WESTERN SOCIETY
OF WEED SCIENCE

RESEARCH PROGRESS REPORT

LAS VEGAS, NEVADA

FEBRUARY 10, 1969

PREFACE

This is the 1969 Annual Progress Report of the Research Committee of the Western Society of Weed Science. It includes the progress of research in weed science conducted throughout the conference area. These reports are grouped into each of the seven projects composing the research committee.

Because of the limited time allowed for compiling and printing the Research Progress Reports, questions of conformity and context were the responsibility of each respective Project Chairman.

The cooperation of the Project Chairman and research workers of the Western Society of Weed Science, in making this report possible, is greatly appreciated. Special thanks is extended to LaMar Anderson for his assistance in printing and assembly of the Research Progress Report.

David E. Bayer
Chairman, Research Committee
Western Society of Weed Science

PROJECT 1. PERENNIAL HERBACEOUS WEEDS

Louis A. Jensen, Project Chairman

SUMMARY

Seven reports were submitted on six different perennial herbaceous weed species from three states. A brief summary of the results on each species is given in alphabetical order, followed by the full reports.

Bermudagrass (Cynodon dactylon L.). University of California research workers found TCA, monuron, atrazine and dicamba at high rates to be quite effective three months after treatment in a high rainfall area where the chemical was applied pre-emergence to prepared soil and incorporated. Single and repeated applications of foliage treatments at high rates in the same area gave good initial control but after 7 1/2 months only dicamba at 40 + 40 + 40 pounds per acre gave over 50 percent control. In a low rainfall area only TCA at high rates showed promise. In another test bromacil alone and in combination with MSMA resulted in the best control.

Canada thistle (Cirsium arvense). In Wyoming picloram and picloram plus 2,4-D combinations at all rates and dichlobenil at heavy rates applied as dormant treatments resulted in excellent control.

Johnsongrass (Sorghum halepense). In California, bromacil plus MSMA was very effective nine months after treatment. MSMA alone and dichlobenil plus MSMA gave fairly good control. The johnsongrass was growing in a mixture with bermudagrass and nutsedge.

Nutsedge (Cyperus esculentus and C. rotundus). In Arizona DSMA or MSMA applied at 2 to 4 week intervals during the growing season destroyed most of the purple nutsedge plants but no yellow nutsedge plants the first year. Other Arizona work with MSMA showed top kill was faster in high temperatures and with lower spray volumes (higher concentrations). In California most rates of bromacil plus MSMA and bromacil alone resulted in fairly good control seven months after treatment.

Russian knapweed (Centaurea repens). In Wyoming picloram, picloram plus 2,4-D, dicamba and heavy rates of 2,4-D gave complete control of Russian knapweed when applied in the fall after spring plowing. Grasses planted the next season survived. In another Wyoming experiment, dormant treatments of picloram and picloram plus 2,4-D give complete control. Most rates of dichlobenil resulted in near complete control.

Herbicide combinations for perennial weed control. Lange, A. H., W. McHenry and R. Rackham. Combinations of herbicides were not more effective at controlling one weed species but generally gave slightly better overall weed control than single herbicides.

Bromacil alone showed good control of all three species by the end of the season. Bromacil plus MSMA showed some advantage on johnsongrass in early and late ratings. Dichlobenil alone was not very effective. Dichlobenil plus MSMA did not increase the kill of johnsongrass but did improve the kill of nutsedge (Cyperus esculentus). MSMA alone was effective on johnsongrass but did not control bermudagrass or nutsedge.

The effect of combinations of MSMA, bromacil and dichlobenil for johnsongrass, bermudagrass and nutsedge control

			Average[1]			Rainfall & furrow irrigation only - non-crop					
			4/4/68	5/7/68		6/27/68			9/12/68		
Herbicide	Act.	lb/A	Johnson-grass	Johnson-grass	Bermuda-grass	Johnson-grass	Bermuda-grass	Nut-sedge	Johnson-grass	Bermuda-grass	Nut-sedge
Bromacil + MSMA[2]	80 WP	2 + 4	3.2	3.5	6.2	6.0	8.2	6.0	8.5	8.0	8.8
" "		4 + 4	7.0	7.2	9.2	8.8	8.8	7.5	10.0	7.8	7.2
" "		6 + 4	6.8	7.2	8.5	8.8	8.2	7.0	10.0	6.5	5.2
" "		8 + 4	6.8	7.2	8.8	9.0	9.5	8.8	10.0	8.5	8.5
Bromacil		8	6.8	5.5	2.8	9.5	9.8	8.8	7.7	7.5	7.5
Dichlobenil + MSMA		8 + 4	3.2	6.2	5.2	7.2	6.0	8.5	8.5	3.8	3.8
Dichlobenil		8	5.5	6.5	1.0	6.5	3.0	6.0	4.5	2.5	2.5
MSMA[2]		4	2.2	6.8	6.8	6.2	0	5.8	9.0	0	0
Check		0	1.8	0.8	3.0	0.8	0	0	1.2	2.5	2.5

[1]Average of 4 replications of mixed johnsongrass, bermudagrass and yellow nutsedge. Weed control ratings where 0 = no effect, 10 = complete weed control (i.e., no weeds present).

[2]MSMA was applied 4/4/68.

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Comparison of several herbicides for Bermudagrass control. Lange, A. H. and H. M. Kempen. Pre-emergence incorporated: Nine herbicides were applied to prepared soil in a heavily bermudagrass infested non-crop area under heavy rainfall conditions on the Island of Molokai, Hawaii. Herbicides were incorporated by a power incorporator run at 4-6 inches immediately after herbicide application. TCA at 60 lb/A was one of the more effective treatments (Table 1). Other herbicides such as monuron, prometone, and atrazine, at rates up to 50 pounds, gave some degree of control. Dicamba at somewhat lower rates showed a degree of control even at rates as low as five pounds. EPTC, diallate, CIPC and pentachlorophenol were essentially ineffective.

Post-emergence applications: A heavily infested stand of mature bermudagrass was treated in repeated applications in the spring of the year over a period of three months. Control ratings were made at monthly intervals one month after the first treatment and continuing for seven months.

One of the most effective treatments was dalapon at repeated applications. Other herbicides showing some control were repeated heavy applications of amitrole, dicamba and linuron, none of which would compete with dalapon economically. In a third test in Kern County, California, 6 herbicides were applied February 7, 1967 under very low rainfall conditions. One half of all plots were incorporated with a disk.

Under the low rainfall conditions (total spring rainfall 3.62 inches) only high rates of TCA gave effective bermudagrass control. It was slightly better when incorporated. There was apparently insufficient rainfall to completely activate the bromacil. Pyriclor was somewhat better incorporated.

The other herbicides were ineffective under the conditions of this trial.

Table 1. A comparison of several herbicides applied and then incorported into the soil for the control of bermudagrass (Cynodon dactylon)

Herbicide	lb/A	Average[1] percent control after 1 mo.[2]	2 mo.[2]	3 mo.[3]
TCA	20	62	64	70
	40	71	84	76
	60	100	94	88
Pentachlorophenol	100	44	29	70
	500	37	0	49
	1000	47	32	15
Monuron	25	82	100	98
	50	71	87	90
Prometone	5	3	8	27
	25	74	77	90
	50	35	87	90

(Continued on Page 4)

Table 1. (Continued)

Herbicide	lb/A	Average[1] percent control after 1 mo.[2]	2 mo.[2]	3 mo.[3]
Atrazine	5	35	32	56
	25	73	71	83
	50	94	94	98
Dicamba	5	79	71	64
	10	97	94	86
	20	97	97	93
EPTC	4	44	52	52
	8	15	23	15
	16	6	6	10
Diallate	4	29	-3	20
	8	41	42	41
	16	32	45	47
CIPC - IPC	4	-3	6	17
	8	18	16	66
	16	9	19	54
Check	0	0	0	0

[1]Average of 4 replicates (5 ft x 5 ft) sprayed and incorporated into the soil on October 11, 1960.

[2]Based on the number of shoots per square foot.

[3]Based on the percent of cover of weed growth.

Table 2. A comparison of several foliar-applied chemicals for bermudagrass (Cynodon dactylon) control. Control ratings from April 10 to September 26 were based on 0 = no control to 10 = 100% or completely dead. Plots were sprayed on March 10, and at approximately monthly intervals thereafter where indicates.

Herbicide	lb/A	Percent control after — Months 1	2	3	4 1/2	5 1/2	6 1/2	7 1/2
Amitrole	8	100	85	58	2	0	-	-
	8+8	100	92	80	32	10	-	-
	8+8+8	100	98	92	78	48	15	12
Amitrole	16	100	95	82	30	8	-	-
	16+16	100	98	100	68	40	25	20
	16+16+16	100	100	100	85	65	40	38
Dicamba	20	80	18	10	0	0	-	-
	20+20	60	48	18	8	0	-	-

(Table 2 continued on Page 5)

Table 2. (Continued)

Herbicide	lb/A	Percent control after Months 1	2	3	4 1/2	5 1/2	6 1/2	7 1/2
Dicamba	20+20+20	82	62	62	62	52	38	40
Dicamba	40	88	60	58	12	0	-	-
	40+40	90	70	65	62	58	30	28
	40+40+40	90	88	82	88	88	80	72
Linuron	8	98	50	18	0	0	-	-
	8+8	95	85	72	18	0	-	-
	8+8+8	88	75	58	32	15	-	-
Linuron	16	100	52	25	2	0	-	-
	16+16	100	88	82	35	18	-	-
	16+16+16	100	90	88	72	50	35	35
Ametryne	8	98	22	8	0	0	-	-
	16	95	38	12	0	0	-	-
Dalapon	10	98	85	78	28	10	-	-
	10+10	95	100	98	82	52	32	20
	10+10+10	95	95	100	92	72	55	50
Check	--------	0	0	0	0	0	0	0

Table 3. Bermudagrass control on ditchbanks

		Bermudagrass[1]			
		Disked		Non-disked	
Treatments	lb/A	4/27	6/8	4/27	6/8
TCA	160	8.9	9.9	8.0	7.7
	241	8.9	9.9	8.3	9.6
	321	9.3	9.9	9.5	8.9
Bromacil	6	2.3	5.2	3.8	2.0
	8	3.0	5.0	3.5	3.7
	10	3.5	5.7	3.8	5.2
Niagara 11092	6	2.3	4.0	3.5	2.5
	8	3.0	6.2	3.5	2.0
	10	2.8	3.2	3.8	3.2
Pyriclor	8	5.0	6.0	4.0	3.0
	12	5.3	7.0	3.8	2.7
	16	7.0	8.6	5.0	4.7
Atratol 8P	200	2.0	2.7	4.0	3.5
	300	2.0	2.7	4.0	5.5
	400	3.0	3.7	5.7	6.2
Pramitol 5P	200	2.0	4.2	4.5	3.5
	300	2.5	4.5	4.5	5.5
	400	3.3	5.0	4.3	5.6
Untreated		0.3	0.2	0	0

[1]Treated 2/7/67; rated 0 to 10 where 0 = no effect, 10 = kill; averages of 2 replications each and 4 independent ratings on bermudagrass.

Note: Atratol 8P (a mixture of 8% atrazine with sodium chlorate and sodium metaborate) and Pramitol 5P (a mixture of 5% prometone with sodium chlorate and sodium metaborate).

Evaluation of picolinic acid, picolinic acid-2,4-D combinations and dichlobenil applied as dormant treatments for control of Canada thistle (Cirsium avense L.). Alley, H. P. and G. A. Lee. A replicated series of plots were established October 27, 1967 to dormant Canada thistle using various rates of picloram and picloram-2,4-D combinations. Dichlobenil was applied as an early spring (dormant) treatment. The picloram and picloram-2,4-D treatments were applied in 40 gpa water. Dichlobenil was applied as a 4 percent granular material.

Data presented in the following table indicate that mixtures of picolinic acid and 2,4-D are as effective as picloram alone, when applied at equivalent rates of picolinic acid per acre. Lower rates, on actively growing plants, would be necessary to determine any increased activity of the combination. Several reports have suggested activity of dichlobenil toward various deep-rooted perennials. The dormant spring treatments of dichlobenil at 6 and 8 lb/A resulted in 99 percent reduction in Canada thistle stand. The remaining plants were healthy. (Wyoming Agricultural Experiment Station, Laramie, SR-153).

Canada thistle control resulting from dormant application of various herbicides

Chemical	lb/A	% Control 7/17/68	Remarks
picloram	1/2	95	
picloram	1	98	
picloram	1 1/2	99++	
picloram + 2,4-D (Tordon-101)	1/2 + 1	98	Thistle seedlings growing
picloram + 2,4-D (Tordon-101)	1 + 2	99	Thistle seedlings growing
picloram + 2,4-D (Tordon-101)	1 1/2 + 3	100	Some grass thinning - thistle seedlings
picloram + 2,4-D (Tordon-212)	1/2 + 1	99+	Thistle seedlings
picloram + 2,4-D (Tordon-212)	1 + 2	99++	
picloram + 2,4-D (Tordon-212)	1 1/2 + 3	100	
picloram gran (Tordon Beads)	1/2 lb active	99	

(Table continued on page 7)

Chemical	lb/A	% Control 7/17/68	Remarks
picloram gran (Tordon Beads)	1 lb active	100	
picloram gran (Tordon Beads)	1 1/2 lb active	100	
*dichlobenil (4% gran)	4 lb active	75	Thistle plants in plots were healthy
*dichlobenil (4% gran)	6 lb active	99	
*dichlobenil (4% gran)	8 lb active	99	

*Dormant spring treatment

Growth and response to organic arsenicals of purple and yellow nutsedge. Hamilton, K. C. Single tubers of 10 Arizona collections of purple nutsedge (*Cyperus rotundus* L.) and 4 collections of yellow nutsedge (*C. esculentus* L.) were space-planted at Tucson in May of 1966 and allowed to grow vegetatively. Two plants of each collection were established. Weeds were controlled by soil applications of low rates of diuron and trifluralin. When treatments with organic arsenicals started in October of 1966, purple nutsedge plants average 150 aerial stems and covered 38 sq ft. Yellow nutsedge plants averaged only 15 aerial stems and covered 1.6 sq ft. Growth of untreated plants of both species continued until topgrowth was destroyed by low temperatures. In the spring of 1967 and 1968, growth of untreated purple nutsedge began in February or early March. Early topgrowth was sometimes injured or killed by late frosts. Growth of yellow nutsedge did not begin until April or May.

Starting in October of 1966, one plant of each collection was sprayed with an organic arsenical at 2- to 4-week intervals if top-growth was present during the growing seasons. In the first six applications, 6 lb/A of DSMA were applied in 100 gpa of water containing 1/2% of a blended surfactant. Later applications were 12 lb/A of DSMA or MSMA in 100 gpa of water containing 1/2% surfactant. Purple nutsedge collections received an average of two treatments in 1966, nine treatments in 1967 and one plant was treated once in 1968. All purple nutsedge collections were treated on April 1, 1967. Yellow nutsedge collections received only one treatment in 1966, eight treatments in 1967 with mid-May the average date of first applications, and four treatments in 1968.

Purple nutsedge began growth earlier than yellow nutsedge so more treatments were made in a year. Most purple nutsedge plants were destroyed in a single year. During the first year less treatments were possible with yellow nutsedge and no plants were destroyed in one year. (Arizona Agric. Expt. Sta., University of Arizona, Tucson.)

Volume and rate of MSMA applications on nutsedge. Hamilton, K. C. Repeat, foliar applications of MSMA have controlled established purple nutsedge (*Cyperus rotundus* L.), but many factors affecting these applications have not been investigated. The affects of varying the volume of spray solution when applying two rates of MSMA to two collections (strains) of purple nutsedge was studied at Tucson, Arizona in 1968.

Two strains of nutsedge were established from tubers in the spring of 1967. Ninety-six plants of each strain were space-planted and maintained without seed production or germination. Weeds were controlled by soil applications of low rates of diuron and trifluralin. Plants averaged 220 aerial stems when treatments started in March of 1968. At 4-week intervals broadcast applications were made with 20, 40, 80, or 160 gpa of spray solution containing 10 or 15 lb/A of MSMA and 1/4% of a blended surfactant. Each plot contained four plants and treatments were replicated three times on each strain. The number of living aerial stems on each plant was estimated before each treatment.

All MSMA treatments destroyed nutsedge topgrowth. Speed of topkill was related to air temperature and concentration of spray solution. Destruction of topgrowth required several days when temperatures were low. Topgrowth was destroyed within 1 or 2 days during the summer. Lower spary volumes (higher concentrations) destroyed topgrowth of nutsedge faster than high spray volumes. Regrowth sometimes occurred sooner where destruction of topgrowth was fastest.

Two applications of MSMA reduced the number of aerial stems by 35%. Four applications reduced the number of stems by 63% but killed only 9 nutsedge plants (see Table). There was no difference in the final control of purple nutsedge with the repeated applications of two rates of MSMA in 20 to 160 gpa of spray solution. After 5 applications strain 11 appeared slightly more susceptible than strain 6. (Arizona Agric. Expt. Sta., University of Arizona, Tucson.)

Plants of two nutsedge strains with topgrowth and number of stems per growing plant after 0, 2, 4, and 6 applications of two rates of MSMA at 4-week intervals

Strain	MSMA	Date 3/26	5/20	7/16	9/9
Plants with topgrowth					
Strain 6	10	48[a]	48	46	30
	15	48	48	46	38
Strain 11	10	48	48	44	27
	15	48	48	45	20
Stems per plant					
Strain 6	10	217[a]	130	32	19
	15	238	139	42	17
Strain 11	10	206	126	39	17
	15	214	115	33	15

[a]Values are averages from four volumes of spray solution

Evaluation of picolinic acid, picolinic acid-2,4-D combinations and dichlobenil applied as dormant treatments for control of Russian knapweed (Centaurea repens L.). Alley, H. P. and G. A. Lee. A replicated series of plots were established October 27, 1967 to dormant Russian knapweed using various rates of picloram and picloram-2,4-D combinations. Dichlobenil was applied as an early spring (dormant) treatment. All treatments were applied in 40 gpa water except the 4 percent granular dichlobenil which was applied as the granule.

All rates of picloram and picloram-2,4-D combinations gave 100 percent control of the Russian knapweed stand. Dichlobenil was effective in reducing the stand with the granular showing increased activity over the wettable powder at the 4 lb/A rate. The Russian knapweed plants remaining in the dichlobenil treated plots were stunted and showed residual activity. (Wyoming Agricultural Experiment Station, Laramine, SR-155.)

Russian knapweed control resulting from dormant applications of various chemicals

Chemical	Rate/A	% Control 7/17/68	Remarks
picloram	1/2 lb	100	White top shows no apparent toxicity in any picloram treated plot
picloram	1 lb	100	
picloram	1 1/2 lb	100	
picloram + 2,4-D (Tordon-101)	1 gal	100	
picloram + 2,4-D (Tordon-101)	2 gal	100	
picloram + 2,4-D (Tordon-101)	3 gal	100	
picloram + 2,4-D (Tordon-212)	1/2 gal	100	
picloram + 2,4-D (Tordon-212)	1 gal	100	
picloram + 2,4-D (Tordon-212)	1 1/2 gal	100	
picloram (gran) (Tordon Beads)	1/2 lb active	100	
picloram (gran) (Tordon Beads)	1 lb active	100	

(Table continued on page 10)

Chemical	Rate/A	% Control 7/17/68	Remarks
picloram (gran) (Tordon Beads)	1 1/2 lb active	100	White top shows no apparent toxicity in any picloram treated plot
*dichlobenil (4 gran)	4 lb active	95	Knapweed plants present are stunted
*dichlobenil (4% gran)	6 lb active	95	
*dichlobenil (4% gran)	8 lb active	95	
*dichlobenil (WP)	4 lb	50	
*dichlobenil (WP)	6 lb	90	
*dichlobenil (WP)	8 lb	90	

*Dormant spring treatment

Perennial weed control and subsequent establishment of grass seedlings. Alley, H. P., G. A. Lee and A. F. Gale. Several herbicides are available that can be used to eliminate established stands of perennial weeds. Many times the areas treated have been so densely infested that the soil is denuded of any vegetative cover upon removal of the perennial weeds. In such cases it is essential to re-establish vegetation as soon as possible. With this situation in mind, a native pasture heavily infested with Russian knapweed (*Centaurea repens* L.) was selected for the study. The infested area was plowed early in the spring of 1967 with plans of clean cultivating the area as needed to complete a clean fallow program. Limited precipitation was received during the growing season and there was not enough regrowth of Russian knapweed to warrant further mechanical operations.

Chemical treatments (following table) were applied September 8, 1967. Treatments were set up in a replicated series of three blocks.

On April 25, 1968, approximately seven months following chemical application, the plot area was lightly disked and cross-seeded with crested, intermediate, and pubescent wheatgrasses, and Russian wildrye. Each grass variety was included in each block, resulting in a replicated seeding across each chemical treatment.

At evaluation, July 11, 1968, there was complete elimination of the Russian knapweed by all treatments except 2,4-D amine at 2 lb/A. Annual weeds were common on most plots and a light rate of 2,4-D was used to reduce their competition. All grass species were well established at the time of evaluation. The most vigorous was pubescent wheatgrass, the weakest was Russian wildrye. Grasses established on the picloram treated plots showed prostrate growth and some thinning of the stand at rates above 1/2 lb/A. However, the grass cover was very good.

This study indicates that areas treated with the chemicals picloram, dicamba and heavy rates of 2,4-D can be reseeded, within a year's time after chemical application, and good stands of grass can be established. (Wyoming Agricultural Experiment Station, Laramie, SR-151.)

Evaluation of Russian knapweed control and grass establishment

Treatment	lb/A	Control and grass seedling evaluation
picloram	1/2	100% control, annual weeds in plots - good stands of all grasses
picloram	1	100% control, few annual weeds in plots - grass stands thinned and prostrate
picloram	1 1/2	100% control, tansy mustard in plots - grass stands thinned and prostrate
picloram	2	100% control, tansy mustard in plots - grass stands thinned and prostrate
picloram (gran)	1 (active)	100% control, plots clean - grass stands thinned and prostrate
picloram (gran)	2 (active)	100% control, plots clean - grass stands thinned and damaged
picloram + 2,4-D (Tordon-101)	1/2 gal	100%. Annual weeds present
picloram + 2,4-D (Tordon-101)	1 gal	100%. Annual weeds present
picloram + 2,4-D (Tordon-101)	2 gal	100%. Plots clean
dicamba	2	100%. Annual weeds present
dicamba	10	100%. Annual weeds present
2,4-D amine	2	÷ 20%. Annual weeds present
2,4-D amine	20	100%. Annual weeds present
2,4-D amine	40	100%. Annual weeds present

PROJECT 2. HERBACEOUS RANGE WEEDS

Roger Scott, Project Chairman

SUMMARY

Four reports were submitted. One report dealt with species of weeds encountered in various situations. One report gave the cost and return estimates for weed control treatment and two reports were on Geyer larkspur control. The reports are briefly summarized below.

The weed species that cause problems under different conditions are listed.

The yield of crested wheatgrass is two to three times that of native big sagebrush and the cost of range improvement will run from $12 to $15 per acre.

Although 2,4-D was not particularly effective against Geyer larkspur, treatments made in late May were more effective than treatments made in early April and the middle of May.

Combinations of 1/4 to 1/2 of picolinic acid plus 1/2 to 1 lb of 2,4,5-TP per acre gave complete elimination of larkspur over a two year period whereas 1 lb of picloram alone was required to maintain 100 percent control over a two year period.

Areas and species encountered in herbaceous range weed control. Young, J. A. The members of Project 2, Herbaceous Range Weeds, Western Society of Weed Science have developed the following definition of areas and enumeration of the species involved in control of herbaceous range weeds.

I. Control of competing annual vegetation to permit establishment of desirable perennial grasses or legumes.

a. Downy brome, *Bromus tectorum*

b. Medusahead, *Taeniatherum asperum*

c. Annual vegetation complex of cismotane California, including many species of *Bromus*, *Festuca*, *Hordeum*, *Lolium*, *Avena*, *Centaurea*, *Erodium*, *Amsinckia*, and *Brassica*.

d. Annual broadleaf complex of the intermountain area:

Russian thistle, *Salsola kali* var. *tenuifolia*; tumble mustard, *Sisymbrium altissimum*; tansy mustard, *Descurainia pinnata*; *Helianthus* spp., redstem filaree, *Erodium cicutarium*. These species are released by control of weedy annual grasses.

e. Perennial broadleaf complex, field bindweed, *Convolvulus arvensis*; and poverty weed, *Iva axillaris*.

II. Control of poisonous species.

a. Larkspur, Delphinium; duncecap, D. occidentale; low, D. nelsonii; plain, D. virescens; tall, D. barbeyi; D. andersonii.

b. False hellobore, Veratrum californicum

c. Halogeton glomeratus

d. Milk vetch, timber, Astragalus miser var. oblongifolia

e. Spring parsley, Cympoterua watsonii

f. Deathcamas, Zigadenus; Z. paniculatus.

g. Arrowgrass, Triglochin palustris

h. Hemlock, Conium; poison, C. maculatum

i. Milkweed, Asclepias; labriform, A. labriformis

j. Sneezeweed, Western, Helenium hoopesii

k. Lupine, silky, Lupinus sericeus; silvery, L. argenteus

l. Copperweed, Oxytenia acerosa

m. Crazy weed, Oxytropis spp.

n. Klamath weed, Hypericum perforatum

o. Bracken fern, Pteridium aquilinum var pubescens

p. Waterhemlock, Cicuta; Western, C. douglasii

III. Control of competing species in established stands of desirable forage species.

a. Prickly pear, Opuntia spp.

b. Annual grasses in perennial wheatgrasses (same species as listed under 1.).

c. Thistle complex--Scotch, Onopordum acanthium; musk, Carduus nutans; Italian, C. pycnocephalus; bull, Cirsium vulgare

d. Cismontane annual complex in California

e. Knapweed, Russian, Centaurea repens; diffuse, C. diffusa; spotted, C. maculosa

f. Delmation toadflax, Linaria dalmatica

g. Mediterranean sage, Salvia aethiopis

h. Tansy, Tanacetum vulgare

i. Fringed sagebrush, *Artemisia frigida* (semi-woody species)

j. Broom snakeweed. *Gutierrezia sarothrae* (semi-woody species)

k. Rabbitbrush, low *Chrysothamnus viscidiflorus*; tall, *C. nauseosus* (semi-woody species)

IV. Control of noxious weeds which inhabit rangelands adjacent to agronomic cropland and in the watersheds of agronomic cropland.

a. Canada thistle, *Cirsium arvense*

b. Lefy spurge, *Euphorbia esula*

c. Hoary cress, *Cardaria draba*

d. Knapweed, *Centaurea*, Russian *C. repens*; diffuse, *C.* diffusa

e. Delmation toadflax, *Linaria dalmatica*

f. Mediterranean sage, *Salvia aethiopis*

V. Control of herbaceous range weeds that serve as host for insect vectors of diseases of agronomic crops

a. Russian thistle, *Salsola kali*

b. Tumble mustard, *Sisymbrium altissimum*

c. *Halogeton glomeratus*

(U.S.D.A.-ARS, Reno, Nevada)

Range improvement statistics. Young, J. A. The following range and livestock statistics were compiled by members of Project 2, Herbaceous Range Weeds, W.S.W.S. in an attempt to provide background information to individuals interested in calculating cost and return estimates for weed control treatments.

1. Average total forage yield of native big sagebrush (*Artemisia tridentata*) range in fair condition.

a.	Northern Nevada	100-300 lb/A
b.	Eastern Oregon	200-400 lb/A
c.	Columbia Basin	150-400 lb/A
d.	Southern Idaho	150-300 lb/A
e.	Wyoming	100-500 lb/A

2. Average yield of crested wheatgrass seeding

a. Northern Nevada	700-800 lb/A
b. Eastern Oregon	600-1000 lb/A
c. Columbia Basin	700-1000 lb/A
d. Southern Idaho	700-1000 lb/A
e. Wyoming	600-1000 lb/A
f. Northeastern California	300-1000 lb/A

3. Average yield of native big sagebrush (*Artemisia tridentata* in fair condition sprayed for shrub control.

a. Northern Nevada	400-500 lb/A
b. Eastern Oregon	400-800 lb/A
c. Columbia Basin	500-900 lb/A
d. Southern Idaho	1000-1200 lb/A
e. Wyoming	1000-1200 lb/A

4. Cost of Seeding

a. Range drill	$0.50/A
b. Seed-crested wheatgrass	$0.30-0.50/lb - $1.80-300/A
intermediate wheatgrass	$0.30-0.46/lb - $1.80-2.76/A
Rose or subterranean clover	$0.50/lb - $5.00/A
c. Pelleted inoculation	$0.10/lb - $1.00/A
d. Fertilization for clovers in California (single super phosphate)	400 lb/A -- $10.00/A

5. Cost of fencing (necessary for most range improvement projects).

$750 - 1,000/mile

6. Cost of tillage for weed control on rangelands

a. Range plow	$1.80 - 3.50/A
b. Disk harrow	$1.50 - 2.50/A

7. Complete development of management unit for range improvement:

Plowing, seeding, water development, fencing, non-use and interest on investment $12.00 - 15.00/A

(U.S.D.A.-ARS - Reno, Nevada)

Larkspur (Delphinium geyeri Greene) control as affected by application of 2,4-D at three different dates. Alley, H. P. and G. A. Lee. There has been concern and differences of opinion as to the stage of growth that larkspur be treated with 2,4-D to obtain maximum control. Early treatments, in the leaf rosette, have been suggested as being more effective than applications made at later stages of growth.

A time series study was initiated early in the sping of 1967. The larkspur was treated when the established plants were in the (1) seedling to 3-4 in. leaf height, (2) plants 4-6 in. leaf height and (3) plants 6-8 in. leaf height. To determine reduction in stand, all larkspur plants in the replicated series of plots were counted just prior to treatment and approximately one year following treatment.

The counts obtained from the plots, at time of treatment, indicate that all of the larkspur plants had not emerged or the seeds germinated by the time the earliest treatments were made.

Although control was not outstanding with any treatment or date of application, these data indicate that treatments made at the later date were more effective than at the earlier dates. (Wyoming Agricultural Experiment Station, Laramie, SR-152)

Larkspur counts and percent control as affected by dates of application of 2,4-D

		Counts and Treatment Dates[1]						Percent Control		
		5/9/67		5/16/67		5/26/67				
Treatment	Rate/A	1967	1968	1967	1968	1967	1968	4/9/67	5/16/67	5/26/67
2,4-D (Butyl Ester)	1	299	293	262	236	420	309	2	10	27
2,4-D (Butyl Ester)	2	301	210	272	215	431	286	30	21	34
2,4-D + X-77 (Butyl Ester)	1	233	188	316	289	506	272	19	9	46
2,4-D + X-77 (Butyl Ester)	2	267	186	366	288	488	377	30	21	23

(Table continued on Page 17)

		Counts and Treatment Dates[1]								
		5/9/67		5/16/67					Percent Control[1]	
Treatment	Rate/A	1967	1968	1967	1968	1967	1968	4/9/67	5/16/67	5/26/67
2,4-D (PGBE)	1	215	163	262	243	298	210	24	7	30
2,4-D (PGBE)	2	290	237	333	255	489	304	18	24	38
2,4-D + X-77[3] (PGBE)	1	340	275	324	270	309	201	19	17	35
2,4-D + X-77 (PGBE)	2	245	188	303	229	339	229	23	24	33

[1]Treatment dates and stage of growth were:

5/9/67 - seedling to 3-4 in. leaf height
5/16/67 - plants 4-6 in. leaf height
5/26/67 - plants 6-8 in. leaf height

All larkspur plants in the replicated series of treatments counted before treatment.

[2]Percent control determined by counting all larkspur plants in the replicated treatments one year following treatment.

[3]X-77 at 1 pt/100 gal mix

<u>Evaluation of several combination treatments of picolinic acid phenoxyacetic acid and propionic acid for control of larkspur (*Delphinium geyeri* Greene).</u> Alley, H. P. and G. A. Lee. A replicated series of plots were established May 12, 1966 when the larkspur plants were in the leaf-rosette (2-6 in.) stage of growth. All chemicals were applied in 40 gpa water. The plots originally treated with only the phenoxyacetic and propionic acid formulations were retreated June 9, 1967 and again June 3, 1968. None of the plots receiving a treatment containing picolinic acid have been retreated.

Evaluations have been made each year since establishment. The first year's data were presented in last year's Research Progress Report. The data obtained one and two years after treatment are presented in the following table.

Several of the combinations gave outstanding control over a two-year period. The lowest rates which resulted in complete elimination of larkspur were: 1) picloram + 2,4,5-T_e (1 + 2) and 4 pt/A and 2) picloram + 2,4,5-TP_e (1/2 + 2) at 6 pt/A. These two treatments represent 1/2 lb of picolinic acid plus 1 lb of 2,4,5-T/A and 1/4 lb of picolinic acid plus 1/2 lb of 2,4,5-TP/A, respectively. Other combinations resulted in 90 percent or better control.

The results obtained with the combinations are of significance since 1 lb/A of picloram was required to maintain 100 percent control over the two-year period as compared to considerably lower rates when included in the various combinations. (Wyoming Agricultural Experiment Station, Laramie, SR-154)

Percent control of plains larkspur one and two years following treatment

Treatment	Rate/A	Percent Control[1]	
		1967	1968
picloram	1/8 lb	34	55
picloram	1/4 lb	55	50
picloram	1/2 lb	100	97
picloram	1 lb	100	100
picloram + 2,4-D (Tordon-101) (1/2 + 2)	2 pt	50	75
picloram + 2,4-D (Tordon-101) (1/2 + 2)	4 pt	96	94
picloram + 2,4-D (Tordon-101) (1/2 + 2)	6 pt	100	88
picloram + 2,4-D (1/4 + 2)[3]a	2 pt	0	29
picloram + 2,4-D (1/4 + 2)[3]a	4 pt	68	79
picloram + 2,4-D (1/4 + 2)[3]a	6 pt	70	70
picloram + 2,4-D (1/2 + 2)[3]a	2 pt	41	69
picloram + 2,4-D (1/2 + 2)[3]a	4 pt	50	29
picloram + 2,4-D (1/2 + 2)[3]a	6 pt	82	77
picloram + 2,4-D (1 + 2)[3]a	2 pt	14	62
picloram + 2,4-D (1 + 2)[3]a	4 pt	93	93
picloram + 2,4-D (1 + 2)[3]a	6 pt	94	88
picloram + 2,4,5-T (1/4 + 2)[3]e	2 pt	56	62
picloram + 2,4,5-T (1/4 + 2)[3]e	4 pt	73	80
picloram + 2,4,5-T (1/4 + 2)[3]e	6 pt	100	89
picloram + 2,4,5-T (1/2 + 2)[3]e	2 pt	97	89
picloram + 2,4,5-T (1/2 + 2)[3]e	4 pt	100	97
picloram + 2,4,5-T (1/2 + 2)[3]e	6 pt	95	87
picloram + 2,4,5-T (1 + 2)[3]e	2 pt	96	92
picloram + 2,4,5-T (1 + 2)[3]e	4 pt	100	100
picloram + 2,4,5-T (1 + 2)[3]e	6 pt	100	100
picloram + 2,4,5-TP (1/4 + 2)[3]e	2 pt	69	67
picloram + 2,4,5-TP (1/4 + 2)[3]e	4 pt	94	68
picloram + 2,4,5-TP (1/4 + 2)[3]e	6 pt	94	88
picloram + 2,4,5-TP (1/2 + 2)[3]e	2 pt	91	62
picloram + 2,4,5-TP (1/2 + 2)[3]e	4 pt	93	89
picloram + 2,4,5-TP (1/2 + 2)[3]e	6 pt	100	100
picloram + 2,4,5-TP (1 + 2)[3]e	2 pt	89	79
picloram + 2,4,5-TP (1 + 2)[3]e	4 pt	98	96
picloram + 2,4,5-TP (1 + 2)[3]e	6 pt	74	83
*2,4-D (Dacamine)	1 lb	74	71
*2,4-D (Dacamine)	2 lb	28	72
*2,4-D (Emulsamine)	1 lb	22	53
*2,4-D (Emulsamine)	2 lb	19	73
*2,4-D (Weedone 638)	1 lb	0	43
*2,4-D (Weedone 638)	2 lb	53	47
*2,4-D (Butyl Ester)	1 lb	44	37
*3,4-D (Butyl Ester)	2 lb	25	25

(Table Continued on Page 19)

Treatment	Rate/A	Percent Control[1] 1967	1968
*2,4-D (PGBE Ester)	1 lb	38	54
*2,4-D (PGBE Ester)	2 lb	57	79
*2,4-D (Butyl Ester + X-77)	1 lb	41	72
*2,4-D (Butyl Ester + X-77)	2 lb	0	75
*2,4-D (PGBE Ester + X-77)	1 lb	50	56
*2,4-D (PGBE Ester + X-77)	2 lb	70	44
*2,4,5-TP (Silvex)	1 lb	51	57
*2,4,5-TP (Silvex)	2 lb	0	47
*2,4,5-TP + X-77	1 lb	39	78
*2,4,5-TP + X-77	2 lb	82	83
*2,4,5-T	1 lb	83	86
*2,4,5-T	2 lb	72	72
*2,4,5-T + X-77	1 lb	18	56
*2,4,5-T + X-77	2 lb	62	91
dicamba + 2,4-D (2 + 2)	1/4 gal	43	40
dicamba + 2,4-D (2 + 2)	1/2 gal	75	40
dicamba + 2,4-D (2 +)	1 gal	0	42
Check		0	0

3 - mixed by researchers
a - amine formualtion of phenoxyacetic or propionic acid
e - ester formulation of phenoxyacetic or propionic acid
* - retreated 6/9/67 and 6/3/68. Larkspur 6-10 in. - no seed elongation
1 - four 1 ft. x 2 ft. quadrates within each square rod plot

PROJECT 3. UNDESIRABLE WOODY PLANTS

L. E. Warren, Project Chairman

SUMMARY

Ten articles were submitted by four authors. They report results with various herbicides on salmonberry, creosote bush, tarbush and miscellaneous weeds in young conifers. Of particular interest is the good control of salmonberry in Oregon with 3 lb of 2,4,5-T per acre. Picloram at 1/2 lb with 2,4,5-T at 2 lb per acre as amine salts were not quite so good as 2,4,5-T ester alone. Tarbush and creosote bush in New Mexico required 2 applications to give the most control with any chemical, and dicamba, and TBA were superior to the phenoxy and picloram herbicides.

A combination of atrazine, 2,4-D and cacodylic acid gave good control of grasses and broadleaf weeds without injury to Douglas fir seedlings in Oregon. The conifers were dormant at time of application.

The degradation rates of amitrole and 2,4-D were about equal in forest floor litter. 2,4,5-T decomposed about 20% as fast and loss of picloram was much slower. The insecticide Sevin seemed to retard loss of 2,4-D but the difference was not of practical importance.

Studies of run-off of picloram and 2,4-D from treated watersheds indicate that very small amounts may be found in the first run-off water, but is quickly dissipated.

Snowbrush and blueblossom ceanothus seeds reacted to heat from a fire to enhance their survival in the soil.

Screening tests of picloram on salmonberry. Gratkowski, H. Salmonberry (Rubus spectabilis) is a major problem on forest land in the Pacific Northwest. It quickly occupies sites after logging and after aerial spraying to release conifers from taller brush and weed trees in the Coast Ranges. Amitrole-T is now widely used to control salmonberry, but foresters are seeking more effective chemicals for use on this species.

On July 22, 1966, two formulations of picloram (M-2951 and M-3083) were applied as foliage sprays on salmonberry in the Oregon Coast Range. M-2951 contains 1/2 lb ae of picloram plus 2 lb ae of 2,4,5-T per gallon; M-3083 contains 1 lb each of picloram, 2,4-D, and 2,4,5-T per gallon in the form of triisopropanolamine salts. Amitrole-T at rates of 1 gal and 1 1/2 gal per acre was applied on adjacent plots for comparison. Low volatile esters of 2,4,5-T were also included in the tests. A 2 percent diesel oil emulsion was used as the carrier for 2,4,5-T; the other herbicides were applied in water carriers.

Response to treatment was evaluated 15 months later using the Dow Rating System based on ten observations per plot.

	Treatment		
Herbicide	Rate/acre	Carrier	Degree of control[1]
Amitrole-T	1 gal	Water	2.4
Amitrole-T	1 1/2 gal	Water	2.4
M-2951	1 gal	Water	2.8
2,4,5-T	3 lb	Emulsion	3.5
M-3083	1 gal	Water	3.5
M-3083	1 1/2 gal	Water	4.1

[1]A rating of 1.0 indicates little or no effect; a rating of 5 indicates complete kill with no resprouting.

M-3083 at a rate of 1 1/2 gal per acre provided a noticeably higher percentage of kill than any of the other treatments. This should be a useful treatment for controlling salmonberry in preparing nonstocked sites for reforestation with conifers. Where conifers are present, the non-selective effect of picloram may make it more desirable to use a chemical like 2,4,5-T that is less damaging to the trees. On these plots, 3 lb ae of 2,4,5-T per acre produced a higher percentage of kill than either of the amitrole-T treatments and at far less cost. Neither amitrole-T nor 2,4,5-T damaged small Douglas firs on the spray plots. (Pacific N.W. Forest and Range Expt. Sta., Forest Service, U.S. Dept. of Agric., Roseburg, Oregon.)

Degradation of several herbicides in red alder forest floor material. Norris, Logan A. In a continuing study of the behavior of introduced chemicals in the forest environment, I measured the relative persistence of four herbicides in red alder (*Alnus rubra* Bong.) forest floor material (litter plus decaying organic matter overlying mineral soil). Results show clearly that herbicides decompose in this forest floor material but at markedly different rates.

Amitrole and 2,4-D are most rapidly lost; 2,4,5-T is intermediate in persistence; and picloram is most resistant to degradation. Although picloram is persistent relative to other herbicides, the data suggest a half life of less than 9 months.

The potential for stream pollution by herbicides due to leaching or overland flow is certainly related to the persistence characteristics of the chemicals. The more rapidly the chemical decomposes, the less is available for pollution. Data indicate that 2,4-D and amitrole offer little potential for stream contamination unless heavy rains come shortly after treatment. Picloram and 2,4,5-T, on the other hand, are more persistent, and the potential for movement to streams lasts longer.

Forest floor material was collected in western Oregon, mechanically chopped, and preconditioned in a growth chamber for 3 weeks under a 15-hour day with 15°C night and 24°C day temperatures. Samples of 25 g (ovendry weight) were weighed into 110-ml waxed paper cups, treated, and returned to the growth chamber. The treatments included 2,4-D and 2,4,5-T potassium salts at 2 lb/A ae, amitrole at 2 lb/A and picloram potassium salt at 0.5 lb/A ae. All treatments were made in water pipetted to the surface of the sample.

Samples were analyzed at intervals for herbicide residue. Those containing picloram, 2,4-D or 2,4,5-T were digested in strong base and centrifuged. The herbicide was partitioned into benzene or ether from the acidified supernatant. Several cleanup steps with basic alumina column chromatography were followed by esterification with BF_3 in methanol. The esters were partitioned into hexane or ether then chromatographed on a Florisil column. Residues were measured with the Dohrmann chloride specific detection system on a gas chromatograph with a 1/4-inch by 4-foot glass column packed with 10% DC-11 coated 70/80 mesh Gas Chrom. Z. The instrument was operated at 160 to 170°C with nitrogen carrier gas at 120 ml/min at 20 psi.

Amitrole was extracted with 70% methanol in a Soxhlet. Ion exchange chromatography was used for sample concentration and initial cleanup. After final cleanup with activated charcoal, amitrole was determined colorimetrically.

Percent recovery of herbicides from forest floor material[1]

Herbicide	Days after treatment 10	20	35	60	120	180
2,4-D	56	14	6	--	--	--
2,4,5-T	--	66	--	35	13	--
Amitrole	42	28	20	--	--	--
Picloram	--	--	--	92	87	65

[1]Corrected for recovery from samples frozen immediately after treatment. Means of three replications.

This research was supported in part by Research Grant WP00477 from the Federal Water Pollution Control Administration and in part by Supplements 39 and 49 to Master Memorandum of Understanding between Oregon State University and the Forest Service, U.S. Department of Agriculture. (Joint contribution, USDA, Forest Service, Forestry Sciences Laboratory, and Oregon Agri. Expt. Sta., Oregon State University, Corvallis.)

<u>Some chemical factors influencing the degradation of herbicides in forest floor material.</u> Norris, Logan A. The influence of rate of application and presence of other chemicals on degradation of 2,4-D, 2,4,5-T, and picloram was investigated in connection with another study

reported in these Research Progress Reports (Degradation of several herbicides in forest floor material). Methods of collecting, handling, and analyzing forest floor samples were as outlined in the previous report.

Results show that degradation rates of commonly used brush control herbicides are not strongly influenced by other pesticidal materials. This fortunate lack of interaction greatly simplifies attempts to predict field behavior of chemical brush control agents.

The herbicides were formulated as their potassium salts from materials of high purity. To determine the effect of insecticide residues on herbicide degradation, I applied the following commercially formulated insecticides to samples of forest floor material 1 month before treatment with 2,4-D at 2 lb/A:

1. DDT 2 emulsive (Ortho) 1,1,1,-trichloro-2,2-bis (p-chlorophenyl) ethane; at 1 lb/A;

2. Sevin 50 W (Niagara) 1-napthyl-n-methyl carbamate (Carbaryl) at 2 lb/A; or

3. Phosphamidon 4 (Ortho) 1-chloro-1-diethylcarbamoyl-1-propen-2-yl dimethyl phosphate at 1.5 lb/A.

The degradation of 2,4-D, 2,4,5-T, and picloram was studied when these herbicides were applied at different rates or in combination (see tabulation). Resulting data were subjected to analysis of variance. Mean recoveries at the last sampling time were compared by the method of individual degress of freedom.

Percent recovery of herbicides from forest floor material[1]

Treatment	Days after treatment[2]					
	10	20	35	60	120	180
2,4-D at 2 lb/A (control)	56	14	6	--	--	--
2,4-D at 4 lb/A	65	14	5	--	--	--
2,4-D at 2 lb/A + DDT at 1/2 lb/A	45	19	9	--	--	--
2,4-D at 2 lb/A + Sevin at 2 lb/A	51	15	11	--	--	--
2,4-D at 2 lb/A + Phosphamidon at 1.5 lb/A	55	20	6	--	--	--
2,4-D at 2 lb/A + 2,4,5-T at 2 lb/A	58	21	8	--	--	--
2,4-D at 2 lb/A + picloram at 1/2 lb/A	62	14	5	--	--	--
2,4,5-T at 2 lb/A (control)	--	66	--	35	13	--
2,4,5-T at 4 lb/A	--	78	--	42	18	--
2,4,5-T at 2 lb/A + 2,4-D at 2 lb/A	--	78	--	24	13	--
Picloram at 1/2 lb/A (control)	--	--	--	92	87	65
Picloram at 1/2 lb/A + 2,4-D at 2 lb/A	--	--	--	82	77	59

[1] Percent recovery of the underlined herbicide corrected for recovery from samples analyzed immediately after treatment. Means of three replications.

[2] No significant differences (5 percent level) among mean recoveries for a given chemical at the last sampling time except between 2,4-D control and 2,4-D + Sevin.

The percent recoveries of 2,4-D and 2,4,5-T are independent of application rate. This same result was found earlier* for amitrole. Since the half lives of these herbicides are independent of starting concentration, it might be suggested degradation follows first order kinetics. However, from the equation for the first order rate law, the calculated rate constants for each chemical varied with time, which indicates first order kinetics did not obtain throughout the test period.

The small reduction in rate of degradation of 2,4-D by Sevin probably presents no serious problem concerning joint use of these chemicals. Earlier tests showed degradation of 2,4-D was stimulated when 2,4-D and DDT were applied together. The present study shows pretreatment with DDT had no such effect. Thus, DDT stimulation of conditions favoring 2,4-D degradation is of short duration.

I suggest that previous treatment with certain other carbamate, organic phosphate, and chlorinated hydrocarbon insecticides will have little impact on 2,4-D degradation. 2,4-D did not influence the rate of degradation of 2,4,5-T or picloram, and neither of the latter chemicals influenced the degradation of 2,4-D.

This research was supported in part by Research Grant WP00477 from the Federal Water Pollution Control Administration and in part from Supplements 39 and 49 to the Master Memorandum of Understanding between Oregon State University and the Forest Service, U.S. Department of Agriculture. (Joint contribution USDA, Forest Service, Forestry Sciences Laboratory, and Oregon Agri. Expt. Sta., Oregon State University, Corvallis.)

*Research Progress Reports, 1968, pp. 31-32.

Herbicide runoff from forest lands sprayed in summer. Norris, Logan A. Picloram is sometimes applied with phenoxy herbicides in the summer for brush control on powerline rights-of-way over forest lands. We investigated the effect of such summertime spraying on stream water quality after the first few storms in the fall.

Runoff of picloram and phenoxy herbicides can occur after the first heavy autumn rains if the chemicals are applied in mid- or late summer. The greatest potential for herbicide runoff appears when early fall storms are sufficiently intense to cause overland flow rather than infiltration of water. The resulting amount of stream contamination is determined largely by the proportion of the watershed that is treated.

Monitoring studies at three locations in Oregon and Washington provided the basis for the foregoing conclusions. The 3.3-acre Beacon Rock study area is on the north bank of the Columbia River in Washington. On July 26, 1967, 11% of the watershed was treated with picloram and 2,4-D at 0.5 and 2 lb/A, respectively. On August 19, 1967, 67% of the watershed was sprayed with picloram and 2,4-D and 1 and 4 lb/A, respectively. The area did not contain a well-defined stream, but runoff water ponded in a large depression at the base of the slope and then overflowed to a small stream. All samples were collected from this pond.

The second study area is on the west slope of the Cascade Range of Oregon near Big Cliff Dam on the North Santiam River. The lower 2% of this 200-acre watershed was treated on August 9, 1967, with picloram and 2,4-D at 1 and 4 lb/A, respectively. Water samples were collected from a live stream at the bottom of the watershed.

The third area, 10 miles east of Roseburg, Oregon, consists of a 112-acre watershed containing four 14-acre plots on which poison oak eradication trials were conducted. Applications were made by helicopter in June 1927. The portion of the watershed adjacent to the stream from which water samples were taken was treated with 0.5 lb/A ae each of picloram and 2,4,5-T amine salts.

Herbicide residues were extracted with ether and measured as their methyl esters with a Dohrmann gas chromatograph. The threshold level of quantitative detection is 1 part per billion (ppb).

Residues in water in the Beacon Rock study area

Date Sampled	Herbicide concentration (corrected for recovery)		Rainfall	
	2,4-D	picloram	Cumulative from 9/1	Current storm[1]
	--------ppb ae------		-------------Inches-------------	
9-11	825	78	1.10	1.00
9-30	250	38	1.77	.38
10-2	22	54	2.66	.99
10-3	19	34	3.44	1.77
10-5	9	26	3.66	1.99
10-11	6	13	4.69	.82
10-13	3	15	6.25	2.38
10-25	1	2	10.25	2.97
10-27	1	1	11.24	3.96

[1]Cumulative precipitation occurring on consecutive days which would influence runoff of stream level immediately preceding a given sampling date.

Despite storms with precipitation up to 4.8 inches in the Beacon Rock study area, no herbicide residues were detected between October 27, 1967, and February 16, 1968, when the last sample was collected.

At Big Cliff Dam, no residues were found in samples collected between October 2 and December 5, 1967. Probably the small proportion of the watershed treated accounted for lack of chemical runoff even during storms totaling 5.8 and 6.4 inches of rainfall.

At Roseburg, several samples were collected during the first substantial storm of the season (4.45 inches of rainfall between December 2 and December 7, 1967). Scattered samples contained residues of 2,4,5-T of about 1.5 ppb, and one sample contained 6 ppb. Picloram was detected in three samples at 1 ppb. Light rains in October and

November preceded the first strong storm and probably favored infiltration rather than overland flow. This area was treated in June, so the herbicide was available for degradation for 6 months after runoff occurred. Time of application and pattern of precipitation probably account for the low levels of herbicide in the runoff from this study area. (Joint contribution from USDA, Forest Service, Forestry Sciences Laboratory; Agri. Exp. Sta., Oregon State University, Corvallis, Oregon.)

Evaluation of herbicide treatments for the control of creosotebush (Larrea tridentata). Gould, Walter L. and Carlton H. Herbel. Creosotebush is an evergreen xerophyte which has invaded extensive areas of desert rangeland in the southwestern United States. Much of the infested area at one time was productive grassland, but drought and grazing by livestock has shifted the balance in favor of the brush, so many areas are heavily infested with creosotebush and nearly devoid of grass. Control of the creosotebush is necessary to effect revegetation. Creosotebush sprouts profusely from the crown when the topgrowth is removed mechanically. Satisfactory seeding methods have not been developed for the arid Southwest, so chemical treatments must be used which will selectively remove the brush and leave the grass.

Treatments were applied on the Jornada Experimental Range near Las Cruces, New Mexico from 1961 through 1965 to determine the most effective herbicides and the optimum date of application for the control of creosotebush. Simulated aerial application was made on 1/100 acre plots at two week intervals from July through October or November. In one year (1963), treatments were initiated in April. Treatments in 1961 included 2,4-D, 2,4,5-T, 2,4-DP, silvex, 2,3,6-trichlorobenzoic acid and amitrole-T. In 1962, dicamba was added to the list of herbicides, and in 1963 picloram was added. The herbicide rate at each application date was 1/2 lb/A in 1961 and 1962, 1 lb/A in 1963, and 1 1/2 lb/A in 1964 and 1965, except that picloram was applied at 3/8 lb/A in 1963. On one spray date in 1962, 1963 and 1964, herbicides were applied at 3 rates to help elucidate the optimum herbicide rate.

The dates of maximum toxicity, as determined by evaluating the degree of defoliation 2 years after herbicide application, varied yearly from late July to early November, but generally in a given year all the herbicides caused maximum defoliation on a common date of application. Treatments during September caused the highest degree of defoliation in three of the five years. Highest levels of defoliation occurred from treatments with dicamba, picloram and 2,3,6-TBA on 3 different dates in two of the years. Very little defoliation was obatined from treatments applied before July. This would indicate that creosotebush is most susceptible to herbicides when treated after the summer rainy season has started.

The phenoxy herbicides and amitrole-T were not effective on creosotebush, giving 20%, or less, defoliation on all application dates in every year except 1961. Seventy percent defoliation was obtained on several spray dates with 1 1/2 lb/A of 2,3,6-TBA, dicamba and picloram, but the results were variable between dates and between years. On a given spray date, increasing the rate of dicamba or 2,3,6-TBA, above 1 lb/A caused an increase in defoliation, but this effect was not always observed using picloram. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U.S. Dept. of Agriculture, and New Mexico Agric. Expt. Sta., New Mexico State University, Las Cruces).

Herbicide evaluation studies for the control of tarbush (*Fluorensia cernua*). Gould, W. L. and C. H. Herbel. Tarbush is a deciduous desert species which is found in dense stands on silty or clay loam sites on flood plains. The date of leaf emergence is dependent upon adequate soil moisture, so in some droughty years it may not leaf out until the summer rains occur.

The studies reported were carried out on the Jornada Experimental Range near Las Cruces, New Mexico from 1961 through 1965 to determine the best time for treatment and the best herbicides for selective control. Treatments were applied semi-monthly on 1/100 A plots using a simulated aerial application from July through October in 1961 and 1965. Treatments were initiated in August in 1962, on May 7, 1963, and on June 3, 1964. Defoliation estimates were made approximately two years after treatments were applied.

The 1961 treatments included 2,4-D, 2,4-DP, 2,4,5-T, silvex, 2,3,6-TBA and amitrole-T at 1/2 lb/A. Dicamba was added to the list of test materials in 1962, and picloram was added in 1963. Herbicides were applied on all spray dates at 1/2 lb/A in 1962, 1 lb/A in 1963, and at 1 1/2 lb/A in 1964 and 1965. Additional treatments with higher rates of herbicides were applied on one spray date in 1962, 1963 and 1964.

The degree of defoliation was quite variable between dates of application with the September treatments being most toxic generally. At rates up to 2 lb/A the phenoxy herbicides and amitrole-T usually gave less than 30 percent defoliation. Dicamba was the most toxic material, causing 70 percent defoliation on one or more spray dates each year. Increasing the rate of dicamba from 1/2 to 2 lb/A, increased the degree of defoliation only when treatment was not on the optimum date. At comparable rates of picloram and 2,3,6-TBA were much less effective than dicamba. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U. S. Dept. of Agriculture, and New Mexico Agric. Expt. Sta., New Mexico State University, Las Cruces.)

Evaluation of aerial treatments for the control of creosotebush (*Larrea tridentata*). Gould, W. L. and C. H. Herbel. Creosotebush frequently occurs in almost pure stands in areas of the Southwest where it has invaded. Selective chemical control of creosotebush offers a means for natural revegetation where remnants of perennial grasses remain. This study was initiated to evalute the response of creosotebush to aerial application of materials which had appeared promising in small plot tests.

The study was conducted near Truth or Consequences, New Mexico, using a fixed wing aircraft. The herbicides were applied to 12-acre plots in 5 gpa of spray material. Application was made each year during the first week of September. Plant kill was determined two years after treatments were applied by counting the number of living and dead plants occurring in groups of 100 plants at random locations within each plot.

In 1964 and 1965 the treatments included dicamba at 1/2, 1 and 2 lb/A, picloram and 1/2, 1 and 1 1/2 lb/A, and 2,3,6-TBA, silvex, 2,4-D, 2,4,5-T and 2,4-DP at 1 and/or 2 lb/A. Combination treatments in 1965 were 2,4-D and 2,4,5-T at 1 lb/A each, dicamba and 2,4,5-T at 1/2 lb/A each and picloram and 2,4,5-T at 1/2 lb/A each. In 1966 combinations of 2,4,5-T with dicamba at 1 lb/A each, and with 2,3,6-TBA at 1/2 and 1 lb/A each was applied.

Preliminary results of the 1964 and 1965 plots in 1966 indicated little control was being effected, so the 1966 treatments were applied over part of the 1965 plots, resulting in an area of each 1965 plot receiving a duplicate repeat treatment. The percent kill of creosotebush obtained from the various treatments are presented in the table. None of the phenoxy herbicides were effective either as single or repeated treatments. Approximately additive effects or better, resulted from the repeated applications of dicamba or 2,3,6-TBA, while there was not an increase in toxicity from picloram. Single combination treatments of 2,4,5-T with dicamba or picloram did not increase the kill over that obtained without 2,4,5-T, but a large increase in kill was obtained with a repeat treatment. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U.S. Dept. of Agriculture, and New Mexico Agric. Expt. Sta., New Mexico State University, Las Cruces.)

Percent kill of creosotebush resulting from aerially applied herbicide treatments

Chemical	Rate lb/A	Year of Application 1964	1965	1966	1965+1966
Dicamba	1/2	0	12	4	15
Dicamba	1	1	25	25	54
Dicamba	2	5	34	51	62
Picloram	1/2	1	16	--	--
Picloram	1	5	25	15	17
Picloram	1 1/2	6	34	39	29
2,3,6-TBA	1	3	3	3	21
2,3,6-TBA	2	16	4	10	51
2,4,5-T	1	2	6	4	0
2,4,5-T	2	3	5	1	0
2,4-D	2	2	5	2	6
2,4-DP	2	3	--	--	--
Silvex	2	2	--	--	--
2,4-D + 2,4,5-T	1 + 1	1	4	1	3
2,4-D + 2,4,5-T	2 + 2	--	--	3	--
2,4,5-T + picloram	1/2 + 1/2	--	7	6	37
2,4,5-T + dicamba	1/2 + 1/2	--	7	7	33
2,4,5-T + dicamba	1 + 1	--	--	19	--
2,4,5-T + 2,3,6-TBA	1 + 1	--	--	13	--

Herbicide interaction in reforestation grass sprays. Newton, Michael. Herbicides used for reforestation of grassy areas frequently fail to control resistant species, especially deep-rooted perennial grasses. Increasing rates of the usual compounds have caused injury on some light-textured soils. In order to increase the activity of atrazine on a broad range of resistant species, a factorial experiment was established to test combinations of atrazine with 2,4-D and cacodylic acid. Plots were planted with two-year-old Douglas fir seedlings, half of which were planted before spraying; half were planted immediately after treatment.

Treatments included atrazine at rates (active) of 0, 2, 3 and 4 pounds per acre. Combined with the atrazine were 2,4-D at rates of 0 and 1/2 pound, cacodylic acid at 0 and 2 pounds, and MSMA at 0 and 3 pounds. Half the plots received surfactant of the non-ionic type, (alkylarylpolyoxyethylene) at 0.3% concentration. Treatments were combined factorially and replicated. Application was in early March.

The growing season was nearly ideal for maximum effect from atrazine, hence all treatments involving 2 pounds or more provided good control of annual and most perennial grasses. Atrazine only, however, had virtually no effect on broadleaved weeds, especially false dandelion; a few perennial grasses, including tall fescue and perennial ryegrass were not killed by atrazine alone. Addition of surfactant did not visibly influence action of atrazine alone.

Addition of cacodylic acid to atrazine caused a substantial increase in knockdown speed. Cacodylic alone had almost no effect, but in combination with atrazine devegetation was nearly complete within nine days, a clear suggestion of synergism. Atrazine alone had had no effect at this time. 2,4-D speeded slightly the knockdown by atrazine. More particularly, it aided substantially in control of broadleaved weeds, a job not accomplished by addition of cacodylic acid or by 2,4-D alone. The effects of 2,4-D were clearly evident at the end of the growing season, and in its absence, false dandelion had completely dominated most of the plots in which atrazine with or without cacodylic had eliminated grasses.

The total mixture of atrazine, 2,4-D and cacodylic acid was unquestionably the best mixture for knockdown capacity. There was a tendency for rapid defoliation of forbs, so that perhaps late-season forb control may not have been quite comparable to that of treatments with 2,4-D and atrazine but no cacodylic.

No treatments demonstrated any signs of toxicity to planted conifers, regardless of whether planted before or after treatment. Survival and seedling vigor were excellent and independent of treatment; unseasonal rains in midsummer maintained moisture levels at above-critical levels throughout the season, hence the experiment was afforded an unusual opportunity to evaluate herbicide toxicity without confounding from vegetation effects.

These findings suggest that 1) dormant conifers may be able to tolerate substantial dosages of foliage-active herbicides, 2) mixtures of foliage-active, hormonal and soil-active materials may prove synergistic as used here, permitting broad-spectrum activity without substantially increasing cost, 3) weed control mixtures may be used that are not completely dependent on soil moisture for activation, possibly permitting good weed control in years of drought during spring months, and 4) good selective weed control is likely possible with reduced rates of atrazine plus non-soil-active adjuvants on soil types where atrazine injury may occur at normal rates. (Oregon State University, School of Forestry. Corvallis)

Inconsistency in response of scrub oak to stump applied herbicides. Plumb, T. R. First year results of a study designed to test the effectiveness of herbicides applied immediately or two weeks after cutting to prevent the sprouting of scrub oak (*Quercus dumosa* Nutt.) were described in the 1967 Research Progress Report. The herbicides tested 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 aegh of nonphytotoxic oil, (3) AMS (ammonium sulfamate) at 4 lb per gallon of water, (4) picloram at 8 lb aehg of nontoxic oil, and (5) weed oil (Annalos 11), each sprayed over the entire stump. Once replicated plots were cut in November, January, March and July. Fourteen months after cutting, a foliage application of brushkiller at 4 lb aegh of water was sprayed on both sprouting and apparently dead stumps. A second foliage spray was applied approximately 12 months later. Results of three consecutive November (or early December) clearing and treatment dates are listed in Table 1.

First year results of this and an earlier study indicated that successful control can be expected only by late fall, winter and early spring treatments. But even during this season results were very inconsistent. In all of our control work results have been inconsistent from year to year. The magnitude of this can be seen in Table 1. 2,4-D amine, which gave 75% plant kill in 1964, gave only 17% in 1966; the yearly average for the four cutting dates in 1964-1965, 65%, dropped to only 32% in 1966-1967. However, a 96% kill was still obtained in January 1967. The other herbicides also varied from year to year but not always in the same pattern. Although the immediate application of 2,4-D amine was consistently superior throughout the test, delayed application of picloram was not always best as indicated by the results from the 1964-1965 cutting dates. Picloram gave the only promise of successful plant kill in July with 61 and 63% kill in 1965 and 1967 respectively, but it only gave 23% kill in 1966.

Since many plants survived the stump treatment, foliage spraying seemed a logical followup treatment and results are shown in Table 1. Pooled results for all five herbicides for the four cutting dates in the 1964-1965 cycle are shown in Table 2. After the November 1964 stump treatment plus one followup foliage application, the 2,4-D amine and delayed brushkiller treatments gave good control. After two successive foliage sprays, results from the 2,4-D amine, picloram, and delayed brushkiller treatments were considered good to excellent.

Based on the pooled results (Table 2) about 20 to 30% additional plant kill can be expected from both the 1st and the 2nd followup foliage treatments on plots cut in November and January. Since the average kill in January was already 49%, the combination of stump and two foliage treatments was very satisfactory. Followup spraying gave the most dramatic results on plots cut in March and July with a total average added kill of 69 and 70% respectively from two foliage spray treatments. Control plants cut in March, which received only the two foliage sprays, were all killed, while only about 30% were killed on the November plots. Good results with only two foliage treatments have been infrequent; usually three successive applications are needed.

Stump treatment alone or in combination with followup foliage spraying has at times given good control of scrub oak plants. However, annual variations and variations between treatments make it difficult to predict which treatment is best on any given date. January appears to be the best date for the immediate 2,4-D amine and the delayed picloram stump treatments. Results of the foliage treatments for the 2nd and 3rd cutting cycles have not yet been determined. (U. S. Dept. of Agriculture, Forest Service Fire Laboratory, Riverside, Calif.).

Table 1. Percent of dead plants 14 months after stump treatment

		Date of cutting					
		November 1964			December 1965		Nov. 1966
Herbicide	Applic. time	Stump	1st Foliage[1]	2nd Foliage[2]	Stump	1st Foliage	Stump
2,4-D amine	Immed.	75	89	100	68	78	17
	Delay	59	90	96	23	33	11
Brushkiller	Immed.	30	41	82	33	32	40
	Delay	78	94	94	14	36	45
AMS	Immed.	30	24	50	41	31	19
	Delay	19	31	74	6	8	4
Picloram	Immed.	17	77	98	22	27	62
	Delay	39	75	90	2	12	13
Weed oil	Immed.	3	18	56	0	8	--
	Delay	6	23	67	2	6	--

[1] Foliage spraying with brushkiller at 4 lb aehg water 14 mo after cutting.
[2] Foliage spraying 12 mo after the previous foliage application; same mix.

Table 2. Average percent of scrub oak plants killed by the five stump treatments and by followup foliage spraying.

	Date of cutting							
	Nov 1964		Jan 1965		Mar 1965		Jul 1965	
Time of application	% kill	Add. kill	% kill	Add. kill	% kill	Add. kill	% kill	Add. kill
Stump	36	--	49	--	31	--	19	--
1st Foliage	56	20	69	20	85	54	45	26
2nd Foliage	81	25	97	28	100	15	89	44

Ecology of snowbrush ceanothus seeds. Gratkowski, H. A study of the response of treated snowbrush ceanothus (Ceanothus velutinus Dougl.) seeds to controlled changes in relative humidity has provided new knowledge concerning behavior of these seeds in forest soils.

A high percentage of mature snowbrush seeds are hard seeds with seed coats impermeable to moisture. These impermeable seeds lie dormant but viable in forest soils for years after dissemination. When wildfires or logging slash fires sweep across an area where such seeds are present in the soil, the soils and seeds are heated and the seeds become permeable to moisture. During the winter, these permeable seeds absorb moisture and stratify naturally in the west soil. With the advent of warm weather the following spring, the seeds germinate and produce a new stand of brush seedlings to occupy the burned site.

As in varnishleaf ceanothus seeds, heat mades the seeds permeable only at the hilum. Heat causes the hilar fissure to open permanently in varnishleaf seeds, and data from this experiment indicates that it effects snowbrush seeds the same way. This results in germination.

Like varnishleaf seeds, hilar fissures of seeds open and the seeds lose moisture when exposed to lower relative humidities than any with which they have previously reached equilibrium. If then exposed to a higher humidity, they regain only a portion of this moisture before the hilar fissures close and the seeds again become impermeable. This reduction in seed moisture content probably reduces respiration rates and conserves stored food. This response of snowbrush seeds is considered a major factor in the ability of the seeds to remain dormant but viable in the soil for years after dissemination. (Pacific N.W. Forest and Range Expt. Sta., Forest Service, U.S. Dept. of Agric., Roseburg, Oregon.)

Heat-induced germination of blueblossom ceanothus seeds. Gratkowski, H. A high percentage of the seeds produced by blueblossom ceanothus (Ceanothus thyrsiflorus Esch.) are impermeable hard seeds that lie dormant but viable in forest soil for years after dissemination. A laboratory-greenhouse experiment has shown that such seeds become permeable and germinate when the soil is heated by wildfires or logging slash fires.

Seeds were buried in fine sand heated to temperatures of 30°, 45°, 60°, 75°, 90°, 105°, 120° and 135°C for periods of 4, 13, 22, 31 or 40 minutes. Each treatment was replicated four times in a factorial experiment in a randomized block design. Thermocouples were used to control soil temperatures during treatment. After heat treatment, the seeds were stratified for 3 months.

Soil temperatures of 60°C or less did not induce germination of the impermeable seeds. A small number germinated after treatment in sand heated to 75°C, but a maximum germination occurred in seeds that had been buried in sand heated to 105°C. Duration of exposure from 4 minutes to 40 minutes had no effect at soil temperatures up to 135°C. Seeds that remained viable after 4 minutes at any soil temperature remained viable even when exposed to that temperature for as long as 40 minutes.

Blueblossom ceanothus seeds of this seed lot displayed more resistance to heat than any other species tested to date. Approximately 7.5 percent survived and germinated even after being buried for 40 minutes in sand heated to 135°C. (Pacific N.W. Forest and Range Expt. Sta., Forest Service, U. S. Dept. of Agric., Roseburg, Oregon.)

PROJECT 4. WEEDS IN HORTICULTURAL CROPS

W. L. Anliker, Project Chairman

SUMMARY

Twenty-six reports were submitted from California and Texas concerning herbicide evaluations with fruits, vegetables, ornamentals and there were a number of reports concerned with application studies which are applicable to horticultural weed control.

Fruits

Several reports dealt with control of specific weeds in citrus. Early repression of bindweed was achieved with granular dichlobenil applied to the surface and sprinkled into the soil. Repreated applications of 2,4-D oil-soluble amine at 1.0 lb has given control comparable to repeated applications of 3.0 lb with no injury reported. Commerical bromacil, granular dichlobenil, MSMA and granular EPTC were evaluated for yellow nutsedge control. Varying degrees of foliar symptoms were evident with all treatments. In a second trial both bromacil and dichlobenil gave commercial control with no phytotoxicity. Outstanding johnsongrass control has been achieved in Central and Northern California with repeated applications of MSMA. Southern California work has shown repeated applications of dalapon to out perform MSMA. Simazine, bromacil, and dichlobenil all gave good early weed control in young Valencia oranges; however, due to the high organic matter soil, weed control was short-lived. Consistent winter annual weed control in Troyer citrange liners was achieved with simazine, terbacil and diuron.

One report on bindweed control in grape vineyards compared several herbicides and combinations with both spring and fall applications. Incorporated dichlobenil and repeated applications of 2,4-D gave the best bindweed control and November applications were generally more effective than March.

Screening work on stone fruits produced several new herbicides showing selectivity. Sprinkler irrigation studies with simazine on young stone fruits showed increasing phytotoxicity with increased levels of overhead sprinkler irrigation and it appeared that much of the movement into the soil was caused by the early irrigation.

Foliar applications of herbicides to young stone fruits produced a variety of effects. Organic arsenicals appeared to translocate better than 2,4-D in the peach and poorer than 2,4-D in the plum. Dalapon moved well in both species and amitrole moved better in plums than peaches. Similar work with combinations on plums and peaches indicated that herbicide combinations were generally more toxic than either herbicide alone; however, the combinations appeared to neither reduce nor enhance translocation. Combinations in this test involved MSMA, 2,4-D and amitrole.

Vegetables

Lettuce: Preplant, pre-emergence trials indicated generally better results with pre-emergence applications. RH 315 appeared to be very promising for pre-emergence weed control in lettuce.

Onions: Outstanding preplant, soil-incorporated results wwere achieved in Texas with combinations of bensulide and propachlor. Post-emergence broadleaf weed control was promising with RP 2929.

Cucurbits: Trifluralin and bensulide controlled jungle rice and common purslane satisfactorily as an over-the-top, soil, incorporated treatment on emergent cantaloupe in Texas. In a test with DCPA, trifluralin, bensulide and nitralin, over emergent watermellons only trifluralin reduced the crop. General preplant, soil-incorporated herbicides were compared for weed control for pickling cucumbers. The best control of barnyardgrass and pigweed was achieved with a combination of bensulide and NPA. These herbicides alone only controlled barnyardgrass and pigweed, respectively.

Solanaceous Crops: Pebulate and trifluralin or mixtures containing either one, appeared to be most effective for controlling barnyardgrass as a preplant treatment with direct seeded tomatoes.

In another report from California, trifluralin was found to be safe on transplanted tomato, egg plant and pepper applied as an incorporated sprinkler-irrigated treatment, but was not tolerated on direct-seeded crops. Other materials in the test were diphenamid, DCPA, bensulide, IPC, pebulate and R 7465.

The effect of three soil types on the soil applications of bensulide to 18 plant species was studied with rates ranging from 0 to 1000 ppm. The herbicidal concentrations required to reduce growth of the plants 50% (GR 50) ranged from 1.2 ppm with barnyardgrass and table beets to a GR 15 at 1000 ppm with lettuce.

Application Considerations

Seven of the 26 reports were concerned with studies where the application considerations were probably more important than any particular crop species; therefore, these are handled in a separate category.

Lange and Associates have done considerable work with the effects of sprinkler irrigation and the timing on herbicide applications. A study on the time interval between herbicide application and overhead sprinkler irrigation, showed no difference in control of Amaranthus when the herbicides were applied two hours prior to overhead irrigation as compared with application at the time of irrigation.

A study to determine the sprinkler activation requirements for diphenamid and trifluralin was conducted on barley, tomatoes, pigweed and barnyardgrass. There were indications that although higher rates of irrigation were generally associated with more herbicide activity of diphenamid and trifluralin, a clear-cut relationship was not obtained. The timing of herbicide application with sprinkler irrigation on cantaloupe and broccoli was reported on. In a herbicide study on Troyer citrange liners simazine, terbacil, trifluralin, and nitralin caused no phytotoxicity at rates up to 4.0 lb. Higher levels of irrigation caused an increase in chlorosis with high rates of dichlobenil.

A broccoli study, designed to evaluate the effect of irrigation rate on herbicide activation with bensulide and trifluralin, suggested that the total amount of irrigation had more effect on broccoli growth, with the lower rate causing somewhat less injury than the high rate of irrigation. Broccoli vigor was less with the faster irrigation.

Precision irrigation equipment was used to evaluate the timing of herbicides applied through the sprinkler irrigation system on Margaret daisey, heather, Calla Lily and iris. The various combinations of trifluralin and nitralin gave the best weed control when injected early in the irrigation cycle (15 min.); however, early injection caused more crop injury at the high rates.

Workers in Texas reported on the performance of soil-incorporated herbicides as affected by the incorporation tool. Bensulide, DCPA and trifluralin are most effective against redroot pigweed, Palmer amaranth and barnyardgrass when incorporated with a PTO rotary tiller, with a mesh wheel, tine wheels, rolling bar incorporator, a reel mower blade and a rolling cultivator, in that order of efficacy. Trifluralin performance was affected more by the type of incorporation than was bensulide.

<u>Herbicide combinations for bindweed control in wine grape vineyards</u>. Hamilton, W. D., and A. H. Lange. Incorporated dichlobenil in November gave commercial season-long bindweed control at 12 lb/A without observable injury to grape vines. March applications were not as effective as November. Repeated application of 2,4-D gave the best bindweed control. Single applications were not effective. MSMA gave some control of bindweed but was not comparable to 2,4-D. (University of California, Agricultural Extension Service, Hayward, Riverside.)

The effect of several herbicides and combinations on the control of bindweed in grapes [Alameda County - Applied November 28, 1967 (winter applications) or March 28, 1968 (Spring Applications)]

Herbicide	lb/A	Applic. Date	Applic. Type*	Average[1] bindweed control 3/7/68	5/2/68	6/14/68	8/30/68
Dichlobenil (4G)	6	11/28	S	8.8	6.2	1.2	0
"	12	"	S	9.5	7.8	4.0	1.5
2,4-D (OSA)	3+3	PB		0.8	1.8	2.0	9.0
"	3+3+3+3	"		0.8	1.8	2.0	9.2
Dichlobenil (+2,4-D)	6(3+3)		S	8.8	8.2	6.5	9.8
2,4-D + non-phytotoxic oil	3+3+3+3	PB		1.0	1.0	1.2	9.0

Herbicide	lb/A	Applic. Date	Type*	Average[1] bindweed control 3/7/68	5/2/68	6/14/68	8/30/68
Dichlobenil + MSMA	6(4+4)	11/28 5/15	S	8.2	7.2	5.2	6.0
MSMA	4+4	5/15		0	2.5	3.0	5.5
Dichlobenil	6	11/28	I	9.5	8.5	6.2	3.0
"	12	"	I	9.8	9.2	8.8	7.5
Dichlobenil + 2,4-D	6(1+1)	"	I	8.5	7.5	5.5	7.5
Dichlobenil + MSMA	6(2+2)	PB	I	8.5	7.5	5.0	6.2
2,4-D + Tronic	2 + 0.5%			-	-	1.5	6.0
Dichlobenil	6	3/28	S	-	3.5	3.0	0.8
"	12	"	S	-	5.2	3.5	3.0
Dichlobenil + 2,4-D	6(3+3)	"	S	-	3.0	2.5	7.8
Dichlobenil + MSMA	6(4+4)	"	S	-	3.8	4.5	5.8
Dichlobenil	6	"	I	-	9.0	6.5	3.5
"	12	"	I	-	9.2	7.8	5.8
Dichlobenil + 2,4-D	6(1+1)	"	I	-	2.5	1.0	8.5
Dichlobenil + MSMA	6(2+2)	"	I	-	3.8	5.0	7.5
Check				0	0	0.8	0.8

[1]Average of 4 replications
S = surface, I = incorporated
PB = Post bloom

Soil Analysis: OM = 2.5%, sand = 48%
silt = 36%.
clay = 17%,
SP = 27%, pH = 7.4
EC_e = 0.57 mmhos
Ca + Mg = 4 me/l

Table 2. The effect of dichlobenil and 2,4-D on the control of bindweed (sprayed 11/28/67) in grapes (Alameda County)

Herbicide	lb/A	Average[1] 3/11/68	5/2/68	5/23/68	6/20/68
Dichlobenil (4G)	6	9.4	7.7	6.2	5.0
Dichlobenil (4G)	12	9.8	9.0	7.7	6.7
2,4-D (OSA)	1	1.0	0.3	1.8	4.3
2,4-D (OSA)	2	0.7	1.0	2.0	2.2

Herbicide	lb/A	Average[1] 3/11/68	5/2/68	5/23/68	6/20/68
Dichlobenil+2,4-D	6+1	9.7	8.3	6.7	6.0
2,4-D+N.P.Oil	2	0	0	0.1	2.7
Check	0	0.7	0	1.3	2.0

[1]Average of 6 replications

Soil analysis: OM = 2.5%, sand = 48%, silt = 36%, clay = 17%, SP = 27%, pH = 7.4 EC_e + 0.57 mmhos, Ca + Mg = 4 me/l

The effect of foliar herbicide combinations on unsprayed terminal foliage of Marianna plum, Nemagard peach and S-37 peach. Lange, A. H. More combinations of herbicides are being used in control of mixed populations of weed species. Additive effects have been noted in the control of weeds. The object of this study was to evaluate the effect of combinations of herbicides on the foliage of young plum and peach trees.

The sprayed foliage was damaged severely by all herbicides and herbicide combinations. The herbicide combinations were generally more toxic than either herbicide alone. MSMA was more toxic on the peach foliage than on the plum; 2,4-D was somewhat similar on the sprayed lower branches, as was amitrole.

The unsprayed terminal foliage showed marked differences in apparent translocation. During the early readings, 2,4-D appeared to translocate readily into the new foliage. Amitrole was much more apparent in the young plum than peach foliage. The combination of 2,4-D and MSMA was more toxic on the plum than on the peach. Later readings indicated larger differences in the terminal foliage with MSMA showing similar translocation in the plum and peach. 2,4-D and amitrole showed more movement in the plum than in the peach. As the season drew on, most of the phytotoxicity disappeared in the new foliage with the exception of the combination of 2,4-D and amitrole on plums. Amitrole generally was more toxic on plum than peaches in this study. It was somwhat surprising to see terminal growth of the plum trees affected even into October. Generally, the combinations neither reduced nor enhanced the translocation. Inasmuch as 2,4-D has been postulated to destroy the phloem, we might have expected less translocation of the herbicides with 2,4-D. There was a tendency for this to be true but not in every case. (University of California, Agricultural Extension Service, Riverside.)

Table 1. The effect of foliar applied herbicide combinations on the sprayed and unsprayed terminal foliage of Marinna plum, Nemagard peach and S-37 peach

Herbicide	lb/A	Phytotoxicity[1] Marianna Plum Lower Sprayed	Marianna Plum Terminal Unsprayed	Nemagard Peach Lower Sprayed	Nemagard Peach Terminal Unsprayed	S-37 Peach Lower Sprayed	S-37 Peach Terminal Unsprayed	Total Total Sprayed	Total Terminal Unsprayed
MSMA	4	3	2	9	3	9	1	21	6
MSMA	8	7	2	10	2	9	3	26	7
2,4-D	2	6	6	9	5	8	3	23	14
2,4-D	4	8	4	6	3	5	3	19	10
Amitrole	2	4	6	2	2	5	1	11	9
Amitrole	4	4	4	4	1	6	3	14	7
2,4-D+MSMA	4	10	6	10	1	10	3	30	10
2,4-D+MSMA	4+4	10	6	10	0	10	2	30	8
2,4-D +Amitrole	2+4	7	6	6	3	7	1	20	10
2,4-D +Amitrole	4+4	8	2	5	0	6	2	19	4
MSMA +Amitrole	4+4	9	1	10	2	9	3	28	6
Check	-	0	1	0	0	0	0	0	1

Herbicide applied 7/23/68 and rated 8/13/68

[1] Phytotoxicity rating where 0 = no effect, 3 = definite pattern of chlorosis or twisting, 5 = severe burn in addition to pattern, 10 = all foliage dead.

Table 2. The effect of foliar applied herbicide combination on the unsprayed terminal foliage of Marianna plum, Nemagard peach and S-37 peach. (Applied 7/23/68)

		Phytotoxicity[1]							
Herbicide	lb/A	Marianna Plum		Nemagard Peach		S-37 Peach		Total	
		8/22	10/2	8/22	10/2	8/22	10/2	8/22	10/2
MSMA	4	3	1	3	3	3	2	9	6
MSMA	8	4	0	2	1	4	6	10	7
2,4-D	2	5	1	4	3	1	0	10	4
2,4-D	4	3	0	0	0	2	0	5	0
Amitrole	2	5	3	4	0	2	0	11	3
Amitrole	4	3	5	3	0	3	0	9	5
2,4-D + MSMA	2+4	4	2	2	0	3	1	9	3
2,4-D + MSMA	4+4	4	0	0	2	3	0	7	2
2,4-D + Amitrole	2+4	2	7	0	1	3	0	5	8
2,4-D + Amitrole	4+4	2	4	0	0	3	0	4	4
MSMA+Amitrole	4+4	4	0	0	0	3	0	7	0
Check		0	0	0	0	0	0	0	0

[1]Phytotoxicity rating where 0 = no effect, 3 = definite pattern of chlorosis or twisting, 5 = severe burn in addition to pattern, 10 = all foliage dead.

<u>The effect of foliar herbicide sprays on young peach and plum trees.</u> Lange, A. H. Most post-emergence herbicide sprays must be carefully directed away from the foliage of young trees. In the study reported here, the herbicides were applied to 2/3 of the foliage (bottom) of young trees in order to measure relative phytotoxicity and to observe the movement into the unsprayed portion (top) of the tree (Table 1).

Herbicides produced quite different effects on old (sprayed) foliage. Cacodylic acid gave the most rapid burn. At equivalent rates, amitrole produced the least initial toxicity of the post-emergent type herbicides. Trifluralin, a pre-emergent type, caused virtually no injury even at the 4 lb/A rate. At the 1 month reading there was a slight temporary stunting of new growth as has been seen in cotton.

About one month after herbicide application, the effect of most herbicides on the sprayed foliage was similar to the 10-day reading. Those herbicides showing a slight increase in damage were MSMA, dalapon and amitrole.

The peach appeared more susceptible to cacodylic acid and MSMA than the plum. On the other hand, the plum appeared more sensitive to amitrole and dalapon, particularly as shown by the new growth.

The new growth which was unsprayed and may represent translocation showed large differences in response to herbicides. Most drastic of these responses was MSMA which appeared to translocated better than

2,4-D in the peach and poorer than 2,4-D in the plum. This better movement of arsenicals in peach, based on visual observations, was true for cacodylic acid also.

Dalapon moved well in both peaches and plum, but not as well as MSMA.

Amitrole moved better in plum than in peach, as observed in the symptom expression of the new growth.

DNBP and paraquat did not appear to move into the new foliage.

By three months after spraying (the lower portion of the tree only) the new growth (unsprayed) of some herbicide-treated trees was showing recovery. The recovery of 2,4-D treated trees was most apparent in the new growth. Cacodylic acid and amitrole showed significant recovery. The peach trees recovered from dalapon injury more readily than the plum. (University of California, Agricultural Extension Service, Riverside.)

Table 1. The effect of herbicide applications on the foliar condition of young peach and plum trees

		Average phytotoxicity					
		10 days		1 month			
		All Varieties		Peach[2]		Plum[3]	
Herbicide	lb/A	New[4]	Old[5]	New[4]	Old[5]	New[4]	Old[5]
Paraquat	1	0.3	3.6	0	3.2	0	3.8
Paraquat	4	0.3	5.3	0.5	5.7	0	6.7
2,4-D	4	2.0	5.0	3.4	6.2	1.7	6.2
2,4-D	16	3.3	7.0	3.8	7.5	6.0	8.0
MSMA	4	0	5.6	3.0	6.7	2.0	5.0
MSMA	16	2.3	7.0	8.1	9.8	3.5	8.3
Cacodylic	4	0	4.6	0.5	4.9	0	4.3
Cacodylic	16	4.3	8.0	5.3	9.0	2.8	7.5
Dalapon	4	1.3	2.6	1.7	3.7	4.2	4.7
Dalapon	16	4.3	4.3	3.7	4.0	5.7	5.2
Amitrole	1	0	3.0	0.2	3.7	1.4	4.0
Amitrole	4	0	3.0	1.7	4.7	5.2	4.7
DNBP	16	0.3	5.0	0.2	4.7	0	4.3
DNBP	64	0	6.0	0.1	6.9	0	6.8
Trifluralin	4	0	0.3	0	1.1	0	0.3
Check	-	0	0	0	0	0	0

[1]All varieties refers to Lovell and Nemaguard peach and Mariana plum, 2 trees each

[2]Two trees of each variety X 2 varieties X 4 replications of each plot equaling 16 trees averaged

[3]Average of 2 trees per plot X 4 replications

[4]New stands for the new growth on the unsprayed part of the tree

[5]Old stands for the lower, more mature foliage receiving the herbicide treatment.

Table 2. The effect of post-emergence herbicide applications on the foliar condition of young peach and plum trees

		Average phytotoxicity[1]					
		Peach			Plum		
Herbicide	lb/A	1 mo. rating		3 mo.	1 mo. rating		3 mo.
		Old	New	New	Old	New	New
Paraquat	1	3.2	0	0.6	3.8	0	0.3
"	4	5.7	0.5	0.8	6.7	0	0.2
2,4-D	4	6.2	3.4	1.3	6.2	1.7	1.8
"	16	7.5	3.8	1.4	8.0	6.0	0.2
MSMA	4	6.7	3.0	4.9	5.0	2.0	1.7
"	16	9.8	8.1	10.0	8.3	3.5	4.5
Cacodylic	4	4.9	0.5	0.1	4.3	0	0.8
"	16	9.0	5.2	0.8	7.5	2.8	1.6
Dalapon	4	3.7	1.7	0.9	4.7	4.2	4.3
"	16	4.0	3.7	0.7	5.2	5.7	2.3
Amitrole	1	3.7	0.2	0	4.0	1.4	0.3
"	4	4.7	1.7	0.7	4.7	5.2	3.5
DNBP	16	4.7	0.2	0.4	4.3	0	0.3
"	64	6.9	0.1	0.4	6.8	0	0.2
Trifluralin	4	1.1	0	0.4	0.3	0	0
Check	-	0	0	0.7	0	0	0.2

[1]Phytotoxicity rated on a 0-10 scale where 0 = no effect; 3 = recognizable symptoms; 10 = complete kill of foliage.
Averages of 3 reps, each containing four peach trees and two plum trees.

Winter annual weed control in Troyer citrange liners. Lange, A. H., G. Suthers and D. Rosedale. Simazine and terbacil at 1 lb/A gave excellent weed control in two separate locations with no apparent injury to Troyer citrange liners. Diuron, likewise, gave similar results at one location.

Weed control with trifluralin and DCPA were variable because of the presence of winter weed species in the San Diego trial and lack of overhead irrigation in the Orange County trial. (University of California, Agricultural Extension Service, Riverside.)

Table 1. The effect of several herbicides and herbicide combinations on annual weed control in Troyer citrange liners under sprinkler irrigation (San Diego, Applied 1/3/68)

			Average[1]			
			Annual weed control[3]			Vigor[4]
Herbicide[2]	Act.	lb/A	3/9/68	4/13/68	7/11/68	7/11/68
Trifluralin	5 G	1	1.0	0.7	0	6.0
Trifluralin		2	1.0	0	2.7	6.0
Trifluralin		4	1.0	1.3	0.7	8.3
DCPA	75 WP	8	7.3	7.3	3.7	5.7
DCPA		16	7.3	7.3	4.7	6.0
Simazine	80 WP	1	8.3	9.3	7.0	7.3
Simazine		4	9.7	10.0	8.7	8.7
Dichlobenil	4 G	6	4.7	4.0	4.3	8.0
Terbacil	80 WP	1	8.3	10.0	6.7	9.0
Terbacil		4	10.0	10.0	9.7	6.7
Trif. + simazine		2 + 1	9.3	10.0	7.7	9.3
Trif. + dichlobenil		2 + 6	5.7	5.0	6.0	9.7
Trif. + terbacil		2 + 1	10.0	10.0	7.0	9.3
DCPA + simazine		8 + 1	10.0	10.0	7.0	8.3
DCPA + dichlobenil		8 + 6	8.3	6.3	4.3	7.7
DCPA + terbacil		8 + 1	10.0	10.0	7.3	7.0
Sirmate (no paraquat)		8	6.0	5.7	2.3	8.7
Sirmate (no paraquat)		16	7.0	7.3	4.7	9.3
Check		0	0.7	0	2.3	6.3
Check (paraquat		1	6.0	6.7	2.7	6.3

[1]Average of 3 replications with 8 liners per plot.

[2]All herbicides except Sirmate had 1 lb/A of paraquate added to the herbicide to take care of standing weeds

[3]Weed species were mustard, ragweed, sow thistle, filaree and cheeseweed.

[4]Vigor rating where 0 = dead plants, 10 = best growth.

Soil analysis: OM = 0.83%, sand = 73%, silt = 16.5%, clay = 10.5%, SP = 26%, pH = 7.2%, EC_e = 1.7 mmhs, mg + Ca = 9.9 me/l

Table 2. The effect of several herbicides and herbicide combinations on annual weed control in Troyer Citrange liners under broad furrow irrigations. (Orange County, Applied 5/23/67 and 1/10/68)

			Average[1]	
Herbicide	Act.	lb/A	Weed Control 4/4/68	Phytotoxicity 4/10/68
Trifluralin	5 G	1	8.8	0
"	5 G	2	6.8	0
DCPA	5 G	8	6.2	0
"	5 G	16	4.5	0
Simazine	80 W	1	10.0	0
Diuron	80 W	1	9.5	0
Terbacil	80 W	1	9.8	0
Trifluralin + simazine		1 + 1	10.0	0
Trifluralin + diuron		1 + 1	10.0	0
Trifluralin + terbacil		1 + 1	9.5	0
DCPA + simazine		8 + 1	10.0	0
DCPA + diuron		8 + 1	10.0	0
DCPA + terbacil		8 + 1	9.8	0
Check		0	2.2	0
Hoed Check		0	8.8	0

[1]Average of four replications 3 ft x 10 ft)

Soil analysis: OM = 1.1%, sand = 82%, silt = 8%, clay = 10%, SP = 24%, pH = 7.5, EC_e = 0.99 mmhs, Ca + Mg = 7.5 me/l

Annual weed control in young Valencia orange trees. Lange, A. H. and D. Rosedale. Excellent early weed control was obtained with simazine, bromacil and dichlobenil in young orange trees. Even double the highest recommended rates did not carry through the summer in this high organic matter soil (3.8%). No phytotoxicity was apparent on these one- and two-year-old Valencia orange trees. Crabgrass has been resistant to all three herbicides in other trials but not generally at these high rates. (University of California, Agricultural Extension Service, Riverside.)

The effect of several herbicides on annual weed control in young Valencia oranges (San Diego County, Applied November 8, 1967. Permanent set sprinkler system)

Herbicide	Act.	lb/A	Average[1] Weed Control 1/3/68	3/9/68	6/9/68[2]	7/10/68[2]	Phytotoxicity 10/12/68
Simazine	80 WP	3	7.7	8.5	2.0	0	0
"		6	8.0	9.5	2.8	0	0
Bromacil	80 WP	6	9.2	8.8	0.7	0	0
"		12	8.7	9.5	4.2	0	0
Dichlobenil	4 G	6	9.5	9.0	1.2	0	0
"		12	10.0	9.7	6.0	0	0
Check		0	6.2	0	5.8*	0	0

1Average of 6 replications - single tree plots

2Crabgrass - Digitaria sanguinalis - control

*Treated with oil by grower

Soil analysis: O.M. = 3.8%, sand = 63%, silt = 22%, clay = 15%, SP = 35%, pH = 7.6, ECe = 1.8 mmhos, Ca + Mg = 15.8 me/l

Dichlobenil - 2,4-D combinations for field bindweed control in citrus. Lange, A. and G. Suthers. The results of a number of uniform trials showed some early repression of field bindweed by granular dichlobenil applied to the surface and sprinkled or rained into the soil.

Repeated 1 lb/A applications of 2,4-D (oil soluble amine) have given control comparable to repeated 3 lb/A rates.

No injury was observed on the foliage or trunks of citrus from 2,4-D. Slight symptoms of dichlobenil were observed. (University of California, Agricultural Extension Service, Riverside, Anaheim.)

The effect of dichlobenil and 2,4-D on the control of field bindweed in citrus (Orange County, Applied February 6, 1968; 2,4-D applied April 10, 1968)

Herbicides	Act.	lb/A	Average[1] 5/20/68 Annuals	5/20/68 Bind-weed	7/30/68 Bind-weed	9/12/68 Bind-weed	Phyto-toxicity[3] 9/12/68
Dichlobenil	4 G	6	9.0	7.5	5.2	3.2	0.8
"		12	9.5	7.7	5.2	2.5	1.0
2,4-D (OSA)	4 EC	1+1+1+1	10.0	10.0	7.7	9.5	0

			Average[1]				
			5/20/68		7/30/68	9/12/68	Phyto-toxicity[3]
Herbicides	Act.	lb/A	Annuals	Bind-weed	Bind-weed	Bind-weed	9/12/68
2,4-D (OSA)	4 EC	3+3+3+3	10.0	10.0	7.5	9.7	1.0
Dichlobenil + 2,4-D		6(3+3)	9.7	8.5	5.5	9.5	0.8
2,4-D (n.p. oil)		1+1+1+1	9.2	10.0	7.2	9.2	0.2
Dichlobenil + 2,4-D	20 G	6+6	9.5	7.0	6.2	6.5	0
Check		0	7.2	4.0	3.5	1.0	0

[1]Average of 4 replications (2 tree per rep)

[2]Weed control based on 0-10 where 0 = no effect, 10 = 100%

[3]Phytotoxicity where 0 = no effect, 3 = definite pattern, 5 = severe chlorosis with burned margin, 10 = complete kill of citrus foliage.

Control of yellow nutsedge in citrus trees. Suthers, G., J. Pehrson and A. H. Lange. Granular dichlobenil, surface applied and sprinkled in, gave commercial control of yellow nutsedge (*Cyperus esculentus* L.) but resulted in considerable foliar symptoms at the high rates. The symptom was a yellowing of the leaf tip and marginal chlorosis extending a short distance back from the tip.

Repeated application of MSMA at 4 lb/A did not give satisfactory, yellow nutsedge control. The combination of dichlobenil plus MSMA improved the control over either alone to some extent.

Bromacil alone gave good yellow nutsedge control but some symptoms at both rates. Granular EPTC applied to the surface and sprinkler irrigated gave good early yellow nutsedge control but some apparent symptoms.

In a second trial in a sandy soil in Tulare County both bromacil and dichlobenil gave commercial control of yellow nutsedge with no phytotoxicity to young bearing Washington Navel orange trees. (University of California, Agricultural Extension Service, Anahemi, Visalia, Riverside.)

Table 1. The effect of several herbicides on the control of yellow nutsedge (*Cyperus esculentus* L.) in three-year-old Valencia oranges (Orange County, Applied May 21, 1968) with dragline sprinkler in a sandy soil

			Average[1]					
			Weed control (nutsedge)[2]			Phytotoxicity[3]		
Herbicide	Act.	lb/A	6/26/68	8/14/68	9/5/68	8/14/68	9/5/68	11/13/68
Dichlobenil	4 G	4	8.0	7.5	6.0	0	1.2	1.0
"		8	9.0	8.5	5.2	0	3.2	0.2
"		16	9.8	9.2	7.2	0.2	4.0	1.2
MSMA	4 EC	4+4+4+4	4.0	6.5	5.8	0	2.8	1.5
Dichlobenil + MSMA		4(4+4+4+4)	8.5	8.0	4.0	0	1.5	1.2
Dichlobenil + MSMA		8(4+4+4+4)	9.5	8.5	7.2	0	0.8	1.2
Bromacil	80 WP	4	7.0	7.8	7.8	1.2	2.2	1.5
"		8	7.5	8.0	8.0	3.0	3.0	2.5
EPTC	5G	4	8.0	5.5	3.0	0	2.8	2.0
"		16	8.2	7.5	4.5	0	2.5	1.5
Check		0	2.2	0.2	0.2	0	0	0

[1]Average 4 replications - 2 tree plots

[2]Weed control rating, 0 = no effect, 10 = complete control

[3]Phytotoxicity where 0 = no effect, 3 = definite pattern, 5 = severe chlorosis with burned margin, 10 = complete kill of foliage.

Table 2. The effect of bromacil and dichlobenil on the control of yellow nutsedge (*Cyperus esculentus* L.) in young (6 year old) Washington navel oranges on Troyer applied 11/17/67

			Average[1]		
			Nutsedge Control		
Herbicide	Act.	lb/A	3/28/68	4/9/68	7/18/68
Bromacil	80 WP	4	6.2	8.2	8.0
Bromacil + MSMA	11+4lb/ gal	4+4	6.5	7.8	9.2
Bromacil + oil		4+	4.2	6.8	8.8
Bromacil		8	6.8	7.0	8.2
Dichlobenil	4 G	4	8.2	7.5	7.0
Dichlobenil + MSMA		4+4	6.2	7.5	8.2
Dichlobenil + oil		4+	7.8	7.8	8.2
Dichlobenil		8	9.0	9.0	8.2
MSMA only		4	3.8	3.2	8.5
Oil		oil	1.5	3.8	3.2

[1]Average of 4 two-tree replications

Soil analysis: SP = 24, pH = 7.1, ECe = 4.6 mmhos, Ca + Mg = 38.8, Sand = 59% silt = 28.5%, Clay = 12.5% and OM = 1.3%

Johnsongrass control in citrus. Lange, A. H., G. Suthers, C. Elmore, R. Jeter and D. Rosedale. Repeated applications of MSMA have generally given outstanding johnsongrass control in central and northern California field trials.

The results of a uniform trial in Glenn County, employing repeated applications of MSMA and dalapon, showed MSMA to perform in the usual manner controlling johnsongrass in one season. Dalapon gave very poor control in one season and no better in the second season.

In a second and third test in southern California, repeated 4 lb/A applications of dalapon out-performed MSMA - much as it does with bermudagrass.

Only slight injury symptoms were observed with dalapon in the Glenn County trial. No injury was observed in the two southern California trials. (University of California, Agricultural Extension Service.)

Table 1. The effect of several herbicide treatments on the control of johnsongrass in two-year-old Washington Navel trees. (Sprayed, 5/20/65, 6/10/65, 7/21/65, 9/7/65, 9/20/65

		Average[1]				
		Johnsongrass control				Phyto-toxicity
Herbicide	lb/A	8/12	9/30	10/18	5/11	10/18
MSMA	4+4+4+4+4	9.3	6.2	9.8	9.0	0
"	8+0+8+0+8	8.2	6.0	8.5	6.7	0
"	16+0+0+0+16	1.0	4.8	8.8	4.5	0.5
Dalapon	4+4+4+4+4	2.8	3.7	5.5	3.5	2.5
"	10+0+0+0+10	2.2	0.5	4.8	2.2	4.0
Check		0	0	0	0	0

[1]Average of 4 single tree replications.

Soil analysis: O.M. = 2.7%, sand = 46%, silt = 34% and clay = 20%

Table 2. The effect of several herbicide on the control of johnsongrass in young Valencia oranges (San Diego applied 11/15/67, 4/13/68, 6/9/68, 7/10/68)

			Average[1] Johnsongrass control					Bermudagrass control
Herbicide	Act.	lb/A	1/3/68	3/9/68	4/13/68	6/9/68	7/10/68	7/10/68
MSMA	4 EC	4+4+4+4	9	2.2	2.5	5.0	6.8	2.2
MSMA		8+8	8.2	2.5	5.2	3.8	3.5	2.2
Dichlobenil	4 G	8	9.8	7.5	8.0	4.5	3.2	6.0
Dichlobenil + MSMA		8+(4+4)	10.0	7.5	7.8	7.5	8.0	4.5
Dalapon	78%	4+4+4+4	8.0	3.0	3.0	6.5	8.2	9.0
Check		0	3.8	1.8	0	2.2	2.0	0.5

[1] Average of 4 replications, single tree

Soil analysis: OM = 3.8%, sand = 63%, silt = 22%, clay = 15%, SP = 35%, pH = 7.6
ECe = 1.8 mmhos, Ca + Mg = 15.8 me/l

Table 3. Johnsongrass control in **Young** Olinda on Troyer citrange rootstock (sprayed 9/21/67, 11/17/67, 4/10/68, 6/1/68, 7/12/68

		Average[1] Johnsongrass control						
Herbicide	lb/A	10/17/67	11/2/67	12/7/67	4/10/68	6/1/68	7/12/68	9/6/68
MSMA	2+2+2+2	4.5	6.5	7.8	3.0	5.8	2.0	5.0
MSMA	4+4+4+4	5.5	7.0	8.0	2.8	5.5	2.8	3.8
MSMA	8+0+8+0	5.5	5.5	5.2	1.5	5.2	2.8	3.5
Dalapon	4+4+4+4	2.2	5.0	5.5	2.5	5.8	7.5	7.8
Dalapon + MSMA	4(+4)+4(+4)	2.2	7.2	6.2	1.8	5.5	4.0	3.0
Check		0.8	1.7	2.8	1.8	0	0.2	0.5

[1]Average of 4 single tree replications

Soil analysis: OM = 1.1%, sand = 54%, silt = 24%, clay 22%;

no phyototoxicity on citrus was observed.

Stone fruit herbicide screening trial. Lange, A. H., B. B. Fischer and M. Lavalleye. A number of promising new herbicides, selected from row crops herbicide screening trials at the University of California, Riverside and Davis were evaluated at the Kearney Field Station on a Hanford series, fine sandy loam, low in organic matter (OM 0.6%; sand 67%; silt 24%; and clay 9%). All herbicides were compared with simazine at 1 and 2 lb/A and terbacil at 2 and 4 lb/A under flood irrigation. A number of the herbicides were tested at a single rate compared with simazine at 2 lb/A and terbacil at 4 lb/A under furrow irrigation.

Stone fruit varieties were planted March 3, 1968 and were treated with herbicides on March 29, 1968. Varieties included Royal Blenheim apricot on Lovell rootstock, Fortuna peach on Lovell, Stark peach on Lovell, Peerless almond on Lovell, Santa Rosa plum on Lovell, Roda plum on Lovell and Red Top peach on Nemaguard. Fourteen herbicides were tested at two rates, one at a single rate. Herbicides showing selectivity at the early summer ratings included SD 15179, RH-315, VCS-438, and R-7465.

All herbicides tested showed very little injury under furrow irrigation which would indicate that less herbicide reached the roots of these young growing trees than in former tests. One acre inch of irrigation was applied by sprinkler immediately after herbicide application. That night 0.76 inch of rain fell. Aside from this overhead watering, the furrow irrigation got no more water over the treated beds. Flood irrigation received 15 acre inches (for a total of 16.76 acre inches) over the herbicide applications.

Further evaluations for herbicide phytotoxicity on the young stone fruit varieties, as well as further evaluation of the weed control characteristics of these herbicides, will give additional information as to which herbicide to test further. At the present time, there appears to be a number of herbicides as safe, or safer than the standard herbicide used in this test, simazine. (University of California, Agricultural Extension Service, Riverside.)

Table 1. Herbicides applied to dormant trees planted 3/20/68 and treated 3/29/68, sprinkle irrigated and subsequently flood irrigated

Herbicide	Act.	lb/A	Average[1] Phytotoxicity Royal Blenheim Apricot	Fortuna Peach	Stark Peach	Red Top Peach	Peerless Almond	Santa Rosa Plum	La Roda Plum	Average	Weed control 11/20/68
Simazine	80 W	1	0.7	2.7	1.7	2.7	0.7	--	0	1.4	4.0
"		2	5.0	5.3	3.7	4.3	2.3	4.7	0	3.6	6.0
Terbacil	80 W	2	2.7	3.3	2.3	3.0	1.3	0.5	0	1.9	5.3
"		4	2.3	4.3	2.0	4.3	4.7	1.0	0	2.7	7.3
Dichlobenil	4 G	4	3.0	2.7	2.0	3.0	2.0	2.0	1.0	2.2	3.8
"		16	5.7	5.0	5.3	5.0	5.0	4.5	4.0	4.9	4.0
Bensulide	6 E	4	0	3.0	4.0	1.7	0.3	0.5	1.0	1.5	3.8
"		16	0	3.0	1.7	1.3	0.3	0	0	0.9	5.3
R-7465	50 W	4	1.0	3.0	1.0	2.0	1.0	1.5	0	1.4	8.3
"		16	1.7	4.3	3.0	4.3	2.7	3.7	--	3.3	7.8
R-11913	75 W	2	1.0	3.7	2.0	1.0	1.0	1.5	2.0	1.7	4.2
"		8	2.3	4.3	2.7	3.3	5.7	1.0	4.0	3.3	6.0
SD-15179	50 W	2	0	1.3	1.7	2.0	0	0.5	0	0.8	5.3
"		8	6.3	3.3	1.0	3.3	0	0	0	2.0	5.8
VCS-438	1 E	2	0	2.7	0.7	2.0	0.3	1.0	0	1.0	8.8
"		8	2.7	3.7	1.0	2.0	1.3	--	0	1.8	9.0
GS-14254	25 W	2	3.0	5.3	4.7	5.3	4.3	5.5	2.0	4.3	5.3
"		4	7.7	5.7	2.7	6.0	5.7	5.0	--	5.5	5.8
RP-17623	3.34E	2	0	2.3	1.0	2.3	0.7	0.5	0.5	1.1	4.3
"		8	0	3.7	2.3	2.3	0	0	0.3	1.2	6.3
CP-44939	4 E	2	4.3	2.0	0	1.3	0	--	0	1.3	4.0
"		8	2.7	3.3	0.7	1.7	0.3	1.5	2.0	1.7	3.3
C-10725	50 W	2	2.0	5.3	1.7	4.7	3.0	3.0	--	3.3	2.8
"		8	0.3	2.0	0.3	2.3	0.7	--	1.5	1.2	4.0
RH-315	75 W	4	3.7	4.0	1.0	1.3	3.7	0.7	--	2.4	6.0
"		16	2.7	3.3	1.3	3.0	0.3	3.0	0	2.0	5.8
Bay 80890	70 W	2	0	2.0	1.0	1.7	0.3	--	0.3	0.9	8.3
"		8	4.0	3.0	2.7	1.7	2.3	0	0	2.0	8.8
DNBP	3 E	40	0.3	1.3	0.3	0	0.7	0.5	0	1.1	4.8
Check		-	3.3	2.3	3.7	2.0	0.7	--	0.7	2.1	4.0

[1]Average of 3 replications

Table 2. Herbicides applied to dormant trees planted 3/20/68 and treated 3/29/68, sprinkle irrigated and subsequently furrow irrigated

		Average[1] Phytotoxicity		
Herbicide	lb/A	Cling Peach[2]	Texas Almond	Weed Control
Simazine	2	1.0	3.3	9.3
Terbacil	4	2.7	2.0	9.7
Dichlobenil	16	1.3	0	6.7
GS-14254	4	3.7	0	9.7
R-7465	16	0	3.0	10.0
Bay 80890	8	2.0	3.3	10.0
RH-315	16	1.7	0.3	9.3
C-10725	8	0	3.3	8.3
SD-15179	8	2.3	3.0	9.7
Check	--	1.0	0	4.0

[1]Average of 3 replications

[2]7 Red top peach and Cling peach tree per plot

The use of simazine around young peach and plum trees under sprinkler irrigation. Lange, A. H. Young, newly planted, peach and plum rootstocks were subjected to three levels of overhead sprinkler irrigation and three levels of simazine for annual weed control in a low organic matter sandy soil (O.M. 1.0%, sand 40.5%, silt 39.5% and clay 20.0%). Appreciable foliar phytotoxicity was observed under heavy and medium irrigation i.e., 18 and 12 hour irrigation set. Only slight symptoms were observed in the light irrigation (6 hour set).

Soil samples were taken about 6 months after applications (sampled from four depths down to 24 inches) and planted with oats. Damage to oat plants was observed in the heavy irrigation treatment below three inches in the soil profile. In the medium irrigation, light symptoms of phytotoxicity on oats were observed at the two pound rate, particularly at the lower depth. No injury was observed on the oats in the light irrigation soil samples.

These results do not indicate whether the herbicides broke down more readily in the surface depths, or whether the main portion of simazine, sprinkler incorporated, was moved to the 9-24 inch level, particularly under the heavy irrigation. Since most of the phytotoxicity occurred early in the season, one can assume that the simazine moved in with the early irrigations. The portion of simazine not moved in would be expected to break down on the surface as shown by the surface soil samples. These results suggest that simazine moved readily into this soil type with sprinkler irrigation. (University of California, Agricultural Extension Service, Riverside.)

Table 1. The effect of sprinkler irrigation on the phytotoxicity of simazine to Prunus varieties as observed on foliage 2-4 months after herbicide application

	Herbicide	lb/A	Average phytotoxicity[1] at 2 months	4 months
Heavy irrigation:[2]				
	Check	0	0	0
	Simazine	1/2	1.0	1.7
	Simazine	1	2.8	3.0
	Simazine	2	6.1	4.3
Moderate irrigation:[3]				
	Check	0	0	0
	Simazine	1/2	1.0	1.5
	Simazine	1	1.7	2.0
	Simazine	2	3.4	3.3
Light irrigation:[4]				
	Check	0	0	0.1
	Simazine	1/2	0.1	0.3
	Simazine	1	1.3	1.1
	Simazine	2	1.0	1.3

[1]Average phytotoxicity rating from 24 trees (1/3 Marianna plum, 2/3 Lovell peach) (0 = no effect, 5 = marginal burn and chlorosis, 10 = all leaves killed)

[2]Heavy irrigation was 18 hour sets through the growing season for a total of 21 acre inches with rainfall

[3]Medium irrigation was 12 hour sets through the growing season for a total of 17.4 acre inches with rainfaill

[4]Light irrigation was 6 hour sets through the growing season for a total of 14.6 acre inches with rainfall

Soil analysis: O.M. 0.94%, sand 71%, silt 22%, clay 7%, SP 26%, pH 7.9, ECe 0.55, and Ca + Mg 3.1%

Table 2. The effect of overhead irrigation on residual simazine in soil samples taken at four depths as determined by the foliar condition of oats

	Depth of Sampling	Average[1] Phytotoxicity[2] to oats planted in soil treated with Simazine[3] at: 1 lb/A	2 lb/A
Heavy irrigation:[4]			
	0-3	0	0
	3-6	0.5	1.3
	9-12	3.0	3.0
	21-24	1.3	2.6

(Table 2 continued on page 55

Depth of Sampling	Average[1] Phytotoxicity[2] to oat planted in soil treated with Simazine[3] at: 1b/A	2 lb/A
Medium irrigation:[5]		
0-3	0	0.9
3-6	0	0.5
9-12	0.5	0.4
21-24	0.7	1.5
Light irrigation:[6]		
0-3	0	0
3-6	0	0
9-12	0	0
21-24	0	0

[1]Average of 12 replications minus values for untreated check samples

[2]Ten oat seeds were grown in 100 grams of soil from soil samples and rated for phytotoxicity (0 = no effect, 10 = all plants dead)

[3]Simazine was applied to the soil surface 4/20/66 and sampled 10/4/66

[4]Heavy irrigation was 18 hr sets through the growing season for a total of 21 acre inches with rainfall

[5]Medium irrigation was 12 hr sets through the growing season for a total of 17.4 acre inches with rainfall

[6]Light irrigation was 6 hr sets through the growing season for a total of 14.6 acre inches with rainfall

Evaluation of preplant and pre-emergence herbicides in lettuce. Agamalian, H. and A. H. Lange. Experiments were designed to determine the efficacy of RH 315, a promising herbicide for weed control in lettuce. Current registered herbicides are extremely tolerant to the Cruciferae family of weeds, common on lettuce producing regions. Preplant and pre-emergence trials were established under furrow and sprinkler irrigation. Comparative evaluations of RH 315 were made at rates of 1/2, 1, 2, and 4 lb/A, with benefin at 1 lb/A, IPC at 4 lb/A, CDEC at 6 lb/A and combinations of the above.

A summary of five pre-emergence trials (Table 1) indicates excellent weed control with RH 315 on shepherdspurse (*Capsella bursa-pastoris* (L.) Medic.), common purslane (*Portulaca oleracea* L.), burning nettle (*Urtica urens* L.) and hairy nightshade (*Solanum villosum* Mill.).

A summary of three preplant trials (Table 2) indicated less effective weed control on some of the weeds mentioned under pre-emergence conditions. Control of burning nettle and purslane was reduced under soil incorporation at the 2-3 inch depth. Chenopodium and Amaranthus spp. were similarly reduced.

Herbicide activity of RH 315 at 1/2, 1, and 2 lb/A, under pre-emergence application was not appreciably reduced when sprinkler irrigation was delayed 72 hours.

Herbicide activity and the excellent crop tolerance of RH 315 make this compound extremely promising for pre-emergence weed control in lettuce. (University of California, Agricultural Extension Service, Salinas, Riverside.)

Table 1. Percent[a] weed control by species Summary of five pre-emegence lettuce trials furrow and sprinkler irrigation

Treatment	Lb/A	Shepherdspurse	Purslane	Nettleleaf goosefoot	Sow Thistle	Burning nettle	Lambsquarter	Hairy nightshade	Pigweed	Groundsel	Malva	Knotweed
RH 315	1/2	94	98	58	16	90	52	100	--	20	--	100
RH 315	1.	97	100	70	33	95	61	100	67	30	66	100
RH 315	2	98	100	92	33	95	90	100	75	0	85	100
RH315	4	100	100	98	--	95	97	--	100	--	100	--
Benefin	1	12	77	25	16	65	35	0	33	4	65	80
Benefin + IPC	1+4	66	100	50	33	100	52	100	42		68	--
IPC	4	56	69	22	33	95	20	76	14	3	53	100
CDEC	6	77	--[b]	58	33	41	64	55	80	--	65	16
Benefine + RH 315	1+1	100	--	97	0	--	98	100	--	--	--	100

a = obtained from weed counts of treatments and control
b = weed species not present at this trial

Table 2. Percent[a] weed control by species
Lettuce summary of three preplant incorporated trials, sprinkler and furrow irrigation

Treatment	Lb/A	Sow Thistle	Neetleleaf goosefoot	Malva	Purslane	Groundsel	Pigweed	Burning nettle	Thymeleaf speedwell
RH 315	1/2	0	30	49	92	0	16	30	25
RH 315	1	0	45	70	98	0	48	64	34
RH 315	2	0	71	83	100	0	72	86	88
Benefin	1	0	85	67	98	0	78	43	77
Benefin + IPC	1+4	0	86	72	100	0	76	91	81
IPC	4	0	58	40	79	0	40	90	52
CDEC	6	54	95	68	94	0	98	95	100
Benefin + RH 315	1+1	0	95	73	100	0	90	77	90
R-11755	2	0	90	88	100	100	--b	--	--
R-11755	4	0	95	88	99	100	--	--	--

a = obtained from weed counts of treatments and control
b = weed species not present at this trial

Weed control in onions. Menges, Robert M., and J. L. Hubbard. Preplanting, soil-incorporated and contact post-emergence applications of herbicides were studied for weed control in furrow-irrigated 'White Granex' onions in a clay soil. During the first 4 weeks after planting, 3.1 inches of rain along with the initial irrigation maintained soil moisture near field capacity. The daily mean maximum and minimum temperatures were 77 and 63°F at 1/4 inch soil depth.

Preplanting, soil-incorporated (1 inch) applications of 3 lb/A of bensulide + 4 lb/A of propachlor were outstanding and controlled *Amaranthus* spp., common purslane (*Portulaca oleracea* L.), and barnyardgrass (*Echinochloa crusgalli* (L.) Beauv.) without reducing onion yield; even the 2 + 3 lb/A of the combination treatment reduced onion stands, however. Bensulide alone controlled weeds without damage to onions at 4 lb/A, but onion yields were reduced at 8 lb/A. Propachlor alone failed to control purslane and barnyardgrass. CP-50144 (2-chloro-2'-6'-diethyl-*N*-methoxymethyl)acetanilide) injured onions at 2 lb/A.

Post-emergence applications of dimethyl amino-4-thiocyanobenzene (RP-2929) controlled broadleaved weeds selectively, failed to control grasses, but controlled weeds more efficiently than bromoxynil and H_2SO_4. (USDA, ARS., CRD and Texas A&M University Agricultural Research and Extension Center, Weslaco, Texas.)

Control of weeds in cantaloupe. Menges, Robert M., and J. L. Hubbard. DCPA, bensulide, and trifluralin, were overall sprayed and soil-incorporated in emergent cantaloupes to study selective weed control on a clay loam. The predominant weeds were junglerice (Echinochloa colonum (L.) Link) and common purslane (Portulaca oleracea L.). Heavy rains followed treatment with air temperatures 56 to 98°F. Soil moisture losses were high, indicating potential losses of herbicide vapors.

Although the rolling cultivator incorporator failed to incorporate the herbicides effectively, and a few emerged weeds remained at treatment, trifluralin and bensulide controlled weeds satisfactorily. DCPA was less effective for control of junglerice. No herbicidal treatment reduced yield. (USDA, ARS, CRD and Texas A&M University Agricultural Research and Extension Center, Weslaco, Texas.)

Herbicidal control in watermelon. Menges, Robert M., and J. L. Hubbard. We sprayed DCPA, trifluralin, bensulide, and nitralin over emergent watermelons, to study their effects. Only trifluralin, 1/2 to 1-1/2 lb/A, reduced the yield of watermelons; somewhat more when a reel mower was used for incorporation than was the case for a rolling cultivator. Neither incorporator mixed herbicides into the row area. The reel mower incorporated the herbicides 3/4 inch deep and the rolling cultivator incorporated herbicides 1/2 to 3 inches with two skips across the treated bed.

A total of 1.3 and 4.6 inches of rain fell in the first and second months, respectively, after treatment. (USDA, ARS, CRD and Texas A&M University, Agricultural Research and Extension Center, Weslaco, Texas.)

Preplant soil incorporated herbicides for pickling cucumbers. Tisdell, T. and R. King. This trial was established to obtain data in support of possible recommendations of NPA or bensulide, and to evaluate the efficacy of a combination of the two materials. The adobe soil (organic matter-4.6%, sand-41.2%, silt-28%, and clay-30.8%) was in a cloddy condition at the time of treatment. The applications were made to double row pre-formed beds on May 9, in 60 gpa with a constant pressure back pack sprayer. The cucumbers were seeded after incorporation of the herbicide treatments with a power driven rotary tiller. Furrow irrigation was used for the duration of the trial. The average weed counts are presented in the accompanying table. The highest level of control was achieved with the combination of bensulide and NPA. The NPA alone gave acceptable control of the pigweed (Amaranthus retroflexus). The bensulide treatments provided good control of barnyardgrass (Echinochloa crusgalli). (University of California Agr. Exp. Sta. and Agr. Ext. Ser.).

Average weed counts[1] and cucumber yields[2]

		weeds/sq ft		
Herbicide	lb/A	barnyardgrass	pigweed	tons/A
bensulide	5	1.3	11.7	1.84
"	10	1.0	7.3	1.63

(Table continued on page 59)

Herbicide	lb/A	weeds/sq ft barnyardgrass	pigweed	tons/A
NPA	5	9.0	6.0	2.48
"	10	10.8	1.8	1.37
bensulide + NPA	5 + 5	0.3	1.3	2.44
" "	10 + 5	0.3	0.0	1.71
DNBP	2	31.3	35.0	1.73
DYANAP	2.5 & 5	8.5	5.7	2.22
control		38.0	31.0	1.58

[1]Average of 4 replicates counted on June 14

[2]Average of 4 replicates from a destructive harvest on July 16.

Pre-emergence and preplant herbicide evaluations with direct seeded tomatoes. Tisdell, T., L. Buschmann, and M. Zobel. These trials were established in order to compare present weed control recommendations with several new materials and combinations. All the treatments in the trial designated as T-4 were incorporated into the tops of pre-formed beds prior to seeding. The treatments in T-5, with the exception of the pebulate and the pebulate-diphenamid mixture, were applied to the soil surface over flat-planted tomatoes. The pebulate and the pebulate-diphenamid combination were applied as pre-plant soil incorporated treatments This trial was sprinkler irrigated for the duration of the season. Trial T-7 consisted entirely of preplant soil incorporated treatments, in a field that was furrow irrigated. The percent weed control obtained from these three trials is presented in the accompanying table. Pebulate and trifluralin or mixtures containing either one, with one or two exceptions had about the highest level of barnyardgrass (Echinochloa crusgalli) control of any of the treatments. (Univ. of Calif. Agr. Exp. Sta. and Agr. Ext. Ser.)

Percent weed control[1]

Herbicide	lb/A	barnyardgrass T-5	barnyardgrass T-7	lambsquarter T-4	lambsquarter T-5	pigweed T-4
diphenamid	4	44.2	57.0	53.8	11.5	97.0
"	8	22.8	85.8	81.0	28.4	100.0
pebulate	4	95.0	25.5	59.0	58.0	49.0
trifluralin	1/4	71.5	55.0	66.5	9.1	81.0
"	1/2	72.5	82.3	90.5	37.5	95.0
bensulide	6	17.6	81.5	62.0	39.7	58.0
nitralin	1/4	--	26.5	--	--	--
"	1/2	--	57.5	--	--	--
trifluralin + pebulate	1/2 + 4	--	94.8	--	--	--
trifluralin + diphenamid	1/4 + 4	57.0	91.5	89.2	28.4	99.0
diphenamid + pebulate	4 + 4	97.0	75.9	49.5	81.8	98.0

[1]Average of 4 replicates

Herbicide evaluations in direct-seeded tomatoes on a peat soil. Tisdell, T., R. King, and E. Stillwell. This investigation was undertaken to examine the effectiveness of available herbicides on soil of high organic matter content. This soil had the following mechanical analysis: organic matter-49.6%, sand-61.2%, silt-30%, and clay-8.8%. The herbicides were applied to the soil surface after the double rows of tomatoes had been flat-planted. These applications were completed with a constant pressure back pack sprayer using the equivalent of 60 GPA. Sprinkler irrigation was started on the plot area within one hour after the last treatment had been finished. The herbicides were applied on April 24, and weed control evaluations made on June 6. The principle weed in this trial was shepherdspurse (Capsella bursa-pastoris). However, data on lesser weeds are also included in the accompanying table. The amiben showed the highest level of activity of any of the materials in this trial. (University of California, Agr. Exp. Sta. and Agr. Ext. Ser.)

Average percent weed control[1]

Herbicide	lb/A	shepherds-purse	lambs-quarter	pigweed	purslane
diphenamid	8	0	0	50	0
pebulate	8	0	0	80	100
trifluralin	1	0	0	30	0
"	2	0	0	80	75
bensulide	12	0	0	80	25
amiben	4	95	50	100	100
"	8	100	100	100	100
CDAA	6	1.4	0	40	50
CDEC	6	0	0	70	100
diphenamid + trifluralin	8 + 1/2	0	0	90	0
diphenamid + pebulate	8 + 8	84	25	70	50
CDAA + CEDC	6 + 6	58	50	100	100

[1]based on total weeds in each of 4 replicates

The effect of eight herbicides on weed control in solanaceous crops. Lange, A. H. Rates up to 4 lb/A of trifluralin incorporated and sprinkler irrigated were safe on transplanted tomato, eggplant and pepper, but not when direct seeded. The lower rate, 1 lb/A, was safe but did not control puncturevine and Russian thistle. Diphenamid showed very little injury except on direct seeded carrot, lambsquarter, and pigweed. A rate of 16 lb/A was necessary to control Russian thistle. DCPA showed considerable safety for transplants but no safety for direct seeded tomatoes and peppers. The low rate was safe on carrots.

IPC was likewise poor on the broadleafed weed species, but showed some injury on the transplanted crop plants at 16 lb/A and direct seeded at 4 lb/A.

Pebulate showed some effect on transplant and direct seeded peppers but considerable safety on tomatoes and weeds.

R 7465 showed considerable promise on the solanaceous crops but extreme toxicity on carrots. It was not effective on puncturevine or Russian thistle at 4 lb/A. Pyrazon was very toxic to the crops and weeds except for Russian thistle which being related to sugar beets is not surprising. (University of California, Agricultural Extension Service, Riverside.)

Table 1. The effect of regular and high rates of several preplant incorporated herbicides on direct seeded and transplanted vegetable crops

		Average[1] phytotoxicity					
		Transplanted			Direct seeded		
Herbicide	lb/A	Tomato	Eggplant	Pepper	Tomato	Pepper	Carrot
Trifluralin	1	2.7	1.0	2.7	2.7	3.0	1.0
"	4	1.3	0.3	2.0	5.0	4.7	2.3
"	16	6.3	5.3	4.7	8.0	7.0	2.3
Diphenamid	4	0.3	0	2.7	1.0	1.3	5.0
"	16	0.7	0.3	3.3	1.3	1.7	7.0
DCPA	6	1.3	0.3	3.0	5.3	5.3	4.0
"	24	3.0	1.7	4.7	8.3	5.0	5.7
Bensulide	6	1.7	0.3	1.7	1.0	0.7	1.7
"	24	2.7	0.7	4.7	2.7	2.0	0.3
IPC	4	1.7	1.3	4.0	3.0	5.7	3.3
"	16	8.3	3.0	7.7	8.0	9.0	7.7
Pebulate	4	0.7	0	0.7	1.3	1.0	3.7
"	16	3.0	1.0	5.3	3.3	8.3	6.7
R 7465	1	2.0	0.7	0.7	1.7	5.0	9.3
"	4	2.3	0.7	4.0	2.7	2.3	9.7
Pyrazon	1	8.0	8.0	7.0	5.7	5.3	7.7
"	4	9.0	9.7	9.7	9.7	8.0	10.0
Check	-	2.0	0.7	2.7	1.7	3.3	4.3

[1]Average of 4 replications, 1 bed by 10 feet with 5 feet untreated buffer areas. Phytotoxicity ratings: 0 = no effect, 10 = no stand or dead.

Soil Analysis: OM = 0.94%, sand = 72%, silt = 21%, clay = 7%, SP = 26%, pH = 7.9, ECe = 0.55 mmhos, Ca + Mg = 3.1 me/1.

Table 2. The effect of regular and high rates of herbicides on weed control in solanaceae crops

		Average[1]		
Herbicide	lb/A	Puncture-vine	Russian thistle	Lambsquarter and Pigweed
Trifluralin	1	3.3	4.3	7.7
"	4	8.7	8.3	10.0
"	16	10.0	10.0	10.0
Diphenamid	4	3.0	5.3	9.0
"	16	3.3	7.0	8.0
DCPA	6	6.3	2.3	7.7
"	24	9.3	7.7	9.7

(Table 2 continued on page 62)

Table 2. (Continued)

Herbicide	lb/A	Average[1] Puncture-vine	Russian thistle	Lambsquarter and Pigweed
Bensulide	6	4.3	1.7	5.3
"	24	1.0	2.0	4.3
IPC	4	3.0	2.7	2.0
"	16	7.0	5.3	7.7
Pebulate	4	3.0	3.3	3.0
"	16	5.0	1.0	5.3
R 7465	1	4.3	2.0	3.3
"	4	5.3	5.3	6.7
Pyrazon	1	9.0	0	9.3
"	4	10.0	1.3	10.0
Check	-	0	1.3	1.7

[1]Average of 4 replications

Phytotoxicity with soil applications of bensulide. Menges, Robert M., and J. L. Hubbard. Seedlings of 18 plant species were grown 3 weeks in 3 soils each containing 0-1,000 ppm of bensulide to determine phytotoxicity values. Eight vegetables were included. The herbicidal concentrations required to reduce the growth of shoots 50% (GR_{50}) ranged from 1.2 ppm with barnyardgrass (Echinochloa crusgalli (L.) Beauv.) and table beets to a GR_{15} at 1,000 ppm with lettuce. Roots were somewhat more sensitive than shoots but phytotoxicity data were more reproducible in shoots. Seedlings showed somewhat more sensitivity in sandy clay loam than in clay or loamy sand. (USDA, ARS, CRD and Texas A&M University of Agricultural Research and Extension Center, Weslaco, Texas.)

Time interval between herbicide application and overhead sprinkler irrigation. Lange, A. H. The time interval between the application of a volatile herbicide and subsequent sprinkler irrigation is generally considered to be critical.

Overhead irrigation was applied immediately after herbicide application and at two hours after herbicide application, using a precision irrigator. Three rates of EPTC, three rates of trifluralin and one rate of bensulide were applied to the surface of pre-formed seeded beds. The results showed excellent control of weeds with EPTC at rates of 6 and 12 pounds, trifluralin at 3 pounds, and bensulide at 12 pounds applied just prior to overhead irrigation. When the herbicides were applied two hours prior to overhead irrigation, there was no difference in weed control. The low rate of EPTC and trifluralin were not adequate for weed control with a total 1.2 acre inches of water. Trifluralin at 1.5 pounds gave commercially acceptable weed control. The weeds were primarily Amaranthus sp. (University of California Agricultural Extension Service, Riverside.)

The effect of short time interval between surface application of three herbicides to dry soil

Herbicide	Act	lb/A	Average[1] Sprinkler irrigation[2] applied immediately after herbicide 27 days (0-10)	84 days No. of weeds	Sprinkler irrigation[2] applied 2 hours after herbicide 27 days (0-10)	84 days No. of weeds
EPTC	6 EC	3	5.5	16	4.5	14
EPTC	6 EC	6	9.5	3	9.5	2
EPTC	6 EC	12	10.0	0	9.5	0
Trifluralin	4 EC	3/4	4.0	22	5.5	6
Trifluralin	4 EC	1.5	7.5	7	8.0	3
Trifluralin	4 EC	3	9.0	2	9.5	2
Bensulide	6 EC	12	10.0	2	8.5	5
Check		--	0	30	0	28

[1]Average of 4 replications, 20 square feet of bed top each.

[2]Sprinkler irrigation was applied at 0.15 acre inch per hour for a total of 8 hours or 1.2 acre inches total. (Note: The weeds were primarly *Amaranthus* sp. Soil Analysis: OM = 0.89%, sand = 72%, silt = 21% and clay = 7%

Sprinkler activation of diphenamid and trifluralin. Lange, A. H., and B. Fischer. Although higher rates of irrigation generally resulted in more herbicide activity with both diphenamid and trifluralin, the results were not consistent which would tend to minimize the importance of the amount of initial sprinkler irrigation in this soil type at levels between 1/2 acre inch and 2 acre inches.

The activity of trifluralin on weeds was greater at 1 lb/A than diphenamid at 16 lb/A. Trifluralin was harder on the tomato plants. The activity of diphenamid was greater on barley than trifluralin.

The jranular form of trifluralin was much more active than the liquid form. The 2 lb/A rate of the granular formulation was quite toxic on everyting but barley. (University of California, Agricultural Extension Service, Riverside, Fresno.)

The effect of sprinkler irrigation level and formulation on the activity of herbicides in a loam soil

Treatment	lb/A	Irrig.[2] level	Average[1] Barley	Tomato	Pigweed	Barnyardgrass
		(A in.)				
Diphenamid 80 W	4	1/2	3.6	0	1.3	2.8
		1/2 + 1/2	2.5	0.75	2.0	4.8
		1	5.8	1.5	0.5	1.5
		1 + 1	9.5	0.75	3.5	2.8
Diphenamid 80 W	8	1/2	6.0	1.8	5.0	3.5
		1/2 + 1/2	3.8	1.0	4.3	4.5
		1	8.8	0.5	2.5	3.8
		1 + 1	8.0	2.8	3.6	2.8
Diphenamid 80 W	16	1/2	6.5	2.8	1.8	1.5
		1/2 + 1/2	7.8	1.5	5.3	5.0
		1	8.8	2.3	6.8	4.8
		1 + 1	5.8	1.8	3.5	6.8
Trifluralin 4 EC	1	1/2	0	0.5	4.5	7.0
		1/2 + 1/2	1.3	2.3	3.5	7.0
		1	1.8	3.3	2.5	5.5
		1 + 1	3.3	4.0	5.3	7.8
Trifluralin 4 EC	3	1/2	0.8	3.8	5.3	8.3
		1/2 + 1/2	1.8	5.3	9.0	7.3
		1	1.3	2.8	8.5	7.0
		1 + 1	4.0	7.5	7.3	7.3
Trifluralin 5 G	1	1/2	1.3	3.3	9.0	8.8
		1/2 + 1/2	1.8	4.5	8.0	8.3
		1	2.5	5.3	9.3	9.3
		1 + 1	2.3	4.5	8.3	8.5
Trifluralin 5 G	2	1/2	2.8	6.0	9.5	9.5
		1/2 + 1/2	2.8	7.8	10.0	9.0
		1	2.3	8.5	9.5	8.8
		1 + 1	2.5	8.5	9.8	8.5
Untreated		1/2	3.0	2.3	2.8	1.5
		1/2 + 1/2	1.3	1.3	1.5	0.8
		1	1.0	2.0	1.0	1.5
		1 + 1	1.5	0.5	0.3	2.0

[1]Average of 4 replications (5 ft x 5 ft plot)

Soil analysis: 42% sand, 38% silt, 19% clay and 0.9% organic matter

[2]Inteval between repeat irrigations was 24 hours

<u>Timing of herbicide application and sprinkler irrigation</u>. Lange, A. H. More and more interest in the use of herbicides through the sprinkler system is being seen in California agriculture. The first question asked is "When, in the irrigation run, should herbicides be injected?"

Using precision irrigation equipment, herbicides were surface applied one hour after irrigation began and six hours after irrigation began. Both sets of plots received the same eight hours total sprinkler irrigation.

Weed control with EPTC appeared to be slightly better at the 3 lb/A rate when applied early in the run, followed by seven hours of irrigation. From the damage on the cantaloupe, it would appear that slightly more EPTC was incorporated with the application of the herbicide early in the run.

Similar results were found with trifluralin on cantaloupes, i.e. slightly less vigorous plants were found from an application of herbicide early in the irrigation run. The differences were not large and may not be significant, especially when it appears that broccoli had reversed that trend at the low rate of herbicide.

With bensulide, the differences were small. In general the results of this study would indicate that there would be slight advantage, if any, to applications early in the run with this herbicide.

These herbicides, all being quite insoluble, may show less effect from timing than more soluble herbicides, i.e. whether two or seven hours of irrigation follows herbicide application. (University of California Agricultural Extension Service, Riverside.)

The effect of timing of herbicide applied in an eight hour run (At 0.15 acre inch/hr)

			Average[1]					
			Weed Control[2]		Vigor rating[3]			
					Cantaloupe		Broccoli	
Herbicide	Act	lb/A	6 hr + 2 hr	1 hr + 7 hr	6 hr + 2 hr	1 hr + 7 hr	6 hr + 2 hr	1 hr + 7 hr
EPTC	6 EC	3	8.2	9.2	3.0	1.2	0.8	0.5
EPTC	6 EC	6	9.8	9.8	2.2	0	0.2	0.5
EPTC	6 EC	12	9.8	10.0	0.5	0.2	0	0
Trifluralin	4 EC	0.75	3.2	5.0	5.5	4.2	4.0	6.0
Trifluralin	4 EC	1.5	6.8	6.5	4.8	5.5	5.0	5.5
Trifluralin	4 EC	3.0	6.8	7.8	6.2	6.2	6.8	4.2
Bensulide	6 EC	12.0	8.0	8.8	5.5	6.8	4.2	4.0
Check		0	0.8	0.5	7.0	5.5	5.5	6.2

[1]Average of 4 replications - two 1 x 5 foot bed tops

[2]Weed control was control of Amaranthus sp. 0 = no control, 10 = complete weed control

[3]Vigor = 10 = largest plant, 5 = about 1/2 size and about 1/2 stand, 0 = no stand

Soil analysis: OM = 0.89%, sand = 72%, silt = 21% and clay = 7%.

The effect of sprinkler irrigation on the phytotoxicity of Troyer citrange liners. Lange, A. and G. Suthers. The initial irrigation or rainfall can easily vary from less than 1/2 acre inch to over 2 acre inches in the first 24 hours after herbicide application.

When 1/2 acre inch and 2 acre inches were applied by precision irrigation equipment immediately after herbicide application in a single irrigation, the higher level of water caused considerable chlorosis with dichlobenil at 16 lb/A of the 4% granular. None of the other herbicides caused toxicity symptoms.

The apparent weed control was excellent with all herbicides but the weed population was not sufficiently heavy for critical evaluation.

Simazine, terbacil, trifluralin and nitralin caused no phytotoxicity at rates up to the highest rate tested, i.e. 4 lb/A per acre. (University of California Agricultural Extension Service, Riverside Anaheim.)

The effect of irrigation level on herbicide activity as measured by Troyer citrange liner (Orange County, applied 6/26/68)

			Average Phytotoxicity[1]			
			Irrig. level		Irrig. level	
			1/2 Acre inch	2 acre inch	1/2 acre inch	2 acre inch
Herbicide	Act.	lb/A	8/14/68	8/14/68	10/16/68	10/16/68
Simazine	80 W	1	0	1.2	1.0	1.0
"		4	0.8	1.5	2.2	1.8
Terbacil	80 W	1	0	0.5	1.5	1.2
"		4	0	1.0	1.5	2.0
Trifluralin	4 EC	1	0.5	0.8	1.5	1.2
"		4	0	0.2	0.8	2.0
Nitralin	75	1	0.2	0.5	1.2	1.8
"		4	0.8	0	1.8	1.2
Dichlobenil	4 G	4	0	1.8	1.5	3.2
"		8	0.2	1.5	1.5	3.2
" (c)		16	1.0	3.2	2.5	4.0
Check			0	0.2	1.0	1.2

[1]Average of 4 replications
Phytotoxicity where 0 = no effect, 3 = definite chlorosis pattern, 5 = chlorosis plus burn, 10 = completely dead foliage.
c = chlorotic

Soil analysis: OM = 1.1%, sand = 82%, silt = 8%, clay = 10%, SP = 24%
pH = 7.5%, ECe = 0.99 mmhos, Ca + Mg = 7.5 me/l

<u>The effect of rate of irrigation on herbicide activity</u>. Lange, A. H. The rapidity with which irrigation water is applied to soil can grossly affect the growing conditions of plants, particularly on those soils which tend to form crusts. Less is known about the effect of irrigation rate on herbicide activation.

Broccoli vigor appeared to be less with the faster irrigation, i.e., 1 acre inch in 2 hours. The total amount of irrigation appeared to have more effect on broccoli growth, the 1 acre inch being somewhat better than the 2 acre inches.

The larger amount of water generally gave better weed control, but this may have been due to adverse growing conditions for the weeds, such as crusting (as seen in the ratings for the untreated check which were affected similar to the broccoli plants).

When 1 acre inch of irrigation was applied in 8 hours vs. the same amount in 2 hours, very little difference in weed control was observed with surface applied bensulide at 6 pounds and trifluralin at 1.5 and 3 pounds per acre.

The low rate of trifluralin gave considerably better weed control at 2 acre inches than it did with 1/2 acre inch of water but this may be in part due to crusting of the soil. (University of California, Agricultural Extension Service, Riverside.)

The effect of rate of irrigation on herbicide activity as measured by crop vigor and weed control

	Herbicide	Act	lb/A	Average[1] 1 acre inch/8hr	1 acre inch/2hr	1/2 acre inch/4hr	2 acre inch/4hr
Broccoli vigor[2]							
(6/27/68	Bensulide	6 EC	6	5.0	4.5	8.0	3.5
	Trifluralin	4 EC	1.5	6.0	5.2	4.8	3.5
	Trifluralin	4 EC	3.0	4.2	4.2	6.8	5.0
	Check	-	0	6.2	5.5	6.2	3.2
Weed Control[3]							
(6/27/68)	Bensulide	6 EC	6	9.0	9.0	7.2	9.2
	Trifluralin	4 EC	1.5	10.0	9.2	6.5	9.8
	Trifluralin	4 EC	3.0	10.0	9.8	8.5	10.0
	Check	-	0	1.2	1.2	0.5	3.2

[1]Average of 4 replications (2 beds by 5 feet)

[2]Vigor of broccoli was rated as 10 = best growth and stand, 0 = severe stunting or no stand

[3]Weed control based on a 0 = 10 rating where 0 = no control, 7 = commercially acceptable and 10 = complete weed control, i.e. no weeds on the bed top

Soil analysis: OM 0.89%, sand 72%, silt 21%, clay 7%.

Timing of herbicide injection in sprinkler irrigation. Lange, A., H. Agamalian and R. Sciaroni. Using precision irrigation equipment, trifluralin and nitrofen were applied in combination through the sprinkler system to newly planted Margaret daisy, heather, calla lily and iris. The first application was inject 15 minutes after the beginning of irrigation. The second was applied 15 minutes before the end of the two-hour irrigation (rate 0.5 acre inch/hr). The soil was near field capacity before irrigation began due to previous rains.

Early herbicide injection gave the best weed control but more injury at the high rate of herbicide.

Iris was most tolerant, Margaret daisy next, then heather and finally calla lily. (University of California Extension Service, Riverside, Salinas, Half Moon Bay.)

The effect of the timing of herbicide injection during sprinkler irrigation on weed control and crop vigor

			Average[1]			
			Weed Control[2]			
			15 min. + 105 min.		105 min. + 15 min.	
Herbicide	Act	lb/A	10/15	11/15	10/15	11/15
Trifluralin	4 EC	3/4	8.0	5.2	6.5	3.8
+ nitrofen	2 EC	6				
Trifluralin		1.5	9.5	8.5	9.5	8.0
+ nitrofen		12				
Check		0	0	0	0	0
			Margaret daisy vigor			
Trifluralin		3/4	9.8	7.0	10.0	8.5
+ nitrofen		6				
Trifluralin		1.5	9.0	5.5	9.8	6.2
+ nitrofen		12				
			Heather vigor			
Trifluralin		3/4	8.5	8.5	9.0	8.6
+ nitrofen		6				
Trifluralin		1.5	6.5	3.8	8.2	4.5
+ nitrofen		12				
			Calla lilly vigor			
Trifluralin		3/4	--	7.2	--	6.8
+ nitrofen		6				
Trifluralin		1.5	--	3.8	--	3.0
+ nitrofen		12				
			Iris vigor			
Trifluralin		3/4	--	9.2	--	8.8
+ nitrofen		6				
Trifluralin		1.5	--	5.5	--	7.8
+ nitrofen		12				

[1]Average of 4 replications

[2]Weed species included common mustard, windmill pink, common groundesl, corn spurry and chickweed.

Weed control by soil-incorporated herbicides as affected by the incorporation tool. Menges, Robert M., and J. L. Hubbard. We tested eight incorporation tools on furrow-irrigated beds in the field with 3 herbicides applied to soil, to study the relative efficiency of tools for incorporating herbicides in air-dry, fine sandy loam. Soil profile studies with fluroescent tracers showed that the PTO-rotary tiller uniformly incorporated herbicides 2-1/4 inches deep in the dry soil. A double-tiered, rolling cultivator incorporated herbicides 1/2 to 2 1/2 inches deep, and a reel mower blade 1-1/4 inches, both with poor distribution across the beds. Mesh wheel, tine wheels, and rolling bar incorporation tools incorporated the herbicides uniformly, approximately 3/4 inch deep.

A total of 1.6 inches of rain fell within 1 day and 5.8 inches in 12 days after treatment. Soil temperatures ranged from 76-110°F. Redroot pigweed (*Amaranthus retroflexus* L.), Palmer amaranth (*Amaranthus palmeri* S. Wats.), and barnyardgrass (*Echinochloa crusgalli* (L.) Beauv.) were most effectively controlled when bensulide, DCPA, and trifluralin were incorporated with the PTO-rotary tiller. They were next best controlled by herbicides with a mesh wheel, tine wheels, or rolling bar incorporators, and then with a reel mower blade. They were least effectively controlled by the herbicides with the rolling cultivator. Trifluralin performance was most affected, and bensulide was least affected, by the type of incorporation tool. The choice of tool affected control of *Amaranthus* spp. more than barnyardgrass. (USDA ARS CRD and Texas A&M University Agricultural Research and Extension Center, Weslaco, Texas.)

PROJECT 5. WEEDS IN AGRONOMIC CROPS

H. E. Chamberlain, Project Chairman

SUMMARY

No summary included.

Diuron and linuron comparisons in winter wheat, Willamette Valley, Oregon. Figuerola, Luis F., P. D. Olson and A. P. Appleby. To assess the effectiveness of diuron and linuron in controlling annual ryegrass (Lolium multiflorum) in winter wheat, six experiments were conducted in five counties in the Willamette Valley during the 1967-1968 season.

The conditions under which the experiments were established were quite varied. Seedbed conditions varied from smooth and moist to cloddy and dry. A smooth seedbed with moist soil conditions at the time of application favored the activity of both herbicides.

Four rates of each herbicide (1.6, 2.0, 2.4, and 3.2 a.i. pounds per acre) were applied in the fall. Ryegrass counts made in the winter and visual evaluations in July showed that good control was obtained with both herbicides with no significant difference between them.

Nugaines and Druchamp were the wheat varieties used in the experiments. Comparing locations with different varieties, no major difference was noted in the response of the two varieties to diuron or linuron treatments.

Under the conditions studied, rates higher than 2.0 pounds active ingredient per acre sometimes gave better ryegrass control than lower rates but did not give higher yields. Therefore, 2.0 pounds per acre of either herbicide appeared to be the maximum economical rate.

Since linuron is considerably higher in price than diuron but appeared to have no consistent advantage in yields, as shown in the following table, diuron seems to offer more net return per acre. (Farm Crops Department, Oregon State University, Corvallis.)

Visual evaluations (v.e.) as percent of control and average yields (y) in bushels per acre for each location.

		Berger		McDaniels		Dietz		Davidson		Van Leewven		Eyman	
Treatment		Washington Co.		Yamhill Co.		Clackamas Co.		Marion Co.		Linn Co.		Clackamas Co.	
	Rate lb/A a.i.	v.e. %	y bu/A	v.e. *	y bu/A	v.e. %	y bu/A	v.e. %	y bu/A	v.e. %	y bu/A	v.e. %	y bu/A
Diuron	0	0	63.3		69.1	0	40.1	0	48.8	0	57.5	0	32.0
	1.6	77	74.3		70.3	75	40.7	83	54.0	41	68.6	77	62.7
	2.0	86	77.9		71.5	86	37.8	85	54.6	54	66.2	81	56.9
	2.4	87	73.2		68.6	75	39.5	88	55.2	65	68.0	83	55.8
	3.2	90	71.5		63.3	78	28.5	89	51.1	72	66.8	85	47.1
Linuron	0	0	70.3		69.1	0	41.8	0	47.1	0	56.4	0	38.3
	1.6	88	87.2		70.9	79	36.0	82	51.1	66	67.4	78	55.2
	2.0	88	78.4		74.9	80	39.5	86	52.9	75	68.0	76	63.9
	2.4	90	78.4		64.5	88	40.1	90	52.9	85	69.1	78	58.7
	3.2	90	76.7		69.7	85	38.3	90	54.0	88	70.3	85	59.8
Variety		Nugaines		Druchamp		Nugaines		Nugaines		Nugaines		Druchamp	
Soil Condition at application		Moist and smooth		Wet and smooth		dry and rough		Moist and rough		Wet and smooth		Wet and cloddy	
Application time		post-emergence		pre-emergence		pre-emergence		early post		pre-emergence		pre-emergence	

* no ryegrass present at time of evaluation

Ryegrass control in western Oregon winter wheat. Mackenzie, J. W., P. D. Olson and A. P. Appleby. Five trials were established at three different locations in the Willamette Valley during the fall of 1967. Two trials were established to screen new herbicides for control of ryegrass (Lolium sp.). Three trials were established to investigate combinations of the standard ryegrass herbicide, diuron, and a wild oat herbicide, barban, along with other new herbicides which had shown promise for wild oat control. Ryegrass and wild oats were over-seeded on each trial. The expected wild oat populations did not materialize. Apart from the fall herbicide applications, standard grower practice was superimposed on each trial. Nugaines winter wheat was grown at all three locations. Herbicide applications were made in 40 gallons of water per acre pre-emergence to the crop, at the two to three leaf stage and about February 1, 1968. Farmer applications of 2,4-D ester were made in March, 1968. Cereal injury was evaluated in April, ryegrass control in July and the plots were harvested in August. Only those treatments visually superior to the standard diuron treatment were harvested.

Results from the two series of trials are presented in Tables 1 and 2. The severity of ryegrass infestation was greatest at the McMinnville site and least at the Rickreall site. Control yields over the five trial series averaged 39 bushels/acre. This average was lowered considerably due to the cereal lodging at McMinnville.

The outstanding chemical in the screening trials was CP 52223, an experimental herbicide from Monsanto Chemical Corporation. Under the rigorous conditions of the McMinnville trial, this herbicide gave such good ryegrass control that no cereal lodging took place. In contrast, 40% of the area of the diuron plots and 100% of the area of the control plots was lodged. Where the ryegrass problem was less severe, as at Rickreall, the yield differential was not so marked. CP 52665 was also an active compound. However, the margin of safety to winter wheat appeared to be less under our trial conditions.

In the diuron-barban trials, application of a diuron-barban combination at the two to three leaf cereal growth stage gave interesting results. The standard rate of 1.6 lb/A a.i. diuron at pre-emergence and 2 to 3 leaf stage yielded 65 and 71 bushels of wheat per acre, respectively. Diuron at the standard rate plus barban at 0.33 and 0.67 lb/A a.i. yielded 77 and 80 bushels of wheat per acre respectively. Barban applications alone or in combination, at higher rates or at low rates at the February 1 date resulted in increased cereal injury.

These results from the 1967-1968 trial would indicate the desirability of further investigation of CP 52223 as a winter wheat herbicide. Diuron-barban combinations also offers promise for ryegrass control under Oregon conditions. (Farm Crops Department, Oregon State University, Corvallis.)

Table 1. Results of two screening trials conducted to investigate new winter wheat herbicides

Pre-emergence Treatment	Yield (Avg. of 3 reps) Bushel/Acre		Cereal injury 1/		Ryegrass % Control 1/	
	Rickreall	McMinnville	Rickreall	McMinnville	Rickreall	McMinnville
CP 52223 1 lb/A	101.5	54.4	22	13	70	78
" 2 lb/A	90.0	70.9	22	10	60	93
CP 52665 1 lb/A	93.4	70.7	22	20	83	88
" 2 lb/A	87.2	59.8	40	40	85	90
Diuron 1.6 lb/A	90.9	33.3	3	0	40	38
Linuron 1.6 lb/A	83.6	31.2	13	0	57	20
Control	74.6	5.8	0	0	0	0

1/ 0% No injury
100% Complete kill

Table 2. Results of three trials conducted to determine ryegrass control and cereal safety of various diuron, barban treatments

Treatment	Yield (Avg. 4 reps)			Cereal Injury[1/]			Ryegrass Control[1/]		
	Rickreall	McMinnville	Sheridan	R	M	S	R	M	S
Diuron 1.6 lb/A 2-3 leaf + Barban 0.33 lb/A 2-3 leaf	94.6	65.4	71.9	2	5	12	59	74	86
" " + Barban 0.67 lb/A 2-3 leaf	100.4	62.5	77.8	2	25	10	71	77	90
" " + Barban 0.33 lb/A Feb.1, 1968	102.9	61.5	68.0	12	15	15	74	72	75
" pre-em + Barban 0.67 lb/A Feb.1, 1968	---	59.5	66.4	--	32	35	--	91	94
" pre-em + Barban 1.5 lb/A Feb.1, 1968	59.0	58.4	55.0	62	52	47	86	95	96
" 2-3 leaf, pre-em + Barban 0.67 lb/A Feb.1, 1968	86.6	----	----	32	--	--	89	--	--
" 2-3 leaf	89.2	58.0	66.5	2	5	2	38	54	58
pre-em	80.0	50.4	65.6	0	0	2	43	50	42
Barban 0.33 lb/A 2-3 leaf	87.2	49.5	65.8	2	15	15	63	78	85
" 0.5 lb/A 2-3 leaf	95.4	48.9	71.2	10	20	10	74	81	95
" 1.0 lb/A 2-3 leaf	----	48.8	63.5	--	48	30	--	92	100
" 0.33 lb/A Feb. 1, 1968	80.5	38.5	63.2	20	25	21	74	41	82
" 0.67 lb/A Feb. 1, 1968	82.1	37.5	62.7	35	42	40	85	71	96
" 1.0 lb/A Feb. 1, 1968	61.6	----	-----	50	--	--	84	--	--
Control	69.0	10.2	36.7	0	0	0	0	0	0

1/ 0% No injury
100% Complete kill

Weed control in sugar beets. Olson, Phillip D., C. E. Stanger, A. P. Appleby. Trials were established in the spring of 1968 at Corvallis and Salem, Oregon, in monogerm sugar beets. Treatments consisted mainly of cycloate combinations and new herbicides. At Corvallis, two methods of incorporation of cycloate were compared; fin-injector and power rototiller. Soil types were as follows: Corvallis, Chehalis silt loam; Salem, Newburg sandy loam. Sprinkler irrigation was used at both locations. Primary weed species present in the two trials were barnyardgrass (Echinochloa crusgalli), redroot pigweed (Amaranthus retroflexus), lambsquarters (Chenopodium album), and nightshade (Solanum sp.). Yields were not taken at either location.

In the Corvallis trial, cycloate was applied at a rate of 4 lb/A a.i. The injection method of incorporation of cycloate resulted in as effective control of pigweed, nightshade and lambsquarters as the power rototiller, but resulted in slightly lower control of barnyardgrass.

Combination treatments of cycloate with post-emergence herbicides, in which cycloate was placed in the soil with either the fin-injectors or power rototillers, resulted in much superior weed control than cycloate applied zone. Phenmedipham, 3-methoxycarbonylaminophenyl - M (3'-methyl-phenyl) carbamate, at 1 lb/A a.i. and two Amchem materials, ACP 65-223 at 12 lb/A product (4 lb pyrazon + 2.2 lb dalapon + wetting agent) and ACP 65-285 at 10 lb/A product (4 lb pyrazon + 2.2 lb dalapon) applied alone post-emergence were fairly effective in controlling the broadleaf weeds, but ineffective in controlling barnyardgrass. However, when these materials were used in combination with cycloate, control of broadleaf weeds greatly improved and grass control was excellent. Overall weed control was almost perfect with these combination treatments without any appreciable sugar beet injury. Lenacil at 1 lb/A a.i. post-emergence was ineffective in controlling either the broadleaf weeds or grasses, but when used in combination with cycloate excellent control of all weeds resulted. Pyrazon plus phenmedipham at 2 + 1 lb/A a.i. in combination with cycloate also resulted in perfect weed control without any sugar beet injury.

At Salem, the cycloate combinations were also the superior treatments. Cycloate was applied at 4 lb/A a.i. and incorporated with a power rototiller. The post-emergence herbicides used in combination with cycloate that controlled all of the broadleaved weeds and grasses present in the trial without any sugar beet injury were pyramin at 4 lb/A a.i., ACP 65-223 (Pyramin plus) at 12 lb/A product and R 11913 at 4 lb/A a.i. R 11913 at 1 lb/A a.i. as pre-plant incorporated treatment in combination with cycloate also gave excellent weed control without sugar beet injury.

At Salem, three coded compounds produced by Schering; CM 993, CM 994 and CM 987 were compared to phenmedipham at equivalent rates. The results indicated that the new compounds were more active on the broadleaf weeds, particularly pigweed, but showed less selectivity towards the sugar beets than phenmedipham. (Farm Crops Department, Oregon State University, Corvallis).

Evaluation of several herbicides for weed control in potatoes. Akhavein, A. A., P. D. Olson, and A. P. Appleby. In 1968, one screening trial in Redmond, Oregon, consisting of 51 duplicated treatments, and three yield trials, having 18 to 24 four-replicated treatments, in Redmond, Ontario and Klamath Falls, Oregon, were conducted to evaluate the safety and weed control performance of several herbicides in potatoes. The soil in all locations was light and low in organic matter. The Redmond and the Klamath Falls trials were sprinkler irrigated. The Ontario trial was furrow irrigated. Visual estimates of the percent weed stand reduction and the percent potato injury were made on all four trials; and the yields were obtained for the three yield trials.

Weed populations in the Redmond yield trial were very heavy and consisted of pigweed (Amaranthus retroflexus), nightshade (Solanum nigrum), lambsquarters (Chenopodium album) and Russian thistle (Salsola kali). (Pigweed and nightshade were predominant in the screening trial.). Major weeds in the Ontario yield trial were pigweed, lambsquarters, nightshade, barnyardgrass (Echinochloa crusgalli), green foxtail (Setaria viridis) and kochia (Kochia scoparia). Pigweed and lambsquarters were major weeds in the Klamath Falls yield trial.

In the screening trial, 15 herbicides which showed safety in potatoes plus moderate to good weed control activity had been selected for further investigation. Among them, post-emergence application of diphenamid + dinoseb (2 + $1\frac{1}{2}$ lb/A or 4 + 3 lb/A) proved an excellent treatment.

In the yield trials, soil incorporated EPTC at 4 lb/A performed reasonably well in all three locations, but did not show a distinct superiority over several other treatments included in the trials. Post-plant incorporated EPTC was somewhat superior to pre-plant incorporation.

Where Russian thistle population was not heavy (Ontario and Klamath Falls), pre-emergence application of maloran, N'(4'bromo'3'chlorophenyl)-N'-methoxy-N'-methylurea, (2 lb/A), metobromuron (1, 2, and 3 lb/A) and linuron (1.5 and 2 lb/A) gave very good weed control and high yields.

RP 17623, at 2 or 3 lb/A pre-emergence, gave excellent control of all the weed species present in all three yield trials with no injury to potatoes. It proved one of the best treatments tested in the trials.

DCPA (pre-plant incorporated, post-plant incorporated and pre-emergence) at 7.5 and 9 lb/A and post-plant incorporated trifluralin at 0.75 and 1.0 lb/A proved ineffective where a diverse and heavy weed population was present (Redmond). In the other two yield trials (Ontario and Klamath Falls), the weed control and the yield performance of these herbicides were comparable with the best performing herbicides tested.

Pre-emergence applications of MBR 3957 (2, 3, and 6 lb/A) and SD 15179 (4 lb/A)were injurious to potatoes. The former induced severe tuber growth distortion. Dinoseb amine at 3 lb/A applied pre-emergence was used in the Klamath Falls trial. It showed no potato injury, good weed control and high yield. (Farm Crops Department, Oregon State University, Corvallis).

Postemergence applications of terbacil in peppermint. Burrill, Larry C. and Arnold P. Appleby. Preliminary research has shown that low rates of terbacil applied postemergence with a surfactant can give good weed control. The use of lower rates would benefit the growers by lowering their costs for herbicides and by reducing the dangers from soil residue. Broadleaf weeds appear to be more susceptible than the grass weeds to postemergence treatments of terbacil. In some instances certain weeds, e.g. pigweed (Amaranthus retroflexus) and Russian thistle (Salsola kali) have proven to be very difficult to kill if they were allowed to get more than three or four inches tall before spraying. Observations have indicated that a surfactant was definitely necessary for good postemergence activity.

A series of experiments to determine possible injury to peppermint from postemergence applications of terbacil indicated that rates as high as six pounds active ingredient per acre with surfactant sometimes caused temporary chlorosis but did not cause permanent injury to the mint. Rates lower than six pounds caused no visible injury.

Because the postemergence applications have been more inconsistent than preemergence treatments it is thought that the preemergence method should be preferred pending further research on the subject. (Department of Farm Crops, Oregon State University, Corvallis.)

Control of wild oats and henbit in winter wheat with triallate. Slater, C. H. Wild oats (Avena fatua L.) is a troublesome grass weed in winter wheat. With the increased use of fall-applied broadleaf herbicides, wild oat populations are increasing rapidly in the higher rainfall areas of northwestern United States.

Triallate is an effective wild oat killer and is currently registered for use in wheat and barley. In Montana, a fall application of triallate provides good control of wild oats in spring-seeded cereals, i.e., wheat and barley.

Triallate was tested at 9 locations in eastern Washington and northwestern Idaho to determine the efficacy of controlling both fall and spring germinating wild oats in winter wheat. The soil types represented in this investigation were Naff, Palouse, Walla Walla, Athena silt loam and clay. The plots were treated with a boom sprayer using 8003 Tee Jet tips at three different rates: 1.0 lb/A, 1.25 lb/A and 1.5 lb/A applied both pre-plant and post-plant pre-emergence. All plots including the untreated check were harvested with a Suzue combine.

Triallate was tested under extremely unfavorable conditions: low soil moisture, shallow seeding and high soil temperatures. Wild oat control as evaluated at harvest time resulted in 84% control when triallate was applied at 1.25 lb/A. The average increase in wheat yields was 13.7% at the 1.25 lb rate at 9 locations. There was no difference between pre- or post-plant treatments as long as the treated zone was above the crop seed. Some crop thinning occurred at the

1.5 lb/A rate on clay soils or where seeds were planted at or near the soil surface. Triallate at 1.25 lb/A gave 96% control of henbit (*Lamium amplexicaule* L.).

Investigation of triallate on winter wheat is being continued during 1968-69. (Agricultural Division Development, Monsanto Company, Spokane, Washington).

Summary Pacific Northwest 1967-68 winter wheat data

Treatment	Rate lb/A	% Control Wild oats	Henbit	Yield bu/A
Triallate	1.0	73	89	48.7
Triallate	1.25	84	96	48.9
Triallate	1.50	80	95	40.8
Check				43.0

Soil persistence of twenty experimental herbicides. Burrill, Larry C., W. R. Furtick, and Arnold P. Appleby. Soil persistence data on experimental herbicides in an early stage of testing has been limited. In conjunction with the new herbicide screening program a soil persistence study was initiated on May 22, 1968 to compare the soil life of twenty coded herbicides with four standard herbicides under field conditions.

After the herbicides were applied the plot area was sprinkler irrigated twice in addition to the normal rainfall in an effort to simulate crop growing conditions. A total of 8 inches of irrigation or rainfall was recorded on the plot area before the test crops were seeded. All plant growth during the period before seeding was kept at a minimum with the use of paraquat. The test crops which were oats, annual ryegrass, green beans, and sugarbeets were seeded without soil tillage on August 9, 1968. The soil is a clay loam with 3% organic matter.

Evaluations were made on September 2, 1968. The data for this trial can be found in table form on the following page. Only one date of seeding is included in this report. A second seeding will be made in December and a third in the spring of 1969. (Department of Farm Crops, Oregon State University, Corvallis.)

Soil persistence of twenty experimental herbicides

0=no effect, 100=complete kill

Treatment	lb ai per acre	% oats injury RI	RII	Avg.	% annual ryegrass injury RI	RII	Avg.	% green bean injury RI	RII	Avg.	% sugarbeet injury RI	RII	Avg.	% annual bluegrass injury RI	RII	Avg.
atrazine	3	0	0	0	0	30	15	0	30	15	70	50	60	90	100	95
bromacil	3	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
terbacil	3	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
diuron	3	0	0	0	80	50	65	40	0	20	20	50	35	100	100	100
CP 50144	3	0	0	0	40	30	35	0	20	10	0	20	10	100	80	90
CP 52223	3	0	0	0	60	80	70	0	50	25	0	0	0	80	80	80
CP 53619	3	0	0	0	0	20	10	0	30	15	0	10	5	50	80	65
RP 17623	3	90	95	93	90	95	93	95	90	93	95	100	97	100	100	100
MB 13992	3	0	0	0	30	20	25	40	20	30	0	0	0	80	100	90
MB 14255	3	0	20	10	40	30	35	50	20	35	0	10	5	70	90	80
AP 889	3	60	50	55	80	80	80	70	80	75	60	80	70	100	100	100
AP 920	3	95	95	95	98	100	99	99	100	99	99	100	99	100	100	100
NC 4780	3	0	10	5	50	90	70	0	20	10	98	95	96	100	100	100
NC 5024	3	0	0	0	20	70	45	0	0	0	98	90	94	100	100	100
NC 5025	3	0	0	0	20	70	45	0	0	0	100	90	95	100	100	100
MBR 3356	3	20	20	20	90	90	90	0	0	0	0	20	10	100	100	100
S 6115	3	0	0	0	0	20	10	0	20	10	0	10	5	30	80	55
VCS 438	3	0	0	0	30	20	25	30	30	30	0	0	0	90	40	65
SD 15419	3	0	0	0	0	20	10	40	20	30	0	0	0	50	70	60
SD 15418	3	0	0	0	0	20	10	50	0	25	0	0	0	50	80	65
Sandoz 6602	3	0	0	0	20	0	10	50	0	25	0	0	0	50	50	50
Bay 86791	3	0	40	20	80	40	60	90	80	85	0	0	0	100	100	100
Bay 88410	3	95	90	93	95	80	87	100	100	100	100	90	95	100	100	100
GS 16040	3	0	10	5	0	0	0	0	0	0	30	30	30	0	20	10

Persistence of terbacil in peppermint fields. Burrill, Larry C. and Arnold P. Appleby. A two-year study of the soil life of terbacil under peppermint production conditions, has shown that detrimental effect to crops seeded after mint plow out can be expected if care is not taken in the planning and use of this herbicide.

Six experiments were established in the major peppermint production areas of Oregon. None of the test crops were injured at any location when they were seeded at least two years after the final application of commercial rates of terbacil. However, at several locations, all crops were severely injured when the seedings were made only one year after the final application.

Of the test crops used, beans and the small grains were the most sensitive while potatoes and possibly bluegrass and corn were the least sensitive. Soybeans, sugarbeets, and alfalfa were apparently intermediate in their sensitivity to terbacil. (Department of Farm Crops, Oregon State University, Corvallis.)

Some factors influencing the use of activated charcoal as a crop protectant. Burr, Ronald J. The use of a narrow band of activated charcoal directly over newly-seeded grass shows promise for protecting this grass from a pre-emergence herbicide. Previously, field trials have shown that this practice is feasible under field conditions. The research reported here was designed to determine some of the factors which may influence this practice. The activated charcoal used was Aqua Nuchar A, the herbicide was diuron, and the grass was annual ryegrass (Lolium multiflorum). The factors studied in this research were depth of planting of the annual ryegrass, soil type, bandwidth of charcoal required, amount of water after charcoal and herbicide application, and type and rate of surfactant added to the charcoal. This research was conducted in greenhouse facilities at Oregon State University.

Annual ryegrass was planted $\frac{1}{4}$, $\frac{1}{2}$, 3/4, and 1 inch deep. Charcoal was then applied to the soil surface and the herbicide was applied as a broadcast treatment. Results indicated that the seed planted $\frac{1}{2}$-inch deep received less protection than seeds planted at $\frac{1}{4}$, 3/4, or 1 inch deep. This may have been due to the fact that the herbicide was concentrated in this area to give greater toxicity.

Soil types were tested to compare the rate of charcoal required to give adequate protection. Sandy loam and clay loam soils were used for this comparison. As would be expected, a higher rate of charcoal was required on the lighter, sandy loam soil than on the heavier, clay loam soil to achieve the same degree of protection for the annual ryegrass.

In previous studies, the charcoal was applied in a narrow band directly over the seed. Research was conducted to determine how wide this band must be to achieve adequate protection from the herbicide. Bandwidths used were 1/3, 2/3, and 1 inch wide. The 1/3-inch wide charcoal band did not provide adequate protection for the annual ryegrass. However, the 2/3 and 1 inch wide bands of charcoal did give adequate protection to the annual ryegrass. Under field conditions, though, a 1-inch wide band of charcoal is necessary since not all seeds can be confined to such a small area. Field experiments conducted at Oregon State University substantiate the fact that a 1-inch band of charcoal will provide adequate protection.

Activated charcoal applied at 200-300 lb/A has provided good protection to seeded grass. This is applied in a 1-inch band directly over the seed. The actual amount applied per acre with 12-inch row spacing and a 1-inch bandwidth is 16.67-25.0 lb of charcoal/acre.

Amounts of water applied after application of the charcoal band and herbicide were also studied to determine the influence of this factor on the ability of charcoal to provide protection from the herbicide. Varying amounts of water, ranging from 0 to 3 inches, were applied as sprinkler type irrigation 12 hours after the charcoal bands and the diuron were applied. No significant differences were found between any of the different amounts of water applied. This would indicate that the amount of irrigation following treatment is not critical and can be determined by availability of water.

Activated charcoal is difficult to get into suspension; once it is in suspension it is difficult to keep it there. To facilitate suspension, a surfactant can be added. Studies were conducted to determine the best type of surfactant and the best rate. Three different surfactants (X-77, Surfactant-WK, and Rhode's spreader-activator) were used, each at four different rates ranging from 0 to 2.7% by volume. The rates were 0, 0.3, 0.9, and 2.7% by volume. Significant differences were found between these rates and between the surfactants. Surfactants used at 0.3% by volume gave no significant reduction in protection provided by the charcoal, but the 0.9 and 2.7% rates gave a highly significant reduction in protection. Rhode's spreader-activator showed less apparent reduction in protection. The 0.3% rate greatly increased the ease of getting the charcoal into suspension and once it is in suspension it is a more stable suspension. (Farm Crops Department, Oregon State University, Corvallis.)

Soil-applied herbicides in irrigated safflower. Arle, H. F. and K. C. Hamilton. Study of herbicides for controlling annual weeds in irrigated safflower continued at Mesa, Arizona, in 1967-68. In two experiments we evaluated the effects on Dart safflower of herbicides applied to the soil before planting and/or at layby.

On December 13, 1967, herbicides were applied to the soil (sand 40%, silt 40%, clay 20%, organic matter 1%). In experiment I, treatments were 1 lb/A of benefin, linuron, or prometryne, 2 lb/A of bensulide, 3 lb/A of CIPC, IPC, or EPTC, and 8 lb/A of DCPA. Treatments were replicated 4 times on 4-row plots 32 ft long. In experiment II, we treated the soil before planting with 3/4 lb/A of trifluralin 3/4 lb/A of trifluralin plus 1 lb/A of prometryne, or trifluralin followed by postemergence applications of diuron, linuron, or prometryne. Rain prevented planting until January. In March, we spread Russian thistle (Salsola kali L.) seed on each test area before an irrigation. When safflower plants were 30 in tall we applied 1 lb/A of diuron, linuron, or prometryne as directed sprays covering the base of the plants and the entire irrigation furrow. Post-emergence applications were made with and without prior trifluralin treatments. Safflower was harvested in July and the yields averaged 2,370 lb/A of seed.

Vigorous growth of safflower combined with herbicide applications controlled weeds with all treatments. Preplanting applications of prometryne or prometryne plus trifluralin reduced safflower stands 60 to 80%, caused severe stunting, delayed maturity, and reduced yields by 42%. Other herbicide treatments did not affect safflower growth or yield. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Phoenix, and Arizona Agric. Expt. Sta., University of Arizona, Tucson.)

Soil applications of bensulide and trifluralin in irrigated sorghum. Hamilton, K. C. and H. F. Arle. Research continued at Mesa, Arizona, in 1968 on methods of applying herbicides to the soil in sorghum. The objects of the test were to determine: (1) safe methods for the use of bensulide or trifluralin in irrigated sorghum; and (2) the best methods of applying these herbicides for the control of volunteer sorghum in other crops.

Soil of the test area averaged 46% sand, 36% silt, 18% clay and 0.7% organic matter. In March, herbicides were applied to the soil and incorporated by disking before furrowing (listing) for the preplanting irrigation. Bensulide was applied broadcast at 0.5 and 1.5 lb/A and trifluralin at 0.25 and 0.75 lb/A. Treatments were replicated 4 times on 4-row plots 32 ft long. The same herbicide treatments were also made (1) to the flat soil surface immediately before furrowing for the preplanting irrigation and (2) after the preplanting irrigation immediately before harrowing for the final seedbed prepreparation. With the latter method, treated soil was temporarily moved from the drill row. Savannah sorghum was planted in moist soil and covered by a mulch of dry soil. In May, when sorghum was 8 in tall, herbicides were applied as a directed spray covering the base of plants and the entire irrigation furrow and incorporated with a sectioned, rolling cultivator. Growth of sorghum was observed during the summer but the test was not harvested because of bird damage to the heads before maturity.

Applications of 0.75 lb/A of trifluralin before furrowing controlled sorghum best (see Table). These treatments reduced sorghum stands 98 to 99%. Control of sorghum with bensulide was less satisfactory. Incorporation of the herbicides by disking before furrowing reduced the effectiveness of bensulide and the low rate of trifluralin. Applications of herbicides after furrowing or after sorghum emergence had no effect on growth of sorghum. Both herbicides affected the crop only when sorghum was planted so that the germinating seed or seedling contacted the herbicide. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Phoenix, and Arizona Agric. Expt. Sta., University of Arizona, Tucson.)

Effect on sorghum stands of bensulide and trifluralin applied by four methods.

Treatment	Estimated percent reduction of sorghum stand--May			
	Method of application			
Herbicide lb/A	Prefurrowing, disked in	Prefurrowing	Preharrowing	Postemergence
trifluralin 0.75	99	98	0	0
trifluralin 0.25	87	96	0	a
bensulide 1.50	74	82	0	0
bensulide 0.50	50	86	0	0

[a]This treatment was omitted to serve as untreated check.

Herbicides in furrow-irrigated sugar beets. Hamilton, K. C. and H. F. Arle. Research on herbicides for controlling annual weeds in sugar beets continued at Mesa, Arizona, in 1967-68. Soil of the test area contained 40% sand, 40% silt, 20% clay, and 1% organic matter. Barley and mustard were seeded as weeds. Preplanting treatments made on September 24, 1967, included 2 and 3 lb/A of pyrazon, 3 lb/A of IPC, 3 lb/A of IPC plus 2 lb/A of pyrazon, and 3 lb/A of IPC plus 2 lb/A of cycloate. Herbicides were applied to the soil surface and incorporated by disking prior to furrowing. Two rows of Spreckels 301-H sugar beets were planted in dry soil on vegetable beds and germinated by a postplanting irrigation. Plots were 4 beds 32 ft long with treatments replicated 4 times.

After emergence when sugar beets were 3 in tall, 3 lb/A of pyrazon plus 1.5 lb/A of surfactant and 3 lb/A of pyrazon plus 1.6 lb/A of dalapon and 1.5 lb/A of surfactant were applied over sugar beets that had received a preplanting treatment of IPC at 3 lb/A. A hand-weeded check was included in the test. Sugar beet injury and control of barley and mustard were estimated periodically during the growing season. Sugar beets were thinned and cultivated once. Because of excessive weed growth on some treatments, a stalk chopper was operated above the sugar beets in April to remove weed topgrowth. Sugar beets were harvested in July and sugar content of beets was determined.

All treatments controlled 90 to 98% of barley. Treatments including pyrazon controlled 90 to 99% of mustard. Preplanting treatments containing pyrazon or cycloate reduced early growth of sugar beets an estimated 25%. Initially, treatments containing pyrazon applied before planting resulted in the best weed control. However, by December all treatments containing pyrazon controlled weeds adequately. Beet yields on the hand-weeded checks averaged 34 tons per acre; yields of treatments containing pyrazon were similar. Yields from the IPC and IPC-cycloate treatments were reduced an average of 11 tons per acre by weed competition. The percentage of sucrose was not affected by any treatment.

The good control of barley and mustard by pyrazon in this test was in contrast to its inadequate control of annual weeds in sugar beets planted in the summer in Arizona. However, the weed species in this test grew as winter annuals and pyrazon controls many winter annual weeds. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Phoenix, and Arizona Agric. Expt. Sta., University of Arizona, Tucson.)

<u>Evaluation of herbicide mixtures for weed control in sugarbeets.</u> Schweizer, E. E. Three pyridazinone compounds --- pyrazon, 1-phenyl-4-amino-5-bromo-pyridazone-(6) (BAS 2430), or 1-phenyl-4(d-hydroxy-β, β,β-trichloroethyl)-amino-5-bromo-pyridazone-(6) (BAS 2572) --- were mixed with benzadox, dalapon, or 3-methoxycarbonyl-aminophenyl-N-(3'-methylphenyl) carbamate (SCH 4075) to evaluate their effectiveness for control of a broader spectrum of annual grass and broadleaf weeds in sugarbeets. An alkyl aryl polyglycol ether surfactant or an emulsifiable oil was added to the spray solution. The base oil was paraffinic, had an unsulfonated residue content of 96%, and its viscosity was 73 Saybolt Seconds at 100 F. Each spray solution was applied to weeds and sugarbeets growing in untreated soil, or in soil treated with 3 lb/A of cycloate.

Sugarbeets were planted April 8 on the Bay Farm at Fort Collins. On May 29, the postemergence mixtures were applied on an 8-inch band over the row at a volume of 21.8 (60 gpa broadcast) gallons aqueous mixture per acre. The spray solution contained 0.3% v/v of surfactant or 3 1/3% v/v of oil. Sugarbeets had six true leaves and were $1\frac{1}{2}$ to $2\frac{1}{2}$ inches tall. Weeds had three to six true leaves and were $\frac{1}{2}$ to $1\frac{1}{2}$ inches tall.

The plots were 2 rows wide and 22 ft long. Row width was 22 inches. A randomized complete block design with 4 replicates was used.

Five species of weeds were present in sufficient numbers to evaluate. They were foxtail millet [<u>Setaria italica</u> (L) Beauv.], kochia, redroot pigweed, lambsquarters, and wild buckwheat.

On June 10 weeds were counted in two random quadrats, 4 3/4 inches by 10 ft, per treatment. Sugarbeets were evaluated visually for injury from herbicides. The injury scale was 0 to 10; 0 meant no retardation in top growth and 10 meant that all plants were killed. On July 15, thirty sugarbeet roots were harvested from each treatment.

Weed control was best where the postemergence mixtures were applied to sugarbeets growing in soil previously treated with cycloate (see table). However, the most striking control of weeds resulted from the application of pyridazinone-SCH 4075 mixtures to sugarbeets growing in untreated soil. The mixture of 3 lb/A of BAS 2430 and SCH 4075 plus surfactant reduced the stand of weeds 90%. On July 15 when weed control was assessed visually, only the pyridazinone-SCH 4075 mixtures --- BAS 2430 plus SCH 4075 and BAS 2572 plus SCH 4075 --- were controlling 90% or more of the weeds. The use of oil with these herbicide mixtures controlled slightly more weeds in most treatments, but the herbicide-oil mixtures retarded the growth of sugarbeets more than the herbicide-surfactant mixtures. For instance, sugarbeet injury for all treatments averaged 3.5 when oil was used in the postemergence mixture as compared to 2.8 for the surfactant.

By July 15 the growth of sugarbeet tops appeared to be similar in all treatments. Sugarbeet injury was 1.0 or less. Only the BAS 2430-dalapon-oil and BAS 2572-dalapon-oil treatments had significantly reduced the weight of roots when compared on July 15 with the untreated, weedy check. A hand-weeded check was not included in this experiment since the experiment was terminated on July 15. Competition from weeds was noticeable in the untreated, weedy check on July 15. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and Colorado Agri. Expt. Sta., Colo. State University, Fort Collins.)

Effect of herbicide mixtures when applied on sugarbeets and weeds

Treatments			Sugarbeets				Weeds			
			Visual injury on June 10		Root weights (kg) on July 15		Stand reduction (%) on June 10		Visual control (%) on July 15	
Preplant	Postemergence	lb/A	Surfactant	Oil	Surfactant	Oil	Surfactant	Oil	Surfactant	Oil
cycloate	pyrazon + benzadox	3 + 2	2.2	2.5	5.26	5.16	61	66	66	81
none	pyrazon + benzadox	3 + 2	1.2	2.5	4.80	5.54	25	26	40	60
cycloate	pyrazon + dalapon	3 + 2	2.7	3.7	4.75	4.36	59	61	60	82
none	pyrazon + dalapon	3 + 2	1.2	3.2	4.36	4.56	25	32	42	50
cycloate	pyrazon + SCH 4075	3 + 3	2.2	4.0	5.26	5.29	80	89	92	90
none	pyrazon + SCH 4075	3 + 3	1.7	3.0	5.44	5.20	75	82	84	90
cycloate	BAS 2430 + benzadox	3 + 2	3.5	4.5	4.82	4.64	74	72	80	79
none	BAS 2430 + benzadox	3 + 2	3.0	4.2	4.87	4.37	51	58	60	66
cycloate	BAS 2430 + dalapon	3 + 2	3.7	7.0	4.56	3.44[1]	66	71	67	71
none	BAS 2430 + dalapon	3 + 2	3.5	6.0	4.75	3.37[1]	54	52	64	61
cycloate	BAS 2430 + SCH 4075	3 + 3	4.2	4.2	5.04	5.19	96	96	98	98
none	BAS 2430 + SCH 4075	3 + 3	2.7	3.2	5.25	5.15	90	87	92	92
cycloate	BAS 2572 + benzadox	3 + 2	1.7	3.0	4.99	4.96	73	74	79	82
none	BAS 2572 + benzadox	3 + 2	2.0	2.0	5.00	5.12	51	52	59	56
cycloate	BAS 2572 + dalapon	3 + 2	2.2	5.7	4.92	3.84[1]	55	76	70	84
none	BAS 2572 + dalapon	3 + 2	1.2	4.7	4.91	3.90[1]	16	53	50	56
cycloate	BAS 2572 + SCH 4075	3 + 3	2.2	4.0	5.57	5.22	92	97	93	95
none	BAS 2572 + SCH 4075	3 + 3	1.7	3.7	6.29	4.79	86	88	93	94
cycloate[2]	none	0	0.3	-	5.06	-	46	-	56	-
none (untreated weedy check)[2]		0	0.0	-	4.87	-	0	-	0	-

[1]Significantly lower than the untreated, weedy check at 5% level of probability.

[2]Surfactant was not added to the spray solution.

Chemical weed control in sainfoin. Stewart, Vern R. An experiment was designed to test EPTC and bromoxynil for weed control in a new seeding of sainfoin (Onobrychis viciaefolia Scop.), the cultivar 'Eski'. Herbicides were applied in water at a rate of 54.4 gallons per acre to plots two hundred square feet in area, replicated three times. The soil is classified as a silt loam. EPTC was applied preplant and incorporated with a double disk, bromoxynil as a postemergence treatment when the sainfoin was in the three to four leaf stage of growth.

Slight crop injury observed after treatment with bromoxynil and the highest rates of EPTC was not apparent two months later. Plant height was used as a measurement of plant vigor later in the growing season (8/8/68). Plots treated with bromoxynil were somewhat taller than the check and equal to the four and six pound rates of EPTC. None of the treatments reduced sainfoin stands.

Weed score in table 1 does not reflect the infestation of foxtail (Setaria viridis (L.) Beauv.) in the bromoxynil treatment, however all rates of this compound provided effective control of all broadleaf weeds. EPTC controlled grassy weeds throughout the growing season, but less effective control of broadleaf weeds. EPTC gave fairly good control of pigweed (Amaranthus retroflexus L.) at four and six pounds per acre. Only partial control of field chickweed (Cerastium arvense L.) was obtained, probably due to its emergence following herbicide application. Night flowering catchfly (Silene noctiflora L.) was very effectively controlled with both EPTC and bromoxynil. Plant populations and weed control percentages by weed species are given in table 2. (Northwestern Montana Branch Station, Agricultural Experiment Station, Montana State University, Kalispell, Montana.)

Table 1. Data from herbicide study on a new seeding of sainfoin. Northwestern Montana Branch Station, Kalispell, Montana in 1968.

Treatment	Rate lb/A	% stand sainfoin	Crop[1] injury 0-10	Plant height	% weed control	Weed[2] score 0-10	Remarks[3]
Check	0	100	0.0	10	0	0.0	plants not very vigorous, high weed population
EPTC	2	100	0.0	14	50	6.3	quite weedy, some plants lacking in vigor
EPTC	3	91	0.0	13	65	6.7	plants very vigorous,few broadleaves,some buckwheat and shepherdspurse
EPTC	4	93	0.0	15	72	7.7	plants very vigorous,good color,light population of broadleaves
EPTC	6	99	1.3	17	80	8.3	plants very vigorous,good color, few fanweed and wild buckwheat
Bromoxynil	1/4	115	3.3	16	79	9.0	very few broadleaves,high population of foxtail

(Table 1 continued on page 89)

Table 1. (cont.)

Treatment	Rate lb/A	% stand sainfoin	Crop[1] injury 0-10	Plant height	% weed control	Weed[2] score 0-10	Remarks[3]
Bromoxynil	5/16	89	4.0	15	76	9.0	high population of fox-tail plants fair in vigor, all broadleaves controlled
Bromoxynil	3/8	99	4.3	16	82	9.0	very high population of green foxtail, sainfoin quite vigorous

1/ crop injury = 0-10 scale (6/20/68): 0 = no injury; 10 = plants dead
2/ weed score (6/20/68): 0 = no control; 10 = complete control
3/ remarks recorded 8/8/68

Table 2. Summary of weed control data from sainfoin study. Northwestern Montana Branch Station, Kalispell, Montana in 1968.

			% weed control							
Treatment	Rate lb/A	% stand	Shep-herds-purse	Fan-weed	Pig-weed	Field chick-weed	Night flowering catchfly	Other broad-leaves	Grasses	Over-all[1]
Check	0	100	0	0	0	0	0	0	0	0
EPTC	2	100	74	0	33	54	33	65	92	50
EPTC	3	91	79	0	39	72	67	80	100	65
EPTC	4	93	89	0	47	78	80	80	100	72
EPTC	6	99	97	19	83	84	73	85	100	99
Bromoxynil	1/4	115	98	85	83	83	97	95	0	79
Bromoxynil	5/16	89	99	93	98	59	95	90	0	76
Bromoxynil	3/8	99	99	93	89	82	100	95	0	82

1/ overall varies slightly from $\bar{x}$ because of the technique of calculation

Fall application of herbicide to sainfoin. Stewart, Vern R. Five herbicides were applied November 2, 1967 following a spring seeding of sainfoin (*Onobrychis viciaefolia* Scop.), the cultivar 'Eski'. Plot size was two hundred square feet in each of three replications. The soil type was a very fine sandy loam. Herbicides were applied in water at a rate of 54.4 gallons per acre. Sixty square feet were harvested to determine seed yields.

Weed species naturally occurring were: fanweed (*Thlaspi arvense* L.); shepherdspurse (*Capsella bursa-pastoris* (L.) Medic); wild buckwheat (*Polygonum convolvulus* L.); field gromwell (*Lithospermum arvense* L.); tumble mustard (*Sisymbrium altissimum* L.).

Seed yield ranged from 525 to 1052 pounds per acre with significance occurring only between the extremes. While the results were not significant there was an apparent trend in favor of diuron for seed yield. The most effective weed control was obtained with 2 sec butylamino-4-ethylamino-6-methoxy-s-triazine (Giegy 14254). Terbacil caused slight crop damage, however sainfoin seemed to recover. Simazine was quite effective in the control of most broadleaf weeds, but did leave a few wild buckwheat and shepherdspurse plants. Diuron was fairly effective, but did not control field gromwell and fanweed. Bromoxynil as a fall application did not give effective weed control. (Northwestern Montana Branch Station, Agricultural Experiment Station, Montana State University, Kalispell, Montana.)

Seed yields and weed control data from sainfoin, fall sprayed with various herbicides in 1967.

Treatment	Rate lb/A	Seed Yield lb/A	Weed control score 0-10[2]	Remarks
Geigy 14259	1	760ab[1]	6.7	leaves mustard
Geigy 14259	1 1/2	837ab	8.7	leaves mustard
Geigy 14259	2	957ab	10.0	
Geigy 14254	1	975ab	9.7	some quackgrass
Geigy 14254	1 1/2	1039a	10.0	
Geigy 14254	2	717ab	10.0	
terbacil	1/2	770ab	9.3	slight crop damage
terbacil	1	1026a	10.0	slight crop damage
terbacil	1 1/2	800ab	10.0	slight crop damage
simazine	3/4	664b	9.3	leaves wild buckwheat and shepherdspurse
simazine	1	834ab	9.7	leaves wild buckwheat and shepherdspurse
simazine	1 1/2	913ab	9.7	leaves wild buckwheat and shepherdspurse
diuron	3/4	1052a	8.3	leaves mustard, shepherdspurse, fanweed and gromwell
diuron	1	1009a	6.7	leaves mustard, shepherdspurse, fanweed and gromwell
diuron	1 1/2	1024a	8.3	leaves mustard, shepherdspurse, fanweed and gromwell
bromoxynil	1/4	819ab	0.7	no control
bromoxynil	5/16	653b	0.3	no control
bromoxynil	3/8	745ab	0.7	no control
check	0	814ab	0.0	no control
check	0	525c	0.0	no control

1/ items having common letters are not significantly different at the 5% level according to Duncan's Multiple Range Test
2/ visual estimate of weed control: 0 = no control; 10 = complete control

Preplanting applications of prometryne and bensulide combinations in irrigated cotton. Hamilton, K. C. and H. F. Arle. Combinations of prometryne and bensulide were evaluated for control of annual weeds in cotton at the Cotton Research Center in Phoenix, Arizona, in 1968. On March 6, prometryne was applied at 2, 3, 4, and 5 lb/A to the soil surface, with and without additional incorporation by disking, before furrowing (listing) for the preplanting irrigation. All prometryne treatments were combined with 1 1/2 lb/A of bensulide incorporated by disking before furrowing. Treatments were replicated four times on 4-row plots 43 ft long. Deltapine 16 cotton was planted in moist soil under a dry mulch on March 28.

The soil contained 36% sand, 42% silt, 22% clay, and 1% organic matter. Weeds present included browntop panicum (Panicum fasciculatum Swartz), Wright groundcherry (Physalis wrightii Gray), and Palmer amaranth (Amaranthus palmerii S. Wats.). Ten-foot sections of row were marked in each plot after cotton emergence, and the number of living cotton plants were counted each week until thinning. The plots were cultivated three times with a sectioned, rolling cultivator. Broadleaf and grass weed control were estimated prior to harvest. The center rows of each plot were machine-picked in October.

Cotton emergence was not affected by herbicide treatments. Preplanting applications of prometryne caused temporary discoloration of the foliage and reduced cotton stands by 8%. The effects on cotton seedlings were greatest when prometryne was not incorporated by disking. Growth of cotton appeared normal within 2 months after emergence. Early-season weed control was 100% with all treatments. In July, many groundcherry seedlings emerged in all plots and were not adequately controlled. At harvest there was 100% grass control, but groundcherry control averaged only 60% with no difference in rate of prometryne or method of application. No herbicide treatment affected the yield of seed cotton which averaged 2.4 bales per acre. (Cooperative investigations of Arizona Agricultural Experiment Station, University of Arizona, Tucson, and the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Phoenix, Arizona.)

Fall applications for weed control in dormant alfalfa. Lee, G. A. and H. P. Alley. Precipitation is often inadequate during the spring months in Wyoming which may often result in poor penetration into the soil and activation of herbicides. Trials were conducted on a dryland location to determine the feasibility of fall application of herbicides on dormant alfalfa for increased weed control.

Plots were established November 10, 1967 at Sheridan, Wyoming. The study location consisted predominately of a clay loam soil type. Treatments were replicated three times and were two square rods in size. The herbicides were applied in 40 gpa of water carrier.

Weed populations consisted of downy bromegrass (Bromus tectorum L.), tansy mustard (Descurainia pinnata (Walt.) Britt.), meadow salsify (Tragopogon pratensis L.), Russian thistle (Salsola kali L.) and blue mustard (Chorispora tenella (Willd.) D.C.).

Terbacil at 2.0 and 4.0 lb/A, GS-14254 at 3.0 lb/A and simazine at 3 lb/A resulted in 1.1%, 3.1%, 4.5%, and 5.7% weeds by weight to pure alfalfa, respectively. The weight of weeds in the nontreated check was approximately 2.5 times as great as pure alfalfa. RH-315 did not control the meadow salsify which accounted for the greatest portion of the weeds remaining in the plots. Yields of alfalfa from plots treated with RP-11561 were increased 2.5 to 3.0 times that of the nontreated check even though the weed control was less than 90%. Diuron at 2.0 and 4.0 lb/A and simazine at 1.0 lb/A did not give satisfactory weed control. (Wyoming Agricultural Experiment Station, Laramie, SR-149.)

Effect of fall applied herbicides on yield and percent weeds by weight.

Treatment	Rate lb/A	Tons/A alfalfa	% weeds/ pure alfalfa hay
Terbacil	2	1.41	1.11
Terbacil	4	.76	3.13
Simazine	1	.52	122.73
Simazine	3	.84	5.66
Diuron	2	.32	297.70
Diuron	4	.60	100.00
RH-315 1/	1	1.00	12.55
RH-315	3	.96	18.85
RP-11561 2/	1	1.02	36.54
RP-11561	3	.87	39.55
GS-14254 3/	1	.84	24.30
GS-14254	3	.88	4.50
Check		.32	260.49

1/ (name unavailable)
2/ (2-tetriobutyl-4-(2,4-dichloro-5-isopropylboxyphenyl)-5-oxo-1,3,4-oxadazoline)
3/ (2-sec. Butylamino-4-ethylamino-6-methoxy-s-triazine)

Effect of pyrazon and cycloate in combination with phorate on phytotoxicity to sugar beet seedlings. Lee, G. A., H. P. Alley and D.J. Krionderis. The purpose of the greenhouse study was to determine the effect of combinations of phorate (0,0-diethyl S- (ethylthio)methyl phosphorodithioate), pyrazon and cycloate (S-ethyl ethylcyclohexythiocarbamate) on emergence and phytotoxicity to sugar beets (*Beta vulgare* L.) when applied preplant. Treatments consisted of phorate at 2.0 lb/A, pyrazon at 4.0 lb/A, cycloate at 3.0 lb/A, phorate + pyrazon at 2.0 + 4.0 lb/A and phorate + cycloate at 2.0 + 3.0 lb/A. The chemicals were thoroughly mixed into the soil before the sugar beet seeds were planted. Percent emergence and stage of growth were determined for each treatment and compared to a nontreated check.

Cycloate at 3.0 lb/A, phorate + cycloate at 2.0 + 3.0 lb/A and pyrazon at 4.0 lb/A resulted in an excelleration of emergence 5 days after planting (attached table). However, pyrazon at 4.0 lb/A retarded emergence from 8 to 20 days after planting. Phorate at 2.0 lb/A and cycloate at 2.0 lb/A were comparable to the nontreated check in total emergence after 20 days. Pyrazon at 4.0 lb/A, phorate + pyrazon at 2.0 + 4.0 lb/A and phorate + cycloate at 2.0 + 3.0 lb/A reduced stand 17%, 10% and 11%, respectively, when comparing to the nontreated check.

Phorate + pyrazon at 2.0 + 4.0 lb/A caused the greatest retardation in stage of growth after 20 days. The seedlings exhibited chlorosis and necrosis of the cotyledons. Although pyrazon at 4.0 lb/A and phorate + cycloate at 2.0 + 3.0 lb/A caused a reduction in emergence which reflected in stage of growth, the seedlings present showed no phytotoxic effects.

It is evident from this preliminary study that phytotoxicity to sugar beet seedlings can be increased with the application of phorate + pyrazon at 2.0 + 4.0 lb/A. However, the addition of phorate with cycloate did not induce severe symptoms. (Wyoming Agricultural Experiment Station, Laramie, SR-150).

Effect of combinations of phorate, pyrazon and cycloate on emergence and phytotoxicity of sugar beet seedlings.

		Percent emergence					Stage of
		Days after planting					growth after
Treatment	lb/A	5	8	12	16	20	20 days*
Check		9	65	81	85	87	5.3
Phorate	2.0	6	56	78	82	82	4.7
Cycloate	3.0	18	62	78	83	84	5.2
Pyrazon	4.0	17	54	68	69	70	4.2
Phorate + cycloate	2.0 + 3.0	12	60	72	74	76	4.7
Phorate + pyrazon	2.0 + 4.0	6	56	75	77	77	3.2

* stage of growth scale: 1 - emerging, 2 - small cotyledon stage, 3 - full cotyledon stage, 4 - full cotyledon stage; starting two true leaf stage, 5 - full two leaf stage, 6 - full two leaf stage; starting four true leaf stage, 7 - full four leaf stage, 8 - full four leaf stage; starting six leaf stage.

Postemergence weed control in corn in Wyoming. Lee, G. A. and H. P. Alley. A study was conducted to determine the effect of various carrier additives on the postemergence weed control obtained with atrazine. Atrazine + linuron and primaze were included as comparison treatments. The weed population was categorized as redroot pigweed (Amaranthus retroflexus L.), common lambsquarters (Chenopodium album L.), nightshade (Solanum sp.), grass (Setaria viridis L.) and (Echinochloa crusgalli (L.)) Beauv.) and "others" (Kochia scoparia (L.) Rath.) and (Polygonum convolvulus L.). Each treatment was replicated three times. Treatments were applied in 40 gpa of water carrier. Diesel oil, nonphytotoxic oil and wetting agent were added at the rate of 1 qt/100 gal of water.

Primaze at 1.0 and 3.0 lb/A gave 97% and 99% weed control, respectively, which was the best performance recorded in the study (attached table).

Atrazine + linuron at 0.5 + 0.5 lb/A, primaze at 1.0 and 3.0 lb/A, atrazine + nonphytotoxic oil at 0.5 and 1.0 lb/A and atrazine + water at 0.75 and 1.5 lb/A controlled all broadleafed weeds. Atrazine at 0.5 lb/A + diesel oil was the only treatment which did not give commercially acceptible control of redroot pigweed. Primaze at 1.0 and 3.0 lb/A were the only treatments which gave adequate grass control. Atrazine + linuron at 0.5 + 0.5 and 0.75 + 0.75 lb/A resulted in better grass control than the higher rates of atrazine with surface active agents added to the water carrier.

When comparing combined averages of atrazine treatments with various surface active agents, the Trionic surfactant gave slightly higher total weed control than either diesel oil or nonphytotoxic oil. (Wyoming Agricultural Experiment Station, Laramie, SR-146)

Evaluation of herbicides and surface active agents used for postemergence weed control in corn.

Treatment		% stand corn	Redroot Pig-weed	Lambs-quarters	Night-shade	Grass	Others	Total weed control
atrazine + linuron	.5 + .5	84	100	100	100	54	100	91
atrazine + linuron	.75 + .75	91	100	100	100	79	100	96
atrazine	.75	87	55	100	100	0	100	75
atrazine	1.5	100	100	100	100	56	100	91
*atrazine + oil	.5	100	100	100	100	37	100	87
*atrazine + oil	1.0	94	100	100	100	2	100	80
Primaze	1.0	88	100	100	100	87	100	97
Primaze	3.0	100	100	100	100	93	100	99
atrazine + diesel oil	.5	93	82	100	97	0	100	75
atrazine + diesel oil	1.0	100	100	100	92	25	100	83
**atrazine + W.A.	.5	91	95	100	100	28	100	85
**atrazine + W.A.	1.0	89	95	100	100	24	100	84

* Atrazine + nonphytotoxic acid
** Atrazine + Trionic surfactant

Preemergence weed control in corn in Wyoming. Lee, G. A., H. P. Alley, and A. F. Gale. Screening trials were conducted at Torrington, Wyoming on a predominately sandy loam soil type. Atrazine was included in the study as the standard herbicide for comparison. Treatments were applied in 40 gpa of water carrier. Each treatment was replicated three times. The series was established on May 8, 1968 and evaluated on June 11, 1968. The weed population was categorized as redroot pigweed (Amaranthus retroflexus L.), lambsquarters (Chenopodium album L.), nightshade (Solanum sp. L.), grass (Setaria viridis L.) and (Echinochloa crusgalli L. Beauv.) and "others" (Kochia scoparia L.) and (Polygonum convolvulus (L.) Rath.).

When comparisons of total weed control were made, 11 treatments were equal to or better than atrazine at 0.75 lb/A (attached table). However, no treatment exceeded the total performance of atrazine at 1.5 lb/A. Six treatments resulted in less than 85% total weed control. Primaze at 2.0 and 3.0 lb/A reduced corn stands 83% and 36%, respectively. Propazine at 0.75 and 1.5 lb/A, GS-13529 at 1.5 lb/A, GS-14260 at 1.5 lb/A, Sutan + atrazine at 3.0 + 1.5 lb/A, SD-15418 at 4.0 lb/A, primaze at 2.0 and 3.0 lb/A, and GS-14260 + GS-13529 at 0.75 + 0.75 lb/A gave better than 95% total weed control. The combinations of GS-14260, GS-13529 and propazine did not increase total weed control over the heavy rates of each herbicide alone. (Wyoming Agricultural Experiment Station, Laramie, SR-147.)

Evaluation of herbicides for preemergence weed control in corn.

Treatment	lb/A	% stand corn	Pig-weed	Lambs-quarters	Night-shade	Grass	Others	Total weed control
Sutan 1/	3.0	100	81	78	48	85	67	71.8
Sutan	4.0	100	100	94	76	91	100	92.2
Sutan + atrazine	3 + 1.5	100	100	100	95	99	100	98.8
Preforan 2/	3.0	100	85	78	100	89	100	88.4
Preforan	6.0	100	96	94	86	88	100	92.8
SD-15418 3/	2.0	100	96	100	86	84	100	93.2
SD-15418	4.0	100	100	100	100	96	100	99.2
SD-15419 4/	2.0	100	100	100	95	94	83	94.4
SD-15419	4.0	100	52	61	0	100	67	74.0
VCS-438 5/	1.0	100	78	89	90	69	100	85.2
VCS-438	2.0	100	81	94	76	85	100	87.2
Ramrod 6/	4.0	100	7	89	0	78	100	52.8
Ramrod	6.0	97	81	89	71	94	100	87.0
Lasso 7/	1.0	100	93	83	52	100	100	85.6
Lasso	2.0	100	100	89	71	94	100	90.8
dicamba	0.5	100	22	56	43	61	83	53.0
dicamba	1.0	97	78	89	38	54	100	71.8
Primaze 8/	2.0	83	100	100	100	94	100	98.8
Primaze	3.0	36	100	100	95	97	100	98.4
atrazine	0.75	100	100	100	95	94	83	94.4
atrazine	1.5	100	100	100	100	98	100	99.6
GS-14260 9/	0.75	95	96	72	62	69	83	72.4
GS-14260	1.5	98	100	100	100	91	100	98.2
GS-13529 10/	0.75	100	100	94	100	53	100	89.4
GS-13529	1.5	100	100	100	100	89	100	97.8
propazine	0.75	100	96	100	100	86	100	96.4
propazine	1.5	97	100	100	100	87	100	97.4
GS-14260 + GS-13529	.75 + .75	100	96	100	100	86	100	96.4
GS-14260 + Propazine	.75 + .75	100	100	94	100	87	83	92.8
GS-13529 + Propazine	.75 + .75	100	100	100	100	72	100	94.4

1/ S-ethyl diisobutylthiocarbamate
2/ p-nitrophenyl 2-nitro-4-(trifluoromethylphenyl) ether
3/ 2-(4-chloro-6-ethylamino-s-triazin-2-ylamino)-2-methylpropionitrile
4/ 2-(4-chloro-6-ethylamino-s-triazin-2-ylamino)2-2methyleutyronitrile
5/ (name not available)
6/ 2-chloro-N-isopropylacetanilide
7/ 2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide
8/ atrazine + 2,4-bis(isopropylamino)-6-methylthio-s-triazine
9/ 2-tert. butylamino-4-ethylamino-6-methylthio-s-triazine
10/ 2-tert. butylamino-4-chloro-6-ethylamino-s-triazine

Weed control in alfalfa under dryland conditions in Wyoming. Lee, G. A., H. P. Alley and P. J. Ogg. Plots were established to determine the performance of several herbicides for weed control in alfalfa under dryland conditions in Wyoming.

Treatments were made in early spring when the alfalfa was dormant. The chemicals were applied in 40 gpa of water carrier on a broadcast basis without incorporation. At the time of harvest, an area four feet square was clipped in each plot to obtain yield and ratio of weeds to pure alfalfa hay. Samples were oven dried at 80°C for 24 hours before weights were determined.

Weed populations at the Sheridan location consisted of downy bromegrass (Bromus tectorum L.), tansy mustard (Descurainia pinnata (Walt.) Britt.), meadow salsify (Tragopogon pratensis L.), Russian thistle (Salsola kali L.) and blue mustard (Chorispora tenella (Willd.) D.C.). The Gillette location was heavily infested with downy bromegrass and tansy mustard.

Data from the Sheridan location show that atrazine at 2.0 lb/A, terbacil at 1.0 and 2.0 lb/A and bromacil at 1.0 lb/A completely eliminated the weed population (following table). The yields of alfalfa for the above mentioned treatments were more than doubled as compared with the nontreated check. Atrazine at 1 lb/A, simazine at 2.0 lb/A, diuron at 2.0 lb/A and bromacil at 0.5 lb/A reduced weed stands to a ratio of less than 7 percent weeds to pure alfalfa. The weight of the weeds in the check was over 2.5 times greater than the weight of alfalfa. Atrazine at 2.0 lb/A and terbacil at 0.5 and 1.0 lb/A were outstanding treatments at the Gillette location. Simazine at 3.0 lb/A and atrazine at 1.0 lb/A substantially reduced the weed population when compared to the nontreated. Diuron at 2.0 and 4.0 lb/A and Simazine at 2.0 lb/A did not perform satisfactorily. The downy bromegrass was 1/2 to 1.0 in. in height at the time of treatment at the Gillette location. (Wyoming Agricultural Experiment Station, Laramie, SR-148.)

Effect of herbicides on yields and percent weeds by weight in alfalfa.

		Sheridan - Clay loam		Gillette - Clay loam	
Treatment	Rate lb/A	Tons/A alfalfa	% weeds/pure alfalfa hay	Tons/A alfalfa	% weeds/pure alfalfa hay
GS-14254[1/]	1	.78	18.59		
GS-14254	3	.78	8.54		
atrazine	1	.96	2.87	.78	25.4
atrazine	2	.74	0	.84	0.9
simazine	2	.72	3.30	.10	403.0
simazine	3	.70	8.43	.69	32.2
terbacil	1/2			.81	6.8
terbacil	1	1.07	0	.98	1.2
terbacil	2	.82	0		
R-11913[2/]	2	.80	12.68		
R-11913	4	.65	40.24		
RP-11561[3/]	1	.46	118.64		
RP-11561	2	.46	90.52		
diuron	2	.86	5.96	.08	1293.0
diuron	4	.34	148.27	.28	411.0

(Table continued on page 97)

(Continued)

Treatment	Rate lb/A	Sheridan - Clay loam Tons/A alfalfa	% weeds/pure alfalfa hay	Gillette - Clay loam Tons/A alfalfa	% weeds/pure alfalfa hay
bromacil	1/2	1.00	6.27		
bromacil	1	.87	0		
check		.32	260.49	.01	3000.0

1/ (2-sec. butylamino-4-ethylamino-6-mahoxy-s-triazine
2/ (name unavailable)
3/ (2-tetriobutyl-4-(2,4-dichloro-5-isopropylaxyphenyl)-5-oxo-1,3,4-oxadiazoline)

<u>Foliar applications of diuron in young cotton.</u> Arle, H. F. and K. C. Hamilton. Directed applications of herbicides covering weeds and minimizing contact with the crop are usually difficult or impossible in young cotton. During the past 3 years the effects of diuron applied to the foliage of young cotton were studied at the Cotton Research Center in Phoenix, Arizona.

Diuron was applied over the top of cotton when it was 2, 4, 6, or 8 weeks old and averaged 2, 5, 8, or 12 inches tall. One-half or 1 lb/A of diuron was applied in 40 gpa of water. The wettable powder was applied with and without an additional 1/2% blended surfactant. Treatments were replicated four times on 1-row plots 43-ft long. Deltapine Smooth Leaf, Hopicala, and Deltapine 16 cotton were planted in 1966, 1967, and 1968, respectively. The effects of diuron treatments on cotton were observed at weekly intervals. Cotton was harvested by hand in 1966 and by machine in 1967 and 1968.

Applications of diuron over cotton at all stages caused temporary chlorosis of foliage. The amount of chlorosis was related to the rate of diuron but was most severe when surfactant was added to the spray solution. Temporary stunting of cotton was produced by 1 lb/A of diuron and was most severe when surfactant was added. Stunting was most severe on younger cotton. Within 2 to 4 weeks cotton resumed normal growth. Yields of cotton were reduced 8 to 12% by diuron with added surfactant as compared with yields when only diuron was applied (see Table). Date of application did not affect the yield of cotton. (Cooperative investigation of Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Phoenix, Arizona, and the Arizona Agricultural Experiment Station, University of Arizona, Tucson, Arizona.)

Average yield of seed cotton after foliar applications of diuron at four dates in 1966, 1967 and 1968.

Treatment: Diuron lb/A	Added surfactant percent	Yield of seed cotton in pounds per plot — Weeks from emergence until treatment: 2	4	6	8	average
1/2	0	8.2	8.0	8.2	8.2	8.2
1/2	1/2	7.4	7.5	7.3	7.6	7.4
1	0	8.1	8.1	8.0	8.1	8.1
1	1/2	7.1	7.5	6.9	7.0	7.1
Average		7.7	7.8	7.6	7.7	

PROJECT 6. AQUATIC AND DITCHBANK WEEDS

V. F. Burns, Project Chairman

SUMMARY

At the Bureau of Reclamation Laboratories, Denver, Colorado, vegetative growth of sago and American pondweeds was not increased by adding nitrogen and/or phosphorus to a water and/or sand media that contained no detectable amounts of these elements. The data suggested that (1) the N and P requirements of these pondweeds are very low and/or the parent vegetative propagules are a major source of these elements for the plants through at least a 60-day growing period.

Also at Denver, continuous application of copper sulfate at a concentration of about 2 ppb in the water effectively controlled most algae in an irrigation canal.

In California, Vapam applied to kill taproots plus treatment with certain contact, systemic, or soil-applied herbicides to kill the topgrowth results in 100% control of alligatorweed.

Effects of nitrogen and phosphorus on pondweed productivity. Otto, N. E. Studies of the inorganic nutrient requirements of pondweeds are being conducted in controlled environment growth chambers. Progress of the effects of various levels of nitrogen and phosphorus fertilization on the productivity of sago pondweed, *Potamogeton pectinatus* L., and American pondweed, *P. nodosus* Poir. are reported. Vegetative pondweed propagules are cultured in sand-filled pots that are placed in 20-liter glass aquaria. These aquaria are maintained at a temperature of 21°C with a 14-hour light period in growth chambers. Biomass productivity of the two pondweeds was determined from growth curves obtained from oven-dry weight of individual plants, less the original propagule, at 20, 30, and 60 days of age.

Replicated cultures of each pondweed species were cultured in tap water, which contained no detectable traces of nitrogen or phosphorus; tap water enriched with two levels of nitrogen and phosphorus individually and in combination; and in distilled water utilizing the same combinations of nitrogen and phosphorus as in the tap water tests. Nutrient solutions containing all major cations were also compared with plant productivity in tap water controls. In addition, the two levels of nitrogen and phosphorus were used to fertilize pondweed propagules sealed in sand-filled jars that isolated the root-propagule environment from the nonenriched aquaria water. Resulting data were analyzed for statistical significance.

The results of these studies have not shown any statistically significant increase in total vegetative growth of either pondweed species by increasing the availability of nitrogen or phosphorus levels either to the roots and/or the leaves and stems.

These data suggest that (1) these two pondweed species inorganic nutrient requirements are being met by very low levels of available elements and excess availability is inconsequential to furthering growth and/or (2) that the parent vegetative propagules are still a major source of food or inorganic element supply to the plant through 60-day growing periods.

Additional studies are underway to further evaluate the effects of other major inorganic elements in combination with nitrogen and phosphorus on pondweed productivity, especially on older vegetative growth stages. The studies are including post-germination removal of vegetative propagules from the parent plants. (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.)

Algae control on irrigation canal by continuous low rate feed of copper sulfate. Bartley, Thomas R. An experiment is underway on the Charles Hansen Feeder Canal of the Colorado-Big Thompson Project to determine the merits of a continuous feed of a very low concentration of copper sulfate as opposed to a slug-type treatment for algae control. Various algal growths that occur in this system reduce the water carrying capacity and interfere with measuring water discharged. The concrete lined canal has a total length of 13.2 miles. The system is operated throughout the year to deliver water for irrigation purposes and power production.

Due to the frequent change in volume of water discharged through the canal which normally ranges from 100 to 600 cfs, it was necessary to use a variable speed feeding device and controls for automatically changing the feeding rate according to the change in water flow. A screw-type feeder with an electric variable speed control was used for dispensing dry, uniform small size copper sulfate crystals directly into the flowing water at the head of the canal. The feeder controls were connected to the transmitter at the gaging station to provide a copper sulfate feed rate proportional to the water height in the flume section at the gaging station.

The feeder was put into operation on May 8, 1968, and the controls adjusted to feed copper sulfate at a rate providing a theoretical copper concentration of about 0.8 ppb. By the middle of June it was apparent that this feed rate was not sufficient to prevent the growth of algae. A band of algal growth, Ulothrix, about 1 inch long and 6 inches wide was found growing on the canal lining just below the water surface in the upper reaches of the canal. The feeder controls were changed on June 26, 1968, to about double the feed rate.

Inspections made on the canal throughout the summer and fall of 1968 showed the increased feed rate to be effective in killing the algae buildup and keeping the system relatively free of algae. The system was found to contain only a small amount of algae following dewatering on November 1, 1968. A thin growth of an association of diatoms and Oscillatoria was found near the bottom of the canal side slopes and sparse growths of the filamentous green alga, Stigeoclonium was observed in two areas. Bureau personnel on the project reported that the canal contained the least amount of algae at the end of the 1968 season ever observed.

Quantities of water discharged and copper sulfate fed were recorded and the copper concentration computed for about the first 5 months of the experiment. The theoretical copper concentration amounted to about 0.9 ppb from May 8 to June 26 and about 2.0 ppb for the June 26 to October 14 period.

The water contained 14 ppm of total dissolved solids, 13 ppm of the bicarbonate ion and 12 ppm hardness of $CaCO_3$.

The experiment to date has shown that the experimental technique of feeding cooper sulfate as compared to the slug treatment required more copper sulfate, provided a more effective control of algae, reduced the labor requirement and reduced greatly the maximum concentration of copper in the water. (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.)

Alligatorweed control with Vapam (SMDC). Pryor, Murray R. Field plot trials exploring SMDC as a soil drench for the eradication of alligatorweed (Alternanthera philoxeroides) at Visalia, Tulare County, California, were conducted in 1967 and 1968 by the California Department of Agriculture in cooperation with the Tulare County Department of Agriculture. Further trials were conducted at the Whittier Narrows Dam reservoir site, Los Angeles County, in 1968, in cooperation with the Los Angeles County Departments of Agriculture and Flood Control and the United States Army Corps of Engineers.

SMDC was applied as a soil drench without tarp, as a soil fumigant to kill the taproots of alligatorweed in combination with contact, systemic, and soil residual herbicides to kill the canopy of the treated plants in addition to the taproots to prevent regenerative growth from the stems.

Materials were applied at trial plot sites when field moisture was high but when the water level was below the root zone of the treated plants. At Visalia, SMDC was applied in irrigation canals in spring and fall treatments before and after water delivery. At the reservoir site at the Whittier Narrows Dam, SMDC was applied within the reservoir in the summer when water was not impounded.

The following table shows those plots that resulted in 100% control:

Herbicide	Application rate /100 sq ft	Volume rate gal/100 sq ft	Percent control
SMDC + weed oil*	1 qt + 1 gal	25	100
SMDC + paraquat + surfactant	1 qt + 1 pt + 2 oz	25	100
SMDC + linuron	1 qt + 2 oz	25	100
SMDC + Ammate	1 qt + 2 oz	25	100
SMDC + dichlobenil (W50)	1 qt + 1 oz	25	100
SMDC + CIPC	1 qt + 2 oz	25	100

*Richfield Weed Killer A

By the end of 1968, cooperative county-state eradication project operations begun in 1967 in Tulare County resulted in near eradication of the entire 100 acre alligatorweed infestation. Combinations of SMDC and paraquat and, later, SMDC and weed oil were used. The combination with weed oil was found to be much more economical. (Weed and Vertebrate Pest Control, Division of Plant Industry, California Department of Agriculture, Sacramento).

PROJECT 7. CHEMICAL AND PHYSIOLOGICAL STUDIES

Project Chairman, Roland Schirman

SUMMARY

Four progress reports were submitted. In the order assembled they report that:

Two proteins are present in pea seedlings following treatment with picloram, NAA or IAA that are not present in controls. Association of this to lateral root induction is suggested.

Foliar uptake of linuron, diuron and GS-14260 by established blue mustard (Chorispora tenella) is the major factor in obtaining control of this weed with these materials.

Picloram residue carryover via potato vines or tubers produced on soils treated with this material does exist. Varietal differences in severity of symptom expression was noted.

Detectable residues of GS-14260, dicamba, linuron, silvex, and picloram were noted in September from May field treatments. After an additional greenhouse incubation of 57 days only picloram could be detected.

Protein metabolism as influenced by growth regulator chemicals in plants. Norris, Logan A. and Roy O. Morris. Alteration of the expression of genetic information has been proposed as one of the mechanisms of action of growth regulator chemicals. Qualitative and quantitative changes in proteins would be expected from such action. We have investigated the electrophoretic behavior of soluble pea root proteins in acrylamide gels in response to the growth regulator chemicals. Our results show that extracts from roots of pea seedlings treated with 2,4-D, picloram, IAA, or NAA contain at least two proteins not found in control seedlings.

Pea seeds are surface sterilized, soaked in water for 8 hours and planted in vermiculite. The roots are about 40 mm long 48 hours after the start of the soaking period, and the seedlings are ready for treatment.

Seedlings are exposed to 5×10^{-5} M, 2,4-D in 10^{-3} M KH_2PO_4 for 2 hours with aeration and are then replanted in vermiculite. Root elongation is completely inhibited, and 48 hours later, lateral root proliferation is starting. The epidermis and cortex are completely split 72 hours after treatment as three closely packed rows of lateral roots emerge. Treating 48-hour-old peas with picloram, NAA, or IAA likewise inhibits root elongation and induces lateral root proliferation.

All treatments result in lateral root proliferation which is much more profuse than in untreated plants of comparable age. Clearly, growth regulators induce formation of root initials from cells which would normally remain nonmeristematic.

We slice the roots laterally into 1- or 2-mm sections and extract the protein with Tris-sucrose homogenization medium of pH 6.9 at 0°C. After centrifugation at 23,500 X g for 30 minutes, an aliquot of supernatant containing 100 to 350 μg protein is layered on the acrylamide gel system. Current is applied at 3 ma/tube for 1 hour. The gels are stained with amido black for 1 hour and destained with 10% acetic acid. Bands of protein are identified by the relative distance they traveled with respect to the buffer front.

The acrylamide gels show two bands of protein from extracts of 2,4-D treated seedlings not present in extracts from untreated seedlings. These proteins are in extracts made 24 and 48 hours after treatment but are not evident 12 hours after treatment. These same two bands of protein are found in extracts made 48 hours after pea seedlings are treated with picloram, NAA, or IAA.

The appearance of the same two proteins after treatment with different chemicals suggests these proteins may be associated with the proliferation of lateral roots which is common to all treatments. We are now studying the temporal relationship between the synthesis of these two proteins and the induction of lateral root initials.

This research was supported in part by a grant from the Herman Frasch Foundation. (A joint contribution from USDA, Forest Service, Forestry Sciences Laboratory, and Oregon Agri. Expt. Sta., Oregon State University, Corvallis, 97331).

Foliar uptake study of three herbicides. Swan, Dean G. On March 26, 1968 a study was set up to determine if GS-14260 at 1.6 lb/A, diuron at 1 lb/A, and linuron at 1/2 lb/A would give blue mustard (*Chorispora tenella*) control by foliar uptake. The experiment was established in a field which had been seeded to Gaines winter wheat. The field was infested with blue mustard at a population of three plants per square foot. Methods used were to protect the soil from spray to prevent any root absorption, wash herbicide from the plants to insure that no spray would be absorbed by the foliage and have a normal treatment as a check. The experimental design was a split plot with one replication. The main plots (5 x 15 ft) were herbicide treatments and subplots (3 x 3 ft) were the following methods: In the first plot the soil was covered with about one inch of vermiculite, leaving the wheat and weed foliage exposed to the herbicide spray; second subplot was the normal treatment; i.e., leaving both the soil and foliage exposed to spray; third subplot, the plants were washed off with water immediately after spraying, using a hose nozzle (coarse spray setting) at 30 psi. After the spray dried on the foliage in subplot one, the vermiculite was removed by vacuuming. Rain occurred two days following treatment and may have washed the herbicide from the foliage. Therefore, a second set of plots were established on April 1. Technique was the same with one important exception. For subplot three, the plants were thoroughly wetted with water, using the hose nozzle, prior to spraying as well as washing after spraying. At both treatment dates wheat was well tillered and blue mustard was 4 to 8 inches in diameter (bolting and 4 inches high at second treatment date). Air temperature was 59 degress on date I and 66 degrees on date II.

There was evidence of herbicide activity one week following the March 26 treatment. Necrotic spots were evident on the older blue mustard leaves, becoming more severe on younger leaves and terminal growth had stopped. It was this evidence (including plants in the spray-washed plot) that led to a change in plant washing technique. The wheat showed some leaf yellowing one week after treatment.

The plots were evaluated on June 29, 1968. There was no evidence of wheat injury. Complete blue mustard control was obtained with all treatments except the date II washed-sprayed-washed plot. No control was obtained in this plot.

These results show that complete control of the weed was obtained by the foliar uptake of these wettable powders. This occurred where root absorption was prevented by keeping the spray off the soil. No weed control was obtained when the plants were washed-sprayed-washed, even though the herbicides were activated by more than 1-1/2 in of precipitation within one week plus the water from the initial hose washing. This suggests that root absorption is not a factor under these conditions. The spray apparently adhered very tightly and quickly when applied to a dry leaf surface as evidenced by complete blue mustard control in subplot three, date I, when plants were sprayed-washed. The herbicide was not removed even though washing followed within seconds after spraying.

Further studies are planned to determine the effect of weed size and time of year which will also include a temperature factor. (Agricultural Experiment Station, Washington State University, Pullman, Washington 99163).

<u>The response of potatoes to soil and plant residues of picloram.</u> Zimdahl, R. L. and B. L. Bohmont. It is known that picloram is absorbed by roots and foliage of potatoes and readily translocated throughout the plant. Because of this fact and the extreme sensitivity of potatoes to picloram two experiments were conducted to determine if picloram could be carried over in tubers or vines and thereby contaminate the land for succeeding potato crops.

Picloram was applied at 1/16 and 1/32 pound per acre at the San Luis Valley branch station. Potatoes were planted on the plots and some growth occurred. The harvested tubers were planted in the greenhouse and if they germinated foliar symptoms of picloram residue appeared. Russett Burbank and Red McClure potatoes were planted in the field and the former were more susceptible to picloram residue or the tubers carried a greated concentration. In all cases the Red McClure variety grew better in the greenhouse and exhibited less obvious symptoms of picloram residue.

In the second experiment Russett Burbank vines exhibiting severe picloram symptoms were harvested in the San Luis Valley. These vines were air dried and ground through a fine mesh screen. The amount of vine material that would normally be returned to the soil was calculated and a series of amounts ranging from normal to 24 times normal of check

Herbicide	Peas			Weeds
	number present	degree of injury	gm. per pea plant	number present
		First greenhouse seeding		
silvex	0.8	1.2		0.9
picloram	2.0	4.5		0.8
Check	3.7	1.0		5.0
		Second seeding in same pots 57 days after first seeding		
GS-14260	4.7	1.0	0.804	0.6
dicamba	4.6	1.4	0.811	0.2
linuron	4.5	1.0	0.838	0.8
silvex	4.7	1.0	0.725	0.5
picloram	4.5	6.1	0.302	0.3
Check	4.3	1.0	0.828	0.2

and picloram affected vines was added to greenhouse pots. Potatoes of the Blanca variety planted in soil incorporated with picloram affected vine material did show mild growth responses similar to picloram symptoms. These symptoms were less severe than those produced by a standard series concentration of 1/64 ppb. No picloram symptoms were produced by Norland potatoes planted under similar circumstances.

Russett Burbank and Blanca are white potatoes and Norland and Red McClures are not. These preliminary studies show the picloram can be carried over in vines and tubers with the potential of yield reduction or total loss of subsequent crops. No estimation was obtained of the suspected stimulatory affect of very low levels of picloram. These results are especially significant to the potato seed grower and to the industry in general. (Dept. of Botany and Plant Pathology, Colorado State University, Fort Collins, Colorado 80521.)

<u>Persistance of five herbicides in Koester silt loam soil.</u> McNeal, H. A. and L. C. Erickson. The objective was to determine the residual presence of the five herbicides at harvest time that had been applied pre-emergence at seeding time. That is, could herbicides applied in the spring persist to interfere with fall seeded crops?

Rates a.i. of each herbicide were: GS-14260 2, 1-1/2, 1, and 1/2; dicamba 1, 3/4, 1/2, and 1/4; linuron 1-1/2, 1, 3/4, and 1/2; silvex 2, 1-1/2, 1, and 1/2; picloram 1/8, 1/16, 1/32, and 1/64 lb per acre.

The crops: barley, flax, peas, sunflower and wheat were seeded May 19, harvest prevailed from August 1 to 30. Total precipitation for the interval May 19-August 30 equalled 2.25 inches. And the mean monthly temperatures averaged 65.6°F.

Soil samples, to a depth of 6-inches, were taken on September 1, from each of the three herbicide-rate replications. The samples were air dried and stored in a cool dry area until February when the samples were moved to the greenhouse and bioassays were started using Improved Alaska peas for the detection organism. The table shows that all the herbicides prevailed in detectable quantities in the original seeding and that only picloram prevailed in detectable quantities in the second run. This study will be enlarged to include winter wheat also as a detection plant since this is the predominant fall crop in this area. (Idaho Agricultural Experiment Station. Moscow, Idaho 83843).

Average effects of four rates of herbicides on the number of plants and injury symptoms prevailing in Alaska peas and weeds after 24 days

Herbicide	Peas			Weeds
	number present	degree of injury	gm. per pea plant	number present
	First greenhouse seeding			
GS-14260	0.9	1.7		0.4
dicamba	1.6	3.0		1.4
linuron	1.3	1.3		0.9

(Table continued on Page 107)

NOMENCLATURE AND ABBREVIATIONS

Tables 1 and 2 below are nomenclature and abbreviation lists of the Weed Society of America (Nomenclature Weeds 16(4), 1968). Authors are urged to use this terminology and abbreviation whenever applicable.

Table 1. Common and Chemical Names of Herbicides[a]

Common name	Chemical name[b]
A	
acrolein	acrolein
ametryne	2-(ethylamino)-4-(isopropylamino)-6-(methylthio)-s-triazine
amiben	3-amino-2,5-dichlorobenzoic acid
amitrole	3-amino-s-triazole
AMS	ammonium sulfamate
atratone	2-(ethylamino)-4-(isopropylamino)-6-methoxy-s-triazine
atrazine	2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine
B	
barban	4-chloro-2-butynyl m-chlorocarbanilate
benefin	N-butyl-N-ethyl-α,α,α-trifluoro-2,6-dinitro-p-toluidine
bensulide	O,O-diisopropyl phosphorodithioate S-ester with N-(2-mercaptoethyl)benzenesulfonamide
benzadox	(benzamidooxy) acetic acid
bromacil	5-bromo-3-sec-butyl-6-methyluracil
bromoxynil	3,5-dibromo-4-hydroxybenzonitrile
buturon	3-(p-chlorophenyl)-1-methyl-1-(1-methyl-2-propynyl) urea
butylate	S-ethyl diisobutylthiocarbamate
C	
cacodylic acid	hydroxydimethylarsine oxide
CDAA	N,N-diallyl-2-chloroacetamide
CDEA	2-chloro-N,N-diethylacetamide
CDEC	2-chloroallyl diethyldithiocarbamate
chlorazine	2-chloro-4,6-bis(diethylamino)-s-triazine
chloroxuron	3-[p-(p-chlorophenoxy)phenyl]-1,1-dimethylurea
chlorpropham	isopropyl m-chlorocarbanilate
CIPC (see chlorpropham)	
CMA	calcium methanearsonate
cycloate	S-ethyl N-ethylthiocyclohexanecarbamate
cycluron	3-cyclooctyl-1,1-dimethylurea
cypromid	3',4'-dichlorocyclopropanecarboxanilide
D	
dalapon	2,2-dichloropropionic acid
dazomet	tetrahydro-3,5-dimethyl-2H-1,3,5-thiadiazine-2-thione
DCPA	dimethyl tetrachloroterephthalate
DCU	1,3-bis(2,2,2-trichloro-1-hydroxyethyl)urea
dinosam	2-(1-methylbutyl)-4,6-dinitrophenol

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

Common name	Chemical name[b]
D	
dinoseb	2-sec-butyl-4,6-dinitrophenol
desmetryne	2-(isopropylamino)-4-(methylamino)-6-(methylthio)-s-triazine
diallate	S-(2,3-dichloroallyl) diisopropylthiocarbamate
dicamba	3,6-dichloro-o-anisic acid
dichlobenil	2,6-dichlorobenzonitrile
dichlorprop	2-(2,4-dichlorophenoxy)propionic acid
dicryl	3'4'-dichloro-2-methylacrylanilide
diphenamid	N,N-dimethyl-2,2-diphenylacetamide
diquat	6,7-dihydrodipyrido[1,2-a:2',1'-c]pyrazinediium salts
diuron	3-(3,4-dichlorophenyl)-1,1-dimethylurea
DMTT (see dozomet)	
DNAP (see dinosam)	
DNBP (see dinoseb)	
DNC (see DNOC)	
DNOC	4,6-dinitro-o-cresol
DSMA	disodium methanearsonate
E	
endothall	7-oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid
EPTC	S-ethyl dipropylthiocarbamate
erbon	2-(2,4,5-trichlorophenoxy)ethyl 2,2-dichloropropionate
EXD	O,O-diethyl dithiobis[thioformate]
F	
fenac	(2,3,6-trichlorophenyl)acetic acid
fenuron	1,1-dimethyl-3-phenylurea
fenuronTCA	1,1-dimethyl-3-phenylurea monotrichloroacetate
fluometuron	1,1-dimethyl-3-(α,α,α-trifluoro-m-tolyl)urea
H	
HCA	1,1,1,3,3,3-hexachloro-2-propanone
I	
ioxynil	4-hydroxy-3,5-diiodobenzonitrile
ipazine	2-chloro-4-(diethylamino)-6-(isopropylamino)-s-trazine
IPC (see propham)	
isocil	5-bromo-3-isopropyl-6-methyluracil
K	
KOCN	potassium cyanate
L	
lenacil	3-cyclohexyl-6,7-dihydro-1H-cyclopentapyrimidine-2,4(3H,5H)-dione
linuron	3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea

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

Common name	Chemical name[b]
M	
MAA	methanearsonic acid
MAMA	monoammonium methanearsonate
MCPA	[(4-chloro-o-tolyl)oxy]acetic acid
MCPB	4-[(4-chloro-o-tolyl)oxy]butyric acid
MCPES	2-[(4-chloro-o-tolyl)oxy]ethyl sodium sulfate
MCPP (see mecoprop)	
mecoprop	2-[(4-chloro-o-tolyl)oxy]propionic acid
metham	sodium methyldithiocarbamate
metobromuron	3-(p-bromophenyl)-1-methoxy-1-methylurea
MH	1,2-dihydro-3,6-pyridazinedione
molinate	S-ethyl hexahydro-1H-azepine-1-carbothioate
monolinuron	3-(p-chlorophenyl)-1-methoxy-1-methylurea
monuron	3-(p-chlorophenyl)-1,1-dimethylurea
monuronTCA	3-(p-chlorophenyl)-1,1-dimethylurea mono (trichloroacetate)
MSMA	monosodium methanearsonate
N	
naptalam	N-1-naphthylphthalamic acid
neburon	1-butyl-3-(3,4-dichlorophenyl)-1-methylurea
nitralin	4-(methylsulfonyl)-2,6-dinitro-N,N-dipropylaniline
nitrofen	2,4-dichlorophenyl p-nitrophenyl ether
norea	3-(hexahydro-4,7-methanoindan-5-yl)-1,1-dimethylurea
NPA (see naptalam)	
P	
paraquat	1,1'-dimethyl-4,4'-bipyridinium salts
PBA	chlorinated benzoic acid
PCP	pentachlorophenol
pebulate	S-propyl butylethylthiocarbamate
picloram	4-amino-3,5,6-trichloropicolinic acid
PMA	(acetato)phenylmercury
prometone	2,4-bis(isopropylamino)-6-methoxy-s-triazine
prometryne	2,4-bis(isopropylamino)-6(methylthio)-s-triazine
propachlor	2-chloro-N-isopropylacetanilide
propanil	3',4'-dichloropropionanilide
propazine	2-chloro-4,6-bis(isopropylamino)-s-triazine
propham	isopropyl carbanilate
pyrazon	5-amino-4-chloro-2-phenyl-3(2H)-pyridazinone
pyriclor	2,3,5-trichloro-4-pyridinol
S	
sesone	2-(2,4-dichlorophenoxy)ethyl sodium sulfate
siduron	1-(2-methylcyclohexyl)-3-phenylurea
silvex	2-(2,4,5-trichlorophenoxy)propionic acid
simazine	2-chloro-4,6-bis(ethylamino)-s-trazine

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

Common name	Chemical name[b]
S	
simetone	2,4-bis(ethylamino)-6-methoxy-s-triazine
simetryne	2,4-bis(ethylamino)-6-(methylthio)-s-triazine
SMDC (see metham)	
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
triallate	S-(2,3,3-trichloroallyl) diisopropylthiocarbamate
tricamba	3,5,6-trichloro-o-anisic acid
trietazine	2-chloro-4-(diethylamino)-6-(ethylamino)-s-triazine
trifluralin	α,α,α-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine
trimeturon	1-(p-chlorophenyl)-2,3,3-trimethylpseudourea
2,3,6-TBA[c]	2,3,6-trichlorobenzoic acid
2,4-D	(2,4-dichlorophenoxy)acetic acid
2,4-DB	4-(2,4-dichlorophenoxy)butyric acid
2,4-DEB	2-(2,4-dichlorophenoxy)ethyl benzoate
2,4-DEP	tris[2-(2,4-dichlorophenoxy)ethyl] phosphite
2,4-DP (see dichloroprop)	
2,4,5-T	(2,4,5-trichlorophenoxy)acetic acid
2,4,5-TES	sodium 2-(2,4,5-trichlorophenoxy)ethyl sulfate
V	
vernolate	S-propyl dipropylthiocarbamate

[a]Herbicides no longer in use in USA are omitted. Complete listing, including these, is in WEEDS 14(4), 1966.

[b]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.

[c]This herbicide usually is 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 minutes
hr	hour(s)
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 units (examples: g/l or lb/gal)
NCWCC	North Central Weed Control Conference

Table 2. Abbreviations of terms used in weed control (continued)

Abbreviations	Definitions
NEWCC	Northeastern Weed Control Conference
SWC	Southern Weed Conference
WSA	Weed Society of America
WSWS	Western Society of Weed Science (formally Western Weed Control Conference)

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