtails the rapidity of range forage production increases on the treated areas. Because of a lack of information concerning the specific herbicide, rate, dates of susceptibility, carriers, etc. and range recovery that could be expected following control measures, a study was established in the 10-14 inch rainfall belt in south central Montana. This study is in cooperation with the Yellowstone County Extension Service staff, Soil Conservation Service, Bureau of Land Management, and Dover Sindelar, a Rancher.

Three herbicides, picloram at ½, 1, and 1½ lb/A ai; 2,4-D and 2,4,5-T low volatile ester at 1, 2 and 3 lb/A ai were applied with a ground sprayer on May 12 and June 11, 1965.

Completely randomized field plots, 30' x 30' were replicated three times. Materials were applied at the rate of 10 gallons total volume per acre with 8001 Tee jet nozzles. Materials were applied in diesel oil or a 1:4 diesel oil-water ratio. The surfactant, X-77 was used in all treatments at 0.1 percent by total volume.

The study was fenced and grazing excluded from May, 1965 through October, 1966. Rainfall for March through June, 1965 period was 0.52 inches below normal and 1.29 inches below normal for the same period in 1966. Herbicidal effects on fringed sagewort were evaluated in May, 1966 using fifteen 2 square foot circular frames (randomly located) per treatment plot counting the number of live sagewort plants per frame. Forage production estimates (four 2 sq. ft. random samples per plot) were made in July, 1966.

Results are shown in the table. The effect of herbicides, etc. on fringed sagewort is expressed as the percent difference of live sagewort plants per treatment plot versus live plants per check plot. Based upon 24 check plots (non-treated) randomly located through the study area, fringed sagewort population estimates with fiducial limits were 6.70 ± 5.11 plants per sample frame, and would represent the sagewort population for the study area prior to treatment. (Cooperative Extension Service, Montana State University, Bozeman, Montana.)

Reduction of fringed sagewort by herbicidal treatment and resultant effects on grass production at two treatment periods

		Average grass production lb/A Carrier		Sagewort reduction percent Carrier	
Herbicide	Rate lb/A	Diesel	Diesel + H_2O	Diesel	Diesel + H_2O
		First date of treatment			
2,4-D	1	800	751	69	47
	2	814	789	76	91
	3	1103	857	99	78

Reduction of fringed sagewort by herbicidal treatment and resultant effects on grass production at two treatment periods (Continued)

Herbicide	Rate lb/A	Average grass production lb/A Carrier Diesel	Diesel + H_2O	Sagewort reduction percent Carrier Diesel	Diesel + H_2O
2,4,5-T	1	794	624	81	63
	2	736	789	44	92
	3	882	857	97	97
Picloram	½	889	986	100	100
	1	823	1020	100	100
	1½	870	844	100	100
Check		354			
		Second date of treatment			
2,4-D	1	631	687	95	90
	2	778	544	95	86
	3	734	737	100	99
2,4,5-T	1	551	395	81	48
	2	536	447	88	63
	3	551	654	98	81
Picloram	½	679	627	100	100
	1	563	582	100	100
	1½	452	609	100	100
Check		417			

Evaluation of several chemicals for the control of snakeweed (Gutierrezia sarothrae (Pursh) Britt. and Rusby. Alley, H. P. and G. A. Lee. Exploratory plots were established in 1964 to determine the chemical or chemicals and date and stage of growth that would give satisfactory control of snakeweed. The outstanding treatments resulting from the 1964 tests were included in a replicated series of plots in 1965. The treatments were applied in 40 gpa water when the snakeweed plants were in the pre-bud stage of growth, July 9, 1965.

The 2,4-D amine and low volatile ester (PGBE) at 2 lb/A gave 98 percent control. The butyl ester and dacamine (N-Oleyl 1, 3-propylene diamine salt of 2,4-D) treatments did not result in as outstanding control. The addition of a wetting agent, X-77, (alkylaryl polyoxyethelene glycol, free fatty acids of isoproponol) did not enhance the activity of any of the 2,4-D formulations. Picloram at 1/4 lb/A and above was the only treatment resulting in complete control, however, picloram + 2,4-D (Tordon-101) gave 99 percent control at 1 and 2 pt/A. This would be equivalent to 1/16 lb/A of picloram and 1/4 lb/A of 2,4-D. (Wyoming Agricultural Experiment Station, Univ. of Wyoming, Laramie.)

Average percent control of snakeweed

Chemical	Rate/A	Percent control
Dacamine	2	88
Dicamba	2	85
2,4-D amine	1	70
2,4-D amine	2	98
2,4-D amine + X-77	1	90
2,4-D amine + X-77	2	96
2,4-D butyl ester	2	85
2,4-D butyl ester + X-77	2	80
2,4-D LVE (PGBE)	1	90
2,4-D LVE (PGBE)	2	98
2,4-D LVE (PGBE) + X-77	1	80
2,4-D LVE (PGBE) + X-77	2	92
Picloram	1/4	100
Picloram	1/2	100
Picloram + 2,4-D (Tordon-101)	1 pt/A	99+
Picloram + 2,4-D (Tordon-101)	2 pt/A	99

X-77 added at the rate of 1/2 pt/100 gallons of spray solution

Dormant boom-applied spray treatments for control of saltcedar (Tamarix pentandra Pall.). Hughes, Eugene E. Field research during 1965-66 showed that dormant applications of Silvex as the butoxyethanol (BE) ester at relatively high rates applied in diesel oil were moderately effective in controlling saltcedar. Rates of 4 and 8 lb/A and volumes of 50 and 100 gpa of oil and a 50:50 oil:water emulsion were used. In addition, one group of plots was mowed immediately before spraying while the other was unmowed.

On mowed plots, the 8 lb/A-rate was considerably better than 4 lb/A. One treatment, 8 lb/A in 50 gpa of diesel oil, killed 67% of the plants. The other 8 lb/A treatments were only half as effective.

All treatments on unmowed plots were superior to those on plots that had been mowed except the 8 lb/A in 50 gpa of diesel oil. It was equal to the same treatment on the mowed plots and was the best in both series.

A combination mowing-spraying dormant treatment experiment was initiated in 1965 by mowing plots each month in June, July, August, and September. This allowed approximately 4, 3, 2, and 1 month for the saltcedar to regrow before frost. The plots with different ages of regrowth were divided into three groups and treated in January 1966 with 4, 6, and 8 lb/A of Silvex as the BE ester in 50 gpa of diesel oil. Results indicate that mowing in July or August then spraying in January with 6 lb/A of Silvex is an effective treatment. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Los Lunas, New Mexico.)

On altering transport of assimilates with herbicides. Glenn, R. K. and Leonard, O. A. For several years we have been studying methods of altering the transport of assimilates in plants. Two reasons for conducting these studies will be given. (1) A herbicide might alter the normal translocation patterns in plants and defeat thereby its own translocation. (2) A herbicidal treatment might alter the normal translocation patterns in plants, without actually being damaging; such a treatment might be used advantageously in setting up the desired translocation pattern desired for an effective herbicide. Studies along these lines were conducted in cooperation with Dr. W. van der Zweep in the Netherlands during 1965 and 1966. Some studies on *Acacia farnesiana* and *Prosopis juliflora* seedlings have been conducted recently using picloram. Picloram reduces photosynthesis and translocation of assimilates to the roots; reduction in transport to the roots is in part related to the creation of sinks within the stems. The creation of sinks is made most evident by defoliation of the upper part of the seedling. When the defoliated part is treated with picloram, assimilate transport into this part of the plant is greatly increased over those plants receiving only the defoliation treatment. (Botany Department, University of California, Davis.)

Heat-induced germination of redstem ceanothus seeds. Gratkowski, H. A laboratory-greenhouse experiment has shown that dormant seeds of redstem ceanothus (*Ceanothus sanguineus*) in forest soils are induced to germinate when the soils are heated by wildfires or logging slash fires.

Seeds were buried for periods of 4, 13, 22, 31, or 40 minutes in fine sand preheated to soil temperatures of 30°, 45°, 60°, 75°, 90°, 105°, 120°, or 130° Centigrade. Each treatment was replicated four times in a 5 x 8 factorial experiment in a randomized block design. Thermocouples and a recording potentiometer were used to control soil temperatures during treatment. All seeds were stratified for 3 months after heat treatment.

Soil temperatures of 60° C. or less did not cause the seeds to germinate. A few seeds germinated after exposure to 75° C. soil temperatures, but maximum germination was obtained from seeds exposed to soil temperatures of 105° C. Although statistical analysis is not yet completed, germination appears to have decreased somewhat with increasing duration of exposure to a soil temperature of 120° C. The 135° C. soil temperature killed redstem ceanothus seeds of this seed lot. Duration of exposure from 4 minutes (minimum) to 40 minutes (maximum) had no effect on germination at soil temperatures up to and including 105° C.

Soil temperatures within the range that will induce germination of redstem ceanothus seeds are produced during burning of logging slash in cuttings. Burning small accumulations of logging slash is most apt to produce soil temperatures that will induce germination. Greater amounts of slash would raise soil temperatures to lethal levels at depths from which redstem seedlings can emerge after germination. Similar effects undoubtedly occur during wildfires. (Pacific N.W. Forest and Range Expt. Sta., Forest Service, U. S. Dept. of Agric., Roseburg, Oregon.)

Herbicides fail to control Ceanothus prostratus. Gratkowski, H. On June 21, 1962, a small exploratory trial of herbicides was established in squaw carpet ceanothus on pumice soil in the Rogue River National Forest. Chemicals and treatments included in this trial are listed below. All herbicides except Amitrol T were formulations containing low volatile esters. All chemicals were applied as foliage sprays.

Treatment number	Application per acre			
	Herbicide	Rate/A	Carrier	Additives
1	2,4,5-T	4	Water	
2	2,4,5-T	4	Emulsion	2 gal diesel oil
3	2,4-D	4	Water	
4	2,4-D	4	Emulsion	2 gal diesel oil
5	Amitrol T	4	Water	
6	Brushkiller[1]	4	Water	
7	Forron 245	4	Water	
8	Brushkiller	4	Emulsion	2 gal diesel oil

[1] 1:1 mixture of 2,4-D and 2,4,5-T

The plots were examined in September 1963, when it was concluded that none of the treatments provided an adequate degree of control. Green sprouts had developed throughout every plot in what was judged sufficient numbers to insure early reoccupation of the sprayed areas. (Pacific N.W. Forest and Range Expt. Sta., Forest Service, U.S. Dept. of Agric., Roseburg, Oregon.)

Height growth of Douglas-firs released from varnishleaf ceanothus. Gratkowski, H. Varnishleaf ceanothus (Ceanothus velutinus var. laevigatus T. & G.) is one of the most common and abundant brush species on forest lands west of the Cascade Range in Oregon and Washington. Excellent stands of Douglas-firs often develop in a young ceanothus cover, but the shrubs quickly overtop and shade the small trees. An unreplicated series of plots was established in one such area on the Umpqua National Forest to determine whether the shrub cover retards growth of the trees and to measure response of the conifers to release treatments. Although analysis is not yet completed, some data are now available for the first 5 years after release.

Three treatments are of special interest: (1) no treatment, where trees continue to grow under the ceanothus cover; (2) ceanothus lopped off, removed and stumps sprayed to give complete release from varnishleaf competition; and (3) basal spray of standing ceanothus resulting in standing dead or partially dead brush similar to effects of aerial spraying.

These data show that a ceanothus overstory does retard height growth of young Douglas-firs. Trees up to 6 feet tall increased height growth after release from the ceanothus cover. Full release by lopping the shrubs and spraying stumps resulted in maximum height growth of the young trees, but basal spraying also produced an appreciable increase in height growth of the conifers. In the stump-sprayed area, trees of all heights up to 6 feet responded equally well when compared to trees of similar height under ceanothus--growth was almost twice that of trees under ceanothus. In the basal sprayed area, 5- and 6-foot-tall trees responded better (146% and 149%) than small 1-foot trees (129%). Intensity of sunlight reaching the taller trees after release was probably increased more than that on smaller trees, which were still dominated to some extent by herbaceous vegetation and low shrub species.

Height growth of young Douglas-firs released from varnishleaf ceanothus

Release treatment[1]	Height of trees when released--feet					
	1	2	3	4	5	6
	--height growth expressed as percentage of untreated control--					
None	100	100	100	100	100	100
Basal spray	129	136	142	143	146	149
Stump spray	183	184	186	183	183	184

[1]Treatment applied to varnishleaf ceanothus

Increased height growth of the released trees can probably be attributed primarily to increased light and decreased competition for soil moisture (Pacific N.W. Forest and Range Expt. Sta., Forest Service, U.S. Dept. of Agric., Roseburg, Oregon.)

Response of ponderosa pine to injections of cacodylic acid. Newton, Michael and H A. Holt. Tests of cacodylic acid for pre-commercial thinning of ponderosa pine were established to determine dosage and seasonal requirements to provide satisfactory kill with minimum insect hazard. One hundred twenty trees were treated with cacodylic acid, with ten trees receiving each treatment combination of season and dosage. Treatments included applications during March, June, September and December of cacodylic acid at rates of one-half milliliter per three, six and nine inches of circumference four and a half feet above ground. The formulation used contained 5.7 pounds per gallon of cacodylic acid, as the sodium salt, plus surfactants and blue dye.

Evaluation was based on a four-point rating scheme, ranging from a rating of 1, for no effect, to 4 for dead trees. The following table summarized responses by season and dosage:

Response ratings of ponderosa pine treated with cacodylic acid

Cut spacing	Season: March	June	September	December	Dosage means
Inches					
3	3.85	3.80	3.25	3.55	3.61
6	3.70	3.65	2.45	3.15	3.24
9	3.45	3.35	3.00	3.10	3.22
Date means	3.67	3.60	2.90	3.27	
				General Mean	3.37

September was the final date of application, with December being the date of initiation. Hence it is possible that the low response to the September treatments was the function of insufficient time for effects to show up. In December, however, responses indicate the need for closer spacing of cuts than during March and June. Virtually any treatment during spring months appeared to produce good results.

Insects were found on very few of the treated trees, although infestations of *Ips* species and *Dendroctonus* beetles were in the area. The only *Dendroctonus* activity was on three trees, on which D. valens, the red turpentine beetle, was found. This is not a serious pest in most areas. Small numbers of *Ips* beetles were found in some fine twigs, but infestations were much lower than in nearby logging slash, and seldom reared broods successfully, regardless of season of treatment. In view of lack of insect activity and high mortality of treated trees, cacodylic acid appears very promising for pre-commercial thinning in ponderosa pine. (Oregon State University School of Forestry, Corvallis.)

Response of lodgepole pine to injections of cacodylic acid. Newton, Michael and H. A. Holt. Injections of cacodylic acid were tested for effectiveness in pre-commercial thinning of lodgepole pine. Ten trees between three and six inches in diameter were treated with each of twelve combinations of season and dosage. The herbicide used in all treatments was cacodylic acid, 5.7 pounds per gallon, formulated as the sodium salt, with surfactants and blue dye. Treatments involved cut spacings of three, six and nine inches between centers, with one-half milliliter herbicide per cut in all cases by an injector hatchet. All dosages were applied in December, March, June and September, in that order. Evaluation was three months after the final treatment. Response was judged on a five-point rating scheme, with rating of 1 indicating no response, and a rating of 5 indicating mortality. Trees with rating of 4 are not expected to recover. One more class (3) of top-kill was needed than for ponderosa pine, because some crowns appeared able to recover the substantial top die-back. The following table lists responses by treatment:

Response of lodgepole pine to injections of cacodylic acid.

Cut spacing Inches	December	March	June	September	Season means
3	4.90	4.45	4.25	3.95	4.39
6	3.65	4.05	3.45	3.40	3.64
9	3.45	3.70	3.30	3.00	3.36
Season means	4.00	4.07	3.67	3.45	
				General mean	3.80

No trees failed to die back at least several feet in the tops, and it was noted, in general, that lower branches of full-crowned trees gave the greatest difficulty. Small-crowned trees were usually killed outright by any dosage during December and March, while the lighter dosages left some green branches in the lower crown, some of which could persist for several years. Generally, lodgepole pine appears to be very sensitive to cacodylic acid. Limits of effectiveness appear to be imposed by lateral translocation restrictions, since all tissue within the apparent range of herbicide movement was badly damaged, regardless of dosage. No insects were found in treated trees or in adjacent stands, hence it is uncertain if the herbicide is repellant to insects attacking lodgepole pine. (Oregon State University School of Forestry, Corvallis.)

Response of Douglas-fir to injected experimental formulations. Newton, Michael and H. A. Holt. Low-cost formulations are needed that will provide good control of conifers and hardwoods in one operation. Screening tests of several materials showing promise on several hardwood species were applied to Douglas-fir of small pole size. All herbicide preparations were injected at the rate of one-half milliliter per cut, with one injection per inch of tree diameter four and one-half feet above ground. All treatments were applied in mid-August, five months before evaluation. Twenty trees received each treatment. The following table illustrates responses based on two rating schemes: 1) a five-point rating system ranging from no effect at a rating of 1 to complete kill at a rating of 5, and 2) a statement of the percentage of trees that are not expected to recover or are completely dead.

Rating of Douglas-fir five months after injection

Chemical and formulation	Kill rating	Percent effectively dead
Picloram, K-salt 2 lb/gal	4.30	85
Picloram, K-salt 1 lb/gal	3.40	50

Rating of Douglas-fir five months after injection (Continued)

Chemical and formulation	Kill rating	Percent effectively dead
Picloram, K-salt 0.4 lb/gal	3.35	40
Picloram, K-salt 0.2 lb/gal	3.18	50
Silvex, K-salt, 6.0 lb/gal	2.45	20
Endothall, Di-K salt, 3.0 lb/gal	2.80	30
Endothall, Di-K salt, 1.5 lb/gal) Silvex, K-salt, 1.5 lb/gal)	2.50	20
Herbicide L-2505 (Ansul Co.)	4.00	75

All preparations except L-2505 caused killing from the bottom of the crown toward the top, which is in contrast to most materials shown to be effective on conifers. L-2505 caused general failure, with no apparent pattern. Undiluted picloram and L-2505 were the only materials providing acceptable control of Douglas-fir. L-2505 was the only effective material with no evidence of root grafting; undiluted picloram may have caused root graft damage on one tree out of twenty. (Oregon State University, School of Forestry, Corvallis.)

Tests of herbicides for multiple species control by injection. Newton, Michael, and H. A. Holt. Forest improvement operations often require herbicides with broad-spectrum activity. Three herbicide preparations showing promise in preliminary tests on hardwoods and conifers were tested concurrently on Oregon white oak, bigleaf maple and red alder. All herbicides were applied undiluted at waist height with a hatchet injector at the rate of one-half milliliter per injection. Injections were spaced three inches between centers. Twenty trees six to twelve inches in diameter were treated with each combination of tree species and chemical. All trees were treated in August and evaluated in September, hence these results are strictly an indication of relative defoliation rather than mortality. The following table summarizes responses in terms of defoliation, by species and chemical:

Percent defoliation of bigleaf maple, red alder and Oregon oak, 43 days after injection.

Herbicide	Oregon oak	Bigleaf maple	Red alder
Endothall, Di-K salt, 3 lb/gal	92.25	88.25	26.25
Endothall, Di-K, 1 1/2 lb and Silvex, K, 1 1/2 lb/gal	87.00	90.00	18.00
Cacodylic acid 5.7 lb/gal	93.25	72.75	75.75

Oak appeared very sensitive to all treatments, and there is some indication that cambial injury is extensive with all compounds. Maple response to cacodylic acid appeared to resemble early abscission without severe injury to cambium. Endothall, on the other hand, appeared to kill foliage in place and cause systemic damage. Alder was virtually insensitive to endothall and the endothall-silvex mixture, but was moderately defoliated by cacodylic acid. None of these materials were completely effective on all species, although cacodylic acid appeared to be the best general defoliant. (Oregon State University School of Forestry, Corvallis.)

Atrazine residues in deer. Norris, Logan A., Michael Newton and Jaroslav Zavitkovski. With the cooperation of the Oregon State Game Commission, we made a preliminary survey of atrazine residues in deer harvested from forest lands treated with this herbicide for grass control. Deer were harvested at various intervals after application of the herbicide, and various organs and body tissues were removed, placed in plastic bags and frozen as quickly as possible. The analytical procedure was essentially that outlined in Geigy Analytical Bulletin Number 7 with the exception that the herbicide was determined with a gas chromatograph. The instrument was a MikroTek MT-220 with the Dohrmann detection system. Each sample was chromatographed on two columns. The quantitative determination was made with a 4 ft. ½ inch pyrex column packed with 70/80 mesh Gash Chrom Z coated with 5% DC 11. Atrazine was qualitatively determined for each sample with a 4 ft. ½ inch pyrex column packed with 60/80 mesh Gas Chrom Z coated with 5% QF-1 with the exit 10" packed with 5% DC 11 coated Gas Chrom Z. The DC 11 column was operated at 180 deg. C and the QF-1 column at 150 deg. C.

The minimum level of detection possible varied with the size of the sample and the final volume of the extract. Results are given for three animals harvested from two different treatment areas. Samples found with no detectable atrazine residue are indicated as containing less than the minimum detectable level of herbicide taking into consideration the size of the sample and the extract volume. The time interval between spray application and harvest of the animal is also indicated.

Atrazine residues in deer

	Animal		
Tissue or organ	CV-3 17 days ppb atrazine	RL-2 26 days ppb atrazine	RL-3 44 days ppb atrazine
Blood	77	--	<12
Brain	--	<48	--
Fat	--	--	<50
Feces	<96	<360	245
Heart	76	15	<36
Kidney	30	13	<36
Liver	25	75	<36
Lung	<24	--	--
Lymph gland	--	76	--

Atrazine residues in deer (Continued)

	Animal		
	CV-3	RL-2	RL-3
	17 days	26 days	44 days
Tissue or organ	ppb atrazine	ppb atrazine	ppb atrazine
Mammary gland	--	30	<36
Meat (round steak)	lost	36	<22
Spleen	24	<24	<48
Stomach contents	3453	178	428
Thyroid	--	<200	--
Urine	<60	--	--

Note: Samples with dotted line indicate no analysis performed for that animal. Samples with a residue of less than (<) some value contained no detectable atrazine residue. The value stated indicates the lower limit of detection possible for that particular sample.

Unfortunately, a control animal was not available; so there is no indication whether or not deer normally carry atrazine residues. However, this possibility appears quite unlikely. On the basis of our analysis using two different columns and a halogen specific detection system there is little question that the chemical measured is in fact atrazine.

We found no atrazine residue greater than 76 ppb in portions of these animals which might normally be used for human consumption. In one animal, not listed above, residues of 326 ppb atrazine were found in the thyroid and 498 ppb in the lymph glands. Another animal yielded a fat sample which contained 688 ppb atrazine.

In general this survey indicates that atrazine applied for grass control on forest lands of southern Oregon will enter several tissues and organs of deer. The length of persistence of the chemical in these tissues is not clear from this study. The likelyhood of encountering dangerous residues of atrazine in tissues of importance for human consumption appears low. This investigation was supported in part by Research Grant WP 00477 from the Federal Water Pollution Control Administration. (Oregon Agricultural Experiment Station, Oregon State University, Corvallis.)

The degradation of 2,4-D in forest litter. Norris, Logan A. and David Greiner. The forest floor is the major receptor of aerially applied herbicides. Herbicide persistence in the litter may influence the availability of the chemical for stream contamination. Experiments were performed to determine the influence of litter type and several chemical factors on the persistence of 2,4-D in forest litter.

Forest litter from douglas-fir, bigleaf maple, vine maple, ceanothus and red alder vegetation types was collected in western Oregon, mechanically chopped and preconditioned for three weeks in a growth chamber. The environment consisted of a 12 hour day with 42 deg. F night and 62 deg. F day temperature to simulate conditions in coastal Oregon during the early spring.

Twenty gram (oven dry weight) samples were weighed into four ounce waxed paper cups which were returned to the growth chamber immediately after treatment. The environmental conditions during the test period were the same as those used during the preconditioning period. A completely randomized 5 x 10 factorial design with two replications was used in this study.

In one treatment series, litter of each type collected was treated with 3 lb/Aa.e. of the triethanol amine salt of 2,4-D. In a second series, alder litter only was treated with 3 lb/A ae of pure 2,4-D acid, the isooctyl ester of 2,4-D, or a solubilized acid formulation of 2,4-D. In the third series, alder litter only was treated with 3 lb/A ae of the isooctyl ester of 2,4-D plus 1 lb/A DDT or 4 gal/A diesel oil.

At 0, 3, 6, 10, and 15 days after treatment, samples were removed from the growth chamber and frozen until analyzed. The herbicide was recovered from the litter by base digestion followed by centrifugation and liquid-liquid extraction of the acidified supernatant with benzene. The benzene extract was esterified and analyzed with Dohrmann gas chromatograph. The results are expressed as percent recovery as a function time after treatment. Recovery at any time is relative to the amount of 2,4-D recovered from samples harvested immediately after treatment. The data, including values for all treatments and harvest dates, were subjected to analysis of variance followed by analysis for differences among recoveries at 15 days after treatment by the method of individual degrees of freedom.

Table 1. Recovery of 2,4-D from various types of litter treated with 3 lb/A ae 2,4-D triethanol amine

	Days after treatment				
Litter type	3	6	10	15	
Alder	95.8	93.0	76.9	60.9	a
Ceanothus	93.9	98.1	75.5	66.8	b
Vine maple	96.8	87.5	76.0	69.6	b,c
Bigleaf maple	97.4	93.6	81.4	71.4	b,c
Douglas-fir	96.8	92.1	79.4	71.8	c

Note: Recoveries at 15 days which have a letter in common are not significantly different at the 5% level.

The data in table 1 indicate apparent differences in the rate of degradation of 2,4-D among litter types. However, with the possible exception of the alder litter these differences do not appear to be important from a practical standpoint.

Table 2. Recovery of 2,4-D from alder litter treated with 3 lb/A ae of pure acid, triethanol amine salt, isooctyl ester or solubilized acid formulations of 2,4-D.

Formulation of 2,4-D	Average percent recovery Days after treatment 3	6	10	15	
Pure acid	95.6	90.3	69.4	46.1	a
Triethanol amine salt	95.8	93.0	76.9	60.9	b
Isooctyl ester	98.3	86.1	77.1	64.9	b,c
Solubilized acid	97.2	80.7	79.6	66.3	c

Note: Recoveries at 15 days which have a letter in common are not significantly different at the 5% level.

The data in table 2 indicate differences exist in the rates of degradation of the four formulations of 2,4-D tested. However, we believe this is a function of constituents of formulation rather than a direct effect of the technical grade acid, salt or ester.

Table 3. Recovery of 2,4-D from alder litter treated with 3 lb/A ae 2,4-D isooctyl ester plus 1 lb/A DDT or 4 gal/A diesel oil

Treatment	Average percent recovery Days after treatment 3	6	10	15	
2,4-D isooctyl ester (control)	98.2	86.1	77.1	64.0	b
2,4-D isooctyl ester + DDT	97.1	84.2	70.8	51.5	a
2,4-D isooctyl ester + diesel oil	97.1	86.9	73.5	60.1	b

Note: Recoveries at 15 days which have a letter in common are not significantly different at the 5% level.

The data in table 3 indicates diesel oil has little or no effect on 2,4-D degradation while the presence of DDT appears to stimulate degradation. This investigation was supported by Research Grant WP 00477 from the Federal Water Pollution Control Administration. (Oregon Agricultural Experiment Station, Oregon State University, Corvallis.)

Stream contamination with amitrole from forest spray operations. Norris, Logan A., Michael Newton and Jaroslav Zavitkovski. In 1965, we reported the results of a study of stream contamination with amitrole following the application of Amitrole-T in western Oregon.[1] The study area included treated portions

[1] Research Progress Reports, Western Weed Control Conference, 1965. Pg. 20-22.

of several small watersheds on the Siuslaw National Forest near Hebo, Oregon. The area was resprayed in July of 1966 and another study of stream contamination made. In the present study, four sampling points were located downstream from 260 acres treated with 2 lb/A Amitrole-T. Application was made by helicopter on July 7, 1965. Samples were collected prior to spraying and at various intervals for five months after treatment.

The samples were collected in plastic or glass gallon jugs and were stored in a 35 deg. F coldroom prior to analysis. The amitrole was removed from the water with Dowex-50 ion exchange resin. Following several cleanup steps the amitrole was determined colorimetrically at 445-505 mu with a Klett colorimeter. N-1-napthylethylenediamine dihydrochloride was used for color development. Check samples had an "apparent amitrole" background of 0.8 ppb which was the same for all sample points. Recoveries of amitrole from spiked checks was 70%. Levels of amitrole as low as 1 ppb could be determined with a high degree of confidence.

The data were corrected for recovery and background and expressed as parts per billion amitrole in the stream water. These values were graphed as a function of time after treatment and the values reported here interpolated from that graph.

Sample point 1 was located just below the boundary of the sprayed unit. Point 2 was located 0.2 miles downstream from point 1 and just below the confluence with another stream from the treated area. Point 3 was 0.3 miles below point 2, and point 4 was 0.8 miles below point 2.

Concentration of amitrole in streamwater parts per billion

Time after start of spraying (hours)	Sampling point 1	2	3	4
0.1	1	0	0	0
0.5	5	0	0	0
1	7	2	0	0
2	45	42	0	0
3	24	15	0	0
4	8	18	4	0
5	10	5	6	0
6	9	5	6	0
8	3	3	12	0
10	2	2	2	0
12	1	1	2	0
14	1	1	2	0
24	1	2	1	0
35	1	0	1	0
48	0	0	0	0
72	0	0	0	0

No detectable quantities of amitrole were detected between three and 150 days after treatment.

These results are strikingly similar to those found in the previous study. It is interesting that the background of "apparent amitrole" in 1966 was only half that found in 1965. This indicates there was no long term stream contamination from the 1965 operation. Although more acreage was sprayed in 1966, the maximum concentration of amitrole in the stream did not exceed that found in the 1965 study. The most likely explanation is that the majority of the additional acreage sprayed did not include live streams. It is evident from the data that considerable loss or dilution of chemical occurred with downstream movement over short distances which confirms the observation reported last year. The present study shows that heavy rains in November and December failed to introduce measurable concentrations of amitrole in this stream.

This research was supported by Research Grant WP 00477, from the Federal Water Pollution Control Administration. (Oregon Agric. Expt. Sta., Oregon State University, Corvallis.)

PROJECT 4. WEEDS IN HORTICULTURAL CROPS

Roman R. Romanowski, Project Chairman

SUMMARY

A total of 37 reports were submitted from California, Colorado, Hawaii, New Mexico, Texas and Washington which included results from herbicide evaluation trials with fruits, ornamentals, turf and vegetables.

Fruits

Extension and research personnel from the University of California submitted a total of 11 papers on deciduous fruits and nuts. In that the papers cover many differing edaphic and ecological conditions in addition to differing stages of growth, the reader is directed to each paper for self-analysis of a fairly complete coverage of chemical weed control in apples, grapes, pears, plums, cherries, peaches, apricots, black walnuts and almonds.

Washington researchers report that "half-rates" of diquat and atrazine look promising with blueberries irrespective of soil type and mulching practices. They also report that of 16 new herbicides evaluated in strawberry plantings, only lenacil shows promise.

Ornamentals

Screening trials with bulbous iris, daffodils and tulips in Washington suggest that the following be considered as important treatments: (1) simazine, pre-emergence with a post-emergence CIPC application. (2) Linuron, pre-emergence with a post-emergence CIPC application, and (3) DNBP plus CIPC combination, pre-emergence with a post-emergence terbacil application.

Secondary evaluation trials in California with Monterey pine trees showed that high rates of simazine, atrazine and diphenamid increased growth considerably over an untreated control.

Turf

Four papers were submitted on chemical weed control in turf from the Colorado Agricultural Experiment Station. In one experiment high rates of Bandane were applied to a bluegrass turf for a period of three years resulting in eradication of crabgrass with some reduction in bluegrass cover in the fourth year. Two years results with pre-emergence herbicides on Kentucky bluegrass showed the following compounds to give excellent control of crabgrass: Turbutol, trifluralin, Sindone, Planavin, bensulide, DCPA, Bandane, PAX-regular and DMPA. KOCN or paraquat appear to be satisfactory for renovating a bentgrass-bluegrass mixed turf by reseeding after treatment with bluegrass. Finally, scientists from Colorado present an excellent summary table showing the effect of a series of herbicides on several weed species.

It was found that high rates of bensulide, DCPA and possibly Turbutol would be effective to control crabgrass throughout the summer germination period in California.

Researchers in Hawaii report that the organic arsonates used in combination with dicamba or phenoxy herbicides results in excellent removal of established grassy and broadleaved weeds in bermuda and zoysia lawns. Ammonium thiosulfate removed spurge when used as a selective post-emergence spray in turf.

Vegetables

Direct seeded broccoli: The results for two experiments were reported from Salinas, California. Of several chemicals tested, TOK and CP 31393 provided good crop tolerance and effective herbicidal activity on several weed species.

Cantaloupes: Results from Texas showed that soil incorporated benefin provided excellent weed control with no injury to the crop. Combinations of CDEC and bensulide are suggested for continued experimentation.

Carrots: Outstanding control of purslane, Palmer amaranth, redroot pigweed and barnyardgrass were obtained in carrot trials in Texas with trifluralin and linuron. Linuron, TOK and amiben controlled weeds satisfactorily in a carrot trial in Hawaii. Severe carrot injury was experienced in Hawaii when linuron was applied at the 2 lb/A rate as an over-the-plant spray at 3 weeks after sowing.

Lettuce: California reported that the combined use of soil incorporated Benefin with CIPC and/or IPC controlled many important troublesome weed species with acceptable crop tolerance. Soil incorporated Benefin and bensulide found favor in Texas evaluation trials, but weeds were not controlled on a high organic matter soil with the two herbicides in Hawaii.

Onions: Southport white globe onions were relatively tolerant to post-emergence applications of several important herbicides at the flag, 1½ leaf and 2-3 leaf stage in California. The data indicate that the onions were more tolerant in the 1½ leaf stage than in the flag stage. Results from Texas, New Mexico and Hawaii are favorable for the use of DCPA in onion culture. Bensulide looked promising in Texas and New Mexico and CP 31393 was of interest in Texas and Hawaii.

Direct seeded peppers: Bensulide was the most promising herbicide as regards weed control and crop selectivity in New Mexico. Benefin and DCPA resulted in yield reductions; however, they are suggested as candidates for continued experimentation along with trifluralin, Trefmid and diphenamid.

Tomatoes: Benefin, bensulide and diphenamid are suggested for further testing in direct seeded tomatoes in New Mexico. Bensulide and diphenamid were exceptional for weed control in Texas where tomatoes were planted into the soil immediately after preplant, soil-incorporation.

Processing peas, spinach and sweet corn: New herbicide chemistry looks promising for use with canning peas in Washington State. The new herbicides may be competitive with the most inexpensive herbicide in use at present. IPC-norea and CIPC-norea combinations, were effective for weed control with spinach. 1,1-dimethyl-3-[3-(N-*tert*-butyl carbamyloxy)phenyl] urea and CP 50144 appear to be effective mixes with low rates of atrazine for annual grass and broadleaved weed control in sweet corn.

Bioassay results with vegetable crops: Researchers in Texas report that lettuce, sorghum and tomato could not be grown safely in a soil 10 weeks after treatment with 1 lb/A of incorporated trifluralin. Similarly, soil persistence trials with DCPA, diuron, prometryne, trifluralin and linuron in a furrow-irrigated soil showed that the herbicides persisted up to 7 months.

Weed control in desert-grown cardinal grapes. Lange, A. H. and D. Rosedale. Simazine and diuron are restricted from use in the desert soils of California because of a poor margin of safety in low organic matter sandy soils.

Two trials were conducted in a sandy soil (0.4% OM, 87% sand, 9% silt, 4% clay) at Borego Springs, California. The first trial in mature Cardinal grapes (1964) showed good control of sandbur and puncturevine at 2 lb/A of trifluralin (incorporated). Varying degrees of control were obtained from several other herbicides (Table 1).

The second year test (1965) herbicides were applied pre-plant and incorporated to a depth of 3-5 inches at an adjacent location to the earlier trial. Uprooted cardinal cuttings were planted (18") in nursery rows into the treated plots. These were irrigated with a broad furrow. The results of the second year again pointed to trifluralin as giving the best control of puncturevine and grasses (Table 2). However, the 4 lb/A resulted in excessive damage. The 1 lb/A rate of trifluralin gave satisfactory weed control and very little injury to young vines. Simazine was weak on weeds but did not give the expected injury up to 4 lb/A. Several of the herbicides gave very little indication of injury when compared with the untreated check including DP-733 which has produced severe injury at other locations in California. (Agricultural Extension Service, University of California.)

Table 1. Weed control of several herbicides in a mature bearing Cardinal desert grape vineyard, Borego Springs, California (Spray application Feb. 27, 1964).

		Percent weed control[1]			
		2 months			6 months
Treatment	lbs/A	Sandbur	Puncture vine	All weeds	All weeds
Simazine	½	42	68	48	60
Simazine	1	68	62	57	92
Simazine	2	80	55	62	97
DCPA	8	62	88	65	45

Table 1. (Continued)

Treatment	lbs/A	Percent weed control[1] 2 months Sandbur	Puncture vine	All weeds	6 months All weeds
DCPA	16	85	98	70	70
Diphenamid	4	77	50	45	50
Diphenamid	8	62	50	50	82
Trifluralin	1	80	85	58	27
Trifluralin	2	98	100	95	75
Bensulide	4	75	10	40	62
Bensulide	8	87	32	50	92
Check	0	10	62	18	50

[1]Each value an average of 4 single vine replications per treatment.

Table 2. Weed control and phytotoxicity from several herbicides applied preplant to Cardinal cuttings in a dormant grape nursery, Borego Springs, California (Spray applied Jan. 8, 1965).

		Percent Weed Control[1]							No.[1] commer-
		All		Puncture	All	All	Crop		cial
		weeds	Grasses	vine	weeds	weeds	phytotoxicity[1,2]		plants/
Treatment	lbs/A	3 mos.	5 mos.	5 mos.	5 mos.	10 mos.	5 mos.	10 mos.	plot
Simazine	1	55	15	3	9	30	0	3.0	10.5
Simazine	2	62	0	0	0	48	0	7.0	3.0
Simazine	4	72	35	27	30	43	1.5	3.8	7.5
Trifluralin	1	82	90	75	82	68	2.8	4.5	6.0
Trifluralin	4	95	95	97	96	92	4.5	7.3	2.5
Bensulide	4	82	30	0	15	52	1.0	7.0	9.5
Bensulide	16	67	32	0	16	45	1.0	4.8	6.2
Diphenamid	4	57	0	0	0	42	0	2.8	4.5
Diphenamid	16	72	21	10	16	40	0	4.0	5.5
DCPA	8	75	30	0	15	40	1.0	4.8	7.0
DCPA	16	78	21	18	20	25	1.8	6.8	3.7
DP 733	4	65	10	0	5	35	0.8	6.0	5.5
Check	0	57	18	0	9	12	1.5	7.3	4.0

[1]Each value an average of 4 replications
[2]Phytotoxicity rating: 0 = no crop injury, 10 = dead.

<u>The effect of several pre-emergence herbicides on bartlett pear liners.</u> Lange, A. H., C. L. Elmore, and J. J. Smith. Newly planted, furrow-irrigated, Bartlett pear liners growing in a sandy, loam soil (organic matter

5.6%, sand 22.8%, silt 60.4%, clay 14.2%) were treated during the dormant season. Diuron showed the most safety at the herbicidal rates (see table). Simazine showed some symptoms but not enough damage was present to effect diameter. Isocil, DP-733 and Terbacil all produced considerable toxicity symptoms, however, only isocil and Terbacil reduced growth. Diphenamid produced some symptoms but did not reduce growth. DCPA and GS-14260 showed no apparent toxicity. Other triazines: GS-13259, GS-14259, GS-14254 produced more injury than simazine. Trifluralin, Planavin, Sindone and dichlobenil showed no apparent injury, however, none of the herbicides were incorporated in this test. (Agricultural Extension Service, University of California.)

The effect of several soil-applied, pre-emergence type herbicides on the foliar condition and growth of young Bartlett pear liners (Applied Feb. 26, 1965).

Herbicide	lb/A	Phytotoxicity[1] 3 mos.	Phytotoxicity[1] 4 mos.	Diameter[1] 6½ mos.
Diuron	1	0	0	14.6 mm
Diuron	4	0	0	13.0
Simazine	1	0.3	0	15.0
Simazine	4	1.6	2.8	14.2
Isocil	1	4.0	5.8	10.4
Isocil	4	7.3	8.8	5.8
DP 733	1	0.6	0	14.4
DP 733	4	3.3	4.8	13.4
Terbacil	1	0.8	1.5	13.6
Terbacil	4	4.0	5.5	11.4
Trifluralin	1	0	0	14.4
Trifluralin	4	0	0.8	13.8
Diphenamid	4	0	0.8	13.8
Diphenamid	16	0.6	2.0	14.9
DCPA	8	0	0	16.3
DCPA	32	0	0	14.4
GS 14260	1	0	0	14.6
GS 14260	4	0	0	15.6
GS 13529	4	2.6	3.8	12.2
GS 14259	4	0.6	3.0	13.4
GS 14254	4	2.0	6.2	10.5
Planavin	4	0	0.2	13.4
Sindone	4	0	0	15.6
Dichlobenil	4	0	0.5	15.0
Check	0	0	0	13.8
Hoed check	0	0	0	13.7

[1]Average of 4 replications growing under good growing conditions.

The relative phytotoxicity of several herbicides to pear seedlings. Lange, A. H., J. C. Crane and C. L. Elmore. A greenhouse study of several herbicides applied to the roots of young Bartlett and Winter Nelis pear seedlings was conducted in the spring of 1965 at Davis, California. The seedlings were grown in 46 oz. cans of nutrient-fed washed river sand. The pre-emergence herbicides were applied as a soil drench once on July 15, 1965. The post-emergence herbicides were applied in a similar manner at weekly intervals for the duration of the experiment. A phytotoxicity rating was made on August 12, 1965.

The results indicated no great varietal difference in susceptibility of pears to herbicides. Winter Nelis may have been slightly more susceptible to simazine and diuron than Bartlett. Bartlett may have been slightly more susceptible to the uracils than Winter Nelis. The uracils were generally more toxic to pears than simazine or diuron. DP-733 was least phytotoxic of the uracils. Most of the triazines appeared to be as injurious as simazine, if not more phytotoxic.

Trifluralin and related herbicides were essentially non-phytotoxic.

Of the post-emergence herbicides, amitrole produced the most symptoms when applied to the root systems. The herbicide showing the least effect was MSMA. Dalapon showed some slight effects, whereas 2,4-D seemed more damaging on Bartlett than Winter Nelis pear although neither were greatly injured even at 16 ppm. (Agricultural Extension Service and Agricultural Experiment Station, University of California.)

Table 1. The effect of 12 pre-emergence herbicides applied to the roots of young pear seedlings growing in nutrient-fed washed river sand as measured by 0-10 phytotoxicity rating at one month after treatment.

		Phytotoxicity Rating[1]					
		Bartlett			Winter Nelis		
Herbicide	ppm at	Low	Medium	High	Low	Medium	High
Simazine	1,2,4	0	0	0	1.6	1.4	1.4
Diuron	1,2,4	0	0	0.8	1.0	1.8	1.4
Linuron	1,2,4	1.4	1.4	0.6	0.8	0.8	1.4
Isocil	1,2,4	0.6	1.4	2.6	1.8	2.0	1.6
Terbacil	1,2,4	0.4	2.6	2.6	1.8	0.8	0.6
DP-733	1,2,4	1.4	1.0	0.8	1.8	0.6	2.0
GS-14259	1,2,4	1.4	0.4	2.8	1.4	1.4	2.0
GS-14260	1,2,4	2.0	1.8	1.4	1.4	2.0	1.6
GS-13529	1,2,4	0	1.4	1.6	0.4	0	0.4
Planavin	1,2,4	0.4	0.6	1.0	0.6	0.8	0.8
Trifluralin	4,8,16	0	0	0	0	0	0
Benefin	4,8,16	0	0	0	0	0.6	1.0
Check	0	0	0	0	0	0	0

[1] Average of 4 replications per treatment. Rating: 0 = no effect, 5 = severe chlorosis with marginal leaf burn, and 10 = all foliage burned and dead.

Table 2. The effect of four post-emergence herbicides applied to the roots of young pear seedlings growing in nutrient-fed washed river sand as measured by 0-10 phytotoxicity rating at one month after treatment.

		Phytotoxicity Rating[1]					
		Bartlett			Winter Nelis		
Herbicide	ppm at	Low	Medium	High	Low	Medium	High
2,4-D	4,8,16	1.0	0.6	1.0	0	0	1.4
Dalapon	16,32,64	0	0.4	0.4	0	1.8	0.4
Amitrole	8,16,32	1.0	1.0	1.8	1.0	1.4	1.8
MSMA	16,32,64	0	0	0	0	0	0
Check	0	0	0	0	0	0	0

[1]Average of 4 replications per treatment. Rating: 0 = no effect, 5 = severe chlorosis with marginal leaf burn, and 10 = all foliage burned and dead.

Post-Emergence Herbicides on Young Nursery Trees. Lange, A. H., C. Elmore, V. Carlson, L. Hendricks, D. Chaney and J. Smith. Young pear and apple liners and plum cuttings were summer sprayed (4-6" of base only) with a number of herbicides at standard rates and four times these rates. Some injury was apparent from most of the treatments on weak pear liners in the Merced tests (soil organic matter 3.0%, sand 23%, silt 56%, clay 21%). Most damaging was 2,4-D amine and least damaging were dinitro and dalapon (Table 1).

Apple liners at Merced were also weak but larger and more vigorous than the pear liners. The apple liners consequently showed somewhat less injury although indications of injury were observed at high rates of amitrole and 2,4-D amine.

The pear liners at the Sutter locations (soil organic matter 3.2%, sand 28.4%, silt 63%, clay 8.6%) were larger and vigorously growing when sprayed, consequently the only indication of injury was from 2,4-D amine at 4 lb/A (Table 2).

The plum cuttings were vigorous but had considerably less bark than the pear liners, having only current seasons growth. Because of this green tissue, more injury resulted from the herbicide treatments. Although most herbicides caused considerable burn and set back when rated at one month after treatment, many plots recovered by fall. Most injury occurred from high rates of MSMA, Paraquat and cacodylic acid. (Agricultural Extension Service, University of California.)

Table 1. The effect of several post-emergence herbicides on first year apple liners and Bartlett pear liners direct-sprayed at 100 gal/A to include about 5-6 inches of the trunk base. (Merced-Nur 28 sprayed on 7/7/65)

		Phytotoxicity[1,2]					Marketable Trees[1,3]	
		Apple			Pear		Apple	Pear
Herbicide	lb/A	1 mo	2 mo	4 mo	1 mo	4 mo	%	%
Dinitro[a]	2	0	0	0.5	0	0.5	57	74
Dinitro[a]	8	0	0.2	0	0.8	0.2	32	79
PCP[a]	2	0	0	0	1.3	1.7	52	47
PCP[a]	8	0	0.2	0	2.0	2.7	63	47
Paraquat[b]	½	0	0.2	0.3	3.8	2.3	43	29
Paraquat[b]	2	0	0	0	2.8	1.7	42	60
Amitrole[b]	½	0	0	0	1.0	3.5	46	29
Amitrole[b]	2	1.0	0	1.0	2.3	1.7	16	52
2,4-D amine[b]	1	0	0	0	2.0	4.7	30	0
2,4-D amine[b]	4	0.2	0	2.3	3.5	5.5	15	6
Dalapon[b]	4	0	0.2	0	1.5	2.2	50	65
Dalapon[b]	16	0	0	0.2	0.5	3.0	48	59
MSMA[b]	4	0	0.5	0	0.8	2.7	57	31
MSMA[b]	16	0.5	0	0.8	2.8	3.7	32	11
Check		0	0	0	0	0	52	72

[1]Each value an average of 4 replications.
[2]Phytotoxicity rating used was 0-10 where 0 = no effect, 5 = severe chlorosis, stunting and marginal burn, 10 = all plants dead.
[3]From number of marketable trees per plot.
[a] = plus 2 lb/100 gal. Osamul 95 plus Volck oil supreme at 1 gal/100 gal.
[b] = plus X-77 at 0.2%.

Table 2. The effect of several post-emergence herbicides on one year old Bartlett pear liners and six month old Marianna 2624 plum cuttings as measured by foliar condition and tree diameter (herbicide applied 6/9/65-Sutter-Nur-10 & 11).

		Pear liners[1]		Plum cuttings[1]	
Herbicide	lb/A	Phytotoxicity[2] 1 mo	Diameter[3] 9/14/65	Phytotoxicity[2] 1 mo	Diameter[3] 9/14/65
DNBP	2	-	-	1.0	8.4
DNBP	8	0	14.6	1.8	8.5
PCP	2	-	-	2.0	9.2
PCP	8	-	-	3.8	8.6
Paraquat	½	0.5	14.0	2.2	8.1
Paraquat	2	0.2	14.2	5.5	7.6
Amitrole	½	-	-	2.2	9.0
Amitrole	2	0	14.3	4.0	6.9
2,4-D amine	1	0.5	14.6	0.5	8.7
2,4-D amine	4	1.2	12.1	3.5	7.1
Dalapon	4	0	15.8	2.0	8.1
Dalapon	16	0	15.1	3.5	7.4
MSMA	4	1.2	15.8	3.2	6.6
MSMA	16	0	15.1	5.8	7.5
Cacodylic Acid	4	-	-	2.0	8.3
Cacodylic Acid	16	-	-	4.2	8.3
Check	0	1.2	14.1	0	8.5
Hoed check	0	-	-	0.5	8.4

[1]Each value an average of 4 replications.
[2]Phytotoxicity ratings 0-10 where 0 = no effect, 5 = severe chlorosis, stunting and marginal burn, 10 = all plants dead.
[3]Diameter at 10 cm from ground level measured in mm.

The effect of continuous annual application of simazine, atrazine and diuron on young pear and apple trees. Lange, A. H. and K. O. Roberts. Annual repeated application of 4 lb/A of simazine and diuron produced no detrimental effects to young Bartlett pears and Gravenstein apples. Atrazine reduced the growth of apples, but not pears. (Agricultural Extension Service, University of California.)

The effect of annual applications of simazine, atrazine and diuron on young Bartlett Pears growing in Yolo clay loam and Gravenstein on standard apple rootstock growing in Goldridge fine sandy loam. (Sonoma)

		Bartlett Pears				Gravenstein Apples			
		Circumference, inches[1]							
Treatment[2]	lb/A	1961	1962	1963	Increase	1961	1962	1963	Increase
Simazine	4	5.1	8.0	13.6	8.5	5.6	6.5	10.0	4.4
Atrazine	4	5.4	8.8	13.7	8.3	7.3	8.0	10.1	2.8
Diuron	4	5.2	7.7	13.5	8.3	6.2	8.2	9.9	3.7
Check[3]	0	5.6	7.8	10.1	5.5	5.7	6.9	8.7	3.0

[1]Each value an average of 3 replications.
[2]All treatments received 2 lb/A amitrole with each years treatments.
[3]Check trees were hoed periodically.

The effect of high rates of pre-emergence herbicides on young trees. Lange, A. H., J. C. Crane and C. L. Elmore. Five pre-emergence type herbicides at two rates each were applied (2/8/65) to nine dormant one-year-old rootstocks which had been headed back to about one foot. The soil type was a Yolo clay loam previously shown to readily inactivate low rates of herbicides (organic matter 5.8%, sand 24%, silt 64%, clay 24%). The weed control and phytotoxicity observations were made periodically through the summer. On September 15, 1965 the trees were cut off at ground level and weighed.

The results showed large differences in the susceptibility of several rootstocks to different herbicides (Table 1). Lovell peach was particularly resistant to the new uracil herbicides as was previously shown in greenhouse and field studies. Pear, walnut and cherry rootstocks were susceptible, plums were intermediate. Of the uracils, isocil and DP-733 were least damaging on plum and bromacil was most damaging.

Simazine produced mild symptoms at the high rate of 16 lb/A (Table 1) and only small reductions in fresh weight of tops in the plums and Winter Nelis. Diuron caused essentially no symptoms and no loss in fresh weight. Symptoms from DP-733 were prevalent in the Black Walnut, pears and plums, but appeared to cause reduction in fresh weight with most varieties except peach.

Black walnut and cherry appeared to be the most sensitive to Terbacil as well as isocil. Pears were also sensitive to isocil. However, peaches appeared to be tolerant to isocil as seen in other greenhouse and field studies. (Agricultural Extension Service and Agricultural Experiment Station, University of California.)

Table 1. The effect of high rates of dormant applied pre-emergence herbicides on the foliar conditions of 10 rootstocks as expressed by a 0-10 phytotoxicity rating (Applied 2/8/65, evaluated 7/15/65)

		Phytotoxicity Ratings[1]								
Herbicide	lb/A	Lovell Peach	Marianna Plum-A	Marianna Plum-B	Winter Nellis	Bartlett	Bing Cherry	Mahalab	Mazzard	Black Walnut
Simazine	4	0	0	0	0	.66	0	0	0	0
Simazine	16	.50	2.0	1.6	.50	1.33	1.3	3.3	2.1	.16
Diuron	4	0	0	0	0	0	0	0	0	0
Diuron	16	0	.50	0	0	0	0	0	0	0
DP-733	4	0	0	0	.33	0	0	.66	.16	.83
DP-733	16	0	4.5	3.6	2.3	2.8	.50	.50	2.0	3.0
Bromacil	4	0	0	0	2.0	1.8	.83	1.5	.83	2.8
Bromacil	16	0	3.1	5.1	7.0	6.1	7.5	4.6	8.6	9.8
Terbacil	4	0	0	0	.66	3.6	0	.83	0	.33
Terbacil	16	.16	4.3	2.6	3.5	3.5	5.1	5.1	4.8	6.1
Isocil	4	0	.33	0	2.5	2.6	0	0	0	5.5
Isocil	16	0	3.6	3.5	7.3	6.6	8.1	3.3	6.5	10.0
Check		0	0	0	0	.33	0	0	0	0

[1] Average 6 replication, phytotoxicity rating where 0 = no effect, 5 = severe chlorosis, 10 = all foliage dead.

Table 2. The effect of high rates of dormant applied pre-emergence herbicides on the fresh top weight one year after application (Applied 2/8/65, harvested 9/15/65)

		Average fresh weight of tops[1]							Weed[2]
Herbicide	lb/A	Lovell Peach	Marianna Plum-A	Marianna Plum-B	Bing Cherry	Mazzard	Winter Nelis Pear	Bartlett Pear	Black Walnut	Control @ 10 mo.
										Percent
Simazine	4	8.6	9.5	8.0	1.5	2.2	1.4	2.0	2.7	22
Simazine	16	7.7	7.5	7.8	1.6	2.2	0.9	2.2	2.2	73
Diuron	4	9.2	7.1	8.6	2.2	2.2	1.2	1.5	3.6	38
Diuron	16	10.2	8.4	7.6	2.5	2.0	1.3	1.5	3.7	80
DP-733	4	7.3	6.9	7.0	2.1	2.4	1.5	1.9	4.3	44
DP-733	16	10.2	9.5	5.9	1.7	1.0	1.0	1.3	1.8	73
Bromacil	4	8.0	9.0	9.7	2.1	1.2	0.8	1.9	1.7	40
Bromacil	16	11.0	4.9	5.8	0.3	0.4	0.8	2.2	1.3	68

Table 2. (Continued)

Herbicide	lb/A	Average fresh weight of tops[1] Lovell Peach	Marianna Plum-A	Marianna Plum-B	Bing Cherry	Mazzard	Winter Nelis Pear	Bartlett Pear	Black Walnut	Weed[2] Control @ 10 mo. Percent
Terbacil	4	8.2	9.1	7.8	2.7	2.2	1.2	1.9	3.6	57
Terbacil	16	8.0	4.0	8.0	0.2	1.3	0.6	1.6	0.5	73
Isocil	4	8.1	7.6	7.1	2.0	1.8	0.7	1.7	1.1	53
Isocil	16	12.9	7.2	6.4	0.1	0.7	0.3	0.4	1.2	77
Check	0	6.4	7.2	7.2	2.0	1.9	1.3	1.8	1.2	7

[1]Average of 6 replications in pounds per tree.

[2]Weeds: Poa annua, shepherds purse, common groundsel, wild lettuce, cheeseweed, filaree, chickweed.

The effect of several pre- and post-emergence herbicides on the foliar condition of young deciduous fruit species at two locations. Lange, A. H., C. Elmore, J. Crane and B. Fischer. The effect of dormant season applications of pre-emergence herbicides on the growth of young orchard trees was influenced by locations.

The Kearney field station trial was conducted in a slight sandy soil, low in organic matter (organic matter 0.6%, sand 67%, silt 24%, clay 9%). Here, the pre-emergence herbicides were phytotoxic at 1 lb/A on most species and excessively phytotoxic at the 4 lb/A rate (Table 1). Of this group, diuron probably showed least injury with the exception that ioscil was consistently less phytotoxic on peaches. Isocil was extremely phytotoxic on walnuts, pear and cherry. Bromacil was as phytotoxic as isocil if not more injurious on peach and most other fruit species.

The post-emergence herbicides showed some symptoms but generally were not phytotoxic when applied during the dormant season. Safest of the group was paraquat. Picloram and dicamba were, by far, the most phytotoxic herbicides with 1 lb/A of picloram killing all species except walnut which showed some resistance to both picloram and dicamba.

Less injury was recorded at the Davis location (organic matter 5.8%, sand 24%, silt 64%, clay 12%) than at the Kearney trial (Table 2). Dicamba was the most toxic at the Davis location. Isocil showed some symptoms on walnut and cherry and bromacil showed symptoms on pear and cherry. No injury was found with simazine and diuron at the Davis location. (Agricultural Extension Service and Agricultural Experiment Station, University of California, Davis, California.)

Table 1. Relative phytotoxicity of several soil applied pre- and post-emergence herbicides sprayed during the dormant season on the foliar condition of 8 young deciduous orchard varieties. Fresno-Kearney Station.

		Phytotoxicity Ratings[1]										
Herbicide	lb/A	Seedling Peach	Grafted Peach	Marianna 2624 Plum	Santa Rosa on Mar. 2624	Bing Cherry	Mahaleb Cherry	Black Walnut	Bartlett Pear	Blenheim on Apricot	Total	Average
Simazine	1	4.0	2.1	4.8	3.8	7.0	7.6	3.8	1.8	9.6	44.5	4.9
Simazine	4	7.8	8.3	7.6	8.3	8.6	9.8	5.8	8.6	10.0	74.8	8.3
Diuron	1	3.0	3.2	0.8	1.5	9.8	5.6	1.5	1.6	9.8	36.8	4.0
Diuron	4	7.0	5.1	6.0	5.5	7.1	7.6	7.0	5.1	9.8	60.2	6.6
Prometryne	1	5.0	6.4	1.8	3.8	9.1	8.6	3.3	5.1	10.0	53.1	5.9
Prometryne	4	7.1	6.1	1.3	3.5	10.0	7.8	1.8	6.3	9.3	53.2	5.9
Bromacil	1	3.8	3.6	2.8	3.0	10.0	10.0	8.6	9.8	9.8	61.4	6.8
Bromacil	4	5.5	6.5	6.8	9.0	10.0	8.6	9.8	10.0	10.0	76.2	8.4
Dalapon	4	2.0	0.1	1.1	2.5	7.0	4.8	4.8	2.0	8.5	32.8	3.6
Dalapon	16	1.3	3.0	0.0	0.0	6.6	2.1	2.3	0.8	6.8	22.9	2.5
ATA	1	5.0	1.6	1.1	1.5	10.0	4.0	4.1	4.6	8.3	40.2	4.4
ATA	4	3.6	1.1	1.6	1.5	8.0	4.0	3.5	2.1	8.6	34.0	3.7
Paraquat	1	0.6	2.5	0.0	1.6	6.8	3.0	4.1	3.3	8.3	30.2	3.3
Paraquat	4	0.5	2.6	2.3	2.5	8.3	3.3	8.1	3.1	8.3	39.0	4.3
2,4-D	1	4.1	2.1	0.0	2.8	6.0	4.0	3.6	3.3	6.5	32.4	3.6
2,4-D	4	7.0	3.3	2.0	4.6	6.0	3.3	6.1	2.3	8.3	42.9	4.7
Isocil	1	0.3	1.6	0.6	0.0	10.0	10.0	9.3	7.1	9.1	48.0	5.3
Isocil	4	3.4	2.3	4.0	3.1	9.6	10.0	9.6	9.8	8.1	59.9	6.6
Dicamba	1	6.6	6.6	6.6	6.6	8.6	8.3	4.0	8.3	8.3	63.9	7.1
Dicamba	4	10.0	10.0	10.0	10.0	10.0	10.0	3.5	10.0	10.0	83.5	9.2
Picloram	1	10.0	10.0	10.0	10.0	10.0	10.0	5.1	10.0	10.0	85.1	9.4
Check		2.6	1.1	0.0	1.5	9.3	4.6	6.0	4.3	8.3	37.7	4.1

[1] Average rating of 6 replications where 0 = no effect and 10 = complete kill.

Table 2. Relative phytotoxicity of several soil applied pre- and post-emergence herbicides sprayed during the dormant season on the foliar condition of 8 young deciduous orchard varieties and rootstocks at University of California, Davis

Herbicide	lb/A	Phytotoxicity Ratings[1] Lovell Peach	Winter Nelis	Bartlett	Black Walnut	Bing Cherry	Mahaleb Cherry	Mazzard Cherry	Marianna Plum
Simazine	1	1.0	0	0	0	0	0.7	1.3	0.7
Simazine	4	2.3	0	0	0	0	0	0.8	0.3
Diuron	1	1.0	0	0	0	0	0.5	0.5	0.2
Diuron	4	1.3	0.3	0.3	0	0	0	0.5	0.2
Prometryne	1	0	0	0.2	0	0	0	1.0	0
Prometryne	4	1.3	0.5	0.2	0.5	1.5	0	1.0	0.3
Bromacil	1	0	0	0.5	0	0.3	0	0.8	0.2
Bromacil	4	0.7	1.5	0.3	0	0.2	1.8	3.3	1.2
Dalapon	4	1.0	0.2	0.5	0	4.8	1.3	0.8	3.7
Dalapon	16	2.0	0.8	0.2	0	0	0	3.0	4.3
Amitrole	1	0.3	0.3	0.3	0	0	1.7	2.7	0.5
Amitrole	4	0.2	0	0	0.3	1.8	0.2	2.7	0.8
Paraquat	1	0.7	0.3	0	1.3	1.5	0	1.2	0.3
Paraquat	4	1.2	0	0	0	1.2	1.2	2.8	1.3
2,4-D	1	0.3	0	0	0	1.5	1.5	1.7	0
2,4-D	4	0.5	0.7	0.5	0.5	0	0.8	0	0.5
Isocil	1	0.3	1.0	0.3	0.5	0.8	0	0.8	0.3
Isocil	4	0.7	0.7	0.7	1.3	2.2	1.3	3.0	1.5
Dicamba	4	8.1	7.2	6.3	2.8	3.8	6.3	9.0	7.2
Check	-	0.3	0.3	0	0.5	1.2	0	2.0	0.3

[1]Average rating of 6 replications where 0 = no effort and 10 = complete kill

<u>The effect of several pre-emergence herbicides on deciduous nursery species.</u> Lange, A. H., C. L. Elmore, V. Carlson and L. Hendricks. Nemaguard peach, Mahaleb cherry, Black Walnut seed, pear and apple liners were treated during the dormant season with six herbicides in a loam soil (sand 23%, silt 56%, clay 21%, organic matter 3.0%).

Diuron was generally less toxic on all species than simazine although the differences were not great. Cherry appeared less susceptible to simazine than diuron. Although symptoms were more apparent in simazine-treated peach seedlings, there were more commercial trees in the 4 lb/A simazine plots than the 4 lb/A diuron plots.

Isocil was less toxic on peach but more toxic on all other species; pear liners were particularly sensitive. DP-733 was less toxic than isocil on all species except peach and walnut. DP-733 was safer than simazine and about the same as diuron on peaches. Terbacil was generally more toxic than isocil or DP-733. Terbacil was safer on apple and pear than isocil but more toxic than simazine or diuron.

GS-14260 was more toxic than simazine on peaches and possibly pears, but less toxic on most other species. It was particularly safe on cherries. (Agricultural Extension Service, University of California.)

The effect of several herbicides applied postplant to nemaguard peach seeds, black walnut seeds, mahaleb cherry, marianna plum cuttings, bartlett pear & apple liners and pre-emergence to the weeds, spring 1965

		Phytotoxicity[1,2]					Number of Commercial Trees Per Acre[1,3]				
		Peach	Cherry	Walnut	Pear	Apple					
Herbicide	lb/A	3 Mo's	3 Mo's	3 Mo's	3 Mo's	3 Mo's	Peach	Cherry	Waln.	Pear	Apple
Diuron	2	0	0	0	0	2.7	7260	6715	5808	5445	5808
Diuron	4	0.7	1.7	0	1.2	3.0	4900	2722	6715	3267	5808
Diuron	8	3.0	2.0	0.3	6.5	4.2	2178	2722	6715	907	5802
Simazine	1	0.2	0.7	0	1.7	1.7	7260	6350	8167	2722	9982
Simazine	4	2.7	0.5	2.3	4.0	3.7	8530	5808	2178	1815	2722
Isocil	1	0.2	3.2	4.5	7.7	3.2	9982	907	0	0	6352
Isocil	4	0.2	3.2	4.3	7.2	6.7	8167	1270	907	0	1452
DP 733	1	0	0	0	2.2	0	7623	11797	8530	2178	7260
DP 733	4	1.0	2.5	5.8	6.7	4.7	6715	3085	0	0	6715
Terbacil	1	0.5	2.7	2.8	2.0	2.7	8530	1270	4537	2722	9982
Terbacil	4	1.0	2.2	7.0	7.0	4.5	7623	2722	0	363	3993
GS 14260	1	2.0	0	0	0	0	5445	11797	9075	3993	10890
GS 14260	4	4.5	0	0	3.7	1.2	907	11253	6352	1452	9075
Check	0	0.2	0	0	0	0	11253	5445	8167	3993	9982

[1]Average of 4 replications 1 row x 6'
[2]Phytotoxicity rating (0-10) where 0 = no effect, 5 = severe chlorosis and marginal burn, 10 = all plants dead.
[3]No. of commercial trees = average no. of trees larger than 10 mm in diameter.

Pre-emergence herbicides for weed control in seedling peaches and plum cuttings (1965). Lange, A. H., C. Elmore, D. Chaney, J. Smith and L. Buschmann. Herbicides at standard rates and four times the standard rate were applied preplant, incorporated (3-4") and post-plant pre-emergence and planted with peach seeds and plum cuttings. The soils at the two locations were loams (Sutter-organic matter 5.6%, sand 22.8%, silt 60.4%, clay 14.2%; Merced-organic matter 3.2%, sand 28.4%, silt 63%, clay 8.6%).

Diuron was generally safer than simazine at both locations (Tables 1 and 2), but the margin of safety appeared to be one of physical placement since when incorporated, both herbicides were quite toxic to the young peach roots as the seed germinated in treated soil. When the herbicide moved downward with water from the soil surface, i.e., pre-emergence surface application, the plums showed considerably greater sensitivity to both simazine and diuron (Table 2).

Isocil was as safe on peaches, if not safer, than either diuron or simazine whether incorporated or not. Isocil was somewhat more toxic than simazine or diuron on Marianna 2624 plum cuttings.

DP-733 was slightly more toxic in field studies than isocil on peaches, but considerably more toxic on plum, when incorporated. DP-733 was less toxic when applied pre-emergence without incorporation. Terbacil was slightly more toxic than DP-733.

GS-14260, a triazine, was less toxic than simazine on peaches. Applied pre-emergence, GS-14260 and ametryne appeared to be more toxic than simazine on plums.

Trifluralin incorporated at 4 lb/A was consistently toxic to peaches but markedly less toxic on plums. Trifluralin showed very little toxicity when applied to the soil surface and left unincorporated (Tables 1 & 2) but it is also generally herbicidally ineffective when used this way in California.

EPTC likewise showed considerable toxicity to peaches at the 4X level (16 lb/A) and markedly less plum injury (Table 2).

Diphenamid was also more toxic to peaches than it was to plum. It was more toxic than simazine when incorporated and on the basis of selectivity, diphenamid was even less selective when applied pre-emergence.

Dichlobenil, when incorporated, like the other volatile herbicides was more toxic to germinating peach seed than when left on the surface. When incorporated, it was less toxic to plum than peach, but when left on the surface it was more toxic to plum than peach (Table 2).

DCPA was consistently the safest material in these tests. However, performance on winter weed species has generally been lacking in soils with more than 3-6% organic matter.

Even though the herbicides in these tests produced more toxicity when incorporated, there were more commercial peach and plum trees where the plots had received the extra tilling from herbicide incorporation than where the beds were left undisturbed before planting at the Merced location (Table 2).

There appeared to be a general pattern for herbicides to be less toxic to germinating peach seeds when the herbicide was applied pre-emergence than when incorporated; on the contrary the herbicides were less toxic to plum, incorporated, than when applied pre-emergence. Peaches were planted into the

Table 1. The effect of several herbicides applied preplant incorporated vs. postplant unincorporated on growth of lovell peach seedlings as measured by foliar condition, plant vigor, stand and diameter

		Phytotoxicity[1,2]								Stand and Diameter[1,3]			
		Preplant incorporated[4]				no incorporations[5]				Preplant incorporated[4]		Postplant no incorporations[5]	
										Stand	Diameter	Stand	Diameter
Herbacide	lb/A	4/15/65	5/11	6/9	7/14	4/15	5/11	6/9	7/14	9/14	9/14	9/14	9/14
Diuron	1	0	4.0	1.2	1.8	1.5	2.0	3.0	1.5	17.5	10.4	17.2	9.1
Diuron	4	2.5	8.2	8.8	8.8	0.8	0	1.5	1.5	2.5	3.6	18.6	9.1
Simazine	1	0.5	5.2	5.0	3.8	2.0	0	2.0	2.0	11.5	10.0	17.0	8.7
Simazine	4	2.2	9.0	9.9	9.8	1.5	3.0	3.2	2.0	0	0	17.3	8.4
Isocil	1	0	0.8	0.2	0.2	1.0	0	0.2	0.5	19.2	11.2	18.7	9.7
Isocil	4	1.0	5.8	8.0	8.5	0.8	0	2.2	1.0	10.0	4.2	19.2	3.9
DP 733	1	0	2.8	2.8	2.0	1.2	0	0	0.8	21.4	11.1	18.2	9.7
DP 733	4	1.2	8.2	9.2	8.8	2.5	0	2.5	1.2	5.2	1.7	18.3	9.1
Trifluralin	1	0	0.8	0.5	1.0	2.0	0	0.5	1.8	19.8	11.1	19.1	9.2
Trifluralin	4	6.2	3.2	3.8	4.0	0	0	0	0	17.5	11.1	18.9	10.9
DCPA	8	0	1.2	1.0	0.8	2.5	0.5	0.2	1.0	18.5	11.4	19.1	10.2
DCPA	32	1.2	1.5	1.5	1.2	1.0	0	2.0	1.0	17.6	10.4	19.0	9.7
Check	0	0	0.5	0.5	0.8	2.8	1.0	1.0	1.2	18.7	14.8	18.9	9.3
Average										13.70	8.58	18.40	10.11

[1]Average of 4 replications 1 row by 6 feet each.

[2]Phytotoxicity rating where 0 = no effect, 5 = severe chlorosis and marginal burn, 10 = all plants dead.

[3]Stand is no. trees per 6' of plot & diameter is the diameter (mm) measured on 9/14/65 at 10 cm of height on the trunk.

[4]Herbicides sprayed in 100 gal/A water on 11/25/64 and incorporated immediately to 3-4".

[5]Herbicides sprayed in 100 gal/A water on 1/29/65 and furrow irrigated until beds were blackened over.

incorporated herbicides whereas the rooting end of the cutting was generally below the treated soil. (Agricultural Extension Service, University of California).

Table 2. The effect of several pre-emergence herbicides on the foliar condition & growth of nursery S-37 peach seedlings and Marianna 2624 cuttings applied 12/15/65 & 3/23/65

		Incorporated[1]				No Incorporations[1]			
		S-37 Peach Seedlings		Marianna 2624		S-37 Peach Seedling		Marianna 2624	
Herbicide	lb/A	Phyto.[2] @ 6 Mo	No. Com.[3] trees/plot	Phyto. @ 6 Mo	No. Com. trees/plot	Phyto. @ 3 Mo	No. Com. trees/plot	Phyto. @ 3 Mo	No. Com. trees/plot
Diuron	1	1.8	6.0	0	2.5	0.5	4.2	0	1.5
Diuron	4	4.2	4.2	1.0	3.2	4.0	0.7	9.7	0.2
Simazine	1	2.0	5.8	0.7	3.8	2.0	3.0	4.5	0.5
Simazine	4	7.2	2.2	2.3	3.0	2.5	2.7	9.2	0
Isocil	1	1.8	5.8	1.7	3.0	1.5	3.5	4.7	1.7
Isocil	4	3.8	3.0	2.3	1.0	2.0	3.0	3.2	1.2
DP 733	1	2.0	4.8	0	4.2	0.7	5.0	5.2	0.5
DP 733	4	3.8	4.8	3.5	0	0	5.0	8.2	0.5
Terbacil	1	1.0	5.8	1.3	3.0	0	3.5	2.2	1.7
Terbacil	4	4.5	5.2	3.5	0.2	1.2	3.7	3.0	3.5
GS 14260	1	1.0	6.2	1.5	3.5	2.0	2.5	5.0	1.7
GS 14260	4	3.8	5.2	0.2	3.0	4.2	0.5	10.0	0
Ametryne	1	--	--	--	--	0	4.2	3.7	0.7
Ametryne	4	--	--	--	--	8.7	1.5	9.7	0.2
Trifluralin	1	2.5	6.8	1.7	1.8	1.2	3.2	4.0	1.2
Trifluralin	4	9.0	0.5	1.3	1.8	0.2	3.2	3.7	1.7
EPTC	4	0.8	6.5	0	6.0	--	--	--	--
EPTC	16	9.2	0.8	3.7	0.5	--	--	--	--
Diphenamid	4	3.8	4.5	0.2	3.8	3.0	2.5	2.0	1.5
Diphenamid	16	9.2	0.5	3.7	0.5	7.2	0	6.0	1.7
Dichlobenil	4	2.2	5.2	1.0	2.0	2.5[4]	4.2[4]	0.5[4]	2.7[4]
Dichlobenil	16	10.0	0	3.0	1.2	1.0[5]	4.2[5]	5.5[5]	1.5[5]
DCPA	8	2.5	5.5	0	3.2	0.5	3.7	6.7	1.5
DCPA	32	3.2	5.0	0.2	4.2	1.7	2.5	3.0	1.5
Check	0	0.5	6.2	0.2	3.2	0	4.2	1.5	2.2
Hoed check	0	2.5	5.0	0	2.2	0	3.5	0	2.7
Average			4.36		2.53		3.08		1.34

[1] Average of 4 replications. [2] Phytotoxicity rating (0 = no effect, 5 = severe chlorosis or burning, 10 = all plants dead). [3] No. commercial trees at end Sept.; i.e., those trees with greater than 10 cm in diameter. [4] Rate changed to 1#/A. [5] Rate changed to 4#/A.

Relative phytotoxicity of several herbicides to peach, plum and apricot seedlings. Lange, A. H. and C. L. Elmore. Six month old seedlings of Rio Oso Gem and Lovell peach, Myrobalan plum and Royal apricot growing in 46 oz. cans of nutrient-fed washed river sand were treated with 16 herbicides in solution on May 20, 1965. Phytotoxicity ratings were made on May 31, June 9, June 14 and June 25. Only the 10- and 35-day readings were averaged (see table).

Only GS-16040 appeared safer than simazine at 4 ppm. GS-13528 was considerably more toxic than simazine.

Of the Bayer materials, B-50870 was less toxic than simazine whereas B-55962 appeared to be more toxic. B-55967 appeared similar to simazine.

Ramrod, Siduron, and dichlobenil were low in toxicity even at 16 ppm. CP-31675 and Cotoran were not too different than simazine at 4 ppm.

DCPA, Glenbar, trifluralin and Planavin were essentially non-toxic under the conditions of this greenhouse trial. (Agricultural Extension Service, University of California.)

The effect of several pre-emergence herbicides on the foliar condition of four stone fruit seedlings

		Average Phytotoxicity Ratings[1]								Avg
		Rio Oso Peach		Lovell Peach		MyrobalanPlum		Royal Apricot		All
Herbicide	ppm	10-day	35-day	10-day	35-day	10-day	35-day	10-day	35-day	Rtg
Simazine	4	2	4	2	5	0	3	2	5	3.0
GS-14259	1	0	3	0	0	0	0	0	0	0.4
"	4	0	8	0	8	0	1	0	3	2.5
GS-16040	1	0	0	0	0	0	1	0	0	0.1
"	4	0	0	0	3	1	3	0	0	0.9
GS-13528	1	1	7	0	3	0	3	0	8	2.8
"	4	5	9	6	9	0	9	4	10	6.5
B-50870	1	1	1	0	2	0	0	0	0	0.5
"	4	0	2	0	2	0	1	0	0	0.6
B-55962	1	0	3	0	3	0	5	0	4	1.9
"	4	5	9	0	8	2	9	1	10	5.5
B-55967	1	0	1	1	2	1	4	1	3	1.6
"	4	3	3	3	3	2	4	3	5	3.3
Ramrod	4	0	0	0	0	0	0	0	2	0.2
"	16	0	0	0	0	0	0	0	0	0
CP-31675	4	2	4	2	4	0	1	4	2	2.4
"	16	2	7	4	5	1	2	4	5	3.8
Siduron	4	1	3	1	0	1	4	2	4	2.0
"	16	2	2	0	0	0	2	1	0	0.9
Cotoran	4	3	3	3	3	4	6	4	6	4.0
"	16	4	7	3	6	0	8	5	8	5.1
Dichlobenil	4	0	0	2	0	0	2	0	4	1.0
"	16	2	1	1	1	0	2	2	4	1.6
DCPA	4	0	0	0	0	0	0	0	0	0
"	16	0	0	0	0	1	0	1	0	0.2

The effect of several pre-emergence herbicides on the foliar condition of four stone fruit seedlings (Cont'd)

Herbicide	ppm	Rio Oso Peach 10-day	Rio Oso Peach 35-day	Lovell Peach 10-day	Lovell Peach 35-day	Myrobalan Plum 10-day	Myrobalan Plum 35-day	Royal Apricot 10-day	Royal Apricot 35-day	Avg All Rtg
		Average Phytotoxicity Ratings[1]								
Glenbar	4	1	0	0	0	2	2	1	0	0.8
"	16	0	0	0	0	0	3	2	0	0.6
Trifluralin	4	0	2	0	2	0	4	0	0	1.0
"	16	0	2	1	2	0	1	4	4	1.7
Planavin	4	0	0	0	0	0	2	0	0	0.2
"	16	0	0	0	0	0	0	0	0	0
Check	0	0	2	0	1	0	1	0	0	0.5

[1]Phytotoxicity ratings: 0 = no effect, 5 = severe chlorosis with marginal leaf burn and 10 = all foliage burned and dead.

Simazine and diuron for weed control in California deciduous fruit orchards. Lange, A. H., C. L. Elmore, B. B. Fischer, E. K. Stillwell and N. W. Ross. Although simazine and diuron have been successfully used for annual weed control in eastern United States, varying degrees of safety have been observed in California's deciduous fruit industry. A summary of field plot work since 1960 has shown sufficient safety for use of these herbicides in grapes, walnuts, pears and apples. Fruits and nuts of the genus *Prunus* have consistently shown more sensitivity to simazine and diuron in greenhouse, nursery and orchard work.

In the heavier soils of the northern San Joaquin and Sacramento valleys only occasional injury has been observed. In the lighter soils, lower in organic matter, injury has been more frequently shown.

Variations resulting from method of irrigation have been found with flood and sprinkler being generally more conducive to injury than furrow irrigation (see table).

Unknown factors, other than organic matter, clay content and method of irrigation, are also undoubtedly responsible for variation in response of the stone fruits to simazine and diuron.

The only injury noted in walnut trials was on a one-year-old orchard in Butte county and this was only mild simazine symptoms (see table).

Simazine showed slight symptoms on young pear trees in one trial in Sacramento county. No effect on growth was noted. Severe injury from herbicidal rates of both simazine and diuron were recorded in a low organic matter sandy soil in Los Angeles county.

No injury has been recorded on even young established apple trees from herbicidal rates of simazine and diuron in a limited number of trials.

Peaches under flood irrigation produced symptoms from both simazine and diuron in a fairly heavy soil in Sutter county and a light soil in Fresno county.

Almonds growing in light soils under sprinkler or flood irrigation have been quite susceptible to both simazine and diuron. The Mission variety has shown more susceptibility than other almond varieties.

Cherries have shown fair resistance in a limited number of trials.

The Mahaleb rootstock appeared more susceptible than Mazzard root or Mazzard-type tops.

Apricots and plums were markedly more sensitive than other species of prunes. Most of the injury was related to sprinkler or flood irrigation. (Agricultural Extension Service, University of California.)

Phytotoxicity from dormant season soil applications of simazine and diuron at 65 locations including walnut, pear, apple, peach, almond, cherry, apricot and prunes (plums) orchards in the major fruit producing areas of California. Age, soil characteristics, irrigation methods and phytotoxicity are listed.

Location	Crop	Approx. Age[1]	Soil Characteristics[2] O.M.	Sand	Silt	Clay	Type[3] Irrig.	Phytotoxicity[4] Simazine	Diuron
Contra Costa	Walnut	3	5.6	12.0	48.0	40.0	Furrow	-	-
Contra Costa	Walnut	10					Furrow	-	-
Contra Costa	Walnut	9	4.1	33.0	35.0	32.0	Furrow	-	-
Contra Costa	Walnut	18	4.1	50.8	37.6	11.6	None	-	-
San Benito	Walnut		4.0	35.2	48.0	16.8	Sprink.	-	-
Butte	Walnut	1	4.2	50.8	39.6	9.6	Sprink.	+	-
Sutter	Walnut	10	2.9	45.2	34.0	20.8	Sprink.	-	-
Sacramento	Pear	2	7.5	18.8	55.6	25.6	Sprink.	-	-
Sacramento	Pear	2+5	6.6	20.1	53.0	26.9	Sprink.	-	-
Sonoma	Pear	4	6.4	32.4	42.0	25.6	Sprink.	-	-
Lake	Pear	Mat.+2	6.2	33.2	56.0	10.8	Sprink.	-	-
Santa Clara	Pear	6	6.0	20.8	54.8	24.4	Sprink.	-	-
Napa	Pear	2	5.8	41.6	36.8	21.6	Sprink.	-	-
Stanislaus	Pear	1+2	5.5	13.6	48.8	37.6	Furrow	-	-
Contra Costa	Pear	2	5.3	26.0	52.0	22.0	Sprink.	-	-
San Joaquin	Pear	3	5.3	24.0	64.0	12.0	Sprink.	-	-
Lake	Pear	Mat.+2	4.8	47.2	38.0	14.8	Sprink.	-	-
Sacramento	Pear	1	4.4	54.8	37.8	7.4	Flood	-	-
Sacramento	Pear	1	4.4	54.8	37.8	7.4	Flood	+	-
Butte	Pear	4	4.2	50.8	39.6	9.6	Sprink.	-	-
Contra Costa	Pear	3	4.1	19.2	56.2	24.6	Furrow	-	-
Los Angeles	Pear	3	0.6	81.0	12.0	7.0	Sprink.	+	+
Placer	Apple	1	11.0	66.4	26.8	6.8	Sprink.	-	-
Santa Cruz	Apple	1	7.3	72.8	16.8	10.4	Furrow	-	-
San Bernardino	Apple	4	3.5	74.0	18.0	8.0	Sprink.	-	-

Phytotoxicity from dormant season soil applications of simazine and diuron at 65 locations including walnut, pear, apple, peach---(Cont'd)

Location	Crop	Approx. Age[1]	Soil Characteristics[2] O.M.	Sand	Silt	Clay	Type[3] Irrig.	Phytotoxicity[4] Simazine	Diuron
Sutter	Peach	7	4.1	31.2	42.0	26.8	Flood	+	+
Fresno	Peach	5+6	2.4	55.2	31.0	13.8	Furrow	-	-
Fresno	Peach	8	2.0	62.0	29.0	9.0	Flood	-	-
San Joaquin	Peach	3	1.8	61.2	28.0	10.8	Flood	-	-
Stanislaus	Peach	2	1.6	52.4	38.6	9.0	Flood	-	-
Los Angeles	Peach	2	1.6	76.0	16.0	8.0	Sprink.	-	-
Fresno	Peach	20	0.6	67.2	24.0	8.8	Flood	+	+
Fresno	Peach	20	0.6	67.2	24.0	8.8	Furrow	-	-
Butte	Almond	4	6.1	42.0	40.0	18.0	Sprink.	-	-
Contra Costa	Almond	720	5.6	21.6	54.0	24.4	Sprink.	-	-
Contra Costa	Almond	720	3.2	25.4	51.0	23.6	Furrow	-	-
Contra Costa	Almond	720	2.7	81.8	14.6	3.6	Sprink.	-	-
San Joaquin	Almond	7	2.1	81.2	14.0	4.8	Sprink.	-	-
Sutter	Almond	4	2.1	47.2	30.0	22.8	Flood	+	+
Stanislaus	Almond	4	1.6	65.4	27.8	6.8	Sprink.	+	+
Fresno	Almond	5	1.4	54.4	37.6	8.0	Furrow	+	+
Fresno	Almond	10	1.4	54.4	37.6	8.0	Furrow	-	-
Stanislaus	Almond	4	1.3	63.4	29.0	8.0	Flood	+	+
Stanislaus	Almond	3	1.2	80.0	14.0	6.0	Flood	+	+
San Joaquin	Cherry	6	---	----	----	----	Flood	+	+
San Joaquin	Cherry	8	6.6	38.0	50.0	12.0	Flood	-	-
Contra Costa	Cherry	6	5.1	13.6	64.0	22.4	Furrow	-	-
Contra Costa	Cherry	8	5.0	22.6	57.0	20.4	Furrow	-	-
Solano	Apricot	5	7.1	24.0	58.0	18.0	Sprink.	-	-
Contra Costa	Apricot	Mat.	5.6	15.6	61.0	23.4	Furrow	-	-
Merced	Apricot	3	5.1	24.0	66.0	10.0	Sprink.	+	+
Montery	Apricot	5	4.4	32.8	47.8	19.4	Sprink.	+	+
Contra Costa	Apricot	Mat.	4.1	33.0	35.0	32.0	Furrow	-	-
Montery	Apricot	5	2.2	77.8	12.8	9.4	Sprink.	+	+
Contra Costa	Apricot	Mat.	1.8	88.0	7.0	5.0	Sprink.	+	+
Riverside	Apricot	2	1.5	75.0	17.0	8.0	Sprink.	+	+
Colusa	Prune,Plum	4	5.5	19.6	52.8	27.6	Sprink.	-	-
Glenn	Prune,Plum	1	5.3	57.0	36.0	7.0	Furrow	+	+
Sutter	Prune,Plum	8+9	4.5	33.2	42.0	24.8	Flood	+	-
Stanislaus	Prune,Plum	2	4.2	13.6	60.0	26.4	Flood	-	-
Glenn	Prune,Plum	2	3.2	47.6	34.8	17.6	Flood	+	+
Santa Clara	Prune,Plum	8	2.9	60.4	23.6	16.0	Sprink.	+	+
Glenn	Prune,Plum	6	2.8	36.0	34.0	30.0	Basin	-	-
Glenn	Prune,Plum	2	2.7	46.0	34.0	20.0	Flood	+	+
Fresno	Prune,Plum	4	0.8	59.2	32.0	8.8	Furrow	-	-

[1]Age refers to approximate tree age at the initial application. Most locations treated for more than 1 yr.
[2]Soil characteristics - soil samples were analyzed for organic matter by the combustion method. Sand, silt and clay were determined by standard techniques.
[3]Irrigation refers to sprinkler, flood or basin and furrow.
[4]Phytotoxicity was arbitrarily assigned a plus or minus on the basis of foliar symptoms in excess of 2 on a scale of 0-10 where 0 = no effect, 5 = severe chlorosis with marginal burn, 10 = all leaves brown and dead.

Effect of diquat and atrazine on blueberry fruit yield. Peabody, Dwight V., Jr. Again, as in the previous two years, mulched blueberry plants irrespective of herbicide treatment yielded more than non-mulched plants. However, this year atrazine in the non-mulched planting and diquat in the mulched planting had no adverse effect on fruit yield while resulting in excellent control of weeds. Since it is well established that both of these herbicides control a wide range of perennial and annual weed species, it would seem that it is now possible to obtain good weed control under many different environmental (soil) conditions without decreasing fruit yield. A compromise as a general recommendation would be "half-rates" of each chemical for weed control in blueberry plantings, irrespective of soil type and mulching practices. (Northwestern Washington Research & Extension Unit, Washington State University, Mount Vernon.)

Annual weed control in strawberry plantings. Peabody, Dwight V., Jr. 3-((p-(p'-chlorophenoxy)-phenyl))-1,1-dimethylurea and diphenamid combination treatments do not show any synergistic activity on the annual weed species present nor on strawberry plants. As a result, it is indicated by this year's data that the advantage of this combination is a broadening of the weed control spectrum of those species that infest strawberries. In other words, at a marked increase in cost, more different weed species can be controlled by this combination, but it is necessary to use the maximum amounts of each herbicide to gain this control. In general, these results were the same for either fall application on established plantings or spring application on new plantings. Of the 16 newer herbicides evaluated in new strawberry plantings, only lenacil showed promise as a selective herbicide in this crop. (Northwestern Research & Extension Unit, Washington State University, Mount Vernon.)

Annual weed control in ornamental bulbs (bulbous iris, daffodils and tulips). Peabody, Dwight V., Jr. To obtain season-long weed control in ornamental bulbs (especially iris) it is necessary to apply herbicides twice during the growing season: (1) in the fall as a pre-emergence spray and (2) in the early spring post-emergently. The three treatments which consistently resulted in the best annual weed control and yielded the greatest number of large-sized bulbs were: (1) simazine, pre-emergence with a post-emergence CIPC application, (2) linuron, pre-emergence with a post-emergence CIPC application, and (3) DNBP plus CIPC combination, pre-emergence with a post-emergence terbacil application. Each of these treatments contains herbicides which have a history of prolonged residual activity, hence they may persist in the soil for an unknown period of time after bulb harvest. (Northwestern Washington Research & Extension Unit, Washington State University, Mount Vernon.)

Effect of soil applied herbicides in Christmas tree plantations. Elmore, C. L., and W. Lusk. Three trials were established on Pinus radiata Monterey pine trees that had been planted one year. All trials were located on a sandy loam type soil. Applications were made on December 1, 1965 with a Namco pressure sprayer at 25 psi. All treatments were applied on moist soil and not incorporated, however the trials received rain the following day.

The following weed species were consistently controlled in the trials: wild oats, bur clover, prickly lettuce, annual bluegrass, common chickweed, red stemmed filaree, marestail and miner's lettuce. Two weeds present that were not controlled were bracken fern and sheep sorrel. Diphenamid also did not control marestail.

Visual observations were made on percent control. The plants were measured to the tip of the growing candle at the time of treatment and 12 months later. Results are shown in the table.

Selected treatments for weed control in Monterey pine

Herbicide	Rate:lb/A ai	Weed control (%) months 3	6	9	% Height Increase in Inches over Control
Simazine	2.0	88	82	57	57
Simazine	4.0	93	100	87	78
Simazine	8.0	97	97	96	100
Atrazine	2.0	92	88	90	67
Atrazine	8.0	96	99	95	103
Dichlobenil	8.0	96	84	78	57
Dichlobenil	16.0	98	91	88	32
Diphenamid	8.0	89	73	64	50
Diphenamid	16.0	89	73	64	93
Control	0	7	0	0	--

Weed control was commercially acceptable from all treatments for six months. By nine months simazine at 2 pounds and diphenamid at 8 and 16 pounds were less effective than other treatments. There was no apparent damage from the herbicide treatments to any trees.

Excellent growth was made in treated areas over the untreated control where weeds were allowed to compete. From this data it would appear that better growth is achieved when higher rates are used with simazine, atrazine and diphenamid. This does not appear to be true with dichlobenil in these tests. (University of California, Davis and Sonoma County, respectively.)

Effects of Bandane applied at high rates for 3 years to control crabgrass in bluegrass turf. Hepworth, H. M., J. W. May and J. L. Fults. Tests were conducted at Luther Park, Greeley, Colorado to determine the effects of repeated applications of Bandane. A granular formulation of Bandane was applied as follows:

Treatment	1962	1963	1965	Total 3 years
A	30 lb/A	15 lb/A	15 lb/A	60 lb/A
B	30 "	30 "	30 "	90 "
C	40 "	40 "	40 "	120 "
D	40 "	20 "	20 "	80 "
E	0	0	0	0

Observations in August 1965 indicated no visible toxicity to bluegrass. All treated areas were free from crabgrass; controls were heavily infested. In May 1966 bluegrass cover in the treated areas was reduced by 20 per cent for treatment A, 25 per cent for B, 40 per cent for C, and 20 per cent for D. Untreated plots appeared normal. By August 1966 all plots treated with Bandane, at the rates shown, were still showing reduced bluegrass cover as in May but had been invaded by white clover (Trifolium repens L.) and mat spurge (Euphorbia serpyllifolia Pers.). No crabgrass was present in treated plots. Controls were heavily infested by crabgrass. Observations will be continued. (Colorado Agri. Expt. Sta., Fort Collins.)

Pre-emergence control of crabgrass in bluegrass turf during 1965 and 1966. May, J. W., H. M. Hepworth and J. L. Fults. A duplicate series of pre-emergence crabgrass control plots were established in Denver and Greeley, Colorado prior to crabgrass germination in the early spring of 1966. Results from these plots were compared with 1965 data involving basically the same compounds and an evaluation was made based on two years of cumulative results.

Compounds which provided excellent to perfect crabgrass control included turbutol at 10 lb/A ai; Sindone at 10-12 lb/A ai; Planavin at 3 lb/A ai; bensulide at 15 lb/A ai; DCPA at 12 lb/A ai; Bandane at 35 lb/A ai; PAX-regular (lead arsenate and other arsenicals) at 20 lb formulation/1000 sq. ft. and DMPA at 15 lb/A ai.

Siduron at 20 lb/A ai; and benefin at 3 lb/A ai gave good to excellent pre-emergence crabgrass control, but were somewhat less effective than the previous compounds.

The crabgrass population involved in these tests was a mixture of Digitaria sanguinalis (L.) Scop. and D. ischaemum (Schreb.) Muhl. The turf-grass was common Kentucky bluegrass (Poa pratensis L.) and there was no injury to the desired grass with any of the compounds listed at the indicated rates. (Botany and Plant Pathology Section, Colorado Agri. Expt. Sta., Fort Collins.)

Selective removal of bentgrass from bluegrass turf--a progress report. Hepworth, H. M., J. W. May and J. L. Fults. Tests using potassium cyanate (KOCN), high rates of ammonium sulfate and several herbicides for selective removal of bentgrass from bluegrass turf were conducted in 1963, '64, '65 and 1966. Early trials using a concentrated water solution of aqueous ammonia (NH_3OH) appeared promising. Tests under "home owner" conditions in

1965 showed this method to be excessively hazardous to both applicators and nearby plants for practical use. On home lawns in Denver potassium cyanate at 20 lb/1000 sq. ft. applied in a water solution and ammonium sulfate applied in water solution at 100 lb/1000 sq. ft. produced excellent top kill of mixed bentgrass-bluegrass turf. Bentgrass did not recover while bluegrass showed considerable recovery followed by stimulated growth. Reseeding with bluegrass 7 to 14 days following treatment resulted in fair to excellent stands. On July 19, 1966 several herbicides were applied to 75 square foot plots of creeping bentgrass (Agrostis palustris Huds.) at Fort Collins with the following results.

Herbicide	Rate	Results
1. KOCN	20 lb/1000 sq. ft.	99 per cent top kill
2. Ammonium sulfate	100 lb/1000 sq. ft.	99 per cent top kill
3. Cacodylic acid (Erase)	11 lb/1000 sq. ft.	95 per cent top kill some recovery
4. Paraquat	4 lb/A	100 per cent top kill
5. Dicamba	4 lb/A	reduced growth 40 per cent recovered completely
6. Siduron (Tupersan)	20 lb/A	retarded growth slightly
7. Bromacil	¼ lb/A	25 per cent top kill growth retarded
8. Atrazine	½ lb/A	30 per cent top kill growth retarded
9. Silvex	4 lb/A	growth reduced 70 per cent recovered by fall

Thatch was removed from 25 sq. ft. of each plot showing 90 per cent or more top kill and this area seeded to bluegrass on August 2, 14 days after treatment. Excellent stands were obtained.

In early September 1966, at Fort Collins, a homeowners lawn of mixed bentgrass (Agrostis tenuis) and bluegrass was treated to eliminate the bentgrass. Prior to herbicide application the lawn was mowed very short and power raked to remove as much thatch as possible. One half the lawn (2000 sq. ft.) was treated with KOCN at a rate of 20 lb/1000 sq. ft. The other half (2000 sq. ft.) was treated with paraquat at a rate of 4 lb/A. Both treatments were applied as water solutions. After seven days the lawn was again power raked to remove the dead thatch and debris and reseeded to bluegrass. Within 2 weeks seedlings were emerging. By late fall an excellent stand of bluegrass was established. Some bluegrass from the prior stand had reappeared in the area where KOCN was applied. No bentgrass had appeared by late fall in either area. Final evaluation will be made in 1967. This method, using either KOCN or paraquat appears satisfactory for removal of bentgrass and allows quick reestablishment of bluegrass. (Botany and Plant Pathology Section, Colorado Agricultural Experiment Station, Fort Collins, Colorado.)

Summary of 1966 experiments for selective herbicidal control of broad leaf weeds in bluegrass turf. Hepworth, H. M., J. W. May and J. L. Fults. Rather than write up fifteen separate experiments it was decided to compile a summary

Herbicide	Rate Applied	Common dandelion	Clover	Common chickweed	Mousear chickweed	Field Bindweed	Pigweed	Common mallow	Corn speedwell	Prostrate knotweed	Black medic	Broadleaf plantain	Western yarrow	Mat spurge	Pineapple weed	Creeping bellflower
Dicamba	2 lb/A	98	100	100	100	99	--	100	--	100	100	75	99	--	100	100
Dicamba	1½ lb/A	99	100	100	100	--	--	---	--	92	100	---	--	--	---	---
2,4-D + Dicamba [1]	1 + .125 lb/A	98	98	---	---	--	--	---	--	---	---	100	--	--	---	---
2,4-D + Dicamba	.9 + .18 lb/A	99	100	100	100	100	92	90	100	92	100	100	--	87	---	---
2,4-D + 2,4,5T [2]	1 + 1 lb/A	99	100	---	---	--	--	---	--	---	100	100	--	--	---	---
2,4-D + 2,4,5TP [3]	2 + 2 lb/A	50	50	---	---	--	--	---	--	---	---	75	--	--	---	---
2,4-D [4]	2 lb/A	98	88	---	---	--	--	---	--	---	100	99	--	--	---	---
MCPP + 2,4-D [5]	1 + ½ lb/A	85	10	---	---	10	--	---	--	---	---	100	--	--	---	---

[1] Super-D-weedone, [2] Dacamine 2D/2T, [3] Nitroform phenoxy, [4] Dacamine, [5] Mecopar are all registered trade names.

table including all of the pertinent information from the trials. All the herbicides listed were not applied to every species listed. The following species are included in the table: common dandelion (Taraxicum officinale), clover (Trifolium sp.), common chickweed (Stellaria media), mouseear chickweed (Cerastium vulgatum, field bindweed (Convolvulus arvensis), common mallow (Malva neglecta), corn speedwell (Veronica arvensis), prostrate knotweed (Polygonum aviculare), black medic (Medicago lupulina), broadleaf plantain (Plantago major), western yarrow (Achilles lanulosa), mat spurge (Euphorbia serpyllifolia), pineapple weed (Matricaria matricarioides), and creeping bellflower (Campanula rapunculoides).

It is known that some of the species listed may be susceptible to more than one of the chemicals shown; however since those combinations were not in these trials they are not included in this report. Nitroform phenoxy produced a rather desirable fertilizer response but gave a rather slow phytotoxicity to weeds. (Botany and Plant Pathology Section, Colorado Agricultural Experiment Station, Fort Collins.)

Control of crabgrass (Digitaria sanguinalis and D. ischaemum) in turf. Elmore, C. L., B. B. Fischer, N. W. Stice, and L. L. Buschmann. Herbicides for pre-emergence crabgrass control in turf were tested in replicated trials in three locations. Three different turf situations were involved: common Bermudagrass, alta fescue, and a mixed bluegrass turf. The selected sites, Fresno, Yuba City and Sacramento respectively, are all located in the central valleys of California. The liquid and wettable powder formulations were applied in water with a knapsack back-pack sprayer at 30 psi with a 3-nozzle boom. Granular materials were applied with a shaker canister. All plots were 10 feet by 10 feet, in areas of a dense crabgrass population.

The formulations and rates of herbicides are summarized in the table below.

Summary of various herbicides, formulations, and rates on control of crabgrass - 1966

Herbicide	Rate: lb/A ai.	Formulation	4	6**	8-9
			Months	after	application
Azak	10.0	50% wp	92	76	55
Azak	15.0		94	79	56
Azak	20.0		93	89	73
Azak*	10.0	5.7% gran. on 22-4-4 fertilizer	70	40	45
Azak*	20.0		72	53	52
Azak	10.0	8% gran.	47		17
Azak	15.0		80		57
Azak	20.0		83		57
Azak	10.0	6.25% gran. on Am.Nit. sulfate	60	28	25
Azak	20.0		100	93	90

Herbicide	Rate: lb/A ai.	Formulation	4 Months	6** after	8-9 application
Glenbar	5.0	1 lb/gal.	77	41	39
Glenbar	10.0		88	60	50
Glenbar	20.0		85	72	67
Glenbar	10.0	5.7% gran.	73	27	34
Glenbar	20.0		90	60	51
DCPA	5.0	75% wp	80		43
DCPA	10.0		98	70	63
DCPA	20.0		100	90	82
Bensulide	10.0	4 lb/gal	77	77	71
Bensulide	15.0		100		90
Bensulide	20.0		97	87	82
Bensulide	10.0	6.87% gran. on Am. sulfate	90	76	60
Bensulide	20.0		98	92	88
Benefin	1.5	0.86% gran.	63	14	33
Benefin	3.0		75	17	39
Benefin	1.5	2 lb/gal E.C.	43	11	24
Benefin	3.0		60	16	23
Herban***	2.0	80%wp	20		17
Herban***	4.0		10		5
Nitroform-Azak-Herban***	5.0 lb.		60		40
Nitroform-Azak-Herban***	10.0 lb.		95		90
Control	-------		30	7	9

* Averages of each of the evaluations for each herbicide rate and formulation from each of the tests.
** Summary of two locations.
*** One location only.

Azak, bensulide, DCPA and Glenbar showed good control up to four months. All treatments showed less control by six months after application. At low rates six months after application, new crabgrass plants began to appear and by eight to nine months they were present in most treatments. As illustrated from these data, high rates of bensulide, DCPA and possibly Azak would be effective to control crabgrass throughout the extended summer germination period in California. (University of California, Davis, Fresno, Sacramento, and Yuba City, respectively.)

Weed control in established bermuda grass and zoysia lawns in Hawaii. Crozier, J. A. and R. R. Romanowski, Jr. Trials have been conducted over the past 15 months on the island of Kauai to test the effectiveness of herbicides registered for use on turf in the continental United States. Both broadleaf and grassy type herbicides were tested singly and in combination using several rates. Many of the turfs used for the tests were severely overgrown with weeds, but through the application of herbicides (usually in combination) it was possible to restore the turf to a uniform carpet in virtually a weed-free condition.

The major weed species found in the turf test areas were divided into broadleaf and grassy type weeds (see Table 1). The herbicides included in the tests were grouped into four categories: arsonates, phenoxys, dicamba, and ammonium thiosulfate (see Table 2). The arsonates were in general grassy type weed killers and the others were effective mainly on the broadleaved weeds. The most effective overall weed control was achieved by combining one of the products listed under the arsonates with one listed under the phenoxy or dicamba products. Each product was used at the rate recommended by the manufacturers in addition to other rates desired for the trial.

The arsonates gave excellent control of most of the grassy type weeds in 2-3 applications when applied at intervals of 2-3 weeks. All were safe on the turf grasses in the test at the lower rates and any injury or discoloration which occurred when using higher rates on the turfgrass usually disappeared in several days or after the first mowing. At higher rates many broadleaved weeds were severely affected by the arsonates but often recovered in a few days.

The phenoxy-type herbicides gave good to excellent control of most broadleaved weeds when applied at frequent intervals. No control of grassy type weeds was noted. In some cases certain broadleaved weeds returned in these plots especially hilahila and kaimi clover.

The dicamba herbicide controlled most of the broadleaved species listed in Table 1. The results obtained in the control of kaimi clover were excellent and it was noted that broadleaved plantain was apparently tolerant to dicamba. Some turf injury resulted from the use of dicamba at the higher rates.

Ammonium thiosulfate gave excellent control of spurge in a post-emergence application with no injury to the turf. The spurge was brown in the test plots at two days after treatment. It was noted that any spurge plants which were not sprayed directly were not affected and no pre-emergence effect was observed.

Following the application of a combination of herbicides some extremely weedy lawns developed into a brown turf for a week or longer if the lawn grass was sparse. Proper fertilization and watering encouraged the grass to close in the bare spots formerly occuped by weeds. The best results were obtained by applying the herbicides in the morning of a calm, bright sunny day when no rain fell for 24 to 48 hours. (Hawaii Agricultural Experiment Station, University of Hawaii, Honolulu.)

Table 1.
Weeds frequently encountered in lawns on Kauai

Broadleaved weeds

- broadleaved plantain (*Plantago major*)
- bur clover (*Desmodium canum*)
- buttonweed (*Borreria laevis*)
- drymaria (*Drymaria cordata*)
- garden spurge (*Euphorbia hirta*)
- hilahila (*Mimosa pudica*)
- kaimi clover (*Desmodium canum*)
- niruri (*Phyllanthus niruri*)
- small leaved horseweed (*Conysa canadensis*)
- spanish needle (*Bidens pilosa*)
- sticky sorrel (*Oxalis corniculata*)
- tar weed (*Cuphea carthengenensis*)
- graceful spurge (*Euphorbia glomerifera*)

Grassy type weeds

- dallis grass (*Paspalum dilatum*)
- foxtail (*Setaria geniculata*)
- green kyllinga (*Cyperus brevifolius*)
- henrys crabgrass (*Digitaria Henryi*)
- hilo grass (*Paspalum conjugatum*)
- kikuyu grass (*Pennisetum clandestinum*)
- large crabgrass (*Digitaria sanguinalis*)
- marsh cyperus (*Cyperus javanicus*)
- nutgrass (*Cyperus rotundus*)
- sandbur (*Cenchrus echinatus*)
- wire grass (*Eleusine indica*)

Table 2.
Herbicides included in the test

I. Broadleaf herbicides

	Common name	Product name	Company
A.	dicamba	Banvel D.	Velsicol Chemical Corp.
B.	phenoxy types		
	2,4-D + 2,4,5-T + dicamba	Improved weedkiller	Millers Products Co.
	2,4-D + 2,4,5-T	Weed B Gon	Chevron Chemical Co.
	2,4-D	Formula 40	The Dow Chemical Co.
C.	ammonium thiosulfate	Spurge X	National Chelating Co.

Table 2. Herbicides included in the test (Cont'd)

II. Grassy type herbicides

	Common name	Product name	Company
A.	arsonates		
	MSMA	Ansar 170	The Ansul Co.
	MSMA	Ansar 529	The Ansul Co.
	MSMA	Daconate	Diamond Alkali Co.
	SMA	SMA-12	Chevron Chemical Co.
	AMA	Crabgrass Killer	Chevron Chemical Co.
	DSMA	Crabgrass Control	Best Chemicals & Fertilizer Co.

Field evaluation of several pre-plant soil incorporated herbicides and post-plant herbicides on directed seeded broccoli. Agamalian, H. and A. H. Lange. Although the broccoli grower can space plant this crop to a stand and/or utilized mechanical thinning, effective weed control is still limited. Two experiments conducted on two soil types in the Salinas Valley were carried through harvest to correlate herbicide tolerance and total yield. Experiment M.B.1-66 was applied to Chualar sandy loam (1 percent organic matter) and M.B.2-66 on Salinas clay loam (5 percent organic matter). Both experiments were grown under sprinkler irrigation. A randomize block design with 4 replications was used, and the treatments were applied to a 3.3 by 50 foot area.

R-2063, CDEC, trifluralin, CP-31393, bensulide, and DCPA were applied as preplant soil incorporated treatments, with power driven equipment. Depth of incorporation was 2-3 inches. TOK, IPC, and CIPC were surface applied following planting. Weed control, crop injury, and yield data are presented in tables 1 to 4.

Crop tolerance at thinning time appeared to be closely related to soil texture. Trifluralin, CDEC, CIPC, and IPC were less selective on sandy loam soil than on clay loam soil. Crop tolerance with CP-31393, bensulide, DCPA, and TOK were less affected with soil texture variation.

Harvest data taken at three dates of harvest were indicative of early crop suppression. Although accumulative yields resulted in significant differences only with R-2063 and trifluralin at the higher rates of treatment.

TOK at 4 lb/A and CP-31393 at 4 lb/A demonstrated effective herbicide activity on most species, while providing good crop tolerance for direct seeded broccoli. (Agricultural Extension Service, University of California, Salinas, California.)

Table 1. Weed control mean of two experiments

Treatment	lb/A	% Weed control Burning Nettle	Shepherds Purse	Hairy Nightshade	Chick-weed	Purslane
R-2063	4	74	64	90	95	95
R-2063	8	91	90	94	99	100
CDEC	6	98	70	65	88	90
Trifluralin	1	70	63	70	95	99
Trifluralin	2	85	80	75	99	100
CP-31393	4	60	82	85	95	80
CP-31393	8	75	97	90	99	85
Bensulide	4	70	60	60	90	90
Bensulide	8	80	70	70	95	95
DCPA	6	65	50	75	95	90
DCPA	12	87	65	80	99	95
TOK	4	98	85	90	50	99
TOK	8	99	95	95	60	100
CIPC	3	100	70	98	100	90
IPC	6	100	75	95	99	90
Control	0	0	0	0	0	0

Table 2. Crop injury ratings at thinning time

Treatment	lb/A	Crop injury[1] M.B.1-66	M.B.2-66
R-2063	4	6	1
R-2063	8	8	6
CDEC	6	4	2
Trifluralin	1	3	0.5
Trifluralin	2	4	1
CP-31393	4	1	0
CP-31393	8	2	2
Bensulide	4	0	0
Bensulide	8	0	0
DCPA	6	0	0
DCPA	12	0.5	0
TOK	4	0	0
TOK	8	0.5	1
CIPC	3	8	2
IPC	6	8	1
Control	0	0	0

[1] 0 = no injury; 10 = dead

Table 3. Fresh harvest weights: Experiment M.B.1-66

Treatment	lb/A		$\bar{X}$ lbs/plot for three dates of harvest 5/21	5/30	6/8	sum
R-2063	4		4.2**	7.2	4.5*	15.9
R-2063	8		3.0**	5.5*	4.2*	12.7*
CDEC	6		5.0*	8.2	4.2*	17.6
Trifluralin	1		7.0	7.5	4.2*	18.7
Trifluralin	2		4.2**	6.2	4.2*	14.6*
CP-31393	4		7.8	6.5	3.5	17.8
CP-31393	8		6.2	7.0	4.2*	17.4
Bensulide	4		7.5	6.2	4.0	17.7
Bensulide	8		6.2	7.7	3.7	17.6
DCPA	6		7.2	8.0	4.7*	19.9
DCPA	12		9.0	7.7	3.2	19.9
TOK	4		8.7	6.5	2.0	17.2
TOK	8		9.2	6.2	2.7	18.1
CIPC	3		3.2**	5.7	6.2*	15.1
IPC	6		4.2**	5.7	5.2*	15.1
Control	0.		8.0	7.0	2.7	17.7
LSD(among mean)		.05	2.2	1.4	1.4	2.6
		.01	2.9	N.S.	1.8	N.S.

Table 4. Fresh harvest weights: Experiment M.B.2-66

Treatment	lb/A	$\bar{X}$ lb/plot for three dates of harvest 6/16	6/23	6/30	sum
R-2063	4	3.8	8.2	5.5	17.5
R-2063	8	3.1	8.2	5.0	16.4
CDEC	6	4.1	9.0	5.0	18.1
Trifluralin	1	4.8	8.2	4.7	17.8
Trifluralin	2	4.3	8.5	5.7	18.6
CP-31393	4	5.9	7.5	5.2	18.6
CP-31393	8	5.0	9.0	6.3	20.2
Bensulide	4	4.5	8.5	5.0	18.0
Bensulide	8	4.3	10.5	5.7	19.8
DCPA	6	5.3	7.2	4.7	18.6
DCPA	12	5.9	9.5	5.0	19.3
TOK	4	5.7	9.5	5.5	20.7
TOK	8	5.0	9.2	6.5	20.5
CIPC	3	3.2	10.0	8.2	21.4
IPC	6	4.4	11.0	6.3	21.7
Control	0	5.4	7.2	5.7	18.3
LSD(among mean)	.05				N.S.

The effects of soil incorporation on the performance of herbicides in cantaloupes. Menges, Robert M. and J. L. Hubbard. Herbicides were soil-incorporated 2 in. just before planting and 3/4 in. just after planting to study the relative selectivity of treatments in cantaloupes grown in a furrow-irrigated sandy clay loam. The soil temperatures ranged from 83° to 98° F and the soil was rapidly dried after irrigation in spite of light rains.

Benefin (N-butyl-N-ethyl-a,a,a-trifluoro-2,6-dinitro-p-toluidine) was the outstanding herbicide when incorporated with the surface 2 in. of soil. The herbicide nearly completely controlled amaranth spp. and barnyardgrass (*Echinochloa crusgalli* (L.) Beauv.) at 3/4 lb/A without injury in cantaloupe. Bensulide failed to control amaranth regardless of incorporation depth but controlled barnyardgrass without injury when incorporated 2 in.

CDEC controlled weeds more efficiently but reduced the yield of cantaloupes when incorporated 2 in. The herbicide selectively controlled amaranth but failed to sufficiently control barnyardgrass when incorporated 3/4 in. Elevated soil temperature may have contributed to greater losses of CDEC vapors with shallow incorporation. Data suggest the combination of CDEC and bensulide for control of both weed species.

NPA failed to adequately control weeds although performances were more efficient with deeper incorporation.

Black polyethylene film controlled weeds efficiently and reduced soil moisture losses and soil temperatures. The design of perforations in the plastic, however, failed to allow a sufficient number of cantaloupe seedlings to emerge. (USDA, ARS, CRD and Lower Rio Grande Valley Research and Extension Center, Weslaco, Texas.)

Effects of soil incorporation and time of seeding on the performance of herbicides in furrow-irrigated carrots. Menges, Robert M. and J. L. Hubbard. Soil surface applications of trifluralin, linuron, amiben, 3-amino-2,5-dichloro benzamide (65-78), methyl ester of 3-amino-2,5-dichloro benzoic acid (65-81), and R-4461 were incorporated within the surface 1 in. of a Hidalgo sandy clay loam immediately before 'Long Imperator' carrots were planted 1/8 in. deep in beds to study herbicide selectivity. Soil was repeatedly wetted and dried and temperatures ranged from 64° to 96° F in the first 4 weeks after treatment.

Applications of 1/2 and 1 lb/A of trifluralin and 1 1/2 lb/A of linuron were outstanding for selective control of common purslane (*Portulaca oleracea* (L.), Palmer amaranth (*Amaranthus palmeri* S. Wats.), redroot pigweed (*Amaranthus retroflexus* (L.),and barnyardgrass (*Echinochloa crusgalli* (L.) Beauv.). R-4461 was somewhat deficient in broadleaf weed control but controlled barnyardgrass selectively. Amiben and its derivatives failed to control weeds but did not appreciably injure carrots. (USDA, ARS, CRD and Lower Rio Grande Valley Research and Extension Center, Weslaco, Texas.)

Weed control in lettuce with herbicide combinations. Agamalian, Harry. Effective control of certain broadleaf weed species in the Salinas valley is often limited by currently registered lettuce herbicides. A series of experiments were conducted in 1966 with Benefin, CIPC, and IPC, to study efficacy and crop tolerance of these herbicides in combination at various rates.

Previous experiments indicated Benefin to be marginal on hairy nightshade (*Solanum villosum*, Mill.) and burning nettle (*Urtica urens* L.). CIPC and IPC are effective on these two species, but are often marginal on the *Chenopodium* sp. at application rates tolerant of lettuce.

The trials were conducted on spring, summer, and fall lettuce. All treatments were pre-plant, soil-incorporated at a 2-3 inch depth, on Salinas clay loam soil. Sprinkler irrigation was used on the three experiments. A randomize complete block design was used with 4 replications. Each treatment was 3.3 by 100 feet. Control treatments were hand weeded at thinning time.

Results given in Table 1 represent mean data from the three experiments. Percent harvest represents two dozen size heads from two dates of harvest. Phytotoxicity ratings were made at thinning time.

The combined use of Benefin, CIPC, and/or IPC can effectively increase the spectrum of certain broadleaf weeds, while maintaining acceptable crop tolerance. See Table 2. (Agricultural Extension Service, University of California, Salinas, California.)

Table 1. Crop injury and percent harvest

Treatment	lb/A	Crop injury rating[1]	% Harvest[2]
Benefin	1	0.5	90.0
IPC	6	0.5	92.5
CIPC	3	0.5	90.4
Benefin + IPC	1+6	1.0	87.7
Benefin + IPC	1+4	1.0	90.5
Benefin + IPC	1+2	0.5	94.0
Benefin + CIPC	1+3	1.0	86.7
Benefin + CIPC	1+2	0.6	93.5
Benefin + CIPC	1+1	0.7	92.8
Control	0	0.5	88.0

[1] 0 = no crop injury, 10 = dead [2] mean % harvest from two cuttings

Table 2. Weed control

		Percent control			
Treatment	lb/A	Hairy Nightshade	Nettleleaf Goosefoot	Burning Nettle	Purslane
Benefin	1	65	98	70	100
IPC	6	96	80	97	90
CIPC	3	91	90	100	95

Table 2. Weed control (Cont'd)

Treatment	lb/A	Hairy Nightshade	Nettleleaf Goosefoot	Burning Nettle	Purslane
Benefin + IPC	1+6	100	98	100	100
Benefin + IPC	1+4	95	98	97	100
Benefin + IPC	1+2	83	98	92	100
Benefin + CIPC	1+3	95	97	100	100
Benefin + CIPC	1+2	87	95	100	100
Benefin + CIPC	1+1	87	91	100	100
Control	0	0	0	0	0

Preplanting, soil-incorporated applications and preemergence applications of herbicides in lettuce. Menges, Robert M. and J. L. Hubbard. Soil surface and soil-incorporated applications of several herbicides were studied in lettuce grown in furrow-irrigated Hidalgo sandy clay loam. Under heavy rainfall, and cool, wet soil with short-termed flooding, all herbicides but bensulide controlled redroot pigweed (*Amaranthus retroflexus* L.) and barnyardgrass (*Echinochloa crusgalli* (L.) Beauv.) more efficiently with 3/4-in. soil incorporation than with soil surface applications.

Benefin (*N*-butyl-*N*-ethyl-*a*,*a*,*a*-trifluoro-2,6-dinitro-p-toluidine) and bensulide were outstanding and controlled all weeds selectively in lettuce when incorporated just before planting. Incorporated CDEC was selective but was inferior in grass control. Soil-incorporated trifluralin controlled weeds even at the 1/2-lb rate but reduced the yield of lettuce with immediate planting.

Bioassays showed that 1 lb/A of incorporated trifluralin persisted in soil 10 weeks in quantities sufficient to control the weeds whereas soil surface applications did not persist 5 weeks with heavy rainfall and flooding. Comparisons of bioassay data to standard growth reduction curves showed that lettuce, sorghum, and tomato could not be safely grown in the soil 10 weeks after 1 lb/A of incorporated trifluralin. Although extremely water-insoluble, trifluralin was moved below its original incorporation zone in soil. (USDA, ARS, CRD and Lower Rio Grande Valley Research and Extension Center, Weslaco, Texas.)

The effects of several post emergence herbicides on three dates of treatment to southport white globe onions. Agamalian, H. Post emergence applications of cypromid, linuron, RP-2929, bromoxynil, DNPB, and KOCN were applied when the majority of the onions were in the flag, 1½ true leaf, and the 2-3 leaf stage of growth. Major weed species were burning nettle (*Urtica urens* L.), purslane (*Portulaca oleracea* L.), hairy nightshade (*Solanum villosum* Mill.), shepherds purse (*Capsella bursa-pastoris* L.) and nettleleaf goosefoot (*Chenopodium murales* L.). Maturation of weed species likewise varied in the three treatments from cotyledon leaf to rosette and 2 to 3 inches in height.

Herbicide applications were sprayed at 100 gpa. The experiments were in a randomize block design, with four replications. Control treatments were handweeded approximately three weeks after initial treatment. Weed control ratings, stand counts, and yield data are presented in tables 1 to 3.

Weed control was closely related to age of the weed species and dosage rate with the exception of certain weeds. RP-2929 was marginal on hairy nightshade at rates below 2 lb/A. Bromoxynil did not control purslane or hairy nightshade at rates treated regardless of their size.

Stand count data reflects some variation between onion tolerance and size, especially with RP-2929 and bromoxynil. These two compounds indicated greater tolerance when onions were past the 1½ leaf stage.

Yield data variation between dates of treatment is partially related to lack of weed control at the lower rates of RP-2929 at the flag stage of treatment; whereas bromoxynil at ½ lb/A flag treatment, caused early injury. Significant yield differences between treatments and control were enhanced by heavy early weed competition prior to hand weeding of the controls. (Agricultural Extension Service, University of California, Salinas.)

Table 1. Weed control at three dates of treatment

Treatment	lb/A	Mean weed control rating[1]		
		flag	1½ leaf	2-3 leaf
Cypromid	0.5	9.2	8.8	0.7
Cypromid	1.0	10.0	9.5	1.5
Cypromid	2.0	10.0	10.0	2.0
Linuron	0.5	10.0	9.2	3.2
Linuron	1.0	10.0	10.0	4.0
RP-2929	1.0	6.7	7.5	1.5
RP-2929	2.0	8.7	8.2	1.2
RP-2929	3.0	10.0	9.5	1.5
Bromoxynil	0.25	5.2	5.2	3.7
Bromoxynil	0.5	7.7	7.2	5.0
DNPB	1.0	10.0	9.5	6.7
KOCN	16.0	6.5	5.8	7.0
Control	0	0	0	0

[1] 0 = no weed control, 10 = maximum weed control

Table 2. Mean stand counts, taken 14 days following treatment

Treatment	lb/A	Onion plants per four foot of row		
		flag	1½ leaf	2-3 leaf
Cypromid	0.5	30.5	33.2	28.5
Cypromid	1.0	32.3	33.2	30.5
Cypromid	2.0	31.8	31.3	27.0

Table 2. Mean stand counts, taken 14 days following treatment (Cont'd)

Treatment	lb/A	Onion plants per four foot of row flag	1½ leaf	2-3 leaf
Linuron	0.5	26.8	29.2	29.7
Linuron	1.0	30.2	26.0	27.7
RP-2929	1.0	26.1	24.7	26.3
RP-2929	2.0	30.5	32.8	31.3
RP-2929	3.0	25.6	30.1	29.0
Bromoxynil	0.25	26.6	30.8	29.8
Bromoxynil	0.5	26.1	32.8	32.0
DNPB	1.0	33.8	29.3	30.2
KOCN	16.0	29.7	30.6	29.0
Control	0	28.2	27.0	29.2

Table 3. Harvest weights of dry bulbs from three dates of treatment

Treatment	lb/A	Mean lbs/area harvested (50 sq. ft.) flag	1½ leaf	2-3 leaf
Cypromid	0.5	43.8*	49.7**	36.7
Cypromid	1.0	44.8*	47.2*	38.2*
Cypromid	2.0	39.7	50.0**	43.2**
Linuron	0.5	44.8*	53.5**	41.0**
Linuron	1.0	43.8*	46.0	37.7*
RP-2929	1.0	38.0	44.2	34.2
RP-2929	2.0	46.7**	55.2*	37.0
RP-2929	3.0	46.7**	54.0**	37.5*
Bromoxynil	0.25	44.2*	47.5**	43.0**
Bromoxynil	0.5	38.6	48.2**	39.5*
DNPB	1.0	46.5**	51.5**	42.0*
KOCN	16.0	43.6	48.2**	36.0
Control	0	39.6	41.0	34.2
LSD (among mean)	.05	4.41	5.9	3.1
	.01	5.92	7.3	4.2

Effects of depth of soil incorporation and time of planting on the performance of herbicides in furrow-irrigated onions. Menges, Robert M. and J. L. Hubbard. Herbicides were incorporated 1/2 or 1 1/2 in. with a steel-mesh wheel or a PTO-tiller just before or 13 days before planting to study the influence of the incorporation tools, incorporation depths, and delay of planting on the herbicidal performances in furrow-irrigated onions. Rains occurred during the first week after planting resulting in a cool, wet environment in the Hidalgo sandy clay loam.

Bensulide, CP-31393 and DCPA selectively controlled redroot pigweed (Amaranthus retroflexus L.) and barnyardgrass (Echinochloa crusgalli (L.) Beauv.) without delay in planting of onions. Granular CIPC failed to control broadleaved weeds and required 13 days between treatment and planting for selectivity in onions. Bioassays of treated soils showed that CIPC was moved below its original incorporation depths in soils presumably by rainfall.

The performance of bensulide was outstanding and was unaffected by the incorporation depth or tool. The steel-mesh wheel provided the best performance with CP-31393 whereas the PTO-tiller was best with DCPA and CIPC at 1/2 in. (USDA, ARS, CRD and Lower Rio Grande Valley Research and Extension Center, Weslaco, Texas.)

Comparison of herbicides for weed control in seeded Sweet Spanish onions. Corgan, J. N., W. P. Anderson, and J.W. Whitworth. In 1965 bensulide, DCPA, and combinations of bensulide and DCPA were applied preplant to field-seeded onions. The field was listed and harrowed, the herbicides sprayed on low beds and soil-incorporated by double-discing, and the beds reshaped. Sweet Spanish onions were seeded and furrow irrigated the same day the herbicides were applied. In 1966, benefin, bensulide, and DCPA were applied preplant as described above, and benefin was also applied preemergence immediately after seeding. Data obtained from these experiments are shown in Tables 1 and 2.

Of the herbicides tested, DCPA was the most promising from the standpoint of weed control and onion selectivity. DCPA gave season-long control of annual grass and good control of most broadleaf weeds. Benefin and bensulide are also promising herbicides for use in onions. Bensulide reduced onion stand, but the surviving plants were healthy and produced larger onions than where stands were thicker. Soil-incorporated, benefin gave good weed control, slight onion stand reduction, and little if any reduction in yield. Benefin, when applied preemergence, did not control weeds. Each of the three herbicides tested are promising enough to include in future experiments. Additional testing is needed to determine more conclusively their toxicity to onions on various soils following different methods of application. (New Mexico Agri. Expt. Sta., Las Cruces, New Mexico.)

Table 1. The effect of preplant applications of herbicides on weed and onion stands at Las Cruces, New Mexico, 1965

		Stand reduction (% of check)					
			Junglerice		Lambsquarter	Broadleaf weeds	
Herbicide	lb/A	onions	June 6	July 12	April 19	June 8	July 12
Bensulide	6	68	95	100	91	14	27
	9	61	95	100	96	0	20
DCPA	6	6	68	79	95	47	7
	9	29	95	93	94	43	39
Bensulide	6+6	58	95	100	97	47	0
+ DCPA	9+6	61	95	86	99	47	39

Table 2. The effect of preplant and preemergence herbicides on onion stands, weed control, and onion yield at Las Cruces, New Mexico, 1966

Herbicide	lb/A	Onion stand reduction (% of check)	Weed control* (% of check)	Onion Yield (% of check)
Preplant, incorporated				
Benefin	0.25	29	60	129
	0.50	15	90	108
	0.75	22	100	146
Bensulide	6.0	50	80	108
	9.0	37	90	100
DCPA	6.0	13	100	141
	9.0	0	100	146
Preemergence				
Benefin	0.25	0	0	50
	0.50	8	20	108
	0.75	26	20	121

* The principal weed was lambsquarters; evaluated April 20, 1966

Herbicide evaluation studies with carrots, lettuce and onions in Hawaii. Romanowski, R. R., P. J. Ito and J. S. Tanaka. Three experiments were conducted in June 1966 at the Lalamilo Branch Experiment Station which is located at an elevation of 2,680 feet on the island of Hawaii. The soil type is a Waimea loam which is finely textured and has an organic matter content of 8%. Several of the herbicides which perform satisfactorily in the continental United States do not meet commercial standards under the edaphic and ecological conditions of this test site which represents approximately one-third of the vegetable acreage in Hawaii.

The results with carrots show that most chemicals tested either injured the crop or provided poor weed control (Table 1). Linuron, amiben and TOK should be explored further as pre-emergence sprays at rates less than those used in the experiments when both crop phytotoxicity and weed performance are considered.

The lettuce test showed that CDEC should still be considered as the standard herbicide for use in this area (Table 2). DCPA applied at three weeks as an over-the-plant spray merits further consideration. It is noteworthy that DCPA performed poorly when soil incorporated. As in past experiments, bensulide and benefin will not control weeds on the Waimea loam at the FDA registered rates.

Transplant onions were tolerant of the herbicides applied singly and in combinations (Table 3). CIPC and combinations thereof were toxic to the direct seeded onions. DCPA, CP-31393 and CDAA should be considered alone and in combination for future experiments with both direct seeded and transplant onions. CP-31393 resulted in good to excellent weed control when compared to the performance of the standard commercially used herbicide CDAA. (University of Hawaii, Department of Horticulture, Honolulu.)

Table 1. Carrot tolerance (cv. Red-cored Chantenay Half-long) and weed response to the herbicides.[1]

Treatment (lbs.active/acre)	Crop[2] rating 4 weeks	Total yield lbs/plot	Weed Rating (4 weeks)[3] Amaranthus spp.	Coronopus didymus	Portulaca oleracea
Check, late cultivation	1.3	4.9	1.0	1.0	1.0
Check, cultivated	1.8	28.0	4.0	4.3	4.5
Linuron 2#	2.5	18.8	5.0	5.0	5.0
Linuron 2# (Broadcast spray at 3 weeks)	3.8	2.7	5.0	5.0	5.0
CIPC 6#	2.5	24.7	3.3	4.0	3.8
CIPC 6# (Broadcast spray at 3 weeks)	2.3	26.5	3.0	3.0	2.8
EPTC 3# (Preplant incorp.)	3.0	19.6	3.0	3.5	3.3
Amiben 4#	3.0	20.9	4.8	4.0	4.8
TOK E-25 6#	2.5	20.9	5.0	4.8	5.0
Trifluralin 1# (Preplant incorporated)	1.3	24.4	3.0	2.0	2.8
Planavin 1# (Preplant incorp.)	1.8	18.6	2.5	1.8	2.3
L.S.D. 5% (1%)	0.8(1.1)	7.1(9.5)	0.9(1.2)	1.2(1.7)	0.8(1.0)

[1] Each value an average of 4 replications
[2] Crop ratings: 1 - no injury, 2 - slight, 3 - moderate, 4 - severe, 5 - dead
[3] Weed ratings: 1 - no control, 2 - slight, 3 - fair, 4 - good (commercially acceptable), 5 - complete control

Table 2. Lettuce tolerance (cv. Early Great Lakes) and weed response to the herbicides.[1]

Treatment (lb/A ai)	Crop[2] rating 4 weeks	Weed Rating (4 weeks)[3] Amaranthus spp.	Portulaca oleracea
Check, late cultivation	1.5	1.3	1.5
Check, cultivated	1.3	4.8	4.8
CDEC 6 lb.	2.5	4.3	4.8
DCPA 6 lb.	3.3	4.0	4.3
DCPA 6 lb. (Preplant incorporated)	1.3	2.3	2.8
CDEC 6 lb. (Pre-emergence at planting) plus DCPA 6 lb. (Broadcast spray at 3 weeks)	2.5	4.3	4.8
CDEC 4 lb. + CIPC 3 lb.	3.0	4.0	5.0

Table 2. Lettuce tolerance (cv. Early Great Lakes) and weed response to the herbicides.[1] (Cont'd)

Treatment (lb/A ai)	Crop[2] rating 4 weeks	Weed Rating (4 weeks)[3] Amaranthus spp.	Portulaca oleracea
Bensulide 6 lb.(Preplant incorp.)	1.3	1.8	2.5
Benefin 1 lb. (Preplant incorp.)	1.3	2.5	3.3
LSD 5% (1%)	0.7 (0.9)	1.0 (1.4)	1.4 (1.9)

1, 2, 3 Same as Table 1

Table 3. Onion tolerance (cv. Early Harvest) and weed response to the herbicides.[1]

Treatment (lb/A ai)	Crop Rating[2] (4 weeks) Direct seeded	Trans-plant[4]	Tot. Yld. lbs/plot Direct seeded	Weed Rating[2] (4 weeks) Amaranthus spp.	Coronopus didymus	Portulaca oleracea
Check, late cultivation	1.3	1.3	62.0	1.0	1.0	1.0
Check, cultivated	1.3	1.3	91.5	5.0	5.0	5.0
DCPA 6 lb	1.8	1.8	84.0	3.8	2.0	5.0
DCPA 10.5 lb	1.8	1.8	82.0	4.0	2.0	5.0
CDAA 6 lb	2.0	1.5	76.3	2.8	2.0	3.5
CP-31393 6 lb	2.0	2.0	77.0	4.8	3.8	4.8
CIPC 6 lb	3.0	2.3	50.0	3.3	4.3	5.0
DCPA 6 lb + CIPC 6 lb	3.3	2.0	60.8	4.8	3.8	5.0
DCPA 6 lb + CDAA 6 lb	1.8	2.0	75.5	4.0	3.0	5.0
DCPA 6 lb + CP-31393 6 lb	2.8	2.0	72.5	5.0	4.8	5.0
CDAA 6 lb + CIPC 6 lb	3.0	2.3	57.3	4.0	3.0	4.3
CP-31393 6 lb + CIPC 6 lb	3.3	2.0	51.3	4.5	4.5	5.0
CP-31393 6 lb + CDAA 6 lb	2.8	2.0	81.3	5.0	3.8	5.0
LSD 5% (1%)	0.6(0.8)	0.5(0.7)	7.6(10.2)	0.5(0.7)	1.0(0.4)	0.3(0.5)

1, 2, 3 Same as Table 1.
4 Sprays applied over-the-onions immediately after transplanting.

Comparison of herbicides for weed control in seeded peppers. Whitworth, J. W., W. P. Anderson, J. N. Corgan and P. M. Trujillo. In 1965, DCPA, bensulide, and Trefmid were applied preplant to level ground and disced twice for incorporation. On the same day beds were listed, harrowed, and shaped, and both bell and chile peppers seeded. The beds were furrow irrigated the next day. Experimental plots were three beds wide and seven feet long, and the herbicides were applied at two or more rates and each treatment was replicated three times. The major weeds present were junglerice, pigweed, and purslane.

In 1966, experiments were located at Las Cruces and Alcalde, in the southern and northern parts of New Mexico, respectively. Preplant applications were made after the beds were listed and harrowed. The preplant treatments were applied and incorporated into the low beds by double-discing, and the beds were then reshaped. Chile pepper was seeded and the beds furrow irrigated the same day the herbicides were applied. At Las Cruces, experimental plots were two beds wide and twenty feet long, and at Alcalde, plots were one bed wide and thirty feet long. At Las Cruces, bensulide, trifluralin and benefin were applied preplant, and diphenamid preemergence. At Alcalde, DCPA, bensulide, benefin, and diphenamid were applied preplant and preemergence. Herbicides were applied at various rates and each treatment was replicated three times. Lambsquarter was the principal weed at Las Cruces; while at Alcalde, there was a broad spectrum of grass and broadleaf weeds. Results obtained in 1965 are shown in Table 1 and those obtained at the two locations in 1966 are shown in Tables 2 and 3.

Of the herbicides tested, bensulide was the most promising as to weed control and crop selectivity. Benefin and DCPA were the least promising due to adverse effect on crop yield. Each of the six herbicides were effective enough to be included in future tests. (New Mexico Agricultural Experiment Station, Las Cruces.)

Table 1. The effect of preplant herbicides on weed and pepper plants at Las Cruces, New Mexico, 1965

		Stand reduction (% of check)				
		Peppers		Weeds		
Herbicide	lb/A	Chile	Bell	Junglerice	Pigweed	Purslane
Bensulide	6	12	29	92	0	16
	9	13	0	95	27	39
DCPA	6	3	17	61	0	12
	9	20	44	88	27	68
Trefmid	1/2	0	25	16	13	39
	3/4	29	28	45	13	0
	1	5	40	55	0	39

Table 2. The effect of herbicides on weed and chile pepper stands and on pepper yields at Las Cruces, New Mexico, 1966

Herbicide	lb/A	Peppers*	Percent weed control	Yield of red chile (bu/A)
Preplant				
Benefin	1/2	3.5	80	160
	1	3.9	90	265
Bensulide	6	3.5	70	243
	9	3.2	80	168

Table 2. The effect of herbicides on weed and chile pepper stands and on pepper yields at Las Cruces, New Mexico, 1966 (Cont'd)

Herbicide	lb/A	Peppers*	Percent weed control	Yield of red chile (bu/A)
Trifluralin	3/4	3.0	100	174
Preemergence				
Diphenamid	5	2.5**	3	189
Untreated check				
	0	1.5**	0	73

* Plants per foot of row
** Low plant counts due to extremely dense cover of lambsquarters and loss of plants during cultivation

Table 3. The effect of preplant and preemergence herbicides on weed and chile pepper stands and on pepper yields at Alcalde, New Mexico, 1966

		Stand counts, hoeing time, and yield of chile (% of check)							
		Preplant				Preemergence			
Herbicide	lb/A	chile	weeds	time	yield	chile	weeds	time	yield
Benefin	0.75	82	69	89	73	92	31	89	75
	1.5	58	74	89	82	100	51	89	75
	2.0	65	63	94	73	60	26	58	41
Bensulide	4.0	100	80	86	118	100	98	100	150
	6.0	100	43	94	127	100	53	86	117
	8.0	100	52	74	109	100	47	88	117
DCPA	4.0	98	75	92	100	95	79	88	117
	6.0	100	92	88	109	100	71	98	117
	10.5	91	81	86	46	92	20	70	92
Diphenamid	3.0	100	81	100	73	92	94	91	108
	5.0	100	82	91	100	100	77	84	83
	7.0	100	74	100	118	95	73	88	100

Comparison of herbicides for weed control in seeded tomatoes. Anderson, W. P., J. N. Corgan, and J. W. Whitworth. In 1965, bensulide, diphenamid, and Trefmid were applied preplant at various dosages to level ground and soil-incorporated by double-discing. Beds were listed on 40-inch centers, harrowed, and shaped, and Chico tomatoes were seeded on alternate beds the same day the herbicides were applied. The beds were furrow irrigated the next day. Experimental plots were three beds wide and seven feet long. Each treatment was replicated three times. In 1966, Benefin, bensulide, CIPC, diphenamid, and Glenbar were applied preplant to low seedbeds and soil-incorporated by double-discing. The beds were reshaped, Chico tomatoes seeded, and the beds furrow irrigated the same day the herbicides were applied. Results obtained from the experiments are shown in the Table.

Of the herbicides tested, Benefin, bensulide, and diphenamid were promising enough to be included in further testing. In 1966, bensulide and diphenamid gave excellent weed control. Tomato yields were not reduced by diphenamid but were seriously reduced by bensulide. In 1965, these herbicides cause little or no crop injury but gave little or no weed control. Benefin caused some stunting of young tomato plants, gave excellent weed control, and caused some yield reduction at 0.75 to 1 lb/A. Tomato seedlings did not emerge following CIPC applications, although weed control was good. Glenbar gave excellent weed control, but injured the tomatoes and reduced yields. (New Mexico Agricultural Experiment Station, Las Cruces.)

The effect of preplant applications of herbicides on seeded tomatoes and on weed control at Las Cruces, New Mexico

Herbicide	lb/A	Tomatoes (% of check) stand 1965	Tomatoes (% of check) injury 1966	Weed control (% of check) 1965	Weed control (% of check) 1966	Tomato yield (% of check) 1966
Benefin	0.50	---	30	---	90	100
	0.75	---	50	---	100	81
	1.00	---	60	---	100	81
Bensulide	6.00	100	0	0	80	81
	9.00	100	0	30	90	57
CIPC	4.00	---	100	---	80	---
Diphenamid	4.00	---	0	---	90	109
	6.00	100	0	0	100	105
	8.00	---	0	---	100	95
	9.00	80	---	0	---	---
Glenbar	4.00	---	60	---	90	48
	6.00	---	60	---	100	48
	8.00	---	70	---	100	57
Trefmid	1.25	100	---	0	---	---
	2.50	88	---	60	---	---
	5.00	54	---	80	---	---

Preplanting and preemergence weed control in tomatoes. 1. Preplanting, soil-incorporated applications of herbicides. Menges, Robert M. and J. L. Hubbard. Preplanting, soil-incorporated application of herbicides were studied in furrow-irrigated tomatoes under heavy rainfall, and low temperatures in a sandy clay loam.

Diphanamid and bensulide were outstanding for long-term, selective control of amaranth spp. and barnyardgrass (*Echinochloa crusgalli* (L.) Beauv.) where tomatoes were planted immediately into herbicide zones in soil.

Pebulate failed to control amaranth but did control barnyardgrass at 10 lb/A.

CDEC controlled all weeds only for a short period and reduced the tomato yield at the 10 lb/A rate. Soil microclimate was not conducive to rapid losses of herbicide vapors from soil. (USDA, ARS, CRD and Lower Rio Grande Valley Research and Extension Center, Weslaco, Texas.)

Annual weed control in processing peas. Peabody, Dwight V., Jr. Herbicides of "new" chemistry continue to show excellent selectivity at low (and hopefully inexpensive) rates of application on processing peas as pre-emergence herbicides. 1,1-dimethyl-3-((3-N-*tert*-butylcarbamyloxy) phenyl)) urea; 1-(3,4-dichlorophenyl)-3,5-dimethylhexahydro-1,3,5-triazinone-2; 3-(m-trifluoromethylphenyl)-1,1-dimethylurea; 3,4-dichloromethylcarbamate and Terbacil all have resulted in as good as or better weed control than the presently recommended DNBP with no concomitant pea injury or yield reduction. Since these newer herbicides are selective and effective at low rates of application, it is possible that they may be competitive in cost to the established and inexpensive DNBP recommendation. (Northwestern Washington Research & Extension Unit, Washington State University, Mount Vernon.)

Annual weed control in spinach. Peabody, Dwight V., Jr. Since it has been established that norea, at the rates used in spinach, is relatively ineffective on certain weed species, specifically those of the genus *Polygonum*, an attempt was made to broaden the spectrum of weed species controlled by combining this herbicide with other materials. Norea in combination with CIPC at a low rate or IPC resulted in better control of more weed species than either compound alone or of any other combination under test. No synergistic effect was observed. Injury to spinach was negligible with IPC-norea and CIPC-norea combinations, and this was reflected in the generally higher yields of both processing and seed spinach when compared to other combinations and the untreated checks. (Northwestern Washington Research & Extension Unit, Washington State University, Mount Vernon.)

Annual weed control in sweet corn. Peabody, Dwight V., Jr. Combination of "half-rates" (1 lb/A) of atrazine with other herbicides in sweet corn has the possibility of reducing residual activity of this long-lived herbicide while augmenting weed control to kill annual grasses. Some of these combinations resulted in as good annual weed control as did atrazine alone at the

2 lb/A rate. However, low rates of the following herbicides in combination with atrazine did not give adequate annual grass control at harvest time: 1,1--dimethyl-4,6-diisopropyl-7-indanyl ethyl ketone; 3-((p-(p'-chlorophenoxy)-phenyl))-1,1-dimethylurea; dimethyl ester of tetrachloroteraphthalic acid; linuron (at 0.5 lb/A); Lenacil; 2-chloro-N-isopropylacetanilide; All. 10614; Bromoxynil and aniline,4-(methylsulfonyl)-2,6-dinitro-N,N-dipropyl. Terbacil definitely reduced the yield of sweet corn and this injury could be attributed to chemical activity and not weed competition. 1,1-dimethyl-3-((3-N-*tert*-butylcarbamyloxy) phenyl)) urea and CP-50144 in combination with atrazine at 1 lb/A gave effective and selective annual grass and broadleaved weed control in sweet corn. (Northwestern Washington Research & Extension Unit, Washington State University, Mount Vernon.)

The persistence of soil-incorporated herbicides in furrow-irrigated soils. Menges, Robert M. and Hubbard, Jack L. The initial activity and persistence of DCPA, diuron, prometryne, trifluralin, and linuron were studied in a furrow-irrigated Hidalgo sandy clay loam.

All herbicides controlled Amaranthus spp. and barnyardgrass (*Echinochloa crusgalli* (L.) Beauv.) selectively in cotton but persisted in soil up to 7 months to injure 1 or more vegetables or indicator plants grown in rotation with cotton. Onions were injured by the soil residues of all 5 herbicides, ryegrass was injured by prometryne and trifluralin, spinach by diuron, and carrots by trifluralin. Oats, cabbage, and lettuce were not significantly injured by herbicide residues in soil. (USDA, ARS, CRD and Lower Rio Grande Valley Research and Extension Center, Weslaco, Texas.)

PROJECT 5. WEEDS IN AGRONOMIC CROPS

W. E. Albeke, Project Chairman

SUMMARY

Twenty-eight reports were submitted on weed control in eleven agronomic crops.

Most of the work dealt with tolerance of herbicides and the effect of combinations of herbicides on these various crops. The reports are summarized below:

In Oregon, some of the uracides and triazines were tested on established alfalfa and looked promising.

In beans, combinations were tested with the standard herbicides EPTC, trifluralin, and DCPA to broaden the spectrum of weed species controlled.

Lowering the rate of atrazine in corn and combining it with other herbicides shows promise in reducing residual carryover.

Layby treatments of one pound diuron per acre indicated late germinating weeds could be controlled in Arizona cotton.

Atrazine damaged sorghum pre-plant but did not when used post-emergence with oil and wetting agent. Propazine and GS-14260 were found to be safer preplant with excellent weed control.

With proper use of herbicides, Norgold potatoes were grown in a trial in Oregon without cultivation when a weed-free environment was maintained.

Several herbicides show promise in controlling cheat grass selectivity in wheat.

Herbicide tolerance trial in established alfalfa. Rydrych, Donald J. A study was conducted in eastern Oregon in 1966 to check the tolerance of established alfalfa to new herbicides. Treatments were applied to year old dormant alfalfa in February 1966 and on an Ephrata loamy sand soil. Water was supplied by sprinkler irrigation.

Bromacil, terbacil, DP-733, DP-766, DP-767, DP-629, DP-327, GS-16065, GS-14260, atrazine, and simazine all at .8 - 2.4 lb/A; RP-11561 at 4 - 8 lb/A; SD-11831 at 1 - 3 lb/A; Tenoran and Patoran each at 1 - 4 lb/A; and CP-50144 at 3 - 6 lb/A, were evaluated for crop injury.

Terbacil, DP-327, RP-11561, SD-11831, GS-14260, simazine, CP-50144, and Tenoran had the greatest margin of crop safety based on forage yields. All other compounds injured the alfalfa particularly at high rates. Several of the newer compounds will be evaluated in more detail during the coming season to check rates, soil residue, and the effect on various weed species.

Terbacil, DP-327, GS-14260, and simazine have already shown to be effective on a variety of grass and broadleaf weed species. (Oregon Agricultural Experiment Station, Hermiston.)

Annual and perennial weed control in established alfalfa. Rydrych, Donald J. Three experiments were established to field test promising herbicides for the control of downy brome (*Bromus tectorum*), perennial rye-grass (*Lolium perenne*), quack-grass (*Agropyron repens*), and mouse barley (*Hordeum murinum*) in established alfalfa. All trials were located on various soil types and irrigation was either by sprinkler or by flooding. Applications were made from December to early February when the alfalfa was dormant.

At all locations, fair to excellent results were obtained using bromacil, atrazine, simazine, terbacil, GS-14260, and DP-767. All compounds were applied at .8 to 2.4 lb/A.

Bromacil, terbacil, atrazine, and DP-767 were the most active on the perennial grasses. However, bromacil, atrazine and DP-767 were also the most injurious to alfalfa at rates above 1.6 lb/A. Simazine and GS-14260 were less active on the perennial grasses but downy brome and wild barley control was fair. Terbacil and GS-14260 both at .8 - 2.4 lb/A had excellent crop tolerance..

All compounds were highly active on the annual grasses at the rates tested but GS-14260 was more active at the higher rates.

Terbacil was the most promising compound tested based on crop safety and weed control. These results are preliminary in nature and further tests are planned. (Oregon Agricultural Experiment Station, Pendleton.)

Pre-plant applications of herbicides for weed control in field beans in Wyoming. Lee, G. A. and Alley, H. P. Herbicide tests were established at the Torrington Agricultural Experiment Substation May 27, 1966. Plots were one sq. rd. in size and replicated three times. Soil type at the location is sandy loam.

Chemicals were incorporated into the soil with a tandem disc set to incorporate four inches deep. Because of the extremely dry soil conditions, the plots were furrow irrigated 48 hrs. after chemical application. Weed counts were taken from an area six inches in width and 10 feet in length from the two center rows of each plot. Weed populations were classified as (1) nightshade; black nightshade (*Solanum nigrum* L.) and buffalo bur (*Solanum rostratum* Dunal.), (2) other broadleaved weeds; rough pigweed (*Amaranthus retroflexus* L.) and lamb's quarters (*Chenopodium album* L.) and (3) grass; green foxtail (*Setaria viridis* (L.) Beauv.) and barnyardgrass (*Echinochloa crusgalli* (L.) Beauv.)

Results presented in accompanying table show that SD-11831 (4-methylsulfonyl)-2,6-dinitro-N,N-dipropylaniline) at 4 lb/A, Dacthal (dimethyl ester of tetrachloroteraphthalic acid) at 9 lb/A, Dacthal + CIPC at 9 + 3 lb/A, amiben + Sindone (1,1-dimethyl-4,6-diisopropyl-5-indanyl ethyl ketone) at 1.5 + .5 lb/A, amiben + Sindone 1.5 + 1.5 lb/A and amiben + Sindone 2.0 + 1.5 lb/A gave over 90 percent control of all weed species present. However, SD-11831 at 4 lb/A and Dacthal + CIPC at 9 + 3 lb/A caused severe damage to the bean plants growing in the plots. Dacthal at 9 lb/A retarded maturity of the crop. Damage was also observed in plots treated with SC-11831 at 2 lb/A, dinoben methyl ester at 2 lb/A, Dacthal + CIPC at 3 + 1 lb/A and 6 + 2 lb/A, trifluralin + EPTC at .38 + 1.13 lb/A and Sindone at 3 lb/A.

Plots treated with amiben + Sindone at 1.5 + .5 lb/A, amiben + Sindone at 2.0 + .5 lb/A, Dacthal at 9 lb/A and trifluralin at 1.5 pt/A yielded over 3000 lb/A. Samples taken from the Dacthal plots contained a high percentage of immature beans. Dacthal + CIPC at 9 + 3 lb/A significantly reduced the yield when compared to the check. (Wyoming Agricultural Experiment Station, Univ. of Wyoming, Laramie.)

Yields and percent weed control as affected by pre-plant herbicide treatments in field beans

Treatment	Rate lb/A	% control Nightshade	% control other broad-leaved weed	% control grass	Yield lb/A
Check					1573.5
EPTC	3	94.7	28.8	84.5	
Amiben Amine (amine salt of 3-amino -2,5-dichlorobenzoic acid)	2	94.7	0	63.1	2153.2
Amiben Amine	4	91.1	15.7	50.5	2413.4
Amiben Ester (ester form of 3-amino -2,5-dichlorobenzoic acid)	2	83.9	0	18.0	2493.8
Amiben Ester	4	82.2	55.9	49.6	2249.3
Amiben Amide (amine form of 3-amino -2,5-dichlorobenzoic acid)	2	96.4	49.2	72.1	2561.9
Amiben Amide	4	89.3	44.1	73.9	2588.1
Dinoben Methyl Ester (methyl ester of 3-nitro-2,5-dichlorobenzoic acid)	2	9	9	9	1564.7
Dinoben Methyl Ester	4	71.4	61.9	24.3	2645.7
CP-31393(2-chloro-N-isopropylacetanilide)	4	92.9	9	72.1	2574.1
CP-31393	6	85.7	11.8	83.8	2455.3

Yields and percent weed control as affected by pre-plant herbicide treatments in field beans (continued)

Treatment	Rate lb/A	% control Nightshade	% control other broad-leaved weed	% control grass	Yield lb/A
SD-11831(4-(methyl-sulfonyl)-2,6-dinitro-N,N-dipropylaniline)	2	83.9	88.0	97.3	2268.5
SD-11831	4	98.2	98.3	99.1	1702.7
Dacthal (dimethyl ester of tetrachloroteraphthalic acid)		98.2	94.9	99.1	3033.4
Dacthal + CIPC	3+1	96.4	89.8	97.3	2467.6
Dacthal + CIPC	6+2	94.7	76.3	92.8	2685.9
Dacthal + CIPC	9+3	94.7	93.2	94.6	932.5
Trifluralin + EPTC	.38+1.13	53.6	98.3	100.0	2039.7
Trifluralin + EPTC	.5+1.5	73.2	96.6	100.0	2949.6
Sindone (1,1-dimethyl-4,6-diisopropyl-5-indanyl ethyl ketone)	3	94.7	21.2	96.4	1762.0
*Trifluralin + Amiben	.5+1.5	64.3	93.2	95.5	2233.5
*Amiben + Sindone	1.5+.5	96.4	96.6	99.1	3159.1
*Amiben + Sindone	1.5+1.0	82.2	96.6	100.0	2949.6
*Amiben + Sindone	1.5+1.5	100.0	97.5	99.1	2430.9
*Amiben + Sindone	2.0+.5	89.3	89.8	97.3	3159.1
*Amiben + Sindone	2.0+1.0	82.2	96.6	100.0	2457.1
*Amiben + Sindone	2.0+1.5	100.0	97.5	99.1	2787.1
Trifluralin	1 pt.	94.7	89.8	99.1	2745.2
Trifluralin	1 1/2 pt.	67.9	95.8	98.2	3075.3

*Plots not replicated

Evaluation of four pre-emergence herbicides for control of annual weeds in pinto beans. Hepworth, H. M., J. W. May and J. L. Fults. To keep recommendations current a continuous testing program is necessary. In 1966 four herbicides were field tested at the Botany Experimental Farm at Fort Collins, Colorado.

Plots were broadcast seeded prior to treatment with kochia (*Kochia scoparia*), setaria (*Setaria viridis*), lambsquarter (*Chenopodium album*), pigweed (*Amaranthus retroflexus*) and wild buckwheat (*Polygonum convolvulus*). Chemicals were applied preplant, incorporated 2 inches deep, in 8 inch bands into a clay loam soil. Bean seed was variety Idaho III. Evaluation for weed control was made 28 days after treatment. Yield data were not taken. Results are shown in the following table.

Herbicide	lb/A	Bean stand per cent	Percent weed control Broadleaf	Percent weed control Grasses
Trifluralin	1	94	72	98
Trifluralin	2	94	89	98
Trifluralin	4	87	94	100
EPTC	3	100	54	98
EPTC	6	94	72	98
EPTC	9	94	80	100
EPTC	15	94	90	100
Sindone-B	2	94	63	98
Sindone-B	4	87	76	100
Sindone-B + Amiben	2+2	94	94	100
Control	0	100	0	0

Plots were carried through blossom stage for observation of possible injury symptoms. No injury to beans was observed. (Botany, Plant Pathology Section, Colorado Agri. Exp. Sta., Ft. Collins.)

Response of field beans to high rates of EPTC and trifluralin. Hepworth, H. M., J. W. May and J. L. Fults. During the summer of 1965, following several calls from farmers to observe fields of beans purportedly damaged by "chemicals", experiments were begun to determine the response of pinto beans to varied rates of EPTC and trifluralin.

Greenhouse trials have shown that pinto beans (var Idaho III) will produce mature plants and set seed when grown in soil containing up to 30 lb/A of EPTC. At 9 lb/A under greenhouse conditions definite symptoms are exhibited. Primary leaves are reduced in size and have a crinkled, misshaped margin. At rates of 15, 20 and 30 lb/A EPTC these symptoms are progressively more evident. Plants treated with the higher rates may fail to develop primary leaves but do produce trifoliate leaves, flower and set seed.

Root development of young plants treated with high rates of EPTC is retarded. As plants approach maturity root growth equals that of untreated plants. Indications are that disease lesions on the hypocotyl decreased as the rate of EPTC increased.

In another series of greenhouse tests field beans were treated with trifluralin at rates equivalent to 0, 1, 2, 4, 8, and 12 lb/A. Foliar growth of plants receiving 8 and 12 lb/A trifluralin was slightly reduced compared to visible untreated controls. All plants matured and set seed. Pinto beans in field trials, in a clay loam soil using trifluralin at the rate of 4 lb/A (4 times recommended rate) applied preplant and incorporated to a 2 inch depth, showed no visible symptoms of injury and flowered normally. Beans grown in field trials treated with EPTC at 6, 9 and 15 lb/A (2, 3 and 5 times recommended rate) applied preplant and incorporated to a 2 inch depth, likewise showed no visible symptoms of injury and flowered normally. (Botany and Plant Pathology Section, Colorado Agri. Exp. Sta., Fort Collins.)

Pre-plant application of chemicals for weed control in corn in Wyoming. Lee, G. A. and Alley, H. P. Pre-plant applications of several new herbicides were made to evaluate weed control and crop tolerance. Soil type was predominately sandy loam. The chemicals were applied full coverage in 40 gpa of water carrier. Weed populations were categorized as (1) rough pigweed (*Amaranthus retroflexus* L.), (2) lamb's quarters (*Chenopodium album* L.), (3) black nightshade (*Solanum nigrum* L.) and (4) grass (*Setaria viridis* L. Beauv.)

Because of dry weather conditions, the field was irrigated a short time after planting to insure adequate seed germination.

Thirteen treatments resulted in over 90 percent control of all broad-leaved weeds (attached table). Grass control of over 90 percent was obtained with six treatments. Dicamba at 2 lb/A resulted in 100 percent control of all weed species with no apparent damage to the corn. Although Catoran (1,1-dimethyl-3-(a,a,a-trifluoro-m-tolyl) urea) at 2 lb/A and 3 lb/A gáve excellent weed control, the rates exceeded the limits of crop tolerance. Tenoran (3-P-(P-chlorophenoxy)phenyl -1,1-dimethylurea) at 2 lb/A and ACP 65-237 (methyl ester of amiben + fenac) at 3 qt/A caused slight growth reduction of the corn. (Wyoming Agricultural Experiment Station, Univ. of Wyoming, Laramie.)

Percent weed control of annual weed with pre-plant treatments in corn

Treatment	Rate	Percent Weed Control				Remarks
		Rough Pigweed	Lamb's Quarters	Night-shade	Grass	
Knoxweed 42 (EPTC + 2,4-D)	2 qt/A	37.5	33.3	68.0	0	
Knoxweed 42	3 qt/A	90.6	100.0	96.2	62.9	
Knoxweed 52 (Gran. form of EPTC + 2,4-D)	10 lb/A	34.4	83.3	91.0	45.9	
Catoran (1,1-dimethyl-3-(a,a,a-trifluoro-m-tolyl) urea)	2 lb/A	100.0	100.0	100.0	96.8	corn stunted, chlorotic
Catoran	3 lb/A	100.0	100.0	100.0	100.0	corn severely stunted-chlorotic
Catoran	4 lb/A	84.4	100.0	84.6	41.9	corn severely stunted
Tenoran (3- P-(P-chlorophenoxy) phenyl -1,1-dimethylurea)	2 lb/A	96.9	100.0	100.0	56.5	corn very slightly stunted
Tenoran	3 lb/A	90.6	100.0	98.7	8.1	
C-6313 (N-(4-bromo-3-chlorophenoxy)-N'-Methoxy-N'-methyl urea)	4 lb/A	100.0	100.0	98.7	90.3	
G-36393 (2-isopropyl-amino-4-(3-methoxy-propylamino)-6-methyl-thio-s-triazine)	1 lb/A	81.2	100.0	0	71.0	

Percent weed control of annual weed with pre-plant treatments in corn (Contd.)

Treatment	Rate	Percent Weed Control Rough Pigweed	 Lamb's Quarters	 Night-shade	 Grass	Remarks
G-36393	3 lb/A	87.5	100.0	87.2	83.9	
GS-18183(a chloro-diamino-s-triazine)	1 lb/A	96.9	100.0	94.9	0	
GS-18183	2 lb/A	62.5	100.0	59.0	32.3	
GS-13529 (2-<u>tert</u>, butylamino-4-chloro-6-ethylamino-s-triazine)	1 lb/A	100.0	100.0	100.0	74.2	
GS-13529	3 lb/A	100.0	100.0	100.0	91.9	remaining grass stunted, corn healthy
GS-14260 (2-tert.butyl-amino-4-ethylamino-6-methylthio-s-triazine)	1 lb/A	100.0	50.0	100.0	53.2	
GS-14260	3 lb/A	100.0	100.0	100.0	83.9	
ACP 65-237 (methyl-ester of amiben + Fenac; 1+.5 lb/gal)	3 qt/A	75.0	100.0	85.9	14.5	
ACP 65-237	4 qt/A	53.2	100.0	64.1	59.7	
Ramrod (2-chloro-N-isopropylacetanilide)	4 lb/A	96.9	100.0	56.4	80.6	
Ramrod	6 lb/A	84.4	100.0	43.6	95.2	
Dicamba	1 lb/A	96.9	100.0	100.0	75.8	
Dicamba	2 lb/A	100.0	100.0	100.0	100.0	
M-2861 (Picloram + 2,4-D; 2 oz. + 2 lb/gal)	1 pt/A	93.8	100.0	92.3	88.7	
M-2861	2 pt/A	34.4	83.3	66.7	0	
M-2863 (picloram + MCPA; 2 oz. + 2 lb/gal)	1 pt/A	87.5	83.3	89.8	56.5	
M-2863	2 pt/A	81.2	100.0	100.0	0	
Clobber (3', 4'-di-chloro-cyclopanecar-boxanclide)	2 lb/A	34.4	100.0	87.2	51.6	

<u>Pre-emergence weed control in sweet corn.</u> Rydrych, Donald J. There are many unanswered questions about the tolerance of sweet corn to many of the herbicides now in common use in field corn. For this reason several compounds were tested in 1966 on sweet corn (var. Golden Bantam Cross) under sprinkler irrigation to test crop safety.

Weeds common in the test area included Russian thistle (Salsola kali), barnyard grass (Echinochloa crusgalli), lambsquarters (Chenopodium album), and rough pigweed (Amaranthus retroflexus). Treatments were applies pre-emergence in April, 1966 on an Ephrata loamy sand soil. Water was supplied by sprinkler irrigation for the first 2 settings and thereafter by furrow irrigation.

OCS-21944 (2, 3, 5, 6-tetrachloro-4-carbomethoxybenzoic acid), OCS-21693 (methyl-2, 3, 5, 6-tetrachloro-N-methoxy-N-methylterephthalamate), and OCS-21799 (2 4-chloro-o-tolyloxy -N-methoxyacetamide), all at 2-4 lb/A; GS-18183 (chlorodiamino-s-triazine), GS-17891 (methoxydiamino-s-triazine), GS-14260 (2-tert. butylamino-4-ethylamino-6-methylthio-s-triazine), all at 1-3 lb/A; BH-584 (5(6)-chloro-2-isopropylbenzimidazole), at 1.5-3 lb/A; CP-50144 at 1-2 lb/A; and linuron were compared with atrazine at 1.5-3 lb/A, EPTC at 2 lb/A, CP-31393 (N-isopropyl-α-chloroacetanilide), at 2-3 lb/A, and DNBP amine at 3 lb/A.

There was satisfactory crop safety with all of the standard herbicides namely, atrazine, EPTC, CP-31393, and DNBP amine. Atrazine was effective on all weeds with excellent crop safety. EPTC was effective on all weed species with fair to good crop safety. CP-31393 was active on the grasses but weak broadleaves but had fair to good crop safety. DNBP amine was active only on the broadleaves and crop safety was fair.

Of the new materials, GS-18183, GS-14260, and CP-50144 looked promising. GS-18183 and GS-14260 were similar to atrazine in activity and both had excellent crop safety. GS-14260 was most effective at 3 lb/A. CP-50144 was active on the grasses and weak on the broadleaved weeds.

BH-584 was active on the grasses but very weak on broadleaves--crop tolerance was good. OCS-21799 at 2-4 lb/A was active on all weed species but crop safety was poor. OCS-21944 and OCS-21693 were weak on broadleaves with some activity on grasses but crop safety was good.

In addition to the single pre-emergence applications there are several combination treatments that appear promising. Combinations of linuron plus atrazine (1.5 + 1.5 lb/A), CP-31393 plus atrazine (2-3 + 1.5 lb/A), CP-50144 plus atrazine (1-2 + 1.5 lb/A), CP-31393 plus dicamba (3 + .25 lb/A), CP-31393 plus 2,4-D (3 + .5 lb/A), EPTC plus atrazine (2 + 1.5 lb/A), EPTC plus CNBP amine (2 + 3 lb/A), CP-31393 plus DNBP amine (3 + 3 lb/A), and CP-50144 plus DNBP amine (2 + 3 lb/A) were effective on both grasses and broadleaves. DNBP amine was applied when corn was in the 4-5 leaf stage and all other compounds were applied pre-emergence or pre-plant incorporated (EPTC). Crop tolerance was good with all combinations except when DNBP amine was in the mixture, in which case crop injury was increased. The combination trials are preliminary in nature and more tests are planned. (Oregon Agricultural Experiment Station, Pendleton.)

Post-emergence weed control in corn in Wyoming. Lee, G. A. and Alley, H. P. Three chemicals at two rates were evaluated as post-emergence treatments for the control of annual broadleaved and grassy weeds in corn.

Applications were full coverage over the corn using 40 gpa of water carrier. The corn was in the four to six leaf stage of growth at the time of treatment. The weed population was classified as to (1) Broadleaved weed, rough pigweed (Amaranthus retroflexus L.), lamb's quarters (Chenopodium album L.) and purslane (Portulaca oleracea L.), (2) black nightshade (Solanum nigrum L.) and buffalo bur (Solanum rostratum Dunal.) and (3) grass, green foxtail (Setaria viridis (L.) Beauv.) and barnyardgrass (Echinochloa crusgalli (L.) Beauv.).

Results show (accompanying table) that the 2 lb/A rate of C-7019 (2-azido-4-isopropylamino-6-methylmercapto-s-triazine) and Catoran (1,1-dimethyl-3-(a, a,a-trifluoro-m-tolyl) urea) was not sufficient to reduce the weed population. However, Catoran at 4 lb/A gave satisfactory control of all weed species present. Clobber (3', 4'-dichlorocyclopanecarboxanilide) at 2 lb/A and 4 lb/A resulted in outstanding control of nightshade and grass but did not give satisfactory control of the remaining broadleaved portion of the weed spectrum.

Catoran and Clobber at all rates showed visible toxicity to the corn. (Wyoming Agricultural Experiment Station, Univ. of Wyoming, Laramie.)

Post-emergence treatments in corn

Treatment	Rate lb/A	% Control Broadleaved weeds	% Control Nightshade	% Control grass
C-7019 (2-azido-4-isopropylamino -6-methylmercapto-s-triazine)	2	0	0	0
C-7019	4	87.8	87.0	81.1
Catoran (1,1-dimethyl-3-(a,a,a-trifluoro-m-tolyl) urea)	2	0	0	0
Catoran	4	70.7	92.4	60.8
Clobber (3',4'-dichlorocyclopane-carboxanilide)	2	58.5	100.0	100.0
Clobber	4	19.5	98.9	95.9

Herbicide mixtures on corn. Olson, Phillip D., Furtick, W. R., and Appleby, A. P. Trials were established in the spring of 1966 in eight locations representing several different soil types in Oregon. Several chemical combinations were tested either as pre-plant incorporated, pre-emergence, early post-emergence (spike stage) or post-emergence (2-4 leaf stage) applications. The purpose of the experiments was to lower the rates of persistent herbicides in field and sweet corn and develop better chemical methods for control of grasses in corn. Primary weed species present were annual ryegrass (Lolium multiflorum), redroot pigweed (Amaranthus retroflexus), barnyardgrass (Echinochloa crusgalli), green foxtail (Setaria viridis), lambsquarters (Chenopodium album), and wild radish (Raphanus raphanistrum).

The most promising of the combinations tested were CP-31393 (N-isopropyl-alpha-chloroacetanilide) plus atrazine, CP-50144 (Monsanto) plus atrazine, EPTC plus atrazine, EPTC plus dicamba (pre- or post-emergence), EPTC plus DNBP amine, CP-31393 plus DNBP amine, CP-50144 plus DNBP amine, CP-31393 plus 2,4-D amine and CP-31393 plus dicamba (pre- or post-emergence). All of the above combinations gave good to excellent control of both grasses and broadleaves with CP-50144 plus atrazine and CP-31393 plus atrazine being the most outstanding treatments tested. The EPTC combinations appeared to cause some visual corn injury on lighter soils. Dicamba pre- and post-emergence appeared to reduce yields in sweet corn and cause some visual injury in field corn.

Other chemicals tested were linuron plus atrazine and GS-14260 (2-methylmercapto-4-tert. butylamino-6-ethylamino-s-triazine). Neither of these treatments achieved satisfactory grass control. (Farm Crops Department, Oregon State University, Corvallis.)

Preplanting applications of bensulide in irrigated cotton. Hamilton, K. C. and H. F. Arle. Research with preplanting applications of bensulide to control annual grasses in irrigated cotton was continued in 1966 at the Cotton Research Center, Phoenix, Arizona. Preplanting applications of 1/2, 1, 2, and 4 lb/A were made to the soil (1) on March 11 to the flat soil surface before furrowing for the preplanting irrigation or (2) April 6 before harrowing for the final seedbed preparation. Treatments were replicated 4 times on plots 4 rows wide, 43 feet long. Deltapine Smooth Leaf cotton was planted April 6 in moist soil under a dry mulch. The plot area received 3 cultivations. On June 21 a basally directed application 1 lb/A of diuron was made to the entire furrow and incorporated.

The surface soil contained 25% sand, 46% silt, 29% clay and 1% organic matter. Grasses present were *Panicum fasciculatum* Swartz, *Echinochloa colonum* (L.) Link, *E. crusgalli* (L.) Beauv., and *Leptochloa filiformis* (Lam.) Beauv. Percent weed control was estimated in September and center rows of cotton were harvested in October and November. Grass control and cotton yields are summarized in the table.

Crop emergence and growth were not affected by preplanting applications of bensulide. Early-season weed control was excellent. Lodging of the cotton in mid-August and later rains increased late-season weed problems. Grass control with 1/2 lb/A of bensulide averaged 86% in September. Better control was achieved with higher rates. Yields of cotton were not affected by herbicide treatment. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and Arizona Agricultural Experiment Station, University of Arizona.)

Grass control and cotton yield following preplanting applications of bensulide

Bensulide treatment Method	lb/A	Grass control percent estimated Sept. 12	Yield[1] as percent of test average
Before furrowing	1/2	86	101
" "	1	89	99
" "	2	90	102
" "	4	94	102
Before harrowing	1/2	86	93
" "	1	95	100
" "	2	98	99
" "	4	98	104

[1]Yield of seed cotton on test averaged 3080 lb/A

Preplanting, preplanting-postemergence, and postemergence herbicide combinations in irrigated cotton. Arle, H. F. and K. C. Hamilton. Four methods of applying herbicide combinations to control annual weeds in cotton were evaluated in 2 tests at the Cotton Research Center in Phoenix in 1966 as follows: (1) bensulide, trifluralin, 4-(methylsulfonyl)-2,6-dinitro-*N*,*N*-dipropylaniline (SD-11831), and DCPA were applied with diuron on March 11 as a broadcast application after furrowing for the preplanting irrigation and incorporated with a sectioned, rolling cultivator; (2) the four herbicides applied by the same method were followed by directed applications of diuron on June 21 covering the entire furrow and incorporated; (3) on April 6 diuron was applied before harrowing for the final seedbed preparation and directed applications of bensulide, trifluralin, Planavin, and DCPA were made on June 21 covering the entire furrow and incorporated immediately; and (4) directed applications of the four herbicides in combination with diuron were made on June 21 and incorporated with the sectioned, rolling cultivator. Postemergence treatments with diuron were made with 40 gpa of water containing 1/2% surfactant. Treatments were replicated 4 times on plots 4 rows wide and 43 feet long. Deltapine Smooth Leaf cotton was planted in moist soil under a dry mulch on April 6. The test area received 3 cultivations.

The surface soil averaged 35% sand, 40% silt, 25% clay and 1% organic matter. Weeds present included *Panicum fasciculatum* Swartz, *Echinochloa colonum* (L.) Link, *E. crusgalli* (L.) Beauv., *Leptochloa filiformis* (Lam.) Beauv., *Physalis wrightii* Gray, and *Amaranthus palmeri* S. Wats. Percent broadleaved and grassy weed control were estimated September 12. In October and November the center rows of each plot were harvested. Treatments, weed control, and cotton yields are shown in the table.

No preplanting application affected cotton emergence or seedling development. All combinations gave excellent control of annual weeds through August. Late-season control of grasses was less satisfactory when bensulide, trifluralin, SD-11831 and DCPA were applied postemergence. Yields of seed cotton did not differ between the 16 combinations. Although weed control at harvest

Weed control and cotton yield with herbicide combinations in irrigated cotton

Treatment						Weed control percent estimated September 12		Yield[1] as percent of test average
Date	Herbicide	lb/A	Date	Herbicide	lb/A	Broadleaved	Grasses	
March 11	Bensulide	4	March 11	Diuron	1 1/4	99	98	101
"	Trifluralin	3/4	"	Diuron	1 1/4	95	97	99
"	SD-11831	3/4	"	Diuron	1 1/4	100	91	97
"	DCPA	9	"	Diuron	1 1/4	100	99	101
"	Bensulide	4	June 21	Diuron	1 1/4	99	99	102
"	Trifluralin	3/4	"	Diuron	1 1/4	100	97	99
"	SD-11831	3/4	"	Diuron	1 1/4	98	96	101
"	DCPA	9	"	Diuron	1 1/4	99	98	101
April 6	Diuron	1 1/4	"	Bensulide	4	100	95	104
"	Diuron	1 1/4	"	Trifluralin	3/4	100	88	99
"	Diuron	1 1/4	"	SD-11831	3/4	100	88	100
"	Diuron	1 1/4	"	DCPA	9	100	97	107
June 21	Diuron	1 1/4	"	Bensulide	4	100	88	101
"	Diuron	1 1/4	"	Trifluralin	3/4	100	74	97
"	Diuron	1 1/4	"	SD-11831	3/4	100	80	98
"	Diuron	1 1/4	"	DCPA	9	100	87	93

[1]Yield of seed cotton on tests averaged 2950 and 2660 lb/A.

time varied significantly between treatment, weeds developed late in the season, thus did not affect yields. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and Arizona Agricultural Experiment Station, University of Arizona.

Combinations of preplanting applications of four herbicides with layby applications of diuron in irrigated cotton. Arle, H. F. and Hamilton, K. C. Research on herbicide combinations for season-long control of annual weeds in cotton was continued in Arizona in 1966. Two tests were conducted at the Cotton Research Center in Phoenix in which 2 rates of trifluralin, 4-(methylsulfonyl)-2,6-dinitro-N,N-dipropylaniline (SD-11831), bensulide, and DCPA were applied on March 11 to the flat soil surface before furrowing for the preplanting irrigation, or April 6 before harrowing for the final seedbed preparation. Treatments were replicated 4 times on plots 4 rows wide, and 43 feet long. Deltapine Smooth Leaf cotton was planted in moist soil under a dry mulch on April 6.

After cotton emerged 10-feet sections of row were marked in each plot and the number of cotton plants were counted each week until thinning. Cotton was cultivated until the third postemergence irrigation when the permanent furrows and beds were shaped. On June 17 all plots were treated with 1 lb/A diuron as a directed application covering the entire furrow and base of cotton plants. The herbicide was incorporated with a sectioned rolling cultivator.

The surface soil averaged 28% sand, 44% silt, 28% clay, and 1% organic matter. Weeds present included *Panicum fasciculatum* Swartz, *Echinochloa colonum* (L.) Link, *E. crusgalli* (L) Beauv., *Leptochloa filiformis* (Lam.) Beauv., *Physalis wrightii* Gray, and *Amaranthus palmeri* S. Wats. Strong winds and heavy rain on August 18 and 19 caused cotton to lodge and increased late-season weed growth. The late-season weed problem was further increased by later rains. Percent broadleaved and grassy weed control were estimated Sept. 12, and boll samples were taken for analyses of fiber properties and boll components. In October and November the center rows of each plot were harvested. Treatments, cotton stands, weed control, and cotton yields are shown in the table.

Preplanting applications of trifluralin and SD-11831 before furrowing reduced cotton stands and caused a temporary stunting of cotton plants. Other herbicides applied before furrowing, and all herbicides applied before harrowing did not affect cotton emergence or seedling growth.

All combinations of preplanting herbicides with layby application of diuron gave excellent control of annual weeds through July. Combinations containing DCPA gave excellent control until harvest. Combinations containing bensulide, trifluralin and SD-11831 gave less complete late-season control, however machine harvest was possible. Combinations with the preplanting applications before furrowing gave better average weed control than the applications before harrowing.

Yields of seed cotton and fiber properties were similar with all herbicide combinations. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U. S. Dept. of Agriculture, and Arizona Agric. Expt. Sta., University of Arizona.)

Cotton stands, weed control, and cotton yield with four herbicides applied preplanting followed by layby applications of diuron

Treatment Preplanting method Herbicide	lb/A	Cotton plants per foot of row April 20	May 11	Weed control percent estimated September 12 Broadleaved	Grasses	Yield[1] as percent of test average
Before furrowing						
Trifluralin	1/2	5.1	5.4	98	96	105
Trifluralin	3/4	2.1	2.1	99	96	95
SD-11831	1/2	2.1	2.6	93	85	88
SD-11831	3/4	3.2	3.2	98	87	94
Bensulide	2	3.7	3.8	100	98	106
Bensulide	3	4.9	5.0	98	98	105
DCPA	8	3.7	3.8	100	94	102
DCPA	12	3.1	3.4	100	97	106
Before harrowing						
Trifluralin	1/2	4.9	4.7	62	88	91
Trifluralin	3/4	3.6	3.7	82	94	99
SD-11831	1/2	4.3	4.7	71	86	101
SD-11831	3/4	4.2	4.4	84	80	102
Bensulide	2	5.0	5.5	88	95	98
Bensulide	3	5.1	5.2	84	95	102
DCPA	8	4.7	4.9	100	99	109
DCPA	12	4.3	4.9	100	99	102

[1]Yield of seed cotton on tests averaged 3020 and 2830 lb/A.

Weed control in grain sorgum. Williams, David, W. P. Anderson, and J. W. Whitworth. The most promising herbicides were selected from 1965 screening trials in sorghum at Tucumcari, New Mexico, and were re-tested in 1966, with emphasis on yield data.

The selected herbicides were Atrazine, GS-14260, and Propazine. Each of these herbicides were applied preplant to low seedbeds spaced on 36-inch centers May 24 and soil-incorporated by double-discing parallel with the beds. The beds were reshaped and sorghum seeded about 1-inch deep the next day. On May 25, these herbicides were applied preemergence. In each case, the herbicides were applied at various dosages.

Due to excessive drying of the soil following the double-discing, the emergence and survival of the sorghum seedlings was poor; the sorghum was replanted June 3 without disturbing the soil-surface other than with the planter shoes, and the beds were furrow irrigated.

On June 14, post-emergence over-the-top sprays were applied containing Atrazine at various dosages in a oil-water mixture (1.5 gpa oil plus 20 gpa water) and in a water-surfactant mixture (20 gpa water plus 0.5% surfactant). The sorghum plants were about six inches tall and the surfactant used was Colloidal X-77.

The preplant, preemergence, and post-emergence applications and dosages were randomized throughout the same experimental area and each treatment was replicated six times. Each treatment was applied to a plot 9 ft wide by 25 ft long. Yield data was taken by harvesting the grain from 21 ft of the center row of each plot. Untreated, non-cultivated plots served as checks.

The data obtained from this research are shown in the Table. They indicate that GS-14260 and propazine, applied preplant and preemergence, are safe and effective herbicides for use in grain sorghum. They also indicate that crop injury and yield reductions may be expected following the use of Atrazine as preplant or preemergence treatments, but that Atrazine is an effective and safe herbicide applied post-emergence in mixtures of oil-water or water-surfactant when the sorghum is about six inches tall. (New Mexico Agri. Expt. Sta., University Park, N. M. 88001.)

The effect of herbicides on weed control and crop injury and yield in sorghum at Tucumcari, New Mexico, 1966

Herbicide	lb/A	Sorghum injury[a] (% of check)	Weed control[b] (% of check) grass	broadleaf	Yield[c] (% of check)
Preplant, soil-incorporated (Applied May 24)					
Atrazine	0.5	10	100	100	99
"	1.0	20	100	100	80
"	1.5	30	100	100	72
GS-14260	1.0	20	70	100	103
"	2.0	10	100	100	123
"	4.0	10	100	100	112
Propazine	1.0	10	100	100	107
"	1.5	20	100	100	103
"	2.0	10	100	100	95
Preemergence (Applied May 25)					
Atrazine	1.0	30	100	100	88
"	2.0	50	100	100	39
"	3.0	70	100	100	40
GS-14260	0.5	20	50	60	96
"	1.0	10	70	70	113
"	2.0	10	70	90	116
Propazine	0.5	20	50	100	103
"	1.0	20	90	100	91
"	2.0	20	100	100	95

The effect of herbicides on weed control and crop injury--(Cont'd.)

Herbicide	lb/A	Sorghum injury[a] (% of check)	Weed control[b] (% of check) grass	broadleaf	Yield[c] (% of check)
Post-emergence, sorghum 6 inches tall (Applied June 14)					
Atrazine in					
oil-water	1.0	20	100	100	116
(1.5 gpa oil +	1.5	10	100	100	113
20 gpa water)	2.0	30	100	100	80
Atrazine in	1.0	10	100	100	113
20 gpa water +	1.5	10	90	100	109
0.5% surfactant	2.0	20	100	100	101

a,b - Visual evaluations August 24, 1966; average of six replications.
c - Average of six replications; check yielded 5117 lbs/A.

Soil-applied herbicides in sugar beets. Hamilton, K. C. and Arle, H. F. Five herbicides and five methods of application to the soil were evaluated at Mesa, Arizona for the control of annual weeds in sugar beets. The soil of the test area contained 38% sand, 42% silt, 20% clay and 1% organic matter. Mustard and barley were seeded as weeds in test. Two rows of beets were planted during October, 1965, in dry soil on vegetable beds and germinated by a post-planting irrigation. Herbicides were applied on October 6 and 7 by the following methods: A - disked into the soil four inches deep before furrowing and shaping beds, B - harrowing in one inch deep before furrowing, C - applied to soil surface and incorporated only by furrowing, D - applied after furrowing and incorporated 1 inch with a rotary cultivator, or E - applied to surface of soil after planting immediately before the germination irrigation. Plots were 4 beds 32 feet long and treatments were replicated 4 times. Weed control on bed top was estimated before thinning. The test was thinned and received normal cultivation. Beets were harvested in July. Herbicides, rates of treatment, effect on weeds and sugar beets, and yield of beets are summarized in the table.

Pyrazon and preplanting applications of ethyl N-ethyl-N-cyclohexylthiocarbamate (R-2063), EPTC, and pebulate controlled mustard. Preplanting applications of EPTC, pyrazon, IPC and pebulate controlled barley satisfactorily. Applications of herbicides before furrowing gave the best weed control with little difference between the three prefurrowing methods. Although several treatments controlled weeds on the bed tops, none gave satisfactory control from the seed rows to the bottom of the furrows.

All applications where EPTC, pebulate, and pyrazon were incorporated in the soil caused severe stand reductions and temporary stunting of sugar beets. The yield of beets at harvest showed no significant reduction due to herbicide treatments. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture and Arizona Agriculture Experiment Station, University of Arizona.)

Effect of soil applications of herbicides on weeds and sugar beets at thinning and beet yields at harvest

Treatment			Percent control estimate October 27 before thinning		Beet injury rating[1]	Yield of beets as percent of check[2]
Herbicide	lb/A	Method	Mustard	Barley		
Pebulate	5	A	81	88	36	102
Pebulate	5	B	98	92	60	101
Pebulate	5	C	99	91	60	111
Pebulate	5	D	99	88	70	98
Pebulate	5	E	48	38	2	101
EPTC	5	a	98	98	70	88
EPTC	5	C	100	95	71	91
EPTC	5	D	100	98	82	92
EPTC	5	E	81	65	45	107
R-2063	2	A	96	75	12	108
R-2063	2	B	100	84	10	107
R-2063	2	C	99	88	48	101
R-2063	2	D	98	83	26	104
R-2063	2	E	35	15	2	111
Pyrazon	5	A	100	94	35	102
Pyrazon	5	B	100	90	41	111
Pyrazon	5	C	100	88	42	103
Pyrazon	5	D	100	94	61	116
Pyrazon	5	E	100	72	58	100
IPC	3	A	72	94	5	107
IPC	3	C	82	90	9	109
IPC	3	D	72	81	12	102
IPC	3	E	18	35	2	116
Untreated check			0	0	0	100

[1]No injury; 100=all plants killed.
[2]Yield of beets on checks averaged 55,600 lb/A.

Weed control in sugar beets. Olson, Phillip D., Furtick, W. R., and Colbert, Floyd O. Trials were established in the spring and fall of 1966 at two locations representing different soil types in the Willamette Valley. Various herbicide combinations and several new herbicides were tested either as pre-plant incorporated, pre-emergence, or post-emergence applications. Primary weeds present were annual ryegrass (*Lolium multiflorum*), barnyardgrass (*Echinochloa crusgalli*), lambsquarters (*Chenopodium album*), redroot pigweed (*Amaranthus retroflexus*), dogfennel (*Anthemia cotula*), and wild turnip (*Brassica campestris*).

Pre-plant applications of R-2063 (ethyl-N-ethyl-N-cyclohexylthiol carbamate) and pyrazon applied as a combination gave excellent results in controlling both grasses and broadleaves without sugar beet injury. These results were repeated under the conditions of all locations in both the spring and fall trials. EPTC applied in combination with pyrazon also resulted in good grass and broadleaf control, but EPTC applied on lighter soils, either in combination with other chemicals or alone, produced some symptoms of injury to the sugar beets. Results obtained with CP-31393 (N-isopropyl-alpha-chloroacetanilide) plus pyrazon showed that CP-31393 had a narrow margin of safety under the conditions tested.

Screening trials were conducted which included the following compounds: ACP-66-28, Sindone B, R-11913, R-11914, RP-11755, ACP-65-233-A, ACP-65-261, ACP-65-1-U-1, and H-275. Of the compounds tested, only Stauffer's R-11913 and R-11914, and H-275 of BASF showed promise as a herbicide in sugar beets. H-257 gave the best results when applied pre-emergence.

Further tests with R-11913 and R-11914 were conducted in the fall. Both compounds showed a wide margin of safety towards sugar beets when applied post-emergence. Both compounds achieved excellent grass and broadleaf control with only a slight weakness towards annual ryegrass. Excellent control of both grasses and broadleaves resulted when R-11913 or R-11914 were applied post-emergence following pre-plant incorporated use of R-2063.

Additional studies indicated that 1½ inches of sprinkler irrigation applied immediately after treatments with R-11913 and R-11914 resulted in a reduction of sugar beet selectivity and increased weed control activity. (Farm Crops Department, Oregon State University, Corvallis.)

Pre-emergent weed control in green peas. Rydrych, Donald J. Several new compounds were tested on green peas (var. Perfection) to determine crop safety and performance under sprinkler irrigation as well as on non-irrigated dryland. All materials were applied pre-emergent in April (dryland) and March (irrigated). Weed species in the area included Russian thistle (*Salsola kali*), lambsquarters (*Chenopodium album*), prickly lettuce (*Lactuca scariola*), and tansey mustard (*Descurania sophia*).

BV-201 (2-4 lb/A), GS-14260 (2-3 lb/A), CP-50144 (2-4 lb/A), GS-19538 (2-3 lb/A), and diuron (.8-1.6 lb/A) had good crop tolerance and fair activity on the weeds in the area. These compounds performed well on dryland as well as irrigated peas.

Linuron (.8-1.6 lb/A), OCS-21799 (1-4 lb/A), and SD-10868 gave good weed control on dryland peas and crop safety was good. However, all three compounds produced slight to moderate injury (10-30%) under irrigation although weed control was effective.

Pea yields will be obtained for the most promising of these materials in 1967. (Oregon Agricultural Experiment Station, Pendleton.)

Weed control in peppermint with terbacil. Burrill, Larry C., Arnold P. Appleby and W. R. Furtick. Research on peppermint weed control in Oregon during 1966 was conducted under a wide variety of conditions using various rates of terbacil. Results from these experiments, as in the previous two years, showed outstanding control of annuals at rates of 1.6 ai/A or less. Excellent quackgrass (Agropyron repens) control was obtained at 1.6 lbs. ai/acre. Only the broadleaf perennials such as field bindweed (Convolvulus arvensis), tansy ragwart (Senecio jacobaea), and Canada thistle (Cirsium arvense) have shown resistance to terbacil. However, a few annuals, such as pigweed and Russian thistle, are somewhat resistant when terbacil is used at low rates or under less than ideal conditions.

No injury to peppermint has been seen in the field at rates of 4.8 lbs. ai/A on new mint on sandy soil. Greenhouse results indicate a possible twenty to thirty-fold margin of safety.

All observations indicate that moisture is the key to the effectiveness of terbacil. Some overhead moisture is necessary to move the material into the soil but excessive moisture following application results in poor weed control.

Terbacil persistence in the soil and its effect on crops following mint will be cause for concern until more extensive data are obtained under field conditions. (Farm Crops Dept., Oregon State Univ., Corvallis.)

Weed control with 5 pre-emergence herbicides in potatoes. May, J. W.; H. M. Hepworth and J. L. Fults. Potatoes were planted 6 in. deep in 40 in. rows on May 19, 1966, at the Botany Experimental Farm, Fort Collins, Colorado. Three replications of each treatment were set up in 2-row plots 25 ft. long. Herbicides were applied pre-emergence, post-plant four days after planting.

Chemicals were applied with 65 gpa of water, and incorporated into the soil immediately following application. Incorporation depth was 2 in. in 10 in. bands.

Pigweed (Amaranthus retroflexus L.) was the dominant weed species in the test. Other weeds included lambs' quarters (Chenopodium album L.), kochia (Kochia scoparia (L.) Schrad.), ground cherry (Physalis heteraphylla Nees.), mallow (Malva neglecta Wallr.), purslane (Portulaca oleracea L.), and green bristle grass (Setaria viridis (L.) Beauv.). On June 27, the following observations were recorded:

Treatment	Rate lb/A	Potato Stand percent	Broadleaf Weed Control percent	Grass Weed Control percent
EPTC	3	84	50	100
Sindone-B	2	91	65	100
Trifluralin	1	91	85	100
EPTC + Amiben	2+3	84	93	100
Sindone-B + Amiben	2+3	88	96	100

Data was obtained by counting 50 inch samples of each row for each replication taking into account everything within the ten-inch band. No yield data was taken. (Botany and Plant Pathology Section, Colorado Agri. Expt. Sta., Fort Collins.)

Herbicide tolerance trial on Norgold potatoes grown in the Willamette Valley. Slater, Clarence H., Phillip Olson and William R. Furtick. Six different herbicides were tested for selectivity in Norgold potatoes on the East Experiment Farm of Oregon State University, Corvallis, Oregon. The soil type was a Chehalis sandy loam with approximately 1.76% organic matter. All herbicide treatments were replicated four times and compared against a hand-weeded check.

The tuber seed pieces were planted seven inches deep with a slight soil ridge over the seed. No further hilling or mechanical cultivation was carried out during the trial period. All plots were maintained weed free by hand weeding.

The following herbicides were tested for crop tolerance under minimum tillage:

Summary of tons per acre of field run Norgold potatoes

Treatment	Application methods	Herbicide lb/A	Potato Yield tons/A	Statistical Significance
1. Patoran	pre-emergence	1.5	26.2	
2. Linuron	pre-emergence	2.0	24.9	
3. Trifluralin	incorporated post-plant	1.0	24.7	
4. Diphenamid	pre-emergence	12.0	24.0	
5. Eptam	incorporated pre-plant	4.0	23.8	
6. Linuron	pre-emergence	1.5	22.9	
7. Patoran	pre-emergence	4.0	22.5	
8. Hand-weeded check			22.4	
9. Patoran	pre-emergence	2.0	22.2	
10. Trifluralin	incorporated post-plant	.75	21.6	
11. Linuron	pre-emergence	4.0	21.3	
12. Diphenamid	pre-emergence	6.0	20.7	
13. CP-31675	incorporated pre-plant	3.0	16.8	
14. CP-31675	incorporated pre-plant	6.0	12.3	

There were no significant differences in yield from treatments one through nine as determined by Duncan's Multiple Range Test. The lowest yielding plots were those treated with CP-31675 where the herbicide was applied pre-plant and incorporated to a depth of three inches.

Patoran at 1.5 lb/A, linuron at 2.0 lb/A and trifluralin at 1.0 lb/A showed a high degree of safety under Corvallis, Oregon conditions. Not only were patoran and linuron relatively safe, they both exhibited season-long weed control.

These results and other data obtained seem to indicate that Norgold potatoes can be grown without cultivation when a weed-free environment is maintained through the use of herbicides. (Dept. of Farm Crops, Oregon State University, Corvallis.)

<u>Herbicide tolerance trials on spring wheat and barley.</u> Brenchley, R. G., Appleby, Arnold, and Furtick, W. R. Tolerance trials were established at the Hyslop Experimental farm near Corvallis, Oregon on March 28, 1966 to determine the toxic effects of various pre- and post-emergence herbicides on Beaver spring wheat and Hannchen spring barley. Pre-emergence herbicides were applied April 1, 1966 when the wheat was in the 3-4 leaf stage and the barley was in the 5-6 leaf stage. All plots except the weedy check plots were kept weed-free by periodic hand weeding throughout the growing season. This was done by using narrow hoes which would fit between the rows of cereals. Weeds were removed from within the rows by hand pulling. Treatments were replicated six times in a randomized block design. Plot size was 10 ft. x 45 ft. with a harvested area of 7.25 ft. x 37 ft. Both the spring wheat and barley were harvested on August 4, 1966. Results are given in the following table.

Yield and statistical significance of spring wheat and barley

Treatment	Active lb/A	Wheat Yield cwt/A	*Significance	Barley Yield cwt/A	*Significance
Chlorflurazole-w	1.5	22.68	ab	27.07	ab
Chlorflurazole-w	3.0	21.96	abc	26.83	abc
Chlorflurazole-w	4.5	21.72	abcd	-----	
Chlorflurazole-w + MCPA	1.5+0.5	23.46	a	26.69	abc
Bromoxynil	6.0 oz.	22.32	ab	26.35	abc
Bromoxynil	12.0 oz.	21.90	abc	27.94	a
GS-14260	1.5	22.08	abc	27.46	a
GS-14260	3.0	21.06	bcd	25.20	bc
2,4-D Amine + Dicamba	0.5+0.125	19.80	d	25.82	abc
2,4-D Amine	0.5	21.06	bcd	26.54	abc
Handweeded Check		21.10	cd	24.67	c
Weedy Check		20.82	bcd	24.62	c
		C.V.=7.2%		C.V.=6.6%	

*Treatments having the same letter are not significantly different at the 5% level.

None of the herbicide treatments significantly reduced the yield of either barley or wheat compared to the hand-weeded check. The 2,4-D Amine + Dicamba combination tended to cause lower yields than the other herbicide treatments, although not all differences were significant.

Some herbicide treatments, particularly Chlorflurazole and bromoxynil, gave significantly higher yields than those obtained from the hand-weeded check plots. It would be tempting to conclude that these treatments stimulated the growth of the grains. However, we suspect that the grains may have been slightly injured during the hand-weeding process. The fact that yields from the hand-weeded checks were equal to or slightly lower than the weedy checks would tend to support that conclusion. The grains were under moisture stress during the entire growing season and any hoe damage to the plant roots could easily have affected the final yields. Proof of stimulation from these herbicides must be obtained under conditions in which manual injury is not a possibility.

None of the treatments had any significant effect on the test weight of either wheat or barley, nor were any appreciable trends noted. (Farm Crops Department, Oregon State Univ., Corvallis.)

Control of silverleaf poverty weed on winter wheat land. May, J. W., H. M. Hepworth and J. L. Fults. An experiment was established on dry land wheat land near Kelim, Colorado to determine the comparative effectiveness and safety in using picloram and dicamba, both alone and in various combinations with 2,4-D to control povertyweed (Franseria discolor).

The test area has been farmed alternate wheat and fallow for many years. A crop of wheat, untreated by any herbicide, was taken from the land in 1965. After harvest the ground was one-wayed and left fallow through the summer of 1966. The herbicide test was started August 16, 1966, when the povertyweed was thick and growing vigorously. Thirteen and 26 days following treatment, Otis barley and Commanche wheat were planted across the plots. Observations made 48 days after chemical treatment are recorded in the attached table.

The toxicity to grain seedlings planted 26 days following chemical treatment appeared to be somewhat less severe at the higher rates than indicated in the table, but still remained too high a level to safely permit planting of a crop. Very little difference was noticeable between the wheat and barley with respect to susceptibility.

Herbicidal effect on povertyweed 48 days after treatment
and toxicity to grain 35 days following planting

Plot Number	Chemical Treatment	lb/A	Povertyweed Reduction	Toxicity to Grain Seedlings
1	Picloram	1/4	50-60%	slight
2	Picloram	1/2	70-80%	slight
3	Picloram	1	90-100%	moderate
4	Picloram + 2,4-D	1/8+2	60-70%	slight
5	Picloram + 2,4-D	1/4+2	70-80%	slight
6	Picloram + 2,4-D	1/2+2	90-95%	slight
7	Picloram + 2,4-D	1+2	95-100%	moderate
8	Dicamba	2	80-85%	moderate
9	Dicamba	3	100%	severe

Herbicidal effect on povertyweed 48 days after treatment
and toxicity to grain 35 days following planting (Cont'd)

Plot Number	Chemical Treatment	lb/A	Povertyweed Reduction	Toxicity to Grain Seedlings
10	Dicamba	5	100%	severe
11	Dicamba + 2,4-D	1+2	90-95%	moderate
12	Dicamba + 2,4-D	2+2	100%	severe
13	Dicamba + 2,4-D	3+2	100%	severe
14	Control	---	0	healthy seedlings

This experiment will be carried through next season for conclusive results. (Botany and Plant Pathology Section, Colorado Agri. Expt. Sta., Fort Collins.)

Evaluation of several post-emergent herbicides for blue mustard (*Chorispora tenella*) control in winter wheat. Rydrych, Donald J. Blue mustard, which was once very difficult to control with the phenoxy compounds, is extremely sensitive to several new materials.

Post-emergent applications of linuron, diuron, bromoxynil, GS-14260, GS-17892 and GS-14253 were applied in March 1966. Blue mustard was 1-2 in. in diameter and Gaines winter wheat was in the 4-5 leaf stage with 1-2 tillers.

Excellent weed control and high crop tolerance was possible with linuron (.8-1.6 lb/A), diuron (.8-1.6 lb/A), bromoxynil (1/3-1 lb/A), GS-14260 (1-3 lb/A), GS-17892 (1-3 lb/A), and GS-14253 (1-3 lb/A). Wheat was injured by 2,4-D because it was in the sensitive stage when treated. All of the treatments were compared with a hand weeded control and yield data and crop injury are recorded in the table.

The results show that blue mustard is a vigorous competitor and it must be controlled in late fall and early spring. This often occurs when wheat is too young for treatment with the phenoxy compounds. Several of the new compounds show excellent selectivity in wheat and treatments can be made early. (Oregon Agricultural Experiment Station, Pendleton.)

Treatment	Rate lb/A	Ave. wheat yield lb/A	Weed control	Visual crop injury
GS-14260	1	1655	8.8	0
GS-14260	3	1910	10	0
GS-17892	1	1275	7	0
GS-17892	3	1810	10	0
GS-14253	1	1290	7.5	0
GS-14253	3	1820	10	0

(Cont'd)

Treatment	Rate lb/A	Ave. wheat yield lb/A	Weed control	Visual crop injury
Linuron	.8	2120	10	0
Linuron	1.6	1880	10	1
Diuron	.8	2020	9.5	0
Diuron	1.6	1990	10	0
Bromoxynil	.38	2015	9.8	0
Bromoxynil	1.0	2150	10	0
2,4-D (LVE)	.75	1000	5	2
2,4-D (LVE)	1.5	1310	10	4
Weeded control	----	1830	10	0
Control	----	36	0	0

Rating scale - 10 = 100% injury or control, 0 = none

Selective downy brome (Bromus tectorum) control in winter wheat. Rydrych, Donald J. Fifteen new herbicides were tested in 1966 for the selective control of downy brome in winter wheat. SD-11831 at .75-1.5 lb/A; CP-50144 and CP-45592 each at 1-4 lb/A; GC-10614 and GC-11156 each at 1-4 lb/A; ACP-65-95, ACP-65-96, and ACP-65-97 all at 2-6 lb/A; Sindone at 1-3 lb/A; OCS-21799 and ASC-188 each at .5-1.5 lb/A; GS-14260 and GS-16065 each at 1-4 lb/A; TD-1042 at .5-2 lb/A; and linuron at .8-1.6 lb/A; were applied pre-emergent in October-November 1965.

Only GS-14260 and ACP-65-96 were effective on downy bromw with a wide margin of crop safety. Linuron was fairly active on downy brome at the higher rates on light soils but was very weak in heavy soils. These three compounds also have excellent broadleaf potential.

Post-emergent applications of several new compounds were not effective. Only GS-14260 showed some activity on downy brome when applied early post-emergent. Many post-emergent type herbicides are less selective on wheat and are also weak on established downy brome. (Oregon Agricultural Experiment Station, Pendleton.)

Chemical fallow screening trials. Rydrych, Donald J. Several herbicides have been tested in eastern Oregon during the past three seasons in an attempt to find a material that was comparable in activity to atrazine plus amitrole-T (.6-1.2 + .5-1 lb/A). This particular combination has been excellent for downy brome and volunteer grain control in stubble fields during the winter months but the residual effect of atrazine has been troublesome on some light soils.

Combination treatments of atrazine plus amitrole-T were compared with GS-14260 plus amitrole-T, and GS-13528 plus amitrole-T (all at .6-1.2 + .5 lb/A), RP-11755 (3-6 lb/A), and RP-11561 (3-6 lb/A). Weed control ratings were made in May prior to the first tillage.

All new combinations gave excellent control of downy brome and volunteer grain during the winter months, the heavier rates being 100% effective. However, none of the new combinations were superior to the standard atrazine plus amitrole-T treatment. RP-11755 was weak on downy brome and was only 70% effective at the highest rate (6 lb/A). RP-11561 was 100% effective at all rates tested and was comparable to the standard chemical fallow combination. RP-11561 was a little weak on annual broadleaved weeds (50-100%) although there was considerable suppression.

The most promising compound in these tests based on weed activity and possible short term soil persistence was RP-11561. Further trials are planned. (Oregon Agricultural Experiment Station, Pendleton.)

Tolerance of several crops to herbicides containing spray drift adjuvants. Ekins, W. Leo, Appleby, A. P., and Furtick, W. R. In the spring of 1966, experiments were conducted at Corvallis, Oregon to determine effects of the spray drift control adjuvants Vistik, Dacagin, and Norbak, separately, and in combinations with herbicides on Beaver spring wheat, field corn, Hannchen spring barley, and red clover.

The amounts of drift adjuvant used in these experiments were as follows: Vistik, 3-5 lb/100 gallons; Dacagin 4-5 lb/100 gallons; and in the case of Norbak, sufficient amounts were added to thicken the spray solution so that it required 40 seconds for the final solution to pass through a Dow consistency funnel. The dacagin formulation used in the wheat and barley trials required kerosene; however, the Dacagin used in the corn and clover was water soluble and did not require an oily solvent.

Spraying in all experiments was done with a plot sprayer having mechanical agitation and 8004 Tee-Jet nozzles. The spraying pressure was 38 psi and the spraying volume 48-55 gpa depending on the treatment.

Applications of 2,4-D amine at rates of 3/4, 1 1/2, and 3 lb/A, and drift adjuvants were made on Beaver spring when in the 6-leaf stage. Visual observations and grain yield determinations indicated no increased injury due to the drift adjuvants.

Similar rates of 2,4-D and drift adjuvants as used in the spring wheat were applied to field corn when in the 3-leaf stage. No significant increase in injury was obtained with the addition of drift adjuvants.

Dicamba and drift adjuvants were applied to Hannchen barley in the 6-leaf stage at the rates of 1/4, 1/2, and 3/4 lb/A. Visual observations indicated no increased injury due to the drift adjuvants, except for Dacagin, which had some tendency towards increasing injury when added to the 3 lb/A rate of dicamba. However, the formulation used in this experiment included kerosene which is no longer used. Visible injury was evidenced in all plots sprayed with dicamba and dicamba + Dacagin, but no significant reductions in grain yield were obtained from any treatment.

Applications of MCPA at rates of 1/2, 1, and 1 1/2 lb/A and drift adjuvants were made on red clover when in the 3-4 leaf stage. Injury due to MCPA was noticeable at all herbicide rates. The addition of Vistik to MCPA increased injury to the clover at the 1 and 1 1/2 lb/A rates.

It appears that any one of the adjuvants may be used with the above herbicides without greatly increasing the risk of injury. However, Norbak-herbicide combinations did not control the weeds as well as other herbicide-adjuvant combinations. This is probably due to the poor spray droplet distribution in the spray swath.

A reduction in the fan angle of sprays containing drift adjuvants was noted, although this can be somewhat corrected by changing the height of the spray boom. (Department of Farm Crops, Oregon State University, Corvallis.)

The influence of drift control adjuvants on herbicidal efficacy and spray drift. Ekins, W. Leo, Appleby, A. P., and Furtick, W. R. In the summer of 1966 two experiments were conducted at Corvallis, Oregon. The purposes of these experiments were as follows: 1) to determine the effectiveness of the products Norbak, Vistik and Dacagin as spray drift control adjuvants and 2) to determine the effect of these products on the herbicidal efficacy of paraquat.

In the first experiment, beans were planted in 4" x 4" pots and grown in a greenhouse until they reached a height of approximately 6 inches. They were then taken to an open field to be used as indicators for spray drift. The potted bean plants were arranged on a grid pattern downwind from the spray swath. They were placed on the ground at 10 foot intervals beginning at the spray swath and extending out 100 feet.

The spray was applied with a plot sprayer having mechanical agitation and using 8004 Tee-Jet nozzles with an output of 48-55 gpa, depending upon the treatment. Two superimposed swaths were sprayed for each paraquat-adjuvant treatment with the direction of travel perpendicular to the wind. The spray solution contained 2 lb/A of paraquat and the appropriate adjuvant.

The bean plants were taken back to the greenhouse and evaluated several days later. The results are shown in the table.

It appears that any one of the three adjuvants used will do an effective job of reducing spray drift, however, they will not completely eliminate all the fine spray droplets as evidenced in the table.

In the second experiment, thirty-two plant species were planted and arranged so all thirty-two species were present in each plot. The treatments consisted of paraquat, paraquat + X-77, paraquat + X-77 + drift adjuvant, paraquat + drift adjuvant, and untreated plots. The treatments were applied with a plot sprayer having mechanical agitation and 8--4 Tee-Jet nozzles with an output of 48-55 gpa depending upon the treatment.

Visual evaluations indicated that the drift adjuvants could not be substituted for the surfactant X-77 and still obtain comparable herbicidal efficacy. However, Dacagin and Vistik in combination with paraquat + X-77 did not appear to reduce the effectiveness of paraquat in killing the plant species. Norbak drastically reduced the herbicidal efficacy of paraquat in all treatments. This is probably due to the poor distribution of spray droplets across the spray swath.

Comparisons of bean injury using Norbak, Dacagin and Vistik with paraquat[1]

Treatment	Lb. active Material	Wind Vel. (MPH)	Percent bean injury[2] Distance from spray swath (ft.) 10	50	100
Paraquat	2/A	7.1	77	18	3
Paraquat+Dacagin	2/A+4.5/100 Gal.	8.9	43	4	1
Paraquat+Vistik	2/A+4.5/100 Gal.	7.0	26	2	1
Paraquat+Norbak	2/A+40 seconds*	4.8	36	1	0
Check			0	0	0

[1]Data are averages of 4 replications
[2]Based on 0 = no injury and 100 = complete kill
*Forty seconds required for final spray solution to pass through a Dow consistency funnel.

(Farm Crops Department, Oregon State University, Corvallis.)

Comparison of weed control treatments in new forage seedings. Peabody, Dwight V., Jr. Of the several inter-related treatments which included time and method of seeding as well as several ways to control annual weeds, both before and after planting, early post-emergence applications of DNBP resulted in the highest yield of the best forage in one test. On the other hand, under optimum soil and moisture conditions, preplanting applications of diquat as utilized in the "stale" seed bed technique have also resulted in the establishment of a good pasture sward with a minimum of annual weed competition. This year's results indicate, all other factors being equal, that preplant chemical (diquat) treatment results in higher yields of "good" forage than preplant flaming treatments. (Northwestern Washington Research & Extension Unit, Washington State University, Mount Vernon.)

Residual effect of picloram on field crops. Rydrych, Donald J. Trials were established in 1964 to study the soil residual effect of picloram on several crops. The original picloram treatments were made in 1964 and the preliminary results were recorded in last year's proceedings. The same area was reseeded and the 1966 evaluations are recorded in the enclosed table.

Winter wheat, winter barley, winter rye, field peas, and safflower were used as the test crops. The area was kept weed free so that crop injury evaluations would not be biased.

Results obtained after two years testing indicate that the cereals are able to tolerate high levels of picloram in the soil. Wheat, barley, and rye were slightly injured at 1 lb/A but were able to mature 60% crops. Rye and barley were severely injured at 2 lb/A and produced only 20-30% of capacity. Wheat was the most resistant crop at 2 lb/A and produced a 40% crop.

Field peas for the first time in two years were able to survive in a soil that had been treated with 1/4 lb/A. However, peas were still highly sensitive at rates above 1/4 lb/A. Safflower could not be established in any of the previously treated soils. (Oregon Agricultural Experiment Station, Pendleton.)

Residual effect of picloram (.25-2 lb/A) in field crops two years after treatment

Species	Check	Injury rating[1] .25	.50	1.0	2.0
Field peas (Perfection)	0	0	10	10	10
Wheat (Gaines)	0	0	0	4	6
Barley (Hudson)	0	0	0	4	8
Rye (Tetra Petkus)	0	0	0	4	7
Safflower (Frio)	0	10	10	10	10

[1]Control rating - 10 = 100% injury, 0 = none

PROJECT 6. AQUATIC AND DITCHBANK WEEDS

E. J. Bowles, Project Chairman

No Summary Submitted by the Project Chairman.

Pre-emergence control of annual weeds on irrigation rights of way, Columbia Basin Project, Washington. Oliver, Floyd E. Large scale field trials of several herbicides for control of annual weeds in established desirable grass stands on the dry portion of drain and canal banks were started in 1963. Low rates of the materials were applied in November and December by conventional boom spray methods to obtain growing season control from the following March to the start of the summer drought in July. The objective of the field trials was to find a method to: (1) move a portion of the spring-summer spray load to the fall thereby reducing extra labor and double shifting; (2) permit greater flexibility in handling that load where wind conditions make maintaining a steady, daily schedule difficult and hazardous. These benefits were to be achieved at near the cost of the present practice. The pre-emergence application would give six months of growing season control and replace two foliage applications of 2,4-D. A goal of $4.50/A total cost was set.

The trials were made in the vicinity of Othello, Washington where the annual precipitation averaged 7.71 inches for the years 1963, 1964 and 1965. The winter precipitation from November 1 through the following March was 3.38, 6.64 and 4.41 inches for these years. The applications were made with a regular project boom sprayer having mechanical agitation and a maximum swath width of 50 feet. Each plot covered about 8 acres or a sprayer load. Diluent averaged 45 gal/A with no adjuvants. Right of way treated varied from original terrain to built-up banks and spoil piles with soils of medium silt to light sandy loams. The herbicides and rates were selected for potential to: (1) control annual broadleaf weeds but principally Russian thistle (*Salsola kali*); (2) leave undamaged or only slightly suppress desirable perennial grasses, principally Crested wheatgrass (*Agropyron cristatum*).

Plot ratings for 1964 (applied Fall, 1963, Spring, 1964) and 1965 (Fall, 1964) made by a team of evaluators are given below. Since the plots were strips a mile or more long and similar rates were scattered, comparisons were difficult. Untreated strips adjacent to the swath and short holidays between plots served as checks. Differences in soil, nutrients, soil moisture, grass stand and incidence for weeds affected the ratings and were not compensated for. Changes between the two ratings of a series reflect seasonal lasting qualities of the particular material and observer inconsistency. Late winter application was abandoned after a March series in 1964 failed and workloads and weather proved to be serious obstacles. Intended rates were: .25, .50, 1.00, 1.50, and 2.00 lb/A ae; the rates of active ingredients which were actually applied are given below. Crew accuracy improved with practice. For convenience, rates for the wettable powders were switched to a product basis for the 1965 series.

The 1964 series served as a good screening with dichlobenil and fenac scoring well. Dicamba seemed to hold promise but gave considerable grass activity. In 1965 picloram and fenac did very well with moderate to no grass effect. Dicamba, atrazine and bromacil were dropped because of erratic weed control and/or grass damage. An unexpected benefit appeared with picloram - Canada thistle (Cirsium arvense) patches in the swath were definitely reduced in vigor and stand.

With its relatively low cost ($3.85 for material plus $1.10 for application) at the successful rate of .25 lb., the 1966 testing was confined to picloram at .25 and .50 lb. A larger acreage was treated but not rated in detail. At .25 lb. picloram thoroughly and consistently controlled the annual weeds with good lasting quality despite summer precipitation and suppressed and thinned stands of Canada thistle and other perennials. At .50 lb. (used where perennials were thicker) the result with annuals was similar while Canada thistle patches were either totally killed or left with a few stunted, deformed survivors except where site factors interfered.

The practice comes close to satisfying the desired objective. With consideration of the additional benefit in perennial control, it goes beyond it. A longer application period in the fall is practical apparently as weather induced degradation is not a large factor with the successful materials. Possibilities for improvement are numerous: lower rates, reduced diluent, combinations of materials, new materials and improved application techniques. Absence of or reduced annual weed growth in 1966 on the 1965 picloram and fenac plots brought out a distinct possibility of two years of control from a single application under our conditions. (Land Management Section, Bureau of Reclamation, Ephrata, Washington.)

Table 1. Evaluation of annual weed control and condition of desirable grasses, 1964 series.

Date:			7-14-64		9-28-64	
Plot No.	Herbicide	lb/A of ae	Weed Control	Grass Condition	Weed Control	Grass Condition
Applied Fall, 1963						
1	Dicamba	1.80	9	4	7	8
8		1.16	8	8	5	8
11		1.16	8	8	4	8
2	Dicamba	2.54	9	5	9	7
7		2.35	8	6	7	9
12		2.10	8	7	8	8
3	Bromacil	.47	8	5	9	7
9		.43	5	3	2	3
4		1.02	9	2	9	4
10		.93	2	4	4	3
5	Dichlobenil	2.00	10	9	-	-
6	Fenac	1.74	9	8	9	8

Table 1. (Continued)

Date:			7-14-64		9-28-64	
Plot No.	Herbicide	lb/A of ae	Weed Control	Grass Condition	Weed Control	Grass Condition
Applied March, 1964						
13	Dicamba	1.47	-	-	-	-
20		.94	1	10	-	-
14		2.40	7	9	-	-
21		2.30	-	-	-	-
15	Bromacil	.69	0	10	-	-
23		.35	3	8	-	-
16		1.06	3	9	-	-
24		.77	6	8	-	-
22	Dichlobenil	1.78	0	10	-	-
26	Fenac	.90	0	10	-	-
17	Atrazine	.49	0	10	-	-
19		.54	1	10	-	-
18		1.14	5	7	-	-
25		1.08	0	9	-	-

Data not recorded or plot not observed (-); Weed control (0)--none; (10)--complete; Grass condition (0)--killed; (10)--no discernible effect.

Table 2. Evaluation of annual weed control and condition of desirable grasses, 1965 series.

Date:						
Plot No.	Herbicide	lb/A of ae	Weed Control	Grass Condition	Weed Control	Grass Condition
(Applied Fall, 1964)						
1	Dicamba	.91	-	-	9	10
7		1.03	3	7	2	10
14		1.03	-	-	-	-
2	Fenac	1.42	-	-	9	10
8		1.54	9	9	5	9
15		1.46	-	-	8	10
3		.98	-	-	7	10
9		.98	-	-	-	-
16		.98	9	10	8	10
4	Atrazine	.84	-	-	-	-
10		.88	9	3	0	2
18		.88	3	7	3	10
5		.39	-	-	-	-
11		.41	9	5	0	4
19		.45	2	7	3	10
6	Picloram	.24	-	-	7	10
12		.26	10	8	8	10
20		.28	10	8	10	10
13	Bromacil	.45	-	-	0	1
17		.45	4	5	3	5
21		.45	-	-	-	-

New innovations for low rate acrolein applications to the Columbia Basin Project Carriage System. Hattrup, Alan R. Low rate, long contact period acrolein applications have been used in the irrigation channels of the Columbia Basin Project for several years to control aquatic weeds. Acrolein has been introduced into flows ranging from less than 100 to over 3,000 cfs at a rate of 0.1 ppm by weight for 48-hour periods. Excellent control of Sago pondweed (*Potamogeton pectinatus*) has been obtained in canals carrying over 300 cfs and satisfactory control has resulted in laterals with 150 to 300 cfs.

A principle problem during a low rate acrolein application to a small lateral has been our inability to maintain a steady flow of the chemical through a Wallace and Tiernan low flow Varea-meter. The flow of acrolein after being adjusted to the desired level would gradually drop, reducing the concentration of acrolein in the water and the effectiveness of the weed control. A Spraying System flow regulator #4908 has been used in conjunction with the Varea-meter to obtain a steady flow of acrolein throughout the 48-hour treatment period. This flow regulator, when equipped with an .015" orifice, will deliver one gallon per hour at a nitrogen pressure of about 20 psi. Nitrogen is used to pressurize the acrolein cylinder, forcing the acrolein through the metering devices and a polyethylene tubing into the water.

Laboratory analysis has shown that a larger percentage of the applied acrolein remains in the water for longer distances when introduced into the inlet of a siphon. Acrolein was introduced into the W20 siphon (1½ miles in length) and water samples were taken at marked locations downstream during this application. The application site was then moved to below the siphon outlet and another treatment was made. Water samples were taken at the same locations as the previous application. These samples were analyzed spectrophotometrically for acrolein by the Agricultural Research Service, Prosser, Washington. The tests showed a recovery of more than 90 percent at the siphon outlet and a correspondingly higher recovery of the applied acrolein at all sampling points from the inlet application. This work indicates that introduction of the acrolein into a closed system results in better mixing of the herbicide with water and a higher concentration.

These two innovations have improved the efficiency of our low rate acrolein applications to the smaller channels. (Land Management Section, Bureau of Reclamation, Ephrata, Washington.)

Alligatorweed control trial under greenhouse conditions with several soil applied herbicides. McHenry, W. B. and N. L. Smith. Two new infestations of alligatorweed, *Alternanthera philoxeroides*, were discovered in the San Joaquin Valley, California, in December, 1965. Prior to this, the only known stand in California existed in what was presumed to be a relatively isolated locale on the Rio Hondo River in Los Angeles County.

A greenhouse trial was initiated at Davis to screen 14 soil applied herbicides. Cuttings were allowed to root for 7 weeks in No. 2 cans (3 1/8 in. diameter) and then treated with the required herbicide. No drainage holes were provided. Liquid and wettable powder formulations were applied to the soil surface in 50 ml of tap water. By 14 weeks, plants receiving the less effective treatments were exhibiting renewed growth.

Results of can treatments after 14 weeks

Less than 95% control		95%-100% control	
Herbicide	lb ai/A	Herbicide	lb ai/A
Bromacil	10	Dichlobenil	10
Bromacil	20	Dichlobenil	20
Diuron	10	Dicamba	5
Diuron	20	Dicamba	10
NIA 11092	10	Picloram	2
NIA 11092	20	Picloram	4
Prometone	10	Sodium chlorate	262
Prometone	20	(Monobor Chlorate)	
Silvex	10	Sodium chlorate	783
Silvex	20	(Monobor Chlorate)	
Fenac	10		
Fenac	20		
2,3,6-TBA	10		
2,3,6-TBA	20		
Pyriclor	10		
Pyriclor	20		
2,4-D (gran. B.E. ester)	20		
2,4-D (gran. B.E. ester)	40		
Monuron (Ureabor)	17		
Monuron (Ureabor)	35		

The more promising herbicides were included in a field experiment established in November, 1966. (Agricultural Extension Service, University of California, Davis.)

Evaluation of copper sulfate for control of pondweeds in irrigation canals. Bartley, T. R. A field study was conducted during the 1966 irrigation season primarily to determine the effectiveness of daily applications of low concentrations of copper sulfate for controlling submersed aquatic weeds in flowing irrigation water. Other factors investigated include: distance that control can be accomplished, fate of the copper applied, effect of water alkalinity on the phytotoxicity of the copper, performance of the feeding device and copper sulfate particle size requirement for the feeder, water temperature, and effects of copper on other aquatic life.

A small unlined earth canal in the vicinity of Loveland, Colorado, having a history of aquatic weed problems was selected for this study. The canal is about 10 miles long and normally carries a waterflow ranging from 20 to 30 cfs. Leafy pondweed (*Potamogeton foliosus* Raf.) was the main species in the first mile. There was a fairly uniform infestation of sago pondweed (*Potamogeton pectinatus* L.) throughout the remaining 9-mile reach of the canal. Copper sulfate was fed into the water at a site about 200 feet below the diversion works. This untreated reach provided a control section for sampling and observations.

Water was turned into the canal about the middle of May. Copper sulfate feeding was started on June 3, at which time the pondweeds had started a rapid rate of growth and were 4 to 10 inches in length. A schedule of the copper sulfate feeding and computed copper concentrations for the season is included in the following table.

Periods of varying feed rates	Average flow, cfs	Total days of copper sulfate feeding	Feeding period per day in hours	Pounds of copper sulfate feed per hour	Mean concentration of copper during feeding period, ppm	Mean concentration of copper for entire feeding period, ppm
June 3 through June 14	24.9	12	16	2.6	0.12	0.08
June 15 through June 19	21.7	5	24	2.5	0.13	0.13
June 20 through August 22	25.0	64	12	8.3	0.37	0.19
August 23 through Sept. 24	12.5	18	6	8.3	0.74	0.19
Figures for the 99-day feeding period	22.5	99		8,100 (total pounds fed)		0.17

Commercial grades of copper sulfate pentahydrate ($CuSO_4 \cdot 5H_2O$) were used. The grade of copper sulfate purchased was specified to contain not less than 25 percent of metallic copper equivalent. Therefore, one-fourth of the total pounds of copper sulfate fed is used in computing the concentration of copper added to the irrigation water.

For the first 12 days of the experiment, the feeder was set to deliver about 1/2 ppm as copper sulfate. The pondweeds continued to grow rapidly during this period and had reached lengths ranging from 7 to 36 inches by June 15. There were no signs of copper toxicity to the pondweeds on this date, June 20 or June 27. However, on July 7 the next observation date which was 34 days from start of copper sulfate treatment the leafy pondweed in the first mile of the canal was definitely injured. The plants had slumped to the bottom and much dead tissue was evident around the edge of the leaves. Sago pondweed plants in the 1- to 2-mile reach below the feeding station showed slight symptoms of injury.

By July 26, most of the leafy pondweed had sloughed away. Sago pondweed plants in the 1- to 3-mile reach below the feeder had lost buoyancy and were reduced in quantity by about 50 percent. Sago pondweed plants throughout the lower reaches of the canal had slumped to the bottom and showed much dead tissue.

The canal was free of pondweeds throughout the 10-mile treated reach on August 23 except for a canal section about 4 miles below feeder. Sago pondweed growth in this area had been suppressed and much of the plant material was dead or severely injured. The ditch bottom was devoid of any aquatic vegetation at the termination of the test except for a few severely injured sago pondweed plants in a section about 4 miles below the feeder. Leafy pondweed developed normally throughout the season in the untreated section.

This experiment demonstrated the effectiveness of copper after a period of time in reducing the pondweed growth to an extent that the weeds did not interfere significantly with water delivery throughout the 10-mile reach. Personnel of the Farmers Ditch Company who operate the canal had to have two rather small areas on the lower portion of the canal mechanically cleaned of pondweeds in early July to restore capacity. This one time was the only cleaning required for the entire season. This corroborates observations made on copper toxicity in that the pondweeds reflected some degree of injury throughout the canal by late July. The degree of plant injury caused by copper increased with time of exposure, and the time required for copper toxicity to become evident increased with distances from the feeding station.

Samples of water, aquatic weeds, ditchbottom soil and agricultural soil irrigated with treated water were collected periodically at stations along the canal for copper analysis by the atomic absorption spectrophotometer. The maximum concentration of copper found in the water was 0.19 ppm at a collection station about 0.3 mile below the feeder. At the end of the canal the maximum concentration of copper found was 0.015 ppm.

Analysis of pondweeds shows that they have a real capacity for extracting copper from the treated water. Samples of leafy pondweed collected about 0.2 mile below the feeder contained an average copper concentration of 4.3 mg per gm of ovendried plant material. Samples of sago pondweed collected in the lower reaches of the canal reached a maximum copper concentration of 2.5 mg per gm of plant material.

The analysis of many samples of ditchbottom and agricultural soil, both treated and untreated, showed a copper concentration ranging from 0.02 to 0.05 mg per gm of air-dried soil. Most of the soil samples showed no increase or a slight decrease in copper content following the season of exposure to the copper sulfate treated water.

The average total alkalinity of the irrigation water was 68 ppm as the bicarbonate ion. Although the effect of this alkalinity on copper precipitation has not been studied thoroughly, the analysis of water and particularly the ditchbottom soil samples indicates that this factor is not of great concern in this water.

A screw-type dry volumetric dry feeder powered by an electric motor and equipped with a timer for operating the feeder for any portion of a 24-hour cycle used in dispensing the copper sulfate crystals into the flowing irrigation water performed very well. Results of sieve analyses performed on a number of samples collected from bags of copper sulfate used during the 1966 season will be used in specifying optimum size copper sulfate crystals for future feeding experiments.

Three kinds of warm water fishes exposed to a portion or a full season of treated water appeared to be in good condition.

In conclusion, the results obtained from this field experiment indicate that pondweeds can be controlled for several miles in irrigation channels through daily applications of low concentrations of copper sulfate from one site, leafy and sago pondweed plants are efficient in extracting copper from water, and the residue of copper contributed to agricultural soil from this type of application is very small. (Cooperative investigations of the Research Division, Bureau of Reclamation, U. S. Department of the Interior, and Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Denver, Colorado.)

PROJECT 7. CHEMICAL AND PHYSIOLOGICAL STUDIES

Reed A. Gray, Project Chairman

SUMMARY

Fourteen research progress reports from six states were received for inclusion in the chemical and physiological section. Since the reports were generally unrelated to each other, a short summary of each is given. 1. Some trifluralin persisted in soil outdoors in flats for 3 months after application at 1 lb/A, but none remained from a 0.25 lb/A application. Persistence increased with increasing depth of incorporation to 1.5 inches. 2. The phytotoxicity (GR_{50}) of trifluralin varied from 0.03 ppm for millet to 36 ppm for carrot. 3. Further studies on site of uptake showed that dichlobenil, EPTC, trifluralin, SD11831, CDEC, DCPA, CP31393, and Sindone were active on oats primarily through shoot exposures, while R-11913, Nia-11092, bromacil, pyrazone, diuron and atrazine were more effective by root exposure. 4. Amitrole was translocated both as amitrole and Unknown II (alanine conjugate) in bean stems and as amitrole, Unknown II and Unknown I in Canada thistle. 5. The addition of Span 20 to diesel oil as a spray carrier for 2,4,5-T ester increased the herbicidal activity on mesquite compared to no surfactant. However a spray containing 2,4,5-T ester in an emulsion of diesel oil in water with Span 85 was more effective than the oil carriers. 6. Application of picloram to a grass nursery in 1965 injured some varieties of smooth bromegrass in 1965, but the bromegrass recovered in 1966. 7. Crops that were injured when planted 20 months after application of picloram at 0.5 to 3 lb/A included clover, alfalfa, soybeans and fieldbeans, but grass crops were not injured. Dicamba showed no injury to the crops in the same test. 8. After application of 2,4-D-1-C^{14} to the foliage of Canada thistle growing in nutrient solution, a considerable amount of the applied 2,4-D was exuded through the roots and then taken up by the plants later on. The amount of exudation varied with different ecotypes. 9. Treating Canada thistle with 2,4-D caused a large decrease in RNA content and an increase in RNase activity which varied with different ecotypes. 10. A mathematical treatment of the leaching of herbicides in soils takes into consideration the linear diffusion, heats of adsorption, rate of water flow and percolation through soil voids. 11. Results in the Willamette Valley of Oregon show that sprinkler irrigation did not bring about contamination of canal water with diuron, 2,4-D, simazine, or CIPC. 12. Residue analysis indicated that dichlobenil was responsible for vapor injury to azaleas in a greenhouse where the soil floor was treated with the herbicide. 13. An improved residue method for the determination of picloram in potatoes was developed. 14. The amount of 2,4-D adsorbed by different soils increased with increasing amounts of organic matter, but increasing the pH decreased the adsorption.

<u>The persistence of trifluralin outdoors in metal flats.</u> Menges, Robert M. and Hubbard, Jack L. In a glasshouse experiment, trifluralin was sprayed at 1/4, and 1 lb/A to the surface of clay and fine sandy loam in metal flats and applications were unincorporated and incorporated with 1/2, 1 1/2- and

3-in. depths of soil. After 1 month, soil in each original plot was mixed to simulate field discing and selected flats were moved outdoors to study the persistence of the herbicide.

The reduction of barnyardgrass (Echinochloa crusgalli (L.) Beauv.) growth was the criterion for soil persistence of trifluralin. At least a GR_{50} indicated a significant residue or 0.2 ppm of the herbicide. After 3 months, the 1/4-lb rate was deactivated but the 1-lb rate persisted. Persistence increased with increasing depth to 1 1/2 in. but decreased at 3 in. Regardless of rate, depth of soil incorporation, or soil type, no herbicide persisted 6 months after treatment. (USDA, ARS, CRD and Lower Rio Grande Valley Research and Extension Center, Weslaco, Texas.)

Phytotoxicity with soil applications of herbicides. A. Trifluralin. Menges, Robert M. and Hubbard, Jack L. Seedlings of 13 plant species were grown in petri dishes in 3 soils each containing 0-100 ppm of trifluralin to determine phytotoxicity values. The herbicidal concentration required to reduce the growth of seedlings 50% (GR_{50}) varied from 0.03 ppm with German millet to 36.5 ppm with 'Long Imperator' carrot. (USDA, ARS, CRD and Lower Rio Grande Valley Research and Extension Center, Weslaco, Texas.)

Site of uptake of pre-emergence herbicides. Nishimoto, R.K., Appleby, A.P., and Furtick, W.R. Previous research has indicated that several pre-emergence herbicides are more effective by exposure to emerging shoots than from root uptake. Information on the site of uptake for all pre-emergence herbicides would be beneficial in using them more effectively. Greenhouse studies were conducted to determine the site of uptake for numerous pre-emergence herbicides. The technique used involved having an inch of treated soil above the seed, below the seed, or both above and below the seed. The seed was placed in the center of a 1-inch layer of untreated soil. Each soil layer was brought to field capacity separately and the entire container was covered with a polyethylene bag. The use of this bag avoided the need for irrigation and subsequent herbicide movement.

By this method, numberous herbicides were active on oats primarily through shoot exposure, with root exposure having little or no effect. These herbicides included dichlobenil, EPTC, trifluralin, 2, 6-dinitro-N, B-dipropyl-4-(methylsulphonyl)-aniline (SD11831), CDEC, DCPA, N-isopropyl-α-chloroacetanilide (CP-31393), and isomers of 1, 1-dimethyl-4, 6-diisopropyl-indanyl ethyl ketone (Sindone).

Some herbicides are more effective on oats through root exposure. These included bromacil, Stauffer's R-11913, 1, 1-dimethyl-3(3-(N-tert-butyl carbamyloxy) phenyl) urea (Nia 11092), pyrazon, diuron and atrazine.

Some herbicides are apparently taken up for lethal action differently by different plant species. Atrazine proved more effective on oats through root exposure, however, with green foxtail and annual ryegrass, shoot exposure was more important. With R-11913, shoot exposure was more effective on sugar beets, but root exposure proved to be more effective on oats.

Summary of results

Herbicide	Concentration ppm	Test Plant	Shoots		Roots		Shoots + Roots	
			Dry wt. of the shoot as percent of check for 3 exposure methods					
EPTC	2.0	Oats	13.2	b	101.1	a	16.4	b
Dichlobenil	0.5	Oats	13.7	b	102.7	a	27.0	b
Bromacil	2.0	Oats	117.6	b	67.6	c	54.5	c
Atrazine	2.0	Oats	101.3	a	85.3	a	48.7	b
	3.0	Oats	80.0	b	48.3	c	38.5	c
	4.0	Oats	52.7	b	49.5	b	45.0	b
	7.5	Green Foxtail	19.9	b	94.0	a	17.7	b
	15.0	Green Foxtail	7.3	c	80.4	b	9.9	c
	3.0	Annual ryegrass	81.7	b	77.1	b	32.5	c
	4.0	Annual ryegrass	32.0	c	65.4	b	14.2	c
	5.0	Annual ryegrass	34.4	c	48.0	b	13.5	d
Trifluralin	1.0	Oats	3.0	c	89.6	b	6.5	c
SD-11831	2.0	Oats	42.7	b	101.1	a	48.3	b
CDEC	8.0	Oats	13.5	b	100.3	a	8.1	b
R-11913	4.0	Oats	106.0	a	65.0	b	70.1	b
	15.0	Sugar Beets	4.2	c	73.6	b	3.4	c
CP-31393	10.0	Oats	70.6	b	82.6	a	73.9	b
Nia-11092	12.0	Oats	51.6	b	24.6	c	21.5	c
DCPA	10.0	Oats	41.8	d	108.1	b	51.2	c
Diuron	8.0	Oats	94.7	a	87.2	b	43.2	c
Sindone	3.0	Annual ryegrass	13.7	b	79.4	a	22.8	b
	35.0	Sugar Beets	0.0	c	77.0	b	0.0	c
Pyrazon	10.0	Oats	83.4	a	61.7	b	53.2	b
2,4-D	1.0	Cucumber	80.5	b	57.2	c	34.2	d

Different letters (a, b, c, d) denote treatments differ from each other at the 5% level. The same letter denotes no difference. The check is represented by a. (Farm Crops Dept., Oregon State Univ., Corvallis.)

<u>Chemical forms of amitrole transported in bean and Canada thistle.</u> Smith, L. W., Bayer, D. E., and Leonard, O. A. An investigation wade made of the chemical forms in which amitrole is transported from bean (red kidney and fava bean) and thistle leaves treated with amitrole-C^{14}. Samples were obtained from fava beans using aphids, while stem and petiole extracts were carried out on red kidney bean and Canada thistle. The aphids were confined by means of small cages either to the stem or to the veins of the basal portions of bean leaves. The upper portion of the leaf was treated with 5 uc amitrole-C^{14} and the aphids and honey dew were sampled from the cages at 12 hour intervals, the previous 6 being harvested.

The aphids were extracted with 80% ethanol and the extracts were chromatographed together with the honey dew samples collected at the same time. Experiments to collect phloem exudate from the severed mouth parts of the aphids have not been successful to date.

Sections of fava bean, red kidney bean and Canada thistle stems from plants treated in the same way as above were cut out and extracted in 80% ethanol at various time intervals and chromatographed by TLC.

The extracts of aphids, honey dew, fava bean and red kidney bean stems contained predominately Unknown II (3-amino-1,2,4-triazoleylalonine) with a small quantity of amitrole at all times tested (12-72 hours). Thistle stem extracts showed a change with time from predominately amitrole at 24 hours to Unknown II at 48 hours to Unknown I at 72 hours.

The possible metabolism of amitrole-C^{14} by the aphids themselves or by the stem tissues was not taken into consideration by these experiments. However the results parallel very closely those obtained previously in excised leaves of bean and thistle and thus it would appear that both amitrole and Unknown II are capable of being transported in bean, while amitrole, Unknown II and Unknown I are transported in thistle. The form transported depends on the metabolized state in the leaves. (Botany Department, University of California, Davis.)

<u>Foliar absorption of 2,4,5-T from emulsions and straight oil carriers in combination with oil-soluble surfactants.</u> Hull, Herbert M. and Shellhorn, Samuel J. Generally speaking, low-volume aerial application of herbicides in a straight water carrier has been relatively ineffective for woody plant control. Perhaps one of the reasons for this, particularly in the arid Southwest, is the evaporation of droplets during their fall from the aircraft to the foliage. Such evaporation may be greatly reduced by use of an oil-water emulsion or a straight oil carrier. Good overall herbicidal effect with such carriers may often be achieved with a relatively small volume coverage, i.e., 5 gpa.

The basic objective of the present experiment was to establish whether the enhancing effect of diesel or nontoxic oil (Mobilsol 100) on 2,4,5-T absorption could be further influenced by the addition of oil-soluble surfactants, thus utilizing a completely oil-soluble system in the case of 2,4,5-T esters. The basal leaves of young greenhouse-grown velvet mesquite seedlings were treated in every case with 1500 ppmw of the unformulated butoxyethanol ester of 2,4,5-T. This was carried in straight diesel or nontoxic oil with and without a surfactant, and (with a surfactant) in a 1:7 emulsion of either diesel or nontoxic oil in water, as well as in water alone. Surfactants, used at the rate of 0.1 per cent, included sorbitan monolaurate (Span 20) and sorbitan trioleate (Span 85). Both are products of the Atlas Chemical Industries, Inc. Other compounds of equivalent chemical characteristics should perform similarly. The surfactants have hydrophile-lipophile balances (HLB's) of 8.6 and 1.8, respectively, and are both miscible with the oils described and with the 2,4,5-T ester.

Apical epinasty, recorded at hourly intervals following treatment, was slightly greater with diesel oil than with a nontoxic oil carrier, whether a surfactant was present or not. The surfactants did not greatly affect herbicidal response when used in straight oils, except in the case of sorbitan monolaurate added to diesel oil. This combination increased epinasty and repressed subsequent growth (both height and fresh weight) more significantly than did any other straight oil or oil-surfactant formulation. Initial epinasty appeared 36 minutes following treatment, the most rapid of any of the formulations used.

The greatest amount of ultimate epinasty (by the 48th hour), and of stem callus and growth repression by the 3rd and 4th weeks following treatment were, however, not achieved with any of the straight oil carriers described above, but rather with diesel oil emulsified in water with sorbitan trioleate. Overall herbicidal superiority of the latter carrier over the straight diesel oil-sorbitan monolaurate treatment was relatively slight, and of questionable significance however. In view of the above response, it would seem desirable to evaluate additional surfactants of low HLB value in a complete oil system with the possible objective of obtaining chemical control equivalent to that available now but with a significantly smaller volume coverage. The resultant reduction in application cost could make aerial spraying feasible for large areas that might otherwise give only a borderline response to aerial spray, economically speaking. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, 2000 E. Allen Road, Tucson, Arizona 85719.)

Grass tolerance to picloram in Wyoming. Alley, H. P. and G. A. Lee. An experimantal grass nursery which included several selections of smooth bromegrass, orchardgrass, meadow foxtail, reed canarygrass, timothy and wheatgrass was treated September 23, 1964 with 1 lb/A of picloram. The area was heavily infested with Canada thistle (*Cirsium arvense* (L.) Scop.) and whiteleaved franseria (*Franseria discolor* Nutt.) Evaluations recorded in 1966, 2 years after treatment, show the treated area being completely free of either weed species. The 1965 evaluations, pertaining to species tolerance, indicated that smooth bromegrass exhibited prostrate growth and slight reduction in yields. No other species exhibited any damage. The smooth bromegrass had recovered in 1966 and there was no apparent damage present.

Reading as to the varietal differences of smooth bromegrass are tabulated in the attached table. It is interesting to note that the southern varieties of bromegrass, which ordinarily possess a larger and more vigorous root system (rhizome) than the northern varieties were the most susceptible to picloram damage as indicated by the 1965 ratings. (Wyoming Agricultural Experiment Station, Univ. of Wyoming, Laramie.)

Bromegrass tolerance to picloram

Variety	Tons/A (Green) 1965	1966	Damage Rating** 1965
Sask. S-5824	11.08	9.96	.75
Carlton	10.94	9.83	.75
Manchar	8.80	9.42	2.00
Saratoga	8.03	9.43	3.75
Lyon	7.59	8.75	7.50
Achenbak	6.68	8.59	7.75
Sac	6.12	8.54	7.75
Wisc. 55	5.96	9.19	6.25
Southland	5.84	8.29	7.75
Lincoln	5.67	9.04	8.00
Lancaster	5.36	8.07	7.50

**Rating scale - 1 = least toxicity; 10 = severe toxicity, measured by amount of prostrate growth which reduced amount of vegetative top growth. Rating used in 1965. No damage was evident in 1966.

Crop tolerance to picloram and dicamba residual. Alley, H. P. and G. A. Lee. A small grain production field which was heavily infested with Canada thistle was treated September 24, 1964 with various rates of picloram and dicamba. Plots were 23' x 600' and the chemical was applied in 40 gpa water. The treated areas were planted to barley in 1965 and cross-seeded to several crops in the spring of 1966, approximately 20 months after initial treatment.

Evaluations in 1966 showed that Canada thistle was reinfesting all the dicamba treated areas except the area treated with 4 lb/A. The plots treated with picloram at all rates were free of Canada thistle.

All the crops (attached table) used in the crop tolerance study showed good growth in the dicamba treated areas. Only the grass crops barley, oats, wheat, corn and sorghum grew in the picloram treated plots. Sweet-clover, alfalfa, soybeans and fieldbeans were killed at all rates of picloram treatment which was from 1/2 lb to 3 lb/A. Stand and toxicity readings on each chemical and crop are presented in the attached table. (Wyoming Agricultural Experiment Station, Univ. of Wyoming, Laramie.) (Attached table on page 126.)

Uptake and exudation of herbicides by Canada thistle. Whitworth, J. W., W. B. O'Rear and K. B. Tolman. Measurements were made of the cyclic uptake and release of 2,4-D by Canada thistle plants growing in nutrient solution. This experiment was carried out under laboratory conditions with the plants growing under low light intensities (250 foot candles) and at a temperature of 80° F. Three ecotypes were used that had previously been classified as

Crop tolerance study

Chemical and Rate lb/A	Betzes Barley	Cody II oats	Thatcher wheat	Hybrid sorghum	Sweet clover	Ladak alfalfa	Harosoy soybeans	Pinto field beans	Field corn
Dicamba 1	matured and filled	mature and filled	mature and filled	good stand and healthy	good stand	good stand	plants present	plants present	good stand
Dicamba 2	mature and filled	mature and filled	mature and filled	good stand and healthy	good stand	good stand	plants present	plants present	good stand
Dicamba 3	mature and filled	mature and filled	mature and filled	good stand and healthy	good stand	good stand	plants present	plants present	good stand
Dicamba 4	mature and filled	mature and filled	mature and filled	good stand and healthy	good stand	good stand	plants present	plants present	good stand
Picloram 1/2	mature and filled	mature and filled	mature and filled	good stand and healthy	no plants	no plants	no plants	no plants	good stand
Picloram 1	mature but no kernels	immature but filled	mature but prostrate	good stand and healthy	no plants	no plants	no plants	no plants	good stand
Picloram 2	immature reduced stand	immature but filled	immature and prostrate	good stand and healthy	no plants	no plants	no plants	no plants	good stand
Picloram 3	immature reduced stand	immature but filled	immature and prostrate	no plants	no plants	no plants	no plants	no plants	poor stand corn hurt

susceptible (FM), intermediate (FI), and resistant (GI) to 2,4-D. Within 5 hours after applying 0.80 mg of 2,4-D-1-C^{14} (2,4-D*) to the foliage of each plant, as much as 5 percent of the applied 2,4-D* was exuded through the roots into the nutrient solution by plants of the FI and GI ecotypes. Within the next 5 hours, the 2,4-D* disappeared almost completely from the solution. Apparently root uptake by the plants was responsible. With the susceptible ecotype (FM), exudation started at 6 hours and by 10 hours 8 percent of the amount applied to the foliage had accumulated in the nutrient solution. The amount decreased to 5 percent in the next three hours followed by a slight increase. However, the sharp peaks of uptake and depressions caused by releases were not nearly so apparent in this ecotype. Rates of 0.40 mg showed the same general pattern except that the first exudation occurred later in plants of the FM and GI ecotypes while it was essentially the same for both rates in the FI plants.

When C^{14} labeled dicamba was applied as in the above experiment, it was translocated and exuded much slower and to a lesser extent than was 2,4-D*. This slower absorption and translocation was also observed when comparing these two herbicides on plants growing in glass-faced boxes in the greenhouse. In this experiment, unlabeled herbicides were used and the rapidity of root inhibition served as a measure of translocation.

In another experiment, Canada thistle plants of the three ecotypes were foliage treated with 0.46 mg of 2,4-D* and removed to fresh nutrient solution each time that a measurable amount of the herbicide was exuded into the solution. After 12 hours, a total of 20 percent of the amount of 2,4-D* applied to the foliage had been moved through plants of the FM and FI ecotypes into the various changes of nutrient solution as compared to 34 percent for the GI. After 50 hours, the amount was 32, 31, and 45 percent, respectively. In this experiment, as with the others using C^{14} labeled herbicides, it was established by thin layer chromatography that the exudate was pure herbicide and not a metabolized by-product.

When 2,4-D* was introduced directly into the nutrient solution in the amount of 0.92 mg per plant (quart jars as growing containers), cyclic uptake from and exudation back into the solution was observed as with the foliage applications. Uptake began immediately and amounted to 40 to 50 percent within the first hour for all ecotypes. Within the first 5 hours, exudation back into the solution decreased the amount taken up and retained by as much as 10 to 20 percent. Sharp peaks of uptake and rapid depressions due to release continued for 74 hours. After 74 hours when the plants were transferred to fresh nutrient solution free of 2,4-D*, plants excreted less than 6 percent of the 2,4-D* they had taken up. Except for slightly less uptake by the FM plants, the three ecotypes gave the same general response. (New Mexico State University, Agricultural Experiment Station, University Park.)

RNA levels and RNase activity in Canada thistle ecotypes as influenced by 2,4-D. Tolman, K. B., and Whitworth, J. W. Three ecotypes of Canada thistle varying in response to 2,4-D were evaluated as to the influence of 2,4-D on RNA levels and RNase activity. RNA levels were determined by phosphate analysis of KOH extracts with phosphate levels serving as a measure of RNA content. RNase activity was measured by decreases in phosphate levels when yeast RNA was incubated with plant homogenates or supernatants centrifuged from homogenates.

Phosphate levels on filtered homogenates from untreated plants were 0.28 mg, 0.77 mg, and 0.82 mg, respectively, for the susceptible, intermediate and the resistant plants. When plants were treated with 2,4-D and the RNA content compared with untreated plants, a decrease was noted. The decrease amounted to 55, 35, and 78 percent, respectively, for the susceptible, intermediate and resistant plants; a rise in RNase activity was also noted and amounted to 44, 8, and 50 percent, respectively.

Using only plants of the resistant ecotype, a comparison was made between the RNase activity of crude homogenates vs the supernatant centrifuged from one-half of the same homogenate at 100,000 x g. Higher activity was found in the crude homogenate as compared to the supernatant whether taken from untreated or treated plants. However, both plant fractions showed 35 percent higher RNase activity in the treated vs the untreated plants.

In another experiment, the 18,400 x g supernatant from a filtered homogenate of an untreated susceptible plant was incubated with 2,4-D at 0, 1, 10, 100, and 1000 ppm for 60 and 80 minutes. After the specified time of incubation, the homogenates were centrifuged at 100,000 x g and assayed for RNase activity. At 60 minutes, the percent hydrolysis of PO_4 (measure of RNase activity) was 39 percent and at 80 minutes it was 66 percent. There were no differences due to levels of 2,4-D --stimulation of RNase activity occurred as readily at 1 ppm as at 1000 ppm.

Radioactive 2,4-D was used in all experiments to facilitate location and identification of the herbicide. Thin layer chromatography was used to determine if the herbicide retained its identity. Free, unchanged 2,4-D was found in the liquid phase of all uncentrifuged fractions. The radioactivity in the supernatant from fractional centrifugations, including the 100,000 x g fraction, was not due to free 2,4-D. This was also true for the radioactivity associated with KOH soluble RNA. (New Mexico State University, Agricultural Experiment Station, University Park.)

Mathematical treatment of the movement of herbicides in soils. Lindstrom, F. T., Freed, V. H., and Haque, R. The movement of herbicides in soil is a primary factor in determining performance and persistence of many herbicides. A considerable amount of work has been done on movement of herbicides in soil, but most studies have been largely qualitative in nature. In attempting to quantitatively predict the movement and distribution of herbicides in soil, a mathematical model is being formulated.

The first step in describing the behavior of herbicides in soils has been to mathematically determine the role of linear diffusion. The derivation is based on Fick's law of diffusion, conservation of matter, and the Freundlich isotherm. Distribution curves have been prepared for high and low energies of adsorption under low influx conditions. As would be expected, the diffusion rate is strongly retarded by large heats of adsorption of chemical by soil. Thus, the effect of diffusion in relation to leaching will be dependent on the heat of adsorption as well as on the rate of water flow. Subsequent equations for describing herbicide distribution and movement will also take into account variable percolation velocity of chemical through the soil voids. (Oregon Agric. Expt. Sta., Corvallis, Oregon.)

The effect of irrigation on herbicide contamination of surface waters. Brannock, Douglas and Freed, Virgil. There has been a concerted effort to increase the productivity of Willamette Valley lands by means of irrigation. A continuing project has been undertaken to determine whether this sprinkler irrigation will result in contamination of surface waters flowing through treated areas. A canal running through treated areas between the cities of Lebanon and Albany were selected for sampling.

Four herbicides are extensively used in this area, so procedures were developed for determining very small amounts of these chemicals. The herbicides were 2,4-D, simazine, CIPC and diuron. Gallon samples of water were extracted with ether at pH 7 to remove simazine, diuron and CIPC. The pH was then adjusted to 2 and 2,4-D was extracted with continued ether extraction. CIPC and simazine were analyzed directly by gas chromatography following concentration of the ether extract. Analysis for 2,4-D was carried out following esterification of the concentrated extract with diazomethane. Diuron was determined by alkaline hydrolysis to 3,4-dichloroaniline, and after extraction with ether, the 3,4-dichloroaniline was determined by gas chromatography.

The above methods were capable of determining 2.5 parts per billion of any of the chemicals. However, none of the suspected chemicals were found. Thus, this preliminary data suggests that sprinkler irrigation will not bring about contamination of flowing surface waters. (Oregon Agricultural Experiment Station, Oregon State University, Corvallis, Oregon.)

Considerations on the vapor pressure of dichlobenil affecting its use and procedures for residue analysis. Brannock, L. D.; Montgomery, M. and Freed, V. H. Although dichlobenil (Casoron) has proven to be an effective herbicide for use on a number of plants including woody ornamentals and nursery stock, its relatively high vapor pressure, 5.5×10^{-4} mm Hg @ 20° C; 1.5×10^{-2} mm Hg @ 50° C, may result in potential vapor losses and affect its performance as an herbicide. (Beynon et al, J. Sci. Food Agr., 17, 151 (1966) and Massini, Weed Res. 1, 142 (1962). Under unusual conditions these vapor losses can result in injury to desirable species.

Recently in a plastic greenhouse containing potted azaleas, the soil floor was treated with 8#/A of dichlobenil. The azalea plants soon became chlorotic and showed symptoms of distress. It was suspected that dichlobenil vapors were accumulating in the greenhouse atmosphere and were being absorbed by the plants. In determining whether this was the probably cause of injury, a method of residue analysis was developed utilizing the high vapor pressure of dichlobenil (0.11 mm Hg @ 100° C).

The plant material to be assayed was macerated in a blender with water to form a slurry which was placed in a 2 liter flask, together with enough water to make 1 liter. This flask was then attached to a continuous steam distillation - solvent extraction apparatus described by Nickerson and Likens, J. Chromatog. 21, 1 (1966). A 50 ml flask containing hexane was attached to the solvent side of the apparatus and the distillation - extraction was carried out for 6 hours. The hexane extract was then concentrated and analyzed by gas chromatography.

A recovery of 100% of added dichlobenil was achieved when 25 µg of herbicide was added to azalea leaves and extracted as described. The sensitivity of the method was 0.2 ppm when 24 grams of plant sample was extracted and concentrated to 2 ml and 10 ul analyzed. A Dohrmann microcoulometric detector with a C-200 coulometer was used in the analysis. Due to the specificity of the instrument, it is anticipated that by using larger samples for extraction and injection aliquots, 0.01 to 0.02 ppm of dichlobenil could be detected by this method.

The leaves from the damaged plants were shown to contain 1.1 ppm of dichlobenil. Thus, it can be seen that these plants did absorb appreciable amounts of dichlobenil. It is not anticipated that vapor uptake will pose a problem when there is air movement. However, it can be seen that there is a potential hazard when dichlobenil is used with warm temperatures and relatively closed conditions. (Oregon Agricultural Experiment Station, Corvallis, Oregon.)

An improved analytical method for picloram. Brannock, Douglas; Witt, James; and Freed, Virgil. Since the introduction of picloram (Tordon) in 1964 a suitable method for its analysis in residue quantities has been slow in developing. This is in part due to its extremely high activity, requiring a very sensitive chemical method. The first methods (OSU, 1964 and Dow method ACR 65.3R, 1966) used a potassium hydroxide extraction. While this method is thorough and gives a high confidence for extracting picloram it also has a tendency to extract large quantities of plant materials which make analysis difficult.

Using C^{14} labeled picloram, Meikle, et. al., J. Ag. Food Chem. 14, 3847 (1966) showed that the simple system of 80% methanol with sodium bicarbonate would extract 97% of the available picloram from cotton plants. All of the activity so extracted was identified as free picloram after acidifying to pH 2.5 with HCl. A residue analytical method based upon the extraction procedure of Meikle was developed.

Potatoes, a plant particularly sensitive to picloram, were believed to have been accidently exposed to picloram in the Klamath Falls area. Samples of these potatoes were analyzed by the new method described below.

Method

1. Chop and thoroughly mix the frozen sample in a food chopper, keeping the sample frozen during the process.
2. Mix 100 g of chopped and frozen sample with 40 g of sodium bicarbonate and 320 ml of methanol, (making 80% methanol with the water from the sample) and blend for 10 minutes in an Omni Mixer at low speed. Allow the resulting slurry to stand overnight.
3. Centrifuge the slurry and decant the supernatent. Wash the pulp with a small amount of methanol, centrifuge and decant as before combining the supernatents.
4. Concentrate the sample on a rotary vacuum evaporation until an aqueous suspension remains.
5. Place the aqueous suspension in the aqueous side of a continuous

liquid-liquid extractor and acidify to pH 2 with sulfuric acid. Extract the sample with diethyl ether for eight hours.

6. Concentrate the ether extract with a gentle stream of nitrogen and dry the concentrate with anhydrous sodium sulfate.

7. Make a column with 25 g of Woelm basic alumina, approximately 20 mm I.D., and pass the dried ether extract through the basic alumina. Wash the column with approximately 150 ml of diethyl ether followed by 50 ml of chloroform. Dry the column by drawing air through it utilizing a vacuum.

8. Elute the columns with 100 ml of 1% sodium bicarbonate. Place the eluate in the aqueous side of a liquid-liquid extractor, acidify to pH 2 and extract with ether as before.

9. Concentrate and dry the extract as before, transfering the concentrate to a suitable volumetric flask (10 ml) for esterification. Esterify the sample with several ml of diazomethane, allowing the diazomethane to stand with the sample for an hour or more. Remove the excess diazomethane with the slight application of heat and a stream of dry nitrogen and dilute the sample to volume.

10. Inject the prepared sample into a gas chromatograph and compare the results with a standard of picloram and a sample carried through the analytical procedure with a known amount of picloram deliberately added at the beginning.

When the above procedure was used with potatoes to which 0.02 ppm of picloram had been added recoveries of 87% and 65% were obtained on two separate samples. Less than 0.005 ppm could be detected using electron capture detection.

A slight improvement in the method may be possible by replacing the ether wash on the alumina column with a hexane or benzene wash. Since picloram salts are very soluble in aqueous media, some may be lost if the ether contains a small amount of water. Also the original bicarbonate extract can be washed with hexane or benzene to remove the fats and neutrals before proceeding.

If a rigorous analysis is desired the pulp could be refluxed with 6 N HCl as described by Meikle, et al. to recover any possible bound picloram, 3% in the case of cotton plants. (Oregon Agric. Expt. Sta., Oregon State University, Corvallis, Oregon.)

The effect of soil organic matter on the adsorption of 2,4-D. McLaren, L. G. and Freed, V. H. The availability of herbicides applied to the soil shows a strong negative correlation with the amount of organic matter present in the soil. It is will known that a soil high in organic matter requires a larger application of herbicide than does a soil low in organic matter.

This study was designed to study the effect of soil organic matter on the adsorption of 2,4-D. A Willamette type soil and a high organic matter (31%) soil were used. A portion of the Willamette soil was treated with H_2O_2 to oxidize and destroy the organic matter. The concentration levels of 2,4-D used ranged from 6×10^{-7}M to 1.2×10^{-4}M. The pH was controlled at pH 6.2, 7.2, and 7.9 with phosphate buffer. Four grams of soil to 10 mls of 2,4-D solution were used for adsorption studies with the Willamette and oxidized Willamette soils, while a 2 gram to 10 mls ratio was maintained with the organic soil.

It was found that the amount of 2,4-D adsorbed increased with increasing amounts of organic matter. An increase in pH however, caused a decrease in the amount of adsorption. (See Table I). The adsorption isotherms were plotted as long on the initial 2,4-D concentration Vs. the log of the amount adsorbed. The results were straight line graphs as predicted by Freundlich adsorption theory.

Heats of adsorption were calculated for the Willamette type soils and are shown in Table II. This shows that the 2,4-D was bound more strongly to the soil having the greater organic matter content.

Sand, Kaolin, Illite and Montmorillonite clays were also used as adsorbates in this study. The results are shown in Table III. In this experiment only one gram of substrate to 10 mls of 6×10^{-4}M 2,4-D solution was used due to the swelling of the montmorillonite clay. The negative adsorption demonstrated by the dry montmorillonite was probably due to preferential adsorption of water by the clay during the swelling process.

Table I. Adsorption of 2,4-D

Initial 2,4-D conc.	Grams 2,4-D x 10^7 adsorbed per gram soil: Will. Soil pH 6.2	pH 7.2	pH 7.9	Oxidized Will. pH 6.2	pH 7.2	pH 7.9	Organic pH 7.9
6×10^{-7}M	1.31	1.09	0.84	1.05	0.77	0.56	4.35
1.2×10^{-6}M	2.98	2.41	2.03	2.04	1.65	1.52	8.24
6×10^{-6}M	12.5	10.3	7.85	8.91	7.07	5.75	40.3
1.2×10^{-5}M	20.7	19.5	14.0	14.7	13.8	10.7	76.8
6×10^{-5}M	88.4	69.2	59.7	62.5	55.0	44.2	333.
1.2×10^{-4}M	163.	133.	102.	111.	91.7	78.9	614.

Table II. Heats of adsorption

Soil type	pH	Heat of adsorption
Willamette	6.2	-10.603
Willamette	7.9	-10.604
Oxidized Will.	6.2	- 6.298
Oxidized Will.	7.9	- 6.152

Table III. Adsorption of 2,4-D by sand and clay

Adsorbate	Percent adsorbed
Sand	0-2%
Kaolin clay	3.9%
Illite clay	24.5%
Dry montmorillonite	-21.2% (negative)
*Wet montmorillonite	22.1%
Organic soil	26.5%
Willamette soil	5%

*Montmorillonite clay was wetted until swelling was maximum. The clay was then centrifuged and excess water discarded. The amount of water taken up by the clay was not used in the calculations. (Oregon Agric. Expt. Sta., Corvallis, Oregon.)

AUTHOR INDEX

AUTHOR INDEX (Continued)

NOMENCLATURE AND ABBREVIATIONS

Tables 1 and 2 below are nomenclature and abbreviation lists of the Weed Society of America (Nomenclature Weeds 14(4), 1966). Authors are urged to use this terminology and abbreviation wherever applicable.

Table 1. Common and Chemical Names of Herbicides

Common name	Other designation(s)	Chemical name[a]
A		
acroleine		acrylaldehyde
ametryne		2-ethylamino-4-isopropylamino-6-methylmer = capto-s-triazine
amiben		3-amino-2,5-dichlorobenzoic acid
amitrole		3-amino-1,2,4-triazole
	AMS	ammonium sulfamate
atratone		2-methoxy-4-ethylamino-6-isopropylamino-s-triazine
atrazine		2-chloro-4-ethylamino-6-isopropylamino-s-triazine
B		
barban		4-chloro-2-butynyl m-chlorocarbanilate
benefin		N-butyl-N-ethyl-alpha, alpha, alpha-trifluro-2,6-dinitro-p-toluidine
bensulide	R-4461	N-(2-mercaptoethyl)benzenesulfonamide S-(0, 0-diisopropyl phosphorodithioate)
	BCPC	sec-butyl N-(3-chlorophenyl)carbamate
bromacil		5-bromo-3-sec-butyl-6-methyluracil
bromoxynil		3,5-dibromo-4-hydroxybenzonitrile
buturon	H-95-1	3-(p-chlorophenyl)-1-methyl-1-(1-methyl-2-propynyl)urea
C		
cacodylic acid		dimethylarsinic acid
	CDAA	2-chloro-N,N-diallylacetamide
	CDEA	2-chloro-N,N-diethylacetamide
	CDEC	2-chloroallyl diethyldithiocarbamate
	CEPC	2-chloroethyl N-(3-chlorophenyl)carbamate
chlorazine		2-chloro-4,6-bis(diethylamino)-s-triazine
chloroxuron		N'-4-(4-chlorophenoxy)phenyl-N,N-dimethylurea
	CIPC	isopropyl N-(3-chlorophenyl)carbamate
	CMA	calcium acid methanearsonate
	CPMF	1-chloro-N-(3,4-dichlorophenyl)-N,N-dimethyl = formamidine
	CPPC	1-chloro-2-propyl N-(3-chlorophenyl)carbamate
cycluron	OMU	3-cyclooctyl-1,1-dimethylurea
cycpromid	S-6000	3,4-dichlorocyclopropanecarboxanilide

Table 1. Common and Chemical Names of Herbicides (Continued)

Common name	Other designation (2)	Chemical name[a]
D		
dalapon		2,2-dichloropropionic acid
	DCB	o-dichlorobenzene
	DCPA, DAC893	dimethyl 2,3,5,6-tetrachloroterephthalate
	DCU	dichloral urea
desmetryne		2-isopropylamino-4-methylamino-6-methyl = mercapto-s-triazine
diallate	DATC, CP15336	S-2,3-dichloroallyl N,N-diisopropylthiol = carbamate
dicamba		2-methoxy-3,6-dichlorobenzoic acid
dichlobenil		2,6-dichlorobenzonitrile
dichlorprop	2,4-DP	2-(2,4-dichlorophenoxy)propionic acid
dichlone		2,3-dichloro-1,4-naphthoquinone
dicryl dicryl	N-4556	3'4'-dichloro-2-methacrylamide
		P,P-dibutyl-N,N-diisopropylphosphinic amide
diphenamid		N,N-dimethyl-2,2-diphenylacetamide
diphenatrile		diphenylacetonitrile
dipropalin		N,N-dipropyl-2,6-dinitro-p-toluidine
diquat		6,7-dihydrodipyrido/1,2-a:2',1'-c/ pyrazidi = inium salt
diuron		3-(3,4-dichlorophenyl)-1,1-dimethylurea
	DMPA	O-(2,4-dichlorophenyl) O-methyl isopropyl = phosphoramidothioate
	DMTT	3,5-dimethyltetrahydro-1,3,5,2H-thiadiazine-2-thione
	DNAP	4,6-dinitro-o-sec-amylphenol
	DNBP	4,6-dinitro-o-sec-butylphenol
	DNC	3,5-dinitro-o-cresol
	DSMA	disodium methanearsonate
E		
	EBEP	ethyl bis(2-ethylhexyl)phosphinate
endothall		7-oxabicyclo/2.2.1/heptane-2,3-dicarboxylic acid
	EPTC	ethyl N,N-dipropylthiocarbamate
erbon		2-(3,4,5-trichlorophenoxy)ethyl-2,2-dichloro = propionate
	EXD	ethyl xanthogen disulfide
F		
fenac		2,3,6-trichlorophenylacetic acid
fenuron		3-phenyl-1,1-dimethylurea
fenuronTCA		3-phenyl-1,1-dimethylurea trichloroacetate
	4-CPA	4-chlorophenoxyacetic acid
	4-CPB	4-(4-chlorophenoxy)butyric acid
	4-CPP	2-(4-chlorophenoxy)propionic acid

Table 1. Common and Chemical Names of Herbicides (Continued)

Common name	Other designation(s)	Chemical name[a]
G		
	G-30026	2-chloro-4-isopropylamino-6-methylamino-s-triazine
	G-31717	2-diethylamino-4-isopropylamino-6-methoxy-s-triazine
	G-32292	2-isopropylamino-4-methoxy-6-methylamino-s-triazine
H		
	HCA	hexachloroacetone
I		
ioxynil		3,5-diiodo-4-hydroxybenzonitrile
ipazine		2-chloro-4-diethylamino-6-isopropylamino-s-triazine
	IPC	isopropyl N-phenylcarbamate
	IPX	isopropylxanthic acid
isocil		5-bromo-3-isopropyl-6-methyluracil
K		
	KOCN	potassium cyanate
L		
lenacil		3-chlorohexyl-5,6-trimethyleneuracil
linuron		3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea
M		
	MAA	methanearsonic acid
	MAMA	monoammonium methanearsonate
	MCPA	2-methyl-4-chlorophenoxyacetic acid
	MCPB	4-(2-methyl-4-chlorophenoxy)butyric acid
	MCPES	sodium 2-methyl-4-chlorophenoxyethyl sulfate
mecoprop	MCPP	2-(2-methyl-4-chlorophenoxy)propionic acid
	MH	1,2-dihydropyridazine-3,6-dione (maleic hydrazide)
molinate	R-4572	S-ethyl hexahydro-1 H-azepine-1-carbothioate
monolinuron		3-(4-chlorophenyl)-1-methoxy-1-methyl-urea
monuron		3-(p-chlorophenyl)-1,1-dimethylurea
monuronTCA		3-(p-chlorophenyl)-1,1-dimethylurea trichloro = acetate
	MSMA	monosodium acid methanearsonate
N		
neburon		1-butyl-3-(3,4-dichlorophenyl)-1-methylurea
norea		3-(hexahydro-4,7-methanoindan-5-yl)-1,1-dimethylurea
	NPA	N-1-naphthylphthalamic acid

Table 1. Common and Chemical Names of Herbicides (Continued)

Common name	Other designation(s)	Chemical name[a]
O		
	OCH	octachlorocyclohexenone
P		
paraquat		1,1'-dimethyl-4,4'-bipyridinium salt
	PBA	polychlorobenzoic acid
	PCP	pentachlorophenol
pebulate	PEBC, R-2061	S-propyl butylethylthiocarbamate
picloram		4-amino-3,5,6-trichloropicolinic acid
	PMA	phenylmercuric acetate
prometone		2-methoxy-4,6-bis(isopropylamino)-s-triazine
prometryne		2,4-bis(isopropylamino)-6-methylmercapto-s-triazine
propanil	DPA	3',4'-dichloropropionanilide
propazine		2-chloro-4,6-bis(isopropylamino)-s-triazine
pyrazon	PCA, H-119-1	5-amino-4-chloro-2-phenyl-3(2H)-pyridazinone
pyriclor		2,3,5-trichloro-4-pyridinol
S		
sesone		sodium 2,4-dichlorophenoxyethyl sulfate
siduron	H-1318	1-(2-methylcyclohexyl)-3-phenylurea
silvex		2-(2,4,5-trichlorophenoxy)propionic acid
simazine		2-chloro-4,6-bis(ethylamino)-s-triazine
simetone		2-methoxy-4,6-bis(ethylamino)-s-triazine
simetryne		2,4-bis(ethylamino)-6-methylmercapto-s-triazine
	SMDC	sodium N-methyldithiocarbamate
solan		3'-chloro-2-methyl-p-valerotoluidide
swep		methyl 3,4-dichlorocarbanilate
T		
terbacil		3-tert-butyl-5-chloro-6-methyluracil
terbutol		2,6-di-tert-butyl-p-tolyl-methylcarbamate
	TCA	trichloroacetic acid
	TCBA	trichlorobenzene
triallate		S-2,3,3-trichloroallyl N,N-diisopropythiol = carbamate
tricamba		2-methoxy-3,5,6-trichlorobenzoic acid
trietazine		2-chloro-4-diethylamino-6-ethylaminol-s-triazine
trifluralin		a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine
trimeturon	B-40557	1-(p-chlorophenyl)-2,3,3-trimethylpseudourea or N-(p-chlorophenyl)-0,N',N'-trimethylisourea
	2,2,3-TPA	2,2,3-trichloropropionic acid
	2,3,5,6-TBA[b]	2,3,5,6-tetrachlorobenzoic acid

Table 1. Common and Chemical Names of Herbicides (Continued)

Common name	Other designation(s)	Chemical name[a]
	2,3,6-TBA[b]	2,3,6-trichlorobenzoic acid
	2,4-D	2,4-dichlorophenoxyacetic acid
	2,4-DB	4-(2,4-dichlorophenoxy)butyric acid
	2,4-DEB	2,4-dichlorophenoxyethyl benzoate
	2,4-DEP	tris(2,4-dichlorophenoxyethyl)phosphite
	2,4,5-T	2,4,5-trichlorophenoxyacetic acid
	2,4,5-TB	4-(2,4,5-trichlorophenoxy)butyric acid
	2,4,5-TES	sodium 2,4,5-trichlorophenoxyethyl sulfate
	3,4-DA	3,4-dichlorophenoxyacetic acid
	3,4-DB	4-(3,4-dichlorophenoxy)butyric acid
	3,4-DP	2-(3,4-dichlorophenoxy)propionic acid
V		
vernolate	R-1607	S-propyl dipropylthiocarbamate

[a]As tabulated in this paper, a chemical name occupying two lines separated by an equal (=) sign is joined together without any separation if written on one line.

[b]These herbicides usually are available as mixed isomers. When possible the isomers should be identified, the amount of each isomer in the mixture specified and the source of the experimental chemicals given.

Table 2. Abbreviations of terms used in weed control

Abbreviations	Definitions
A	acre(s)
ae	acid equivalent
aehg	acid equivalent per 100 gallons
ai	active ingredient
aihg	active ingredient per 100 gallons
bu	bushel(s)
cfs	cubic feet per second
cu	cubic
diam	diameter
fpm	feet per minute
ft	foot or feet
g	gram(s)
gal	gallon(s)
gpa	gallons per acre
gph	gallons per hour
gpm	gallons per minute
hr	hour(s)

Table 2. Abbreviations of terms used in weed control

Abbreviations	Definitions
ht	height
in	inch(es)
L	liter(s)
lb	pound(s)
mg	milligram(s)
mi	mile(s)
min	minute(s)
ml	milliliter(s)
mm	millimeter(s)
mp	melting point
mph	miles per hour
oz	ounce(s)
ppmv	parts per million by volume
ppmw	parts per million by weight
ppt	precipitate
psi	pounds per square inch
pt	pint(s)
qt	quart(s)
rd	rod(s)
rpm	revolutions per minute
sp gr	specific gravity
sq	square
T	ton(s)
tech	technical
temp	temperature
wt	weight
w/v	weight per volume. Do not use this abbreviation. Instead give specific specific units (examples: g/L or lb/gal)
NCWCC	North Central Weed Control Conference
NEWCC	Northeastern Weed Control Conference
SWC	Southern Weed Conference
WSA	Weed Society of America
WWCC	Western Weed Control Conference

HERBACEOUS WEED INDEX

HERBACEOUS WEED INDEX (Continued)

WOODY PLANT INDEX

Page No.

CROP INDEX