H. M. Hull

March 25-26
Salt Lake City, Utah

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RESEARCH PROGRESS REPORT

Research Committee
Western Weed Control
Conference

SUPPLEMENT TO:

1964 RESEARCH PROGRESS REPORT

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PROJECT 1. PERENNIAL HERBACEOUS WEEDS

Ken W. Dunster, Project Chairman

SUMMARY

Twenty-one reports from personnel in 8 states were submitted for publication in this section. Research was conducted on twelve perennial weed species with Russian Knapweed, Canada Thistle and field Bindweed receiving the major emphasis.

A wide range of herbicides were investigated with the materials dicamba and Tordon receiving considerable attention. Of the twenty-one reports received, thirteen include results with dicamba while eight include Tordon results.

Developments of the past year are briefly summarized.

Canada Thistle (Cirsium arvense). Results obtained in Idaho indicate stand densities of Thistle may be influenced by soil moisture, inter-species competition and genetic variation. Seed yields varied greatly from area to area and are perhaps influenced by the wide variability of types or varieties observed within the species.

Results from 3 states indicate effective control may be obtained with dicamba and Tordon at rates as low as 2 lb/A. Tordon may be more effective than dicamba at low rates between 1/4 and 1 lb/A. Results suggest short term soil sterilization with dicamba.

Russian Knapweed (Centaurea repens). Good initial control of Knapweed was obtained in Nevada with 2-4 lb/A of dicamba. Considerable regrowth occurred later, however there was enough soil residue toxicity 18 months after treatment to prevent grass reseeding.

A four year study from Wyoming showed 29 treatments to be effective in the eradication of Russian Knapweed. Treatments with Fenac, 2,3,6 TBA, benzabor and heavy rates of 2,4-D allowed native grass species to recover while eradicating the Kanpweed.

Black Knapweed (Centaurea nigra). Oregon results indicate that seasonal control of this plant is readily obtained with several formulations of 2,4-D at rates as low as 1.3 lb/A. Tordon and dicamba at 1/2 lb/A active also gave effective control.

Field Bindweed (Convolvulus arvensis). Trichlorobenzoic acid (2,3,6) performed most consistently in soil sterilant type trials in Oregon. Dicamba at comparable rates appeared somewhat less consistent while tritac was more damaging to subsequent crops of grain.

Foliage treatments in Oregon showed 2,4-D amine to be as good or better than equivalent rates of MCPA or other formulations of 2,4-D.

Wyoming researchers found 2,3,6-TBA at 8 lb/A and dicamba at 10 lb/A provided effective control one year after treatment. Two year observations indicate that dicamba may have a shorter residual life in the soil as reinvasion is more apparent in the case of the dicamba.

Leafy spurge (Euphorbia esula). Montana research indicates that distinct strains of spurge exist which exhibit considerable variability in terms of growth and morphological characteristics. The effect of 2,4-D and gibberellic acid applications on these strains are considered in this report.

Of 11 treatments applied in Montana in 1959, only atrazine at 60 lb/A provided complete eradication of spurge as evaluated in 1963.

Povertyweed (Iva axillaris). Results obtained from Nevada indicate that low rates of several herbicides including 2,4-D, dicamba, 2,3,6-TBA and amitrole can be utilized effectively when povertyweed is growing in competition with a good stand of bluejoint hay. Where hay stands were poor, higher rates of 2,3,6-TBA and dicamba were required to provide effective control.

Tansy ragwort (Tanacetum vulgare). Tordon and dicamba applied at 1/2 lb/A produced 90-93 per cent control in Oregon trials. An oil soluble amine of 2,4-D gave 95 per cent control when applied at the rate of 1.5 lb/A while other 2,4-D formulations were less effective.

Curley dock (Rumex crispus). Tordon applied at 1.2 lb/A active was effective in controling dock in Oregon trials. Nine other herbicides under investigation proved ineffective.

Perennial smartweed (Polygonum punctatum). Tordon, dicamba and 2,4-D amine were the compounds evaluated for smartweed control in Oregon. None of these materials produced more than 65 per cent control at the 2 lb/A rate.

Bracken fern (Pteris aquilina). Work in Oregon shows isocil to be a promising chemical for the control of bracken fern. Amitrol-T, dicamba and Tordon applied at the rate of 8 lb/A active gave 70 per cent control.

Horsetail rush (Equisetum arvense). Trials in Oregon indicate that excellent initial control can be obtained with Tordon, dicamba and amitrole-T applied at 1, and 2 lb/A respectively.

Purple nutsedge (Cyperus rotundus). New Mexico research indicates that only Eptam and possibly R-4461 (Betasan) of the several herbicides under consideration shows enough promise to warrant continued testing.

Johnsongrass (Sorghum halepense). Research was conducted in Arizona to determine the susceptibility of various strains of Johnsongrass to dalapon treatments at 2 levels of application. Of the 6 strains under observation only one was eradicated with dalapon while the other strains showed varying degrees of susceptibility.

Bermudagrass (Desert and Coastal). California results indicate that the addition of a surfactant to dalapon may serve to increase the activity of this material in terms of Bermuda control. Increased activity was most apparent under somewhat humid, coastal conditions.

Increased activity was less apparent when surfactant was added to isocil.

Seed yields of Canada thistle (Circium arvense). Lawrence R. Pennington and Lamber C. Erickson. Idaho Agricultural Experiment Station, Moscow, Idaho.

Square yard samples of Canada thistle obtained at optimum maturity were harvested from 31 different field, pasture, and roadside infestations. These infestations were located in the northern Idaho counties of Benewah, Latah, Lewis and Nez Perce.

Although stem stand densities varied widely, the maximum densities were selected for sampling in each infestation. Several factors influenced stand densities. The most conspicuous were soil moisture and inter species competition. The latter varied from short growing Reed's canary grass which quite submerged the Canada thistle. Stand densities were probably also influenced by inherent growth characteristics due to genetic variation. There were discernable morphological differences among the plants growing in the different locations.

Seed yields ranged from 48 to 126 achenes per head, averaging 81 achenes per head from the 31 locations. Area yields ranged from 151 to 2043 achenes per square yard, averaging 692 per square yard for all locations. Seed densities varied from 831 to 2360 achenes per gram. This again illustrates the wide variability in types or varieties within this species. Calculations based on seed yields per square yard indicated that the seed yields within these 31 lots ranged from 71 to 1493 pounds per acre equivalent.

Chemical control of Canada thistle (Cirsium arvense Scop). Fechtig, A.D., and Furtick, W. R. An extensive research project on Canada thistle was initiated in 1963 to gain insight on the activities of twelve different compounds in controlling this species.

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

Approximately five months after the date of application the trials were evaluated for percent control of thistle. Initial control of approximately 95 percent was prevalent on all plots treated with Tordon and dicamba at 2 pounds per acre. Increased rates up to 8 pounds per acre showed very little change in activity. Dicamba and 2,4-D amine in combination of 1/2 pound active material of each per acre was about 90 percent effective. A 10 pound application per acre of 2,3,6-TBA was comparable to the dicamba and 2,4-D combination, while amitrole at 4 pounds per acre was 10 percent less effective. Three other compounds responsible for 80 percent top kill after three months were MCPB ester, 2,4-DB ester, and 2,4-D amine at the rate of 3 pounds per acre. Tritac at 16 pounds per acre showed essentially no activity on the thistle. The same was true for three of Du Pont's uracils, 762*, 634**, and bromacil.

Final readings on these trials will be made in late spring or early summer of 1964, and data concerning this experiment will be available at that time. (Dept. of Farm Crops, Oregon State Univ., Corvallis, Oregon).

* 5-bromo-6-methyl-3-phenyluracil

** 3-cyclohexyl-5,6-trimethyl-eneuracil

<u>Chemical control of Canada thistle (Circium arvense).</u> Alley, H. P., and Chamberlain, E. W. Further evaluation of treatments applied June 30, 1961, when Canada thistle was in the late bloom stage indicated that 2 years after treatment fenac at 20 lb/A and benzabor (borate-benzoic acid mixture) at 1 1/2 lb/sq.rd. had maintained 100% control. TBA at 20 lb/A, Fenac at 10 lb/A, and 2,4-D butyl ester at 4 lb/A gave 95% control 2 years following treatment. Dicamba at 10 and 20 lb/A gave 100% control 1 year after application but in 1963 a 20 and 40 percent reinfestation, respectively, had occurred. This suggests that dicamba may be a very good short term soil sterilant.

Treatments applied to Canada thistle July 16, 1962 and evaluated in 1963 indicated that dicamba at 5 lb/A was as effective as 10 lb/A one year after application. Fourteen months after applicationboth treatments had given 100% control.

Dicamba was applied to Canada thistle regrowth October 1, 1962 at 1 and 2 lb/A. Readings in July 1963 indicated that 1 lb/A gave 80 percent control and 2 lb/A controlled 90 percent of the established stand. (Wyoming Agricultural Experiment Station, Univ. of Wyoming, Laramie).

<u>Control of Canada thistle with 4-amino-3,5,6-trichloropicolinic acid and dicamba.</u> Hodgson, Jesse M. Dicamba at 5 pounds per acre or more has given almost complete elimination of Canada thistles in replicated plot trials at Bozeman, Montana, during the past three seasons. In June 1962 the potassium salt of 4-amino-3,5,6-trichloropicolinic acid (Tordon)1/was applied to Canada thistle infesting winter wheat at various rates in a replicated trial. Evaluation of these plots 13 months after treatment showed that control was 66, 85, 98, and 99% for rates of 1/4, 1/2, 1 and 2 pounds per acre, respectively, by this chemical.

An experiment to compare these two herbicides for control of Canada thistle was begun in 1963. Four rates of both chemicals were applied to Canada thistles at the early bloom stage of growth on July 2. Plots,

1/Tordon is a company name which is included for the benefit of the reader and does not infer any endorsement or preferential treatment of the product listed by the USDA.

one square rod in size, were located in a noncropped field infested with a fairly uniform stand of Canada thistle. The chemicals were applied in 40 gallons of water per acre with a small portable compressed air sprayer.

Evaluation of these plots four months after the treatment showed no regrowth of Canada thistle after Tordon at 1/4, 1/2, 1, or 2 pounds per acre. Regrowth was 6, 17, 17, and 1% after dicamba treatment at 1/4, 1/2, 1 and 2 pounds per acre, respectively.

Tordon has shown considerable promise for control of Canada thistle. From these preliminary results, it appears more effective than dicamba at low rates of 1/4 to 1 pound per acre. (Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture; and Plant and Soil Science Department of the Agricultural Experiment Station, Bozeman, Montana.)

Russian knapweed control. Killinger, L. L. and Cords, H. P. These studies began in June, 1962. Ten materials were applied with a variable dosage (logarithmic) plot sprayer. Included were four formulations of 2,4-D (amine, emulsifiable acid, and two low volatile esters, one of which was a high detergent formulation) emulsifiable acid 2,4,5-T, silvex ester, amitrole, amitrole-T, 2,3,6-TBA and dicamba. The initial rates varied from 80 lb/A (2,4-D LV ester) to 10 lb/A (2,4,5-T) and final rates from 4 lb/A (TBA) to .4 lb/A (dicamba), generally covering the expected effective rates with a generous overlap on both heavy and light sides.

In the fall, a second series of plots was sprayed at the original location near Lovelock, Nevada, and another series was sprayed in the Pahrump Valley in southern Nevada. New materials in these trials included fenac, erbon, and monuron TCA at Lovelock, and two additional 2,4-D formulations at Pahrump Valley. Only the most promising materials were sprayed at Lovelock, while all of the materials included in the spring Lovelock trial were repeated at Pahrump Valley.

In general, 2,3,6-TBA and its analogues were the only really successful chemicals, with dicamba outstanding. One year after treatment, apparent erradication was achieved at 2 to 4 lb/A when this herbicide was applied either in the spring or fall. The fall applications were strictly soil applications since the top growth had been removed prior to treatment. Fifteen to 20 lb/A of TBA were generally required for similar results and, in some instances, 40 lb/A of TBA did not result in erradication. Later, considerable regrowth appeared in all areas except where the heaviest rates of dicamba had been applied. Evidently one year is not long enough to wait when evaluating results on Russian knapweed.

Residual toxicity studies show considerable toxicity remaining in dicamba treated soils at rates as low as 1.25 to 2.5 pounds per acre 18 months after treatment. Consequently, this material should not be applied when seeding is contemplated within two years after treatment. (Nevada Agric. Exp. Sta., University of Nevada, Reno, Nevada).

Four year evaluation of soil sterilants for control of Russian Knapweed (*Centaurea repens*). Alley, H. P. and Chamberlain, E. W. An evaluation in 1963 of treatments applied on Russian knapweed at the early bud stage June 23, 1959 at Laramie, Wyoming showed that 29 out of the 53 initial treatments had controlled 100 percent of the established stand of Russian knapweed and not one of these plots had new knapweed seedlings growing in them. The four year summary of these results are listed in the table below.

The plots treated with fenac, 2,3,6-TBA, benzabor (borate-benzoic acid mixture), and heavy rates of 2,4-D amine were outstanding in their control of Russian knapweed, as well as showing a complete recovery of grass species. Grasses found growing in these plots were western wheatgrass, alkali sacatan, and Kentucky bluegrass. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Chemical control of Russian Knapweed (*Centaurea repens* L.) 1959 - 1963.

Chemical	Rate 1/	Percent Control 2/ 1960	1961	1962	1963
Fenac Powder	5#/A	90	99	98	98
Fenac Powder	10#/A	100	99	100	100
Fenac Powder	20#/A	100	99	100	100
Fenac Liquid	5#/A	100	99	99	100
Fenac Liquid	10#/A	100	100	100	100
Fenac Liquid	20#/A	100	100	100	100
ATA	8#/A (40 gal H_2O)	50	0	50	40
ATA	8#/A (200 gal H_2O)	50	0	50	40
TBA	5 gal/A	95	100	100	100
TBA	10 gal/A	100	100	100	100
Amitrol-T	4#/A	75	50	0	0
Amitrol-T	8#/A	50	0	0	0
Weedone 638	1½#/A	50	50	50	50
Weedone 638	3#/A	75	90	85	90
Simazine	20#/A	25	85	50	60
Simazine	40#/A	25	90	100	100
Atrazine	20#/A	50	95	100	100
Atrazine	40#/A	50	98	100	100
Benzabor	3/4#/sq.rd.	100	99	100	100
Benzabor	1½#/sq.rd.	100	100	100	100
Ureabor	6#/sq.rd.	25	100	100	100
Ureabor	4#/sq.rd.	25	100	100	100
D.B. Granules	3.3#/sq.rd.	90	60	75	75
D.B. Granules	6.6#/sq.rd.	100	99	90	85
Atlacide+15% 2,4-D	5#/sq.rd.	100	100	100	100
Atlacide+15% 2,4-D	10#/sq.rd.	100	100	100	100
Atlacide+6% 2,4-D	5#/sq.rd.	100	99	100	100
Atlacide+6% 2,4-D	10#/sq.rd.	100	100	100	100
Chlorea Gran. 1	6#/sq.rd.	100	100	100	100
Chlorea Gran. 1	9#/sq.rd.	100	100	100	100
Chlorea Gran. 3	3#/sq.rd.	90	100	100	100
Chlroea Gran. 3	4½#/sq.rd.	100	100	100	100
Urox Liquid	14½ gal/A	90	100	100	100
Urox Liquid	22 gal/A	90	100	100	100
Urox Granules	2#/sq.rd.	50	100	100	100
Urox Granules	3#/sq.rd.	50	100	100	100
Urab	6 gal/A	90	100	90	90
Urab	9 gal/A	75	100	98	95
2,4-D Powder	2#/A	50	0	0	0
2,4-D Powder	4#/A	50	50	30	25
2,4-D Amine	2#/A	50	50	30	25
2,4-D Amine	4#/A	50	50	50	50
2,4-D Amine	20#/A	90	80	80	80
2,4-D Amine	40#/A	95	99	96	96
2,4-D Amine	80#/A	100	100	96	96

Continued:

Chemical	Rate 1/	Percent Control 2/ 1960	1961	1962	1963
Garlon	6 gal/A	25	0	0	0
Garlon	9 gal/A	25	0	0	0
Fenuron pellets	1#/sq.rd.	50	100	100	100
Fenuron pellets	2#/sq.rd.	50	100	100	100
Diuron	¼#/sq.rd.	50	0	0	0
Diuron	½#/sq.rd.	50	0	0	0
Monuron	¼#/sq.rd.	50	90	90	90
Monuron	½#/sq.rd.	70	100	100	100

1/ Rate is expressed in lbs. of active ingredient per acre unless otherwise indicated.

2/ Percent control is an average of three replications.

Results of logarithmic dilution treatments on Russian knapweed — 1963. Ames, G. D. Several growth regulator type herbicides were evaluated 6-27-63 for effectiveness in eliminating Russian knapweed. Application was made 9-23-62 by logarithmic dilution sprayer as a 20 gallon per acre foliage spray. The knapweed patch was located in the middle of a dry-land winter wheat field and was sprayed in the fall of the summer fallow year. The density was such as to discourage incorporation of this area into field operations. The results are shown in the table as percent ground cover of adjacent check plot readings. There was considerable reduction in plant vigor by amitrole, 2,3,6-TBA and amitrole 2,4-D treatments which does not show in the percent ground cover method of reporting.

Applications on Russian knapweed 11-16-60 of 2,3,6-TBA and 2,4-D in the Blackfoot, Idaho area produced nearly complete eradication by 8-1-61 at herbicide doses as low as 5 and 10 lbs. per acre respectively.

In view of the results reported here, and other reports and observations, considerable variation in influencing environmental conditions, methods of application, and/or formulations are probable and effort should be made toward evaluation of these. (U. of I., Tetonia Br. Exp. Sta., Box 72, St. Anthony, Idaho.)

Logarithmic dilution plots on Russian knapweed, treatments applied 9-23-62

Treat-ment	Chemical	ppg	initial dosage ppa	pounds per acre 100	50	25	10	*
				% of check as grd. cover				
A.	2,4-D diethanol amine	4	50	0	25	46	27	13
B.	2,4,5-T triethanol amine	4	50	0	0	46	80	11
C.	2,4,5-T (LV)	4	50	7	12	15	33	4
D.	Amitrole	50% a.i.	40	33	62	54	67	
E.	2,3,6-TBA diethanol amine	2	25	96	100	100	100	--
F.	amitrole (constant)	-	4	---	---	---	---	--
	2,4-D (variable)	-	20	100	100	100	100	--
G.	2,4-D butoxyethanol ester	-	50	0	0	100	100	13
H.	2,4,5-T ethylene glycol ester	6.1	50	0	0	53	100	13

* pounds per acre at the lowest point judged to provide adequate control reading taken 6-27-63.

Chemical control of black knapweed (Centaurea nigra L.) in western Oregon. Fechtig, Allen D. and Furtick, W. R. Although black knapweed is not presently a serious problem in western Oregon, a program has been initiated to gain information which might be helpful in eradicating this particular species before it becomes well established.

Two replications of a completely randomized block with plots 10' x 30' were sprayed with a field plot sprayer. The plots were sprayed on a sunny day with the air temperature at 85° and a wind velocity of 0 mph. The volume of water used for each application was approximately 34 gallons per acre.

The plots were evaluated five monts after the date of application. Of the compounds evaluated, namely isocil, bromacil, atrazine, Tordon, dicamba, 2,4-D (75w), 2,4-D (LVE), 2,4-D amine, 2,4-D solubalized acid, and 2,4-D emulsifiable acid, all of the 2,4-D materials at the rate of 1.3 pounds per acre gave 100 per cent control of this species. Dicamba and Tordon at ½ pound active material per acre were also responsible for 100 per cent control. The other three materials did not indicate any activity at rates up to and including 5.6 pounds of active material per acre.

These plots will be re-evaluated during the spring of 1964 to determine any residual effect in controlling new germinating seeds. (Dept. of Farm Crops, Oregon State University, Corvallis.)

Field bindweed control. Appleby, Arnold P. Three experiments were established in August of 1962 to test various herbicides for the control of field bindweed (Convolvulus arvensis). In all cases the land was in summer fallow and had been tilled until approximately July 1. At that time the bindweed was allowed to emerge and was in the early bloom stage at the time of application. Either wheat or barley was seeded across the experimental area at each location. Bindweed control and crop injury were rated July, 1963.

Of the soil sterilant-type materials for field bindweed control, 2,3,6-TBA performed most consistently and had the addition advantage of allowing a considerable amount of grain growth for ground cover. While Tritac performed quite well under certain circumstances, it was much more damaging to the grain and left the soil more exposed to wind and water erosion. Dicamba at high rates was comparable to TBA in certain instances but appeared to be somewhat less consistent in its performance. MCPA amine at rates of 30 and 40 pounds per acre was quite inconsistent and probably will not be considered further for bindweed control.

Results from low cost materials for field-wide application were quite variable from one location to the next. 2,4-D amine at the recommended rate of 3 pounds per acre performed equally well or better than did MCPA amine at the same rate. The emulsifiable acid and the oil-soluble amine of 2,4-D showed an advantage over the water-soluble amine at one location, showed no difference at a second location, and showed a disadvantage at the third location. Taking cost into consideration, it appears that the three pound rate of 2,4-D amine performs just as consistently as any other formulation of 2,4-D. (Oregon Agric. Exp. Stat., Oregon State Univ., Corvallis)

Control of field bindweed (Convolvulus arvensis). Alley, H. P. and Chamberlain, E. W. The 1963 readings on plots established June 27, 1961 show that TBA at 5 lb/A gave 90 percent control and dicamba at 5 and 10 lb/A gave 60 and 70 percentrol, respectively. The percent control obtained with dicamba was less than the previous year again indicating its short residual life in the soil.

On plots established June 28, 1962 and evaluated in 1963, TBA at 8 lb/A and dicamba at 10 lb/A gave 100% control 1 year after application. TBA at 2 lb/A and 2,4-D amine at 3 lb/A gave 95% control of the established stand.

Treatments applied October 4, 1962 on field bindweed regrowth were evaluated in June 1963. A combination of dicamba and dacamine (Balcom Industries) gave 98 percent control. Other effective treatments were 2,4-D LVE at 2 lb/A (93 percent control), dicamba at 1 and 2 lb/A (87 and 89 percent control respectively), fenac at 4 lb/A (88 percent control), and TBA at 2 and 4 lb/A (90 and 95 percent control respectively). (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Variation in leafy spurge strains. Baker, Laurence O. and Duane R. Arneklev. Root pieces of leafy spurge were collected from locations in Canada, Colorado, Idaho, Montana, North and South Dakota, and Wyoming.

Roots from each collection source were designated as a strain. These were propagated in the greenhouse, transplanted to cans 7 inches in diameter by 36 inches in length, and placed below ground level in the field.

Leaf length and width and plant height differed as much as 100% among the various strains. Differences were also observed in length of internode, length of internode, length of peduncle, number of shoots branching, rate of early spring growth, time of first bloom, amount of root growth, and degree of winter dormancy. Well established plants of each strain were treated with 2,4-D, amino triazole, and Tordon. Topkill was uniformly rapid and differed from plants treated with 2,4-D in the greenhouse where visual rating of topkill and the rapidity of regrowth both indicated differential tolerance.

The following conclusions were made from greenhouse and lab studies:

1. Both foliage and soil treatments of gibberellic acid caused increased shoot growth.

2. Plants which appeared to be more susceptible to the killing action of 2,4-D usually showed greatest response to gibberellic acid.

3. There was no apparent advantage to using gibberellic acid as a pre-treatment for 2,4-D application.

4. No differences in the amount of leaf cuticle were found between strains.

5. Stomata numbers on different strains were found to fluctuate both within and between strains.

6. Neither cuticle thickness nor the number of stomata on leaf surfaces appeared to be important in determining the response of the strains to 2,4-D. (Montana Agriculture Experiment Station, Bozeman).

Leafy spurge control with soil sterilants. Guenthner, H. R. and Baker, L. O. Eleven herbicides were applied on May 13, 1959 on a stand of leafy spurge (Euphorbia esula) located on a non-cropped area. Plots were evaluated primarily for leafy spurge control and also to determine the residual control over a long period of time. The only other vegetation present was a uniform stand of downy brome grass (Bromus tectorum).

Five years after application atrizine at 60 lbs/A was the most effective in controlling both the leafy spurge and downy brome. Ureabor applied at 2.33 lbs/100 sq. ft. provided a reasonably good control of the leafy spurge. The following table presents the results obtained from 1959--1963:

(Table on following page)

Treatment	lb/A (active)	Degree of leafy spurge control 1959	1960	1961	1962	1963
simazine	60	3	7	5	7	7
monuron	60	9	10	9	8	8
fenuron	60	10	10	10	9	8
atrazine	60	9	10	10	10	10
urox	60	5	5	3	5	6
chlorea	4 lb/100 sq.ft.	7	7	3	5	1
ureabor	2.33 lb/100 sq.ft.	8	8	8	9	9
2,3,6-TBA granules	15	7	7	9	5	2
" "	20	8	8	8	5	3
DB granular	1 lb/100 sq.ft.	9	7	3	4	1
" "	2 lb/100 sq. ft.	10	8	5	5	4

* Rating is from 0 to 10 with 10 representing complete control. (Montana Agricultural Experiment Station, Central Montana Branch, Moccasin)

Control of povertyweed (*Iva axillaris*). Harris, G. K. and Cords, H. P. A number of herbicidal trials have been set out during the past two seasons for the control of povertyweed. Some of these were at Battle Mountain, Nevada and some at Reno. Those at Battle Mountain were on the community pastures of the Pershing County Water Conservation District. This area was formerly irrigated and large crops of bluejoint (*Elymus triticoides*) hay harvested. Today, the bluejoint stand is being invaded by povertyweed because of the drier conditions prevailing now. At Reno, the plots are in a saline-sodic soil area of the Main Station Field laboratory. The field is not in cultivation and is not irrigated at the present time.

At Battle Mountain, various 2,4-D formulations, dicamba, 2,3,6-TBA and amitrole were applied with a variable dosage plot sprayer at continously varied rates ranging from 80 lb/A to 0.8 lb/A for the PGBE ester of 2,4-D, from 40 lb/A to 0.4 lb/A for dicamba, from 40 lb/A to 4 lb/A for 2,3,6-TBA and from 20 lb/A to 2 lb/A, for all the other materials. All were effective where there were good stands of bluejoint, producing virtually 100 percent reduction in povertyweed at all but the lowest rates. In areas with no bluejoint or where bluejoint stands were poor, kills were poor except at the higher rates of 2,3,6-TBA and dicamba. In the case of the latter chemical, the higher rates drastically thinned the bluejoint stands. This was true also, but to a lesser degree, for the higher rates of 2,3,6-TBA.

At Reno, most of the same chemicals plus a few others were applied in December in soil sterilant applications. Under these conditions, without competing vegetation, the only effective chemicals were dicamba and 2,3,6-TBA. Results are given in the table below. (Nevada Agricultural Experiment Station, University of Nevada, Reno.)

No. of povertyweed plants per square foot

lb/A	dicamba	2,3,6-TBA	2,4-D	fenac	erbon
62.4	-	-	8.3	-	-
48.0	-	-	10.0	-	-
36.8	-	-	5.3	-	-
31.2	0	0	-	4.3	17.6
28.4	-	-	6.0	-	-
24.0	0	0	-	8.3	12.6
22.0	-	-	8.0	-	-
18.4	0	0	-	10.0	23.6
16.8	-	-	12.6	-	-
14.2	0	0	-	7.6	17.0
12.8	-	-	12.6	-	-
11.0	0	0	-	11.0	15.6
10.0	-	-	12.5	-	-
8.4	0	1.6	-	16.6	19.3
6.4	1.0	8.0	-	13.3	10.0
5.0	1.3	7.6	-	12.3	17.6

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<u>Tansy ragwort (Tanacetum vulgare) control with organic chemical compounds</u>. Fechtig, Allen D. and Furtick, W. R. With an increase in the number of acres infested with this perennial species, and the annual loss of cattle due to poison from this weed, an extensive research project was initiated to determine the effective control of a number of different compounds. An area primarily infested with tansy ragwort seedlings, and an area with the majority of the tansy plants in the rosette stage were sprayed with a number of compounds showing herbicidal activity.

A separate trial consisting of one plot each of 2,4-D amine at 2 pounds active material per acre, and Tordon and dicamba at the rate of 1/2 pound active material per acre were treated, and an additional plot was left untreated. These plots were established so that the seed could be collected and germination studies conducted at a later date.

The compounds which exhibited the most activity on this particular species were Tordon and dicamba at 1/2 pound active material per acre. This rate gave from 90-93 percent control of the tansy plants. A one pound application of Tordon gave complete eradication while 1 and 2 pound rates per acre of Banvel D showed no increase of activity. Dacamine D at the rate of 1 1/2 pounds per acre gave 95 percent control while 2,4-D amine, 2,4-D ester, and 2,4-D (75 W) at comparable rates were less effective. Bromacil at the rate of 5 pounds per acre active ingredient gave 100 per cent control while isocil at 10 pounds per acre showed no activity.

Four replications of 100 seeds per rep of the tansy previously treated with 1/2 pound per acre of Tordon and dicamba, and 2 pounds per acre of 2,4-D amine were germinated to determine the effectiveness of the various compounds by inhibiting seed germination. Seeds from the check plot had a germination of 86 percent, while the seeds from the area treated with 2 pounds of 2,4-D amine were reduced to 24 percent. However, the plots which had received 1/2 pound per acre of Tordon and dicamba germinated only 2 percent. (Dept. of Farm Crops, Oregon State University, Corvallis.)

Chemical control of curly dock (Rumex crispus L.) Fechtig, Allen D., and Furtick, W. R. The primary objective of this experiment was to evaluate a number of chemical compounds in controlling dock. Since dock is a serious perennial weed species in many of the wet pasture, hay, and seed-producing fields in western Oregon, particularly in Clatsop County, information concerning a chemical means for control of this species was evident.

A completely randomized block design was employed to evaluate eight different compounds. Three replications of 10' x 40' plots were sprayed with a field plot sprayer. At the time of application the dock plants present were in various growth stages ranging from small seedlings to plants in the early bud stage. The plots were sprayed on a sunny day with a temperature of 55° and a wind velocity of 0-3 mph. A water volume of approximately 34 gallons per acre was used to apply the various compounds.

The plots were evaluated after three months for initial control of this perennial species. Only one of the compounds which had originally been applied was effective in controlling the dock population. This compound was Tordon at 1/2 pound per acre of active material; higher rates of this material up to 4 pounds per acre gave comparable results. The compounds that were tested are as follows: 2,4-D amine, 2,4-D ester, 2,4-DB amine, MCPB, dicamba, carbyne, isocil, tritac and atrazine. Final evaluation of this trial will not be conducted until late spring or early summer of 1964. (Dept. of Farm Crops, Oregon State University, Corvallis.)

Control of perennial smartweed in Astoria bentgrass. Fechtig, Allen D. Perennial smartweed (Polygonum punctatum) is found primarily in extremely wet areas. This species is a very serious problem in pastures, hay fields, and in grass seed-producing fields. An attempt has been made to determine the attributes of three chemical compounds in controlling this species.

Three replications were sprayed with a field plot sprayer on a sunny day, with an air temperature of 78° and a wind velocity of 0-3 mph. The water volume used for applying these compounds was 34 gallons per acre. The three compounds which were evaluated were Tordon, dicamba, and 2,4-D amine. Tordon at 1/2 pound per acre appeared to control the perennial smartweed at approximately 45 percent on the plots which had been sprayed 3 months previously. Rates of 1 pound and 2 pounds per acre of this material gave 55 and 65 percent weed control, respectively. Dicamba was less effective than Tordon in controlling this perennial weed. At rates of 1/2, 1 and 2 pound of active material per acre the percent control was 5, 20, and 63 percent respectively. A two-pound application of 2,4-D amine proved to be only a 35 percent effective control measure, and serious invasion from small plants was evidient at the end of three months. A re-evaluation of the effectiveness of the various compounds on controlling perennial smartweeds is scheduled for the current season. (Dept. of Farm Crops, Oregon State University, Corvallis.)

Control of bracken fern (Pteris aquilina L.) in western Oregon by employing the use of organic compounds. Fechtig, Allen D., and Furtick, W. R. Bracken fern has invaded thousands of acres of timber-cut areas, and is an increasingly serious problem in many of the pastures. Although the foliage of this deep-rooted perennial dies completely back in the winter, its vigorous growth in the early spring tends to eliminate any grass or legume species in pastures, as well as many of the young tree seedlings on the tree plantations. This research experiment was initiated to determine the effectiveness of a number of compounds showing herbicidal activity and to establish optimum rates for the various compounds that proved effective for controlling bracken fern. Twelve different compounds showing herbicidal activity were applied to each of two different locations of completely randomized blocks, with plots 10' x 40', on an extremely cloudy day with the wind velocity at 0-3 mph and the air temperature at 59°. The plots were sprayed with a field plot sprayer, and a volume of 34 gallons per acre was used to apply each of the compounds. The percent initial control of bracken fern in the plots was evaluated six months after the date of application. Additional evaluations will be made during the current year.

Two of Pennsalt Chemical Company's compounds, TD 191* and TD 282**, at four pounds per acre gave approximately 45 percent control. Ammate at three pounds per square rod was comparable in control to the two Pennsalt compounds. Amitrole-T at four pounds per acre was also responsible for approximately 45 percent bracken fern control, while higher rates of this material at 8 pounds and 16 pounds per acre gave 70 and 85 percent control, respectively. A four pound application of Banvel D and of Tordon was responsible in each instance for a 50 percent initial control of this species, while an eight pound application of each of these materials gave 70 percent control. Isocil was extremely effective in controlling this species. A 5 pound application gave 80 percent control, while a 10 and 15 pound application gave 96 and 98 percent control, respectively. The highest rate of bromacil tested was four pounds per acre which proved to be only 65 percent effective. Four other compounds which were evaluated but which failed to show good herbicidal activity on this particular species were Tritac at 30 pounds per acre, MH 30 at 12 pounds per acre, prometone at 16 pounds per acre, and borascue at 12 pounds per square rod. The inefficiency of the borascue to show any activity was probably due to a delayed date of application. (Dept. of Farm Crops, Oregon State University, Corvallis.)

Chemical control of horsetail rush (Equisetum arvense). Fechtig, Allen D., and Furtick, W. R. A number of organic compounds which have shown herbicidal activities in the past were applied to several horsetail rush plots to evaluate their effectiveness on this particular species.

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* TD 191 - mono-N,N-dimethylcocoamine salt of 3,6-endoxohexahydrophthalic acid.

** TD 282 - Pensalt Experimental.

Each of two locations was arranged in a completely randomized block design with individual 10' x 40' plots. These plots were sprayed with a field plot sprayer, and a volume of approximately 34 gallons of water per acre was used. The climatic conditions were as follows: sunny, 0 mph wind, and an air temperature of 85°. The horsetail plants were approximately 10" - 16" high when the chemicals were applied.

The plots were evaluated approximately four months after the date of application to determine the percent control of horsetail for the various compounds. Rates of 1, 1, and 2 pounds per acre of active ingredient of Tordon, dicamba, and amitrole-T, respectively, gave excellent initial control of this particular species. However, the true effectiveness of these compounds will not be known until these plots are re-evaluated in 1964. Use of higher rates of dicamba and amitrole-T showed a slight increase in the control of this species, while the one pound application of Tordon gave 100 percent control. A 20 pound application of isocil per acre was approximately 85 percent effective in controlling this species. Three of Monsanto Chemical Company's experimentals, CP 42718*, CP 43659*, and CP 44176* at rates up to 10 pounds per acre were ineffective. (Dept. of Farm Crops, Oregon State University, Corvallis.)

<u>Chemical control of purple nutsedge (Cyperus rotundus L.)</u>. Anderson, W. P., Whitworth, J. W., and Mccaw, Larry. Of the eight herbicides applied in August 1962, only R-4461 (Betasan) and Eptam have shown sufficient long-term control of nutsedge to warrant continued testing, based upon evaluations during 1963. Essentially 100% control of nutsedge has been obtained from application of 10 and 20 lbs/A ai of R-4461. However, subsequent application at another location during the summer of 1963 have not appeared as promising. Eptam, at rates of 5 and 10 lbs/A ai, has given about 50% control of nutsedge and repeat applications are essential for continued control. Extensive field and laboratory research is currently underway to verify the potential of R-4461 for the control of nutsedge.

The following six herbicides were also applied in August 1962, but did not effectively control nutsedge, based upon evaluations during 1963: R-1607, PEBC, dichlobenil, H-82, diuron, and trifluralin.

Each of these materials was applied August 31, 1962, and incorporated into the soil by double-discing. The area was then flood-irrigated and subsequent watering has been by flood-irrigation. (New Mexico State University, Agricultural Experiment Station, University Park, New Mexico.)

<u>Response of established clumps of six strains of Johnsongrass to repeated applications of dalapon</u>. Hamilton, K. C. The response of Johnsongrass (<u>Sorghum</u> <u>halepense</u> (L.) Pers.) to grower application of 2,2-dichloropropionic acid (dalapon) has been erratic in Arizona. This test was conducted in 1962 to determine the effects of two rates of dalapon on six strains of established Johnsongrass in the field.

Johnsongrass strains were collected in 1960 and have been increased and maintained vegetatively by periodic clipping to prevent seed production and applications of 3-(3,4-dichlorophenyl)-1,1-dimethylurea to the soil to prevent seed germination. During 1961 the relative susceptibility to

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* Monsanto Experimental.

dalapon of established Johnsongrass clumps of these strains were determined in the field. In these tests strains W20, E8, and W15 had some resistance and strains E1, E16, and W3 were susceptible to dalapon.

In April of 1962, 48 rhizome segments (10 to 20 nodes with at least one active bud) from one parent plant of six strains were space planted in a randomized complete block design with 12 replications. After transplants were established, 36 uniform plants were selected in each strain and maintained vegetatively by periodic mowing.

On 7/18, clumps were 10 to 16 inches high and averaged 50 stems per plant, the first dalapon applications were made. Plants with topgrowth were treated again on 8/26 and 9/24. The spray solution, containing .74 lb of dalapon in 5 or 10 gallons of water with 2.4 ml of "Colloidal X-77", a blended surfactant, per gallon, was applied to thoroughly wet the foliage and stems.

Two to three days after treatment topgrowth on all plants was removed. After three to four weeks the number of plants with topgrowth, number of stems per growing plant, and length of longest stem on growing plants were determined. Data on plants with topgrowth and stems per plant are summarized in the Table.

Johnsongrass strains differed significantly in their response to foliar applications of dalapon. Topgrowth and rhizomes of strain E16 were destroyed by a single application. The number, height, and stems per plant of other strains were reduced but no other strain had all plants killed by three dalapon treatments. Strain E1 appeared more resistant to dalapon in 1962 than in 1961. The response of other strains were similar in both years.

The lower rate (.74 lb in 10 gal of water) of dalapon was as effective as the higher rate (.74 lb in 5 gal of water) in over-all control of the six strains of Johnsongrass. After two treatments, strain W15 had significantly more and longer stems on plants treated at the higher rate. However, after the third treatment regrowth on this strain was similar for the two dalapon treatments. (Arizona Agri. Expt. Sta., University of Arizona, Tucson.)

Regrowth from established clumps of Johnsongrass following applications of dalapon.

Date measured	Treatment lb dalapon in gal water	W20	E8	W15	E1	E16	W3
		Johnsongrass Strains					
		Plants with topgrowth					
8/22	Check	12	12	12	12	12	12
	.74-10	12	11	12	8	0	3
	.74- 5	10	11	11	6	0	2
9/24	Check	12	12	12	12	12	12
	.74-10	11	10	11	9	0	2
	.74- 5	10	8	12	4	0	0
10/23	Check	12	12	12	12	12	12
	.74-10	11	10	8	9	0	3
	.74- 5	6	5	10	8	0	3
		Number of stems per growing plant					
8/22	Check	41	57	45	58	58	40
	.74-10	19	24	16	9	0	9
	.74- 5	16	12	21	8	0	4
9/24	Check	55	72	63	78	77	66
	.74-10	21	17	7	9	0	3
	.74- 5	14	23	15	7	0	0
10/23	Check	48	64	68	71	59	50
	.74-10	18	6	10	8	0	7
	.74- 5	10	2	11	9	0	10

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The effect of dalapon, isocil, and surfactant combinations on bermudagrass. Lange, A. H., Sisson, R. L., Halsey, D. D., and Bayer, D. E. Combinations of two herbicides with and without several surfactants were sprayed on Bermuda grass growing in two widely different environments, ie. the hot, dry Coachella Valley and a small, cool coastal valley at Asti in Sonoma County, California. The initial effects of dalapon and surfactant were generally better than dalapon alone, particularly in the more humid coastal valley (Table 2). The increase in activity resulting from adding a surfactant to isocil was generally less than with dalapon. Tween 20 was probably the most effective surfactant with dalapon in both locations (Tables 1 and 2). Tween 20, Vatsol-OT, Surfactant WK, Colloidal X-77, Tergitol TMN, and Triton X-100 were about equal when applied with dalapon. (Department of Botany, University of California, Davis)

Table 1. The effect of herbicide and surfactant combinations on desert Bermuda (Indio, California, 7/26/63).

Average[1/] percent effect

Surfactant	None	Dalapon 5 lb/A	Dalapon 10 lb/A	Isocil 2 1/2 lb/A	Isocil 5 lb/A
None	4	31	50	30	41
Colloidal X-77	--	35	--	39	--
Tergitol TMN	--	29	--	--	--
Quaternary O	--	35	--	--	--
Vatsol-OT	--	30	--	--	--
CH_3-Cellulose	--	34	--	--	--
Tween 20	--	44	--	--	--
Surf. WK	--	38	--	39	--

1/ Average of 4 replications and two separate ratings (0 = no effect, 10 = 100% apparent kill, ie, complete brown and dry condition with no green showing). These ratings were made 2 and 11 weeks after applicating.

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Table 2. The effect of herbicide and surfactant combinations on coastal Bermuda (Asti, California, Sonoma County, 9/13/63).

Average[1/] percent effect

Surfactant	None	Dalapon 5 lb/A	Dalapon 10 lb/A	Isocil 5 lb/A	Isocil 10 lb/A
None	16	37	42	43	36
Colloidal X-77	--	62	--	48	--
Tergitol TMN	--	63	--	47	--
Triton X-100	--	62	--	46	--
DuPonal	--	49	--	54	--
Vatsol-OT	--	70	--	66	--
Tween 20	--	68	--	42	--
Surf. WK	--	68	--	44	--

1/ Average of 4 replications and two separate ratings (0 = no effect, 10 = 100% kill, ie. complete brown and dry condition with no green showing). These ratings were made 4 and 6 weeks after application.

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PROJECT 2. HERBACEOUS RANGE WEEDS

W. C. Robocker, Project Chairman

SUMMARY

Of nine reports submitted under this project, four are concerned directly or indirectly with control, production, or utilization of medusahead. Other reports are concerned with the continuing problems of tall larkspur, prickly pear cactus, and selective control of weeds on annual type rangelands.

Experiments with tall larkspur (Delphinium occidentalis). Baker, Laurence O. Tall larkspur on an open, grassy, west exposure, at an elevation of about 6500 feet has been treated with formulations of 2,4-D, 2,4,5-T, silvex, 2,3,6-TBA, DB granular, amitrole, and other chemicals. Liquid and granular forms of several chemicals have been used. Both oil and water have been tested as carriers. Several surfactants have been included. Treatments have been made over a 6 year period with the larkspur plants ranging from 4 to 30 inches in size during the various years. All treatments are made in triplicate to rod square plots. Plant counts are made on each plot just before treatment.

Larkspur vigor is greatly reduced by 2 or 3 annual spray treatments with 2,4,5-T or silvex, but in no case at this location has the stand been eliminated. A 2 pound per acre rate is only slightly less effective than 3 pounds. Oil has been no more effective than water as a carrier. It does have the advantage of being easy to see which plants were treated when making spot applications. Surfactants have not increased kills. Granular forms of 2,4-D, 2,4,5-T, fenac and 2,3,6-TBA have generally, but not always, given good results when placed in the crown of the larkspur plant. In heavy infestations it is hard to treat each plant. Amitrole and several s-triazines have been ineffective and/or have injured associated grasses excessively. Spray applications have been successfully made with knapsack sprayers and with a backpack mist blower.

Cutting at a 5 to 6 inch depth kills larkspur plants but not at a 2 to 3 inch depth. Spring, but not fall, roto-tilling has given satisfactory results.

Belt transects have been established, and together with greenhouse studies, indicate that tall larkspur establishes itself slowly. Seedlings do not grow beyond the cotyledon stage the first year. The second year only two or three small leaves are produced. Seed has been induced to germinate at temperatures below 55° F but only after chilling near freezing temperatures for 8 to 10 weeks. Established larkspur plants transplanted into gallon cans in the fall will not grow until they have been chilled, but not necessarily frozen, for 8 weeks or longer. (Montana Agriculture Experiment Station, Bozeman)

Chemical control of prickly pear cactus (Opuntia polyacantha) on Wyoming Rangeland. Alley, H. P. and Chamberlain, E. W. Data from treatments applied in the summer of 1961 and evaluated in June 1962

indicated that silvex was the most promising herbicide for prickly pear control in Wyoming. Large experimental plots (1 acre in size) were treated in June 1962 with silvex at 2 and 4 lb/A in 40 gal. of water per acre. Four plots were established, 2 plots received a mechanical treatment by use of a culti-packer before chemical application and two plots did not receive the mechanical treatment. The four treatments and the 1963 evaluation data are listed below:

Silvex at 2 lb/A without mechanical injury - 65 percent control

Silvex at 2 lb/A with mechanical injury - 90 percent control

Silvex at 4 lb/A without mechanical injury - 95 percent control

Silvex at 4 lb/A with mechanical injury - 99 percent control

(Wyoming Agricultural Experiment Station, University of Wyoming, Laramie.)

Paraquat for selective control of range weeds. Kay, Burgess L. Paraquat sprayed at 0.5 lb/A removed weedy annual grasses such as medusahead (*Elymus caput-medusae* L.), foxtail fescue (*Festuca megalura* Nutt.) and wild barleys (*Hordeum* spp.) from seedings of rose clover (*Trifolium hirtum* All.) and subclover (*T. subterraneum* L.) with only temporary damage to the clovers when applied at early growth stages during the period of slow growth in the winter. Paraquat applied under weed-free conditions reduced herbage yields of Lana woollypod vetch (*Vicia dasycarpa* Ten.) and Wimmera ryegrass (*Lolium rigidum* Gaud.) at three dates of application; neither herbage nor seed yield of rose or subclover was reduced. The addition of a surfactant further reduced herbage yields of ryegrass, and caused a reduction in rose clover yields, but did not affect yields of subclover or further reduce Lana vetch yields. Varying the concentration of the surfactant had no significant effect. (Department of Agronomy, University of California, Davis.)

Paraquat for competition control during seeding of annual ranges. Kay, Burgess L. Hardinggrass (*Phalaris tuberosa* L. var stenoptera (Hack.) Hitch.) was successfully established on a range severaly infested with medusahead (*Elymus caput-medusae* L.) without the aid of cultivation. Weeds (mostly medusahead) were controlled by spraying an eight inch band of paraquat ahead of the drill opener during the seeding operation. Excellent weed control persisted in this band for most of the growing season. Hardinggrass establishment was measured as the percent of twelve inch segments of row which had at least one plant when sampled during the second growing season. The rows sprayed with paraquat were 76% stocked compared to 3% on the unsprayed checks. A heavy litter appears to be essential to obtaining complete germination of weeds before spraying. Under conditions of moderate to light litter a second crop of weeds appears after the first weeds are killed. (Department of Agronomy, University of California, Davis.)

Effect of barban on rose clover, subclover, Lana woollypod vetch, and Wimmera ryegrass. Kay, Burgess L. Barban was applied to rose clover (*Trifolium hirtum* All.), subclover (*T. subterraneum* L.), Lana woollypod vetch (Vicia dasycarpa Ten.), and Wimmera ryegrass (Lolium rigidum Gaud.) at an early growth stage in response to seed producers questions regarding the use of this material to control wild oats (Avena fatua L.). Barban (1 lb/gal) was applied logarithmically to two replications of each species at rates beginning at 4 lb/A. The clovers and vetch showed little or no herbicide symptoms even at the 4 lb/A rate. Ryegrass was severely affected by rates above 0.5 lb/A. Associated weeds which were controlled to 1.5 lb/A were common chickweed (Stellaria media L.) and shepherds purse (Capsella bursa-pastoris L.). The growth stages at times of spraying and the effect of barban at 1 and 2 lb/A on forage yield are shown in the following table. Data are means of two replications.

Effect of barban on herbage yields

Yields, cwt/A dry weight

Species	Rose	Sub	Vetch
Growth Stage	1 1/2-2 trifoliate leaves	2-3 trifoliate leaves	1 1/2 in high 3-5 tillers 6-16 leaves
Check	50	60	59
Barban 1 lb/A	63	47	55
2 lb/A	67	58	67

(Department of Agronomy, University of California, Davis.)

Ecology and control of medusahead (Elymus caput-medusae subsp. asper?). Dahl, B. E., Hironaka, M. and Tisdale, E. W. Tests of seedling emergence and survival in small containers set out under field conditions were made with squirrel-tail (Sitanion hystrix) and Siberian wheatgrass (Agropyron siberiaum) in competition with uniform stands of medusahead. Seedling establishment of squirrel-tail was obtained in 41% of the containers, compared to 12.5% for the wheatgrass. These results confirm other observations of the ability of squirrel-tail to become established in stands of medusahead.

Environmental conditions favoring growth and site dominance by medusahead were investigated with 43 paired field plots, one of each dominated by medusahead and the other with little or none of this species. Cheatgrass (Bromus tectorum) was dominant on most of the latter plots. It appears that the major environmental differences between the paired study plots are edaphic. Soils on the medusahead plots are well developed with a heavy clay B horizon less than 18 inches from the surface. This clay horizon is either lacking on plots dominated by cheatgrass or is found at greater depth. Soils under medusahead plots have higher water holding capacities, are more slowly permeable, and have less air capacity than soils under cheatgrass plots. Data from one set of paired plots are given as an illustration:

Dominant Species	Inches of Available water (in 24")	Depth to Clay B	% non-capillary pores (aeration) Top 11"	11"-24"
Medusahead	4.7 "	11"	15%	0%
Cheatgrass	2.05"	33"+	16%	14%

Field germination and mortality rates of medusahead and associated species were recorded in detail on a site in Nez Perce County of northern Idaho from September, 1962, through December, 1963. Conditions were favorable for germination in the autumns of both years and most of the current seed of medusahead germinated by November 15. Seeds remaining after this date appeared to be dormant. Seed samples were collected from the spikes on November 5, 1962. Collections were made again on February 11, 1963, with one sample taken as before and a second one taken from seed lying on the ground. Laboratory tests made immediately after the second collection date, gave germination rates of 96 percent for the November 5 samples, while the February 11 collections gave only 4 percent for the seed head lots and 16 percent for seed from the ground. This behavior pattern is being studied further in 1963-64. (Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow)

PROJECT 3. UNDESIRABLE WOODY PLANTS

H. Gratkowski, Project Chairman

SUMMARY

The 34 abstracts published on the following pages were submitted by 20 authors from 9 western states. The large number of abstracts and the character and quality of the work most represent are heartening, for they seem to indicate an increasing tempo of research on undesirable woody plants and show a good distribution of available research time on all aspects of this project.

Absorption, Translocation, and Metabolism of Herbicides. Chemical and physiological studies by Norris, Freed, and Newton are providing basic information needed to control bigleaf maple in Oregon. In experiments with tagged herbicides, they determined that both formulation and molecular configuration affect absorption and translocation of herbicides in bigleaf maple. They also learned that the ring portion of 2,4-DB seems to be more mobile than that of other phenoxy herbicides, and concluded that the butyric herbicides may prove useful for species in which poor translocation is a problem.

This research should not only prove useful in controlling bigleaf maple. It also illustrates how chemical and physiological studies can lead to more effective methods for controlling other resistant brush species.

Phreatophyte Studies. The important field of phreatophyte control continues to occupy the attention of a number of investigators in Wyoming, Nevada, Arizona, New Mexico, and Texas. Comes and Timmons determined that fenuron pellets will control salt cedar when broadcast or applied in bands up to 11 feet apart. Hughes and Arle evaluated a variety of chemical and mechanical methods for controlling salt cedar in Arizona, New Mexico, and Texas; while Harris and Cords in Nevada studied the effect of immersion on survival of salt cedar.

Establishment of an especially noteworthy study to determine water use by phreatophytes on a 9,900-acre area in New Mexico is reported by Lowry. Results of this study should provide some of the much-needed quantitative data on benefits to be derived from phreatophyte control.

Herbicides in Farm, Range, and Forest Management. Pelleted fenuron and the sodium salt of 2,3,6-TBA produced good kills of alligator juniper when applied to the soil by Johnsen, who also tested herbicides as dessicants to prepare this juniper for burning. Nonemulsifiable monochloroacetic acid proved a good dessicant.

Davis found 4-amino-3,5,6-trichloropicolinic acid a promising chemical for brush control in Arizona. Newton also reported good results with this chemical on bigleaf maple in Oregon.

A large number of herbicides were evaluated on brush species by numberous investigators. Of the herbicides tested, the following were most effective: silvex on Gambel's oak (Jefferies); 2,4,5-T, Tordon, or amitrol-T on poison oak; Tordon on Himalaya blackberry; and Tordon or 2,4,5-T on gorse (Fechtig and Furtick); and 2,4-D on greenleaf manzanita (Gratkowski). Leonard reports the triethylamine salt of 2,4,5-T more effective than alkanolamine salts of 2,4-D on stumps of blue oak and California black oak. The stumps should be treated when fresh cut and left uncovered.

Spring application of atrazine at a rate of 4 lbs. ai per acre on herbaceous vegetation shows promise as a method to prepare sites for planting Douglas-firs in Western Oregon according to Newton. The herbicide may be applied before or after planting. He also reports that cacodylic acid and Tordon are effective herbicides for low cost chemical thinning of Douglas-fir. Both techniques should prove extremely useful in the Douglas-fir region of the Pacific Northwest.

Ecology of Brush Species. A series of experiments on varnishleaf ceanothus in Oregon were reported. These were part of an extensive autecological study of this species designed to learn whether silvicultural methods might be modified to restrict the spread of varnishleaf ceanothus on cuttings in the Douglas-fir region.

Effects of Formulation and Molecular Configuration on Absorption and Translocation of Some Phenoxy Herbicides in Bigleaf Maple Seedlings. Norris, Logan A., and Freed, V. H. Bigleaf maple seedlings, *Acer macrophyllum*, 10 inches high, were transplanted from the field and held in a cold room at 35°F. under an 8 hour day for four months. The seedlings renewed growth shortly after being placed in the 75°F. greenhouse under a 16 hour day. The plants were selected for treatment at random after an initial screening to reduce variation in vigor and size. The herbicides tested were C^{14} carboxyl labelled 2,4-D and 2,4,5-T, formulated as the acid, triethanol amine salt and isooctyl ester, and the isooctyl esters of 2,4-DP and 2,4,5-TP. Two thousand micrograms acid equivalent of herbicide was applied in 200 microliters of water containing .5% Tween 20, to two upper leaves. Seventy-two hours later, the treated leaves were washed with 80% isopropyl alcohol and the plant divided into the treated leaf, the current growth, including the leaves and the current stem growth, the old stem, and the roots. The materials were extracted with 80% isopropyl alcohol. The extracts were plated and counted with a thin window gas flow Geiger counter. The following results were observed:

Table I

Effect of Formulation on Absorbtion and Translocation

Chemical Formulation	Acid	2,4-D Triethanol amine	Isooctyl ester	Acid	2,4,5-T Triethanol amine	Isooctyl ester
Number of Plants	2	3	4	2	3	3
Average % Absorbed	2.91	1.67	20.83	2.35	.71	16.49
Average % of the Absorbed Activity in the Treated Leaf	77.04	68.81	95.36	71.34	62.03	95.94
New Growth	10.01	17.40	2.64	21.42	17.57	2.15
Stem	8.06	9.74	1.36	6.52	7.53	0.63
Roots	4.39	4.04	0.55	0.71	12.93	1.28
Micrograms in the Roots	2.8	1.4	2.3	0.3	2.0	4.3

Table II

Effect of Molecular Configuration on Absorbtion and Translocation

Chemical Formulation	2,4-D Isooctyl ester	2,4,5-T Isooctyl ester	2,4-DP Isooctyl ester	2,4,5-TP Isooctyl ester
Number of Plants	4	3	2	4
Average % Absorbed	20.83	16.49	30.95	22.09
Average % of the Absorbed Activity in the Treated Leaf	93.85	95.94	94.87	96.11
New Growth	2.64	2.15	2.83	2.99
Stem	1.36	0.63	1.14	0.61
Roots	.55	1.28	1.17	0.29
Micrograms in the Roots	2.26	4.23	6.16	1.12

It is evident from these data that both formulation and molecular configuration have a marked effect on absorption and translocation of phenoxy herbicides. Translocation is influenced by the amount of herbicide which enters the plant. It is seen that the amines are most mobile from the treated leaf, followed by the acid and the ester. Part of this effect is undoubtedly due to the herbicide concentration in the treated leaf. Movement to the roots appears to be strongly influenced by both formulation and molecular configuration. 2,4,5-TP was translocated the least, possibly due to a high degree of toxicity. 2,4-DP translocated readily; however, its effectiveness on bigleaf maple is not known. It is anticipated that the differences in translocation noted would be magnified in larger trees, due to adsorbtion and breakdown of the material in transport tissues and leakage from the phloem to the xylem. Difficulties encountered in controlling bigleaf maple by air applications of herbicides would seem to be, in part, due to poor translocation. (Oregon Agricultural Experiment Station).

The Metabolism of Some Phenoxy Herbicides in Bigleaf Maple. Norris, Logan A., and Freed, V. H. This study was made to determine the importance of detoxification on the effectiveness of a series of phenoxy herbicides on bigleaf maple, *Acer macrophyllum*. Single, detached, nearly fully-expanded leaves were treated with 1 micromole of acid equivalent in 200 microliters of a water solution containing .5% Tween 20. The herbicides tested were the triethanol amine salts of 2,4-D, 2,4,5-T, 2,4-DP and 2,4,5-TP. The leaf surface was brushed with tissue paper prior to application to insure maximum absorption. Immediately after treatment, the leaf, with it's petiole in a small tube of water, was placed in a three-liter glass container. The incoming air was CO_2 free and the outgoing air was scrubbed twice in CO_2 free .5 normal NaOH. The flow rate was 100 mls. per minute. The tests were run in the dark for 72 hours at 27° C. After the exposure period, the treated leaf was washed and homogenized with 80% isopropyl alcohol. After 24 hours the homogenate was filtered, and the alcohol extract was spotted on Whatman #1 filter paper and developed in normal butanol, propionic acid and water (12:5.6:8). The strips were counted step-wise with a thin window gas flow Geiger counter strip scanner. The fibrous residue was further extracted with base. Barium carbonate plates were prepared from the respired CO_2 and counted with a thin window gas flow Geiger counter.

Table I

Effect of Molecular Configuration on
Rate of Alteration of Herbicides

	% of the Absorbed Activity Respired as $C^{14}O_2$			
Chemical	2,4-D	2,4,5-T	2,4-DP	2,4,5-TP
Number of Plants	4	3	4	4
% (average)	.43	.43	.63	.54

	% of the Absorbed Activity not as Parent Compound i.e., $C^{14}O_2$ Evolution Plus Activity on Paper Chromatograms Not Possessing R_f of Parent Compound			
Chemical	2,4-D	2,4,5-T	2,4-DP	2,4,5-TP
Number of Plants	3	3	4	4
% (average)	5.08	7.96	13.36	16.46

The results of these tests show that decarboxylation is not an important detoxification mechanism in bigleaf maple. The total amount of change, that is $C^{14}O_2$ evolution, plus amount of material on the chromatogram not corresponding to the herbicide, shows some large differences which may be important. The difference between 2,4-D and 2,4,5-T was not significant, and a further test was made to determine the extent of formation of detoxification products in other plant parts. Maple seedlings were treated with 5 micromoles of 2,4-D or 2,4,5-T as the triethanol amine salt on two or more leaves. After one week in the greenhouse, the treated leaves were washed and the plant sectioned into the treated leaves, untreated leaves, the new stem, the old stem, and the roots. These parts were homogenized with 80% ethanol, and paper chromatograms prepared. The chromatograms were developed as before and cut into half inch strips for counting in a scintillation counter. The following results were observed:

Table II

Effect of Molecular Configuration on Herbicide Alteration in Various Plant Parts

	% of the Activity as Herbicide by Plant Parts	
	2,4-D	2,4,5-T
Treated Leaf	94.06	93.74
Untreated Leaves	84.41	98.77
New Growth Stem	73.97	60.70
Old Stem	62.23	67.07
Roots	53.78	86.46

These data indicate that 2,4,5-T is more stable than 2,4-D. The most important difference shows up in the roots, where some 1.6 times more of the activity is 2,4,5-T compared to 2,4-D. It would seem that the greater effectiveness of 2,4,5-T over 2,4-D on maple is a combination of greater translocation and reduced breakdown of 2,4,5-T. (Oregon Agricultural Experiment Station).

The Absorption, Translocation, and Metabolism of 2,4-DB in Bigleaf Maple Seedlings. Norris, Logan A. The relatively poor translocation of a series of phenoxy acetic and phenoxy alpha propionic herbicides in bigleaf maple, *Acer macrophyllum*, prompted a study to determine the absorption, translocation, and metabolism of 2,4-DB. One micromole acid equivalent of C^{14} carboxyl labelled 2,4-DB as the triethanol amine salt was applied to a detached maple leaf in a three liter respiratory chamber swept with 100 mls. per minute of CO_2 free air. After 72 hours, the treated leaf was washed and homogenized with 80% isopropyl alcohol. Twenty-four hours later the homogenate was filtered and the residue extracted with base. The filtrate was spotted on Whatman #1 filter paper and developed with normal butanol, propionic acid, and water (12:5.6:8). The strip was counted step-wise with a thin window gas glow Geiger counter strip scanner.

In three days, 15.9% of the absorbed activity was respired as $C^{14}O_2$. The paper chromatograms showed two major peaks one of which is the 2,4-DB acid, and the other an unknown. The unknown material has an R_f of .75 which may represent one or more organic acids from the incorporation of $C^{14}O_2$ or $CH_3C^{14}OOH$ groups. The paper chromatograms show 57.3% of the absorbed material present as 2,4-DB acid. The remainder, or at least a good part of it, is probably 2,4-D.

Due to the rapid decarboxylation of 2,4-DB noted in the above test, the absorption and translocation study was run with C^{14} ring-labelled material. Two upper leaves of maple seedlings 18 inches tall were treated with 2,000 micrograms acid equivalent 2,4-DB C^{14} ring labelled as the isooctyl ester in 200 microliters of water plus .5% Tween 20. After three days, the leaves were washed with 80% isopropyl alcohol. The plant was sectioned into the treated leaf, the new growth, which included the current stem growth and the leaves, the stem and the roots for extraction with 80% isopropyl alcohol. The extracts were plated and counted with a thin window gas flow Geiger counter.

The average results for four plants showed 12.3% absorbed. Of the absorbed material, 77.5% was found in the treated leaf, 4.5% in the new growth, 11.8% in the stem, and 6.2% in the roots. These results indicate that the ring portion of the molecule is very mobile in bigleaf maple when compared to the other phenoxy herbicides.

The leaf metabolism work had demonstrated that leaves were able to decarboxylate 2,4-DB rapidly, but the end product was not known, although 2,4-D was anticipated. A study was designed to determine the form of breakdown products and translocated material. Maple seedlings were sprayed with 10,000 ppm water emulsions of non-labelled isooctyl esters of 2,4-DB or 2,4,5-TB. After 72 hours, the leaves were washed with 80% isopropyl alcohol, and the plant sectioned into the treated leaves, the stem, and the roots. These sections were extracted and cleaned up for analysis on an Aerograph Hi Fi gas chromatograph with hydrogen flame detector. The results show that for both 2,4-DB and 2,4,5-TB, the leaves contained various proportions of butyric and acetic herbicide, the stem had almost exclusively butyric, while the roots were predominantly the acetic. It is clear then, that the transported material is primarily the butyric. The stem shows a much lower ability than the leaves to oxidize the butyric. The roots have an intermediate capacity for this oxidation. An additional test, where root and stem tissues were incubated with 2.47 part per million carboxyl labelled 2,4-DB solutions, showed the roots were capable of oxidizing six times as much of the absorbed butyric as the stem tissue as indicated by the liberation of $C^{14}O_2$.

These studies indicate that the butyric herbicides may have a real place in the control of some woody plants where poor translocation is a factor in their resistance to aerial sprays. Additional work is necessary to get estimates of the absorption and translocation of the butyric and its conversion to the biologically active acetic form for a number of woody plants (Oregon Agricultural Experiment Station).

Herbicide effects on maple trees according to compound, formulation, solvent, and method of application. Newton, Michael. Screening tests of 28 compounds on bigleaf maple indicated that formulation-solvent relationships are important with respect to the selection of a method of treatment. It was shown that ester-in-oil solutions were exceedingly effective as bark treatments, but that esters applied to cut surfaces had little effect. Conversely, the water-soluble amines and potassium salts of the phenoxy herbicides were moderately to very effective in cuts, whereas the ineffectiveness of water solutions and emulsions on bark surfaces was repeatedly demonstrated.

Some compounds which were relatively insoluble in water, such as several triazines and uracils, were dissolved in solvents which were compatible with water, and were used in cut-surface applications. These were uniformly ineffective. The use of dimethyl sulfoxide (DMSO) as a solvent for cut-surface applications and basal sprays with either esters or amines of phenoxy compounds proved ineffective. Concentrations of less than 25% of the water soluble formulations appeared to be much less successful in cuts than maximum-strength solutions, but concentrations of 0.18% active ingredient have been highly effective for basal treatment in oil solutions.

The compounds which appeared promising after earlier late-spring applied injections were subsequently applied in higher concentrations with the following results:

Compound	Concentration	Formulation	Average Defoliation
Silvex	400 aehg	Amine	73%
Silvex	600 "	Potassium salt	100
Dicamba	400 "	Amine	87
2,4,5-TB	400 "	Amine	0
Amitrole	200 "	Tech. Material	0, chlorotic
Atrazine	200 "	N-butyl alcohol sol'n	0
2,3,6-TBA	400 "	Amine	7
MCP	400 "	Amine	3
Amitrol-T	200 "	Commercial preparation	73
Amiben	400 "	Amine	0
Isocil	200 "	N-butyl alcohol sol'n	0
Bromocil	200 "	N-butyl alcohol sol'n	0
4-amino-3,5,6-trichloropicolinic acid	200 "	Potassium salt	100
2,4,5-T	200 "	DMSO salt in n-butyl alcohol	0

While efforts to screen compounds at lower concentrations in the cut-surface applications produced inconclusive results, the most effective two of the above formulations were not represented in the low-concentration trials. All cut-surface trials involved the application of a 1 cc per cut in axe cuts spaced at six-inch intervals at breast height; basal treatments included a variety of formulations in both diesel oil and DMSO.

The inferences drawn from these test series were that the physico-chemical properties of the compounds and formulations may be substantially more important than the toxicological properties, and that many of our failures to get proper translocation and killing effect are due to formulations which cause (1) absorption in the conducting tissues, (2) precipitation at phase changes, and (3) energy barriers resulting from mis-matching solvent with treatment surfaces. (Oregon State University, School of Forestry, Corvallis, Oregon).

Phreatophyte water use and removal studies. Lowry, Orlan J. For many years, evaluation of nonbeneficial consumptive use of water by phreatophytes under various ground water conditions and changes in ground water conditions has been based on relatively limited data. A program to evaluate the total water used in an area is underway. The area being studied totals approximately 9,900 acres of which approximately 6,428 acres are infested with phreatophytes (salt cedar, cottonwoods, willow, etc.). A record of the water inflow and outflow along with ground water data has been collected for three years. These records were obtained with the area in a natural phreatophyte infested condition. In December 1963, a contract was awarded for the area to be cleared of phreatophyte growth. When clearing operations are completed, a phreatophyte control program will be conducted for a minimum of 2 years. During this time, water inflow and outflow records will again be obtained in an effort to determine the extent that clearing of phreatophytes will affect the availability of water. The removal of the phreatophyte growth is being accomplished with mechanical equipment at a total cost of $288,990. Regrowth control will be accomplished by several methods, including mowing, root cutting, and the use of chemicals. The area of study is located along the Rio Grande approximately 50 miles south of Albuquerque, New Mexico The work is under the supervision of the Bureau of Reclamation. (Bureau of Reclamation, U. S. Department of the Interior, Amarillo, Texas).

Saltcedar studies. Harris, G.K., and Cords, H. P. An experiment to find how long saltcedar must be immersed in order to assure that it is killed was begun August 30, 1963. Two water temperatures were employed, i.e. 45°F and 75°F. 80 potted plants varying from about 1 to 2 feet in height were totally immersed at each temperature. Four plants were removed from each tank every five days until all plants were removed. Thus, the time of immersion varied from 5 to 100 days. The results are presented in the following table. (Nevada Agricultural Experiment Station, University of Nevada, Reno).

No. of days immersed	Hot tank (75°F) plants Dead	Hot tank (75°F) plants Alive	Cold tank (45°F) plants Dead	Cold tank (45°F) plants Alive
5	3	1		4
10	2	2	1	3
15	2	1	2	2
20	4			4
25	4		1	3
30	4		1	3
	19	4	5	19

No. of days immersed	Hot tank (75°F) Plants		Cold tank (45°F) Plants	
	Dead	Alive	Dead	Alive
	19	4	5	19
35	3	1	2	2
40	4		2	2
45	4		2	2
50	4		4	
55	4		1	3
60	4		4	
65	4		2	2
70	4		3	1
75	4		3	1
80	4		3	1
85	4		4	
90	4		3	1
95	4		4	
100	4		2	2
Total	75	5	44	36

Comparison of different methods of applying fenuron pellets for control of mature salt cedar (*Tamarix pentandra* Pall.). Comes, R.D. and Timmons, F.L. Previous experimentation has shown that mature salt cedar can be effectively controlled with broadcast applications of fenuron pellets at 10 to 15 lb/A. An experiment was begun on April 1, 1960, to compare the following methods of application: (1) broadcast, (2) bands 1 ft. wide and 5 1/2 ft. apart, and (3) bands 1 ft. wide and 11 ft. apart. Three application rates, 10, 15, and 20 lb/A, were used with each method.

Treatments were applied in triplicate on plots 22 x 33 feet in size. The experimental area contained a uniform stand of salt cedar 7 to 12 ft. tall. In 1960, a total of 4.70 inches of precipitation was received after treatment. Only 5.33 and 4.50 inches of precipitation were received in 1961 and 1962, respectively.

None of the treatments caused any visible injury to the salt cedar plants until July 1961, when drying and browning of the foliage commenced. By September 1961, many plants appeared dead in all treated plots and the broadcast application at 20 lb/A resulted in 99-percent control, tabular material.

The percent control on all plots that still contain live plants has been increasing steadily over the past 2 years. In June 1963, there was no difference between the two band methods of application at equivalent rates. However, band applications at 20 lb/A were required to eradicate the salt cedar. When broadcast, all application rates of fenuron pellets completely eliminated the salt cedar. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture and the Wyoming Agricultural Experiment Station, Laramie, Wyoming).

Comparison of different methods of applying fenuron pellets for control of mature salt cedar. All data are averages of three replications.

Treatment	Rate lb/A	Percent Control 9-6-61	Percent Control 7-10-62	Percent Control 6-28-63
Broadcast	10	87	97	100
Broadcast	15	96	100	100
Broadcast	20	99	100	100
Strips 1 ft. wide and 5 1/2 ft. apart	10	78	96	97
Strips 1 ft. wide and 5 1/2 ft. apart	15	86	95	99
Strips 1 ft. wide and 5 1/2 ft. apart	20	89	96	100
Strips 1 ft. wide and 11 ft. apart	10	79	84	97
Strips 1 ft. wide and 11 ft. apart	15	76	90	98
Strips 1 ft. wide and 11 ft. apart	20	93	96	100
Check	--	2	0	2

<u>Control of salt cedar with granular herbicides and herbicides sprayed on the soil surface.</u> Hughes, Eugene E. Six granular herbicides were applied at two rates on 1/160-A plots of salt cedar 4 feet high on April 16, 1962. Treatments were replicated three times. A total of 7.05 inches of precipitation fell from the time of application of herbicides until the kill evaluation was made on July 10, 1963.

Herbicide	Rate ai/A	Percentage Kill
Atratone	5	0
Atratone	20	0
Prometone	5	0
Prometone	20	0
2,3,6-TBA	5	3
2,3,5-TBA	20	23
Fenac	5	0
Fenac	20	6
Fenuron	5	0
Fenuron	20	2
Dicamba	5	66
Dicamba	20	79

Dicamba appeared to be the only promising granular herbicide for control of salt cedar.

Two wettable-powder herbicides and one liquid herbicide were sprayed on the soil surface of 1/160-A plots. The herbicides were isocil, monuron, and fenac. Rates used were 5 and 20 lbs. ai/A applied in 300 gallons water per acre. They were applied on July 11, 1962, and evaluated on July 10,1963. All treatments were ineffective. (Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, and New Mexico Agricultural Experiment Station, cooperating, Los Lunas, New Mexico).

Basal-spray and cut-surface treatments for control of salt cedar. Hughes, Eugene E. Basal-spray treatment studies were carried out during the fall and winter of 1962-63 in an effort to find out some of the factors affecting basal spray effectiveness. One hundred forty-four plants were treated in December and a similar set in April. Two formulations of silvex were used, the butoxy ethanol (BE) ester and an oil-soluble amine, each at two rates, 6 lbs. aehg and 12 lbs. aehg in diesel oil. Two tree sizes, less than 2 inches in diameter and more than 2 inches, were used. Three types of application were compared, spraying from the ground up 1 foot, spraying from the ground up 2 feet, and spraying the cut stump. Results of this study are summarized as follows:

Treatment		Dead	Live	Average percentage kill
Month treated:	December 1962	90	54	62
	April 1962	84	60	58
Formulation:	Ester (BE)	102	42	71
	Oil-soluble amine	72	72	50
Tree size:	Small trees:<2"	108	36	75
	Large trees:>2"	66	78	46
Area treated:	Basal 1 ft.	44	52	46
	Basal 2 ft.	51	45	53
	Cut stump	79	17	82
Rate:	6 lb. aehg	76	68	53
	12 lb. aehg	98	46	68

There was no statistically significant difference in month of application, but there was a highly significant difference in each of the following: formulation, rate, area treated (no difference between 1 and 2 ft.), and size of tree.

Another study was conducted on March 28, 1963, to compare the oil-soluble amine of silvex with the butoxy ethanol ester, each at 8 lb. aehg in diesel oil, and the cut stump with spraying from the ground up 2 feet. Ten trees were used in each treatment. Results showed that both cut-stump and basal spray (2 ft.) treatments using the oil-soluble amine killed all the plants. Cut-stump treatments using the ester formulation were also effective in killing all the plants but the basal spray (2 ft.) killed only 7 out of 10 plants. Plants in the ester formulation treatments averaged 2 inches in diameter larger than those in the oil-soluble amine, which could explain the decrease in kill.

The two sets of results appear contradictory, but results of previous experiments have shown the ester to be more effective than the oil-soluble amine. (Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, and New Mexico Agricultural Experiment Station, Cooperating, Los Lunas, New Mexico).

A comparison of single treatments and combinations of burning, mowing, and spraying treatments for control of salt cedar. Hughes, Eugene E. A study was initiated in the winter of 1961-62 to compare the effectiveness of mechanical and/or chemical control of salt cedar. The plants ranged in height from 4 to 10 feet, with a good stand of grass undergrowth. Mowing was done with a rotary mower and burning done by igniting the grass understory with a propane torch. Sprayed plots were treated with 4 lb ae/A of silvex PGBE ester in 20 gallons of water. All treatments were replicated 3 times. Treatments, dates of treatments, and results are as follows:

Treatment	Date of treatment in 1962	Average percentage kill
Spray only:	5/31	18
Mow-spray:	mowed 3/8	
	sprayed 6/11	48
Burn-mow-spray:	burned 2/22	
	mowed 5/31	
	sprayed 8/30	4
Burn-mow:	burned 2/22	
	mowed 5/17	
	mowed 7/19	
	mowed 9/17	0
Burn-spray:	burned 2/22	
	sprayed 5/31	53

Results show that spraying regrowth salt cedar, whether after mowing or burning, was more effective than spraying undisturbed plants. Also, burning followed by mowing every 2 months was ineffective. All three treatments, burning in winter, mowing at the approximate low point in carbohydrate cycle and then spraying August 30, also was ineffective. The August spraying date could possibly have been too early and have not allowed the regrowth to reduce root carbohydrate levels to their low point. (Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, in cooperation with New Mexico Agricultural Experiment Station, Los Lunas, New Mexico.)[1]

[1]Assistance by the Bureau of Sport Fisheries and Wildlife, U.S. Department of the interior, is appreciated.

Aerial application of herbicides for control of salt cedar. Hughes, Eugene E., and H. Fred Arle. Two-acre plots were sprayed with a helicopter in three states in 1962. Plots sprayed near Buckeye, Arizona, on May 16, 1962, and evaluated on September 18, 1963, showed the following results:

Chemical	Rate lbs ae/A	Carrier	Volume gal/A	Percentage kill
2,4-D + 2,4,5-T (50:50) PGBE ester	4	Water	10	92
Silvex PGBE ester	4	"	10	92
2,4-DP IO ester	4	"	10	82
Silvex OS amine	4	"	10	85
Silvex OS amine	2	"	10	57

These plots were burned over by a wild fire in mid-August, 1962.

A similar series of plots sprayed at Red Bluff, Texas, on July 16,1962, and evaluated on October 9, 1963, gave the following kill data:

Chemical	Rate lbs ae/A	Carrier	Volume gal/A	Percentage kill
2,4-D + 2,4,5-T (50:50) PGBE ester	4	Oil:Water	10	20
Silvex PGBE ester	4	" "	10	21
2,4-DP IO ester	4	" "	10	15
Silvex OS amine	4	Oil	10	13
Silvex IO ester	4	Invert	10	2
2,4,5-T IO ester	4	"	10	3

In addition, a similar series of plots were put out a Bernardo, New Mexico, on August 1, 1962, and evaluated on June 10, 1963. Chemicals included were silvex PGBE ester, 2,4-DP IO ester, 2,4-D + 2,4,5-T (50:50) PGBE ester, in oil:water emulsion, silvex OS Amine in oil, and 2,4-D + 2,4,5-T (50:50) IO ester as an invert. All were applied at 4 lb ae/A in 10-gallon volume. This series was completely ineffective, probably because of the late date of application.

There appears to be little difference in the effectiveness of silvex ester and 2,4-D + 2,4,5-T (50:50) ester at 4 lb ae/A in oil:water emulsion on salt cedar, both being superior to all other herbicides and carriers tested. Differences in percentage kill in the three locations are probably due to the date of spraying. Rainfall in the three locations was about the same before spraying date. (Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, in cooperation with Arizona Agricultural Experiment Station, and New Mexico Agricultural Experiment Station.)[1]

[1]Assistance by the Scull Chemical Company, San Antonio, Texas, Bureau of Reclamation, U.S. Department of Interior, Red Bluff Water District, Pecos, Texas, is appreciated.

Soil application of pelleted or granulated herbicides to individual alligator junipers. Johnsen, Thomas N., Jr. The results of applications of pelleted fenuron to the soil surface at the base of individual junipers have shown the feasibility of this method to control these trees on rangelands. To obtain information about using other herbicides similarly, a number of pelleted or granulated herbicides were applied to the soil surface around the base of alligator junipers (*Juniperus deppeana*) 4 to 6 feet tall in northern Arizona in January 1960. There were 10 trees per treatment. The active ingredient rate of application was equal to that in 1 tablespoonful of 25 percent fenuron pellets. The soil was a clay loam. Observations of defoliation and apparent plant kills are reported in the following table:

Results of application of various pelleted or granulated herbicides to the soil surface at the base of alligator junipers

Herbicide	Defoliation, percent			Apparent plant kill, percent		
	9 mos	21 mos	33 mos	9 mos	21 mos	33 mos
Fenuron (25%)	77	89	89	0	50	70
Fenuron (50%)	78	93	99	10	70	90
Fenuron TCA	22	50	54	0	0	20
PBA Na salt	61	84	96	0	50	60
2,3,6-TBA Na salt	76	97	99	10	70	90
2,4-D Na salt	1	0	0	0	0	0
Silvex Na salt	2	0	0	0	0	0
Dalapon Na salt	15	2	2	0	0	0
None (check)	0	0	0	0	0	0

Fenuron and sodium salt of 2,3,6-TBA gave the best plant kills. The sodium salt of PBA gave high defoliation but only medium amount of plant kill. The other herbicides were ineffective at the rates applied. (Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, Forestry Sciences Laboratory, ASC, Flagstaff, Arizona).

Combined use of herbicides and fire to control nonsprouting junipers. Johnsen, Thomas N., Jr. One method of controlling nonsprouting junipers on range lands is intentional broadcast burning. Two major problems, however, are encountered: (1) getting the fire started and (2) containing the fire in the prescribed area once it has started. Use of foliage applied herbicides to desiccate the trees before burning could solve the problem of fuel flammability which affects these two problems. Studies on chemical desiccation of one-seed and Utah junipers (*Juniperus monosperma* and *J. osteosperma*) have been conducted in northern Arizona since early 1960.

Although evaluation tests are not yet completed, nonemulsifiable monochloroacetic acid has given the better desiccation than the other herbicides tested so far. Rate and volume application studies are still being carried out; these will have to be completed before cost studies can be made.

In burning tests, individual junipers which had been desiccated burned readily any season of the year, whereas untreated trees burned readily only during the hot, dry, late spring or early summer if they burned at all.

Small-scale broadcast burning of desiccated trees has shown limited success to date due to the small amount of light fuels available to carry the fire in the test area. Untreated trees in the same area would not burn at all. (Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, Forestry Sciences Laboratory, ASC, Flagstaff, Arizona).

4-Amino-3,5,6-trichloropicolinic acid--A promising chemical for brush control studies in Arizona. Davis, Edwin A. 4-Amino-3,5,6-trichloropicolinic acid (ATCP), as the potassium salt in liquid formulation, was evaluated in greenhouse studies for the control of shrub live oak (Quercus turbinella Greene). This shrub, which composes 60-80% of the chaparral type in Arizona, is one of the most difficult species to control.

Soil applications of ATCP were applied to 2-year-old shrub live oak plants in gallon cans. The soil was a sandy loam. The chemical applied at rates of 1,2,4,8, and 16 lb/A was compared with fenuron at the same rates. Each treatment was replicated 4 times, making a total of 20 plants for each chemical. When the data for all rates of each chemical were pooled, ATCP killed 80% of the plants and fenuron killed 70%. The two chemicals were comparable at the higher rates, but at the lower rates ATCP was superior. The pooled toxicity index for all rates was 89.6 for ATCP and 78.1 for fenuron. To evaluate the effect of ATCP on grass and its persistence in soil, oats were planted a few days after treatment and at 3 intervals thereafter for 20 weeks. ATCP was less toxic to oats than fenuron, but the persistence of the two chemicals was comparable. After 15 weeks, normal yields of oats occurred in the soil initially treated with 1,2, and 4 lb/A of either ATCP or fenuron. After 20 weeks, the mean percent inhibition of oats for all rates (1-16 lb/A) was 17.8% for ATCP and 19.0% for fenuron.

In another test, conducted with 4-year-old shrub live oak plants, ATCP and fenuron were applied to the soil at rates of 2 and 4 lb/A. There were 2 plants per treatment. The effects of the chemicals were complete after 3 1/2 months. When the data for both rates were pooled, ATCP and fenuron killed 75% and 25% of the plants, respectively. The mean percentages of stem dieback, original-leaf injury, and growth reduction were considerably higher for ATCP than for fenuron. The mean toxicity indexes were 87.3 for ATCP and 42.2 for fenuron. ATCP did not inhibit oats planted in the soil 10 days after treatment, but the 2 and 4 lb/A treatments of fenuron cause 27% and 91% inhibition, respectively.

Low-volume foliage sprays of ATCP were compared with the butoxy ethanol ester of 2,4,5-T in which the soil as well as the plants received spray. The chemicals were applied to 2-year-old plants on April 4, 1963, at rates of 1/16 - 2 lb/A at 10 gpa in a 2x geometric progression. Neither ATCP nor 2,4,5-T at rates up to 2 lb/A effectively controlled shrub live oak. The effects of the two chemicals were very different. 2,4,5-T caused stem dieback and severe leaf injury, whereas ATCP did not. However, ATCP at 1/2 - 2 lb/A inhibited regrowth to a greater extent than 2,4,5-T at the same rates. The morphological characteristics of the regrowth of ATCP-treated plants were similar to those of 2,3,6-TBA-treated plants.

To determine the extent of foliage activity of ATCP, the tops of 2-year-old shrub live oak plants were sprayed to the point of runoff while the bottom 5 inches of stem and the soil were protected from spray. The plants were sprayed with 0.0375% - 2.4% solutions of ATCP in a 2x geometric progression. These wetting sprays, which were restricted to the leaves and stems, resulted in complete leaf kill even at the lowest concentration of 375 ppm; previous low-volume sprays caused only minor leaf damage. The effect of these foliage sprayes on plant survival was extremely erratic; there was no consistent relation between chemical concentration and plant kill. Of the 21 plants sprayed, 9 were killed (42.9%).

Although a single low-volume spray (such as an aerial application) does not appear promising for eradication of shrub live oak, high-volume sprays with ground equipment may be of value ATCP was active through both the roots and shoots of shrub live oak. However, control of this plant was much more effective when ATCP was applied to the soil rather than to the foliage. On the basis of these studies ATCP should be very useful in brush control studies in Arizona. (Crops Research Division, Agricultural Research Service, U.S.D.A., Arizona State University, Tempe, Arizona).

Herbicide studies of Gambel's oak in southwest Colorado: Jefferies, Ned W. Research on the chemical control of Gambel's oak (Quercus Gambellii) was started in 1962 at the San Juan Basin Branch Station at Hesperus, Colorado. Three herbicides (2,4,5-T butoxyethanol ester; 2,4,5-TP propylene glycol butyl ether ester; and 2,4,5-T tertiary dodecyl primary amine) were applied to 1/10 acre oakbrush plots. Applications were made at 1.0, 2.0, and 3.0 pounds a.e./acre during three periods (June 8-12, July 2-5, and July 26-31). The herbicides were applied in an oil-water mixture (1 part diesel oil to 40 parts water) at the rate of 100 gpa with an orchard sprayer.

Treatment results were evaluated by two methods: 1. The percentage of dead stems on each plot was compared to the percentage on control plots; 2. The percent kill was determined using stem count data taken prior to treatment. The individual plants were stratified into two size groups; Mature = 1.0 inch or more in diameter; Immature = less than 1.0 inch in diameter. Average kill for all treatments was 27.6 percent for the larger stems and 40.4 percent for the smaller stems. On the smaller stems, the 2.0 and 3.0 pound rates applied during the middle period were superior to other treatments. Silvex was significantly more effective than the 2,4,5-T ester or amine. On the larger stems, only the date of application was significant, with the middle and later date more effective than the early application. The results from the single 1962 application were not satisfactory; However, the study will compare one, two, and three successive years of application. (Colorado Agric. Expt. Sta., San Juan Basin Branch Station, Hesperus, Colorado).

Chemical Control of poison oak (Rhus diversiloba T. & G.) in western Oregon. Fechtig, Allen D., and Furtick W.R. Poison oak is a serious problem on a great number of acres in western Oregon. Although information concerning the activities of amitrole-T and 2,4,5-T have been known for some time, information concerning the herbicidal activities of dicamba and Tordon in contiolling this species is lacking. Therefore, this project was initiated to gain insight on the latter two compounds. Two replications of plots, 10' x 30', were sprayed with a field type plot sprayer employing the use of a modified hand spray boom. The plots were sprayed on a sunny day with the air temperature at 75°, and a wind velocity of 0 mph.

The plots were evaluated three months after the date of application for the percent control which was visible at that time. These plots will be re-evaluated during the spring months of 1964 to get a clear picture of the percent control of the poison oak plants. The first evaluation of the plots showed that amitrole-T at 3 pounds active material per acre gave approximately 90 percent control, while 2,4,5-T at this same rate gave 100 percent control. Dicamba and Tordon at rates of 1,2, and 4 pounds active material per acre gave 25, 50, 100, and 75, 80, and 100 percent control respectively. (Department of Farm Crops, Oregon State University, Corvallis).

Control of giant Himalaya blackberry (Rubus procerus P. J. Muell) with organic chemical compounds. Fechtig, Allen D. and Furtick, W.R. Ten different compounds which were known to exhibit herbicidal activity were applied to blackberry bushes in an attempt to determine the effectiveness of the various materials on this brushy species. Another function of this experiment was to attempt to establish optimum rates for those compounds indicating promise on this species. Blackberries have become a very serious problem invading pastures, woodlands, fence rows, and many other places. The seriousness of this species and the lack of information concerning many of the organic compounds was responsible for the initiationof this project.

Plots 10' x 20', replicated three times, were sprayed with: dicamba, Tordon, amitrole, 2,4,5-T, 2,4,5-T + amitrole, 2,4-D solubalized acid, bromacil, 2,4-D emulsifiable acid, TD 191*, and TD 282**. The plots were evaluated five months after the date of application, and only three of the materials applied were effective in controlling this species. Tordon at 1 pound active material per acre gave 95 percent control while rates of 2,4, and 8 pounds per acre gave complete eradication. The 1 pound rate of 2,4,5-T gave 75 percent control, while rates of 2 and 4 pounds per acre gave 85 and 93 percent control respectively. The combination of amitrole and 2,4,5-T at 2 pounds per acre of each material and an application of 2 pounds of 2,4,5-T and four pounds of amitrole both gave approximately 90 percent control. Amitrole alone at 8 pounds per acre gave less than 30 percent control; therefore, the per cent control received from the 2,4,5-T-amitrole combination tend to indicate that the percent control received was from the 2,4,5-T and not the amitrol. All of the remaining compounds tested were less than 40 percent effective in controlling this species. These plots will be evaluated again during the 1964 season. (Department of Farm Crops, Oregon State University, Corvallis, Oregon).

*mono-N,N-demethylcocoamine salt of 3,6-endoxohexahydrophthalic acid.
**Pennsalt experimental.

Gorse (Ulex europaeus L.) control with the aid of organic chemicals. Fechtig, Allen D., and Furtick, W.R. This experiment was initiated primarily to evaluate a number of organic compounds with respect to the control or complete eradication of gorse plants, because they present a continuous fire hazard to farm land, forest, and even residential dwellings. The principal gorse area of Oregon is located along the southern coastal area.

A complete randomized block, consisting of 10' x 40' plots, replicated three times was sprayed with a number of organic compounds exhibiting herbicidal activity. An area of seedling gorse approximately 3 - 5 inches high and an area of more mature plants 6 - 10 feet high was sprayed to gain insight on the effectiveness of the various organic compounds on this species.

The compounds were applied to the seedling gorse with a plot sprayer at 40 psi. The volume of water used to apply the various compounds was approximately 34 gallons per acre. The herbicides were applied on a cloudy day, with the wind velocity at 0 - 3 mph, and an air temperature of 70°.

In seedling gorse a ten pound per acre active material rate of isocil and a five pound per acre rate of bromacil were comparable in the percent control of seedling gorse, each giving approximately 90 - 95 percent control. In the established gorse these two compounds were not effective. Diuron at the rate of 10 pounds per acre gave 100 percent gorse control in both the seedling and in the more mature plants. Tordon at the rate of 1/2 pound per acre controlled this brush-type species 65 percent in the seedling gorse and 50 percent in the more mature plants, while a rate of 1 pound per acre gave 95 percent control in each case. When the rate of Tordon was increased to two pounds per acre of active material, 100 percent control of both the seedling and the more mature plants was obtained. Another compound whose activity on gorse has been known for some time, namely, 2,4,5-T, gave 100 percent gorse control in both the seedling and in the more mature plants at the rate of 4 pounds active material per acre. Dicamba and 2,4-D solubalized acid were not effective in controlling either the gorse seedlings or the more mature plants.

The percent control reported was recorded four months after the date of application, and the final evaluation will be made sometime during the current year. (Department of Farm Crops, Oregon State University, Corvallis, Oregon).

Aerial spraying to control greenleaf manzanita. Gratkowski, H. and Anderson, Lyle. Results of small plot tests of herbicides on the nonsprouting form of greenleaf manzanita (*Arctostaphylos patula*) in the Cascade Range have been borne out in aerial applications on the Rogue River National Forest. Earlier tests had shown that low volatile esters of 2,4-D are effective on this manzanita and that an applicationof 2 to 4 lbs. ae/acre is needed to insure a high percentage of kill with midsummer foliage sprays.

During June 1958, a Stearman biplane was used to spray 100 acres of manzanita near Butte Falls, Oregon. An application of 4 lbs ae/acre killed 96 percent of the treated shrubs on a 60-acre tract; while 2 lbs of 2,4-D per acre killed only 74 percent of the shrubs on an adjacent 20-acre plot. Two lbs of 2,4-D plus 1 lb of 2,4,5-T per care killed 96 percent of the manzanita shrubs on another 20-acre plot. All sprays were applied in diesel oil-water emulsions at a rate of 7 gallons of spray per acre.

Several combinations of seeding, planting, and mechanical eradication are being tried on this and other areas in an effort to develop methods for reforestationof dense manzanita brushfields in old cuttings. (Pacific N.W. Forest and Range Expt. Sta. in cooperation with Rogue River National Forest, Forest Service, U.S.Department of Agriculture, Roseburg, Oregon).

Control of stump sprouts. Leonard, O.A. and Murphy, A.H. About 1500 blue oak (*Quercus douglasii*) and California black oak (*Q. kelloggii*) stumps were treated from December 14, 1960 through February 14, 1961 on the Hopland Field Station. The treatments involved the application of either the alkanolamine salts of 2,4-D or triethylamine salt of 2,4,5-T to the cut surfaces, using about 1 gm ae/square decimeter of cut-surface. One half of the stumps were cut to a height of 30 cm while the other one half were cut about 90 cm high. One half of the stumps were treated immediately after being cut and the other one half were treated 7 days after cutting. Some stumps were covered with aluminum foil to protect from rain. Data on sprouting were recorded in 1961, 1962, and 1963.

Results on sprouting in 1962 indicated that all variations in the treatments markedly influenced sprouting of both oak species. Sprouting was greatest with 2,4-D amine, for stumps cut high (90 cm), for treatments that were delayed for 7 days, and for stumps that were covered. Results in 1963 indicated that the responses observed in 1962 had become nullified, since most of the sprouts that were alive in 1962 had died with all treatments.

Tracer studies with 2,4-D on interior live oak (*Q. wislizenii*) have indicated that protecting a stump from rain by covering the cut-surface markedly impedes the downward movement of the label, but does not prevent it from occurring. Some movement downward does take place slowly; such movement was observed to occur over a 103 day period during the winter. It appears that in the course of 2 years or more that sufficient movement may take place to be herbicidal to sprouts. It is possible that the total movement is less with covered stumps and that the final kill would be related to dosage; however, this aspect has not been studied. (University of California, Davis and Hopland).

Chemical weed control in conifer plantations. Newton, Michael. High mortality in conifer plantations set out in areas of low summer precipitation and high densities of herbaceous vegetation requires that some method of planting be used that enables the seedlings to evade, resist, or never be subjected to drought conditions. In view of the relationship between the use of water and vegetation density, chemical weed control offers an economical method of controlling drought. To test this hypothesis, four chemicals were applied on quarter-acre plots at application rates which gave roughly the same cost. Treatments were applied in December and April, and replicated at each date. A total of twenty plots received treatment. In each plot, Douglas-fir seedlings were planted in the center of the treatment area. Of the forty seedlings per plot, half were planted immediately before treatment, and half were planted immediately afterward. The results are summarized below:

(1) Atrazine. Spring treatments of five pounds, active, per acre gave complete weed control, no conifer damage. Seedlings very vigorous. 64% survival. Most of the dead seedlings in application skips. Little vegetation recovery the first year. Application on seedlings appears to have no effect. Fall treatments produced poorer weed control, and possibly some conifer damage.

(2) Amitrole, Simazine, 1:3 mixture. Spring application of five pounds, active, per acre produced excellent weed control, but seedlings already planted when sprayed showed definite symptoms of amitrole damage, though little mortality attributable definitely to this cause. Untreated seedlings show excellent vigor; 56% survival. Fall treatment gave poorer weed control, 50% survival. Perennial grasses recovering rapidly at end of first summer in both winter and spring treatments.

(3) Simazine. Spring application of five pounds, active, per acre reduced annual weed development, but favored perennials. Seedlings showed no chemical symptoms, but were exposed to drought conditions. 31% survival. Poor thrift due to drought. Fall treatment slightly better weed control, and 39% survival. Little evidence of treatment at end of first growing season except for changes in vegetation composition.

(4) Isocil, (Hyvar). Three pounds per acre, active, in spring treatments gave good control of nearly all grasses, but poor control of tarweed and some other forbs. Apparently highly toxic to conifers, 1% survival in spring treatments. Fall application gave 23% survival, which was not significantly different from control, yet in view of weed control, it must be assumed much of mortality was due to chemical.

(5) Control, (No chemical). Heavy weed development consisting mostly of <u>Danthonia californica</u>, <u>Dactylis glomerata</u>, <u>Elymus caput-medusae</u>, <u>Daucus carota</u> <u>Plantago lanceolata</u>, <u>Prunella vulgaris</u>, <u>Madia</u> gracilis, and <u>Torilis nodosa</u>. The stands in the untreated plots averaged slightly over 1000 KGs per acre, dry weight, and had depleted soil moisture in the top foot of soil to fifteen atmospheres tension prior to the end of June. Survival was the same in both winter and spring plantations, 19%. Vigor was poor at the end of the first season, and it is expected that second-season mortality will take a heavy toll of the remaining seedlings.

In summary, it is concluded that spring applications of herbicides are generally superior to fall treatments in this region of low summer precipitation and wet winters, and that it is wise to avoid chemicals which either allow rapid regrowth of weeds, or damage seedlings through their own toxicity. These results suggest atrazine as the most promising chemical for this type of treatment under local conditions, and rates of roughly four pounds active material in spring applications. Nearby aerial treatments support this conclusion. (Oregon State University, School of Forestry, Corvallis, Oregon).

<u>Chemical control of conifers for pre-commercial thinning.</u> Newton, Michael. In view of high labor costs for thinning young stands of conifers, a method is needed which will accomplish the same objective as the conventional cutting methods, but which can be done with fewer man-hours. Six chemical treatments were evaluated in some tenth-acre plots in a twenty-five-year-old stand of Douglas-fir to determine the feasibility of chemical thinning. The stands supported numerous stems of undesirable hardwoods which were also treated.

The treatments used were all of the hatchet-oil can type, in which one cc of chemical solution was applied to each of cuts spaced at six-inch intervals. The summary of the treatments and results follows:

(1) Cacodylic acid 25% aqueous solution gave 100% kill of all Douglas-fir, cherry, willow and hawthorne, and relatively poor control of bigleaf maple.

(2) Tordon 22K* gave 100% kill of Douglas-fir, cherry and bigleaf maple, the only species treated. Chemical applied undiluted, 2 lb/gallon.

(3) Dicamba, undiluted, gave good control of cherry, poor on Douglas-fir, maple.

(4) Amitrol-T top-killed 100% of the Douglas-fir, (sufficient for thinning purposes) and gave satisfactory control of bigleaf maple. No complete kills the first year.

(5) 2,4-D amine, undiluted, provided good kill on cherry and willow, but spotty top-kill on Douglas-fir and bigleaf maple.

(6) Kurosal #, undiluted, gave excellent control of maple, mediochre on Douglas-fir.

Based on cost per unit of effectiveness, and overall utility, the compounds tested warrant further testing in the following order of priority: Cacodylic acid, amitrol-T, Tordon, 2,4-D amine, Kurosal and Dicamba (Oregon State University, School of Forestry, Corvallis, Oregon).

*Tordon 22K is the Dow Chemical Co. product containing 2#/gallon of the potassium salt of 4 amino-3,5,6-trichloropicolinic acid.

#Kurosal is the Dow Chemical Co. product containing six pounds per gallon of the potassium salt of silvex.

Dormant, viable Ceanothus seeds in soil under old-growth Douglas-fir forests. Gratkowski, H. Foresters in southwestern Oregon have questioned the origin of dense stands of varnishleaf ceanothus (*Ceanothus velutinus* var. *laevigatus*) that often appear on cuttings after logging and slash disposal in virgin stands of old-growth Douglas-fir (*Pseudotsuga menziesii*). Soil sampling, and laboratory and greenhouse experiments have answered this question at least for two areas on the Umpqua National Forest in the Cascade Range. Large numbers of viable varnishleaf ceanothus seeds were found in samples of soil from two virgin stands of old-growth Douglas-fir where no parent plants of this brush species were present in the understory.

Ocular examination showed that varnishleaf ceanothus seeds were present in approximately 40 percent of the concentrates prepared from sixty 1/50,000 acre samples of surface soil. No seeds were found in comparable samples of the litter and duff layer.

Greenhouse and laboratory experiments with the samples later proved that these seeds require heat treatment before they will germinate. None of the seeds germinated during an initial germination period of 2-2/3 months in special flats in a greenhouse. But when the soil in the flats was heated to a temperature of 80°C at the depth of the seed concentrates, stratified for 2 months, and returned to the greenhouse, seeds in the soil samples germinated rapidly and produced the equivalent of 131,000 varnish-leaf ceanothus seedlings per acre. No seeds germinated in the duff and litter samples even after heat treatment. (Pacific N.W. Forest and Range Expt. Sta., Forest Service, U.S. Department of Agriculture, Roseburg, Oregon).

Anatomy of Ceanothus seeds indicates they may be long-lived. Gratkowski, H. The anatomical structure of varnishleaf ceanothus seeds was studied in one phase of intensive autecological research on this troublesome forest land brush species. Anatomy of the ceanothus seeds proved similar in many respects to that of hard seeds of legumes

In a nearly mature varnishleaf ceanothus seed, a thin layer of cuticle covers the exterior surface of a thick, palisade-like layer of radially-oriented Malpighian cells that form the main structure of the seed coat. As in legume seeds, this closely packed, sclerenchymatous layer is evidently responsible for impermeability of ceanothus seeds to moisture. Beneath the palisade layer is a two to three-cell-deep layer of regular parenchyma containing dark colored deposits--pigmented material and probably tanins. Inside the pigmented cells is a deep layer of large, clear parenchyma analagous to the nutrient layer in legume seeds. In the interior of the seed, a generous amount of endosperm encloses a well-developed, dicotyledonous embryo. In mature seeds, the pigmented cells and remnants of the nutrient layer are crushed between the sclerenchyma of the palisade layer and endosperm that almost entirely fills the seed coat.

As in many legume seeds, a hilar fissure forms a gap in the palisade layer at the hilum. On mature seeds, this fissure is covered by a hilar cap, remnant of the funiculus that remains attached to the hilum when the seed is disseminated.

Hard seeds of legumes are considered especially well adapted to remain dormant, but viable for long periods of time. The structural similarities of hard seeds of varnishleaf ceanothus to hard seeds of legumes indicates that varnishleaf ceanothus seeds may also remain dormant but viable in the soil for long periods of time. (Pacific N.W. Forest and Range Expt. Sta., Forest Service, U.S. Department of Agriculture, Roseburg, Oregon).

Heat and Germination of ceanothus seeds in wet and dry soils. Gratkowski, H. Results of a laboratory-greenhouse experiment indicate that heat of slash fires can induce germination of varnishleaf ceanothus (Ceanothus velutinus var. laevigatus) seeds in wet or in dry soils.

Large amounts of dormant but viable varnishleaf ceanothus seeds are present in soils under overmature Douglas-fir forests in southwestern Oregon. When the timber is logged and the slash burned, dense stands of ceanothus spring up and retard growth of tree seedlings in the cutover areas. To determine whether slash fires may be responsible for germination, ceanothus seeds were planted 1/8 inch below the surface in wet and in dry soils and heated in an electric oven at temperatures up to 420°F. After stratification, the heat-treated seeds were germinated in a greenhouse.

Few weeds germinated after heat treatment at oven temperatures up to 180°F., but germination increased significantly when seeds in dry soil were heated at 260° for 20 minutes or at higher temperatures for shorter lengths of time. Due to the high specific heat of water, higher oven temperatures were required to stimulate germination of seeds in wet soil than in dry soil.

Soil temperatures similar to those which stimulated germination of varnishleaf ceanothus seeds in this experiment can undoubtedly occur under light logging slash during broadcast burning. Soil temperatures under heavy accumulations of logging slash would either kill the brush seeds or completely consume all seeds and organic matter at depths from which germinating ceanothus seedlings can emerge. (Pacific N.W. Forest and Range Expt. Sta., Forest Service, U.S. Department of Agriculture, Roseburg, Oregon).

Fire-induced germination of ceanothus seeds. Gratkowski, H. A laboratory experiment has provided evidence that fire will induce germination of varnishleaf ceanothus seeds in soil.

Three hundred seeds were planted in each half of six flats at a depth of 1/8 to 1/4 inch below the surface of a fine sandy soil enriched with kaolinite clay. One half of each flat was selected for burning and covered with a 6 inch layer of excelsior. Wooden barriers, sheet metal flame shields, and a cover of aluminum foil were used to minimize heat transmission to the remaining half of each flat. Then the excelsior was ignited and allowed to burn to ash.

Germination in the burned halves of the flats was much greater than in the unburned halves. Three hundred and five seeds germinated in the burned halves while only 32 germinated in the unburned parts of the flats. (Pacific N.W. Forest and Range Expt. Sta., Forest Service, U.S. Department of Agriculture, Roseburg, Oregon).

Method of logging slash disposal affects germination of dormant Ceanothus seeds in the soil. Gratkowski, H. An experiment designed into a commercial logging operation on the Umpqua National Forest has shown that burning logging slash induces germination of dormant varnishleaf ceanothus seeds in the soil. Broadcast burning logging slash in the usual manner stimulated germination of a greater number of seeds than did piling and burning. In contrast, ceanothus seedlings were far less abundant where slash was left unburned than where slash was either broadcast-burned or piled and burned. (Pacific N.W. Forest and Range Expt. Sta., Forest Service, U.S. Department of Agriculture, Roseburg, Oregon).

Item	Logging slash treatment		
	Broadcast-burned	Piled and burned	Not burned
Percentage of plots[1] stocked with seedlings	19	19	8
Average number of seedlings per stocked plot	6.5	1.9	1.3
Average number of ceanothus seedlings per acre	6,305	1,568	439

[1]/Plot size 1/5000 acre

The use of chemicals in thinning dense lodgepole pine. Finnis, J.M. A study on the use of fenuron in thinning very dense lodgepole pine (*Pinus contorta* Dougl.) was initiated in 1963 at the Spruce Canyon Youth Camp in Stevens County, Washington. The stand was so dense that it was almost impossible to use an axe. Various treatments were applied on a grid basis in an attempt to open up the stand. Treatments tested were:

1. 1 tablespoon fenuron at 4 ft. X 4 ft. spacing.
2. 1 tablespoon fenuron at 8 ft. X 8 ft. spacing.
3. 1 teaspoon fenuron at 4 ft. X 4 ft. spacing.
4. 1 teaspoon fenuron at 8 ft. X 8 ft. spacing.

The first three treatments killed all trees including the leaved trees. The fourth treatment affected most trees but some are still green. Plans call for testing one teaspoon at 12 X 12 ft. spacing in 1964. (Forestry Research Center, Washington State Department of Natural Resources, Olympia).

Cost of thinning Douglas-fir. Finnis, J.M. Three methods of thinning young stands of Douglas-fir (*Pseudotsuga menziesii*) were tested at the Mission Creek Youth Camp under the direction of J. Lathrop. Costs per acre were:

Falling and lopping the tops	$31.20
Axe girdling	24.45
AMS solution in axe frills	16.99

The AMS solution consisted of 1 lb. of AMS per pt. of water. (Forest Research Center, Washington Department of Natural Resources, Olympia).

Chemical frill treatment of alder. Finnis, J.M. Aerial application of phenoxy herbicides on large areas is an accepted treatment to control red alder (*Alnus rubra*). However, there are many places where a small area must be controlled, and this calls for individual tree treatment.

Five chemicals were tested in axe cuts spaced four inches apart around stems of alder trees:

1. AMS. An aqueous solution of 1 lb. of AMS in 1 pint of water.
2. Dicamba. 4 lbs. acid equivalent per gallon applied undiluted.
3. Silvex. 6 lbs. acid equivalent per gallon applied undiluted.
4. 2,4,5-T L.V. ester. 4 lbs. acid equivalent per gallon applied undiluted.
5. 2,4-D amine. 4 lbs. acid equivalent per gallon applied undiluted.

Twenty-five trees were treated with each chemical at six dates during the year. The study is being replicated in Clallam, Thurston, and Clark Counties, Washington.

Trees treated with AMS and dicamba late in August were dead in late October. Effect of the other chemicals was less dramatic, but final evaluation cannot be made until the 1964 growing season. Completed results will be available by the end of 1964 (Forestry Research Center, Washington State Department of Natural Resources, Olympia).

Chemical control of salmonberry. Finnis, J.M. The following chemicals were tested on salmonberry (*Rubus spectabilis*) in July 1962:

1. Amitrol-T
2. 2,4,5-T solubilized acid
3. Silvex
4. Butoxone ester
5. Decamine
6. 2,4,5-T L.V. ester
7. Dicamba
8. Trysben 200
9. Diesel oil

Chemicals were tested at 16 and 32 lbs. per acre on two replicates per treatment. The plots were examined in May 1963 and degree of control, especially amount of resprouting, was recorded.

The most promising chemicals were amitrole-T, dicamba, and the low volatile ester of 2,4,5-T. These were tested again in 1963 at the following rates: amitrole-T and dicamba at 1,2,and 4 lbs. per acre; 2,4,5-T at 2,4, and 8 lbs. per acre. (Forest Research Center, Washington Department of Natural Resources, Olympia).

Chemical control of snowberry. Finnis, J.M. A number of chemicals were tested in May 1963 to control snowberry (*Symphoricarpus albus*) in Clark County, Washington. Examination in the early fall of 1963 showed that the most promising chemicals were:

1. Amitrol T
2. Simazine plus Amitrol T
3. 2,4,5-T L.V. ester

The plots will be examined in 1964 to assess degree of control at the end of the second year after application. (Forest Research Center, Washington Department of Natural Resources, Olympia).

Control of bracken fern. Finnis, J.M. Three plots were laid out during 1962 in Grays Harbor County, Washington, in an area covered with a dense, uniform stand of bracken fern (*Pteridium aquilinum pubescens*).

Plot 1. Scarified in February and planted in March 1962.
Plot 2. Sprayed in August 1962 and planted in the spring of 1963.
Plot 3. Planted in March 1962 and sprayed in August 1962.

The herbicide used was a butoxy ethanol ester of 4-CPA applied at a rate of 8 lbs. ae per acre in an oil-in-water emulsion; 10 gallons of spray per acre.

Douglas-fir seedling survival, bracken fern height, and density were recorded in September 1963. Results are:

Plot Number	Treatment	Seedling survival	Av. Ht. bracken	Av. No. Stems per milacre
1	Scarified-planted	100%	55.85 in.	42.9
2	Sprayed-planted	92	44.1	26.1
3	Planted-sprayed	97	48.4	22.2

While the spray treatment has reduced the height and density of the bracken, this has had no effect on seedling survival. By visual inspection, adequate control of bracken fern has not been achieved.

This study was carried out in cooperation with R.F. Strand of Crown-Zellerback Corporation. (Forestry Research Center, Washington State Dept. of Natural Resources, Olympia).

Chemical control of dwarfmistletoes on California conifers. Quick, Clarence R. Development is continuing on methods for direct control of dwarfmistletoes (*Arceuthobium* spp.) on conifers in California. About 2500 trees in some 245 tests were treated with a variety of herbicides--largely phenoxy herbicides-- during the years 1959-1963. Many early attempts were unsuccessful in eradicating dwarfmistletoes throughout crowns of trees by spraying basal portions of boles, and many trees were killed in some tests. More recent tests emphasize control of directly sprayed infestations on boles and limbs. Saplings and poles of five species of trees commonly have been treated--sugar pine, Jeffrey pine, ponderosa pine, white fir, and red fir.

Dwarfmistletoe control experiments mature slowly. Results of 1959 tests now appear to have stabilized, but trees treated in 1959 will be checked again in 1964. Best 1959 tests, on Jeffrey pine with ester formulations of 2,4-D and MCPP at 2000 ppm in kerosene carrier, still show 2/3 or better control of directly sprayed dwarfmistletoe plants. There is little leeway in choice of effective safe concentrations of phenoxy herbicides for treatment of dwarfmistletoes on California conifers. Sugar pine and ponderosa pine react to phenoxy compounds similarly to Jeffrey pine, but the two firs (*Abies* spp.) are more easily damaged. All treated species are very easily damaged by herbicides during the spring surge of growth, but are much less affected after new growth has hardened off. Most advantageous time for direct treatment appears to be late summer and early fall.

Three principal spray carriers have been used: (1) petroleum fuel oil, e.g., stove oil, (2) water with 10 to 20 percent of agricultural spray oil added, and (3) water with 10 to 15 percent of a polyglycol added. It is not certain which carrier is most generally satisfactory, but higher concentrations of phenoxy herbicides can be applied safely in water-base carriers.

Trichlorophenoxy compounds are more promising on pine species than dichloro and methyl-chloro materials. 2,4,5-TP appears to be more systemic than 2,4,5-T or 2,4,5-TB, but 2,4,5-TB in fuel oil has a less restricted range of safe concentrations on pines then either 2,4,5-T or 2,4,5-TP. Formulations of 2,4-D and 2,4-DB offer little selectivity between tree species and dwarfmistletoe. 4-CPA, as well as 2,4,5-TP, is somewhat systemic in pines, but neither material holds much hope of general effective control of dwarfmistletoe by basal-stem treatment. Within a few years a safe and effective chemical method for direct control of dwarfmistletoe on pines should be available for special forest situations. Tests are continuing. (Forest Service, U.S. Department of Agriculture, Berkeley, California).

PROJECT 4. WEEDS IN HORTICULTURAL CROPS

Don F. Dye, Project Chairman

SUMMARY

Investigators in seven states have contributed fourteen abstracts which represent eleven crops. Those crops for which more than one abstract was received are tomatoes, onions, grapes and shelter belts.

Tomatoes. Tillam and Diphenamid were reported in both abstracts as having shown the most promice. Neither herbicide was phytotoxic.

Onions. DCPA, R-4461, Paraquat and Diquat were reported as showing promise on onions. The abstracts indicate that no phytotoxicity was observed from these herbicides. Since each of the other abstracts represent separate areas of endeavor and cannot be compared, a summary has not been prepared for them.

Evaluation of soil-incorporated herbicides for selective weed control in tomatoes. Hamson, Alvin R. Six herbicides were evaluated for crop tolerance and control of mixed annual weeds in transplanted tomatoes. Herbicides were applied to 4-row plots on a prepared seedbed and incorporated within minutes by a power-driven, hooded, rotary tiller with L-shaped teeth set 3 inches deep. A randomized block design was used with 4 replications including weeded check plots. Weed control was rated four weeks after application on a subjective scale with 0 indicating no control of weeds and 10 complete control. Ratings were made on individual weeds and as an overall rating of all weeds combined. Size of tomato plants was indicated at the same time by subjective ratings with 0 indicating stunting and 10 normal growth. Yields of U.S. No. 1, No. 2, and cull tomatoes were not significantly different between the herbicide treatments at the 5% level. Weeds present were mallow, Malva neglecta Wallr; black nightshade, Solanum nigrum L.; lambsquarters, Chenopodium album L.; redroot pigweed, Amaranthus retroflexus L.; purslane, Portulaca oleracea L.; and stinkgrass, Eragrostis cilianensis All. All plots were weeded by hand by one person who worked at a uniform rate recording time of weeding each plot. The conversion of these records to hours per acre appears in the table which also includes herbicide rates and subjective ratings of weed control and tomato growth.

The most promising herbicides were tillam and diphenamid. Tillam gave nearly complete control of all weeds including black nightshade. Diphenamid gave slightly better control of lambsquarters, redroot pigweed, and stinkgrass but was less effective in controlling black nightshade. R4461 was nearly as effective as tillam but did not control black nightshade. CDEC, solan, and amiben were intermediate in weed control. Amiben caused considerable stunting of tomato plants. (Dept. of Hort., Utah Agr. Exp. Sta., Utah State University, Logan, Utah.

1963 WEED CONTROL EVALUATION ON TOMATO TRANSPLANTS

Weed Control Ratings*

Herbicide and rate	Handweeding Hrs/Acre	Mallow	Nightshade	Lambs-quarters	Redroot	Purslane	Stink-grass	Combined Weed Control	Tomato Growth
Tillam 4 lbs/Acre	19.7	10	8.75	9.75	9.50	10	9.50	9.75	9.75
Diphenamid 6 lbs/Acre	39.8	10	6.75	10	10	10	9.75	8	9.75
R4461 10 lbs/Acre	46.4	8.75	5.50	10	9.75	10	9.75	7	9
CDEC 6 lbs/Acre	62.3	9.5	5	8.5	8.75	9.25	8.25	6	8.5
Solan 4 lbs/Acre	74.1	9.25	6.25	7	6.75	7.75	5.75	4	7.5
Amiben 4 lbs/Acre	32.3	8.75	7	9.5	9	10	6.75	7.75	5.75
Check	86.0	7.5	4.25	6.25	5.5	7.5	5.75	2.25	7

* Rated on a basis of 0 to 10 with 0 = no control.

Field evaluations of pre-plant herbicides in tomatoes, onions, and cucumbers in Colorado. Ross, Merrill A. Several pre-plant herbicides were evaluated for their effectiveness (under Colorado conditions) in tomatoes and onions at Rocky Ford, Colorado Branch Station in 1962 and 1963 and NPA was evaluated in cucumbers at Fort Collins in 1963. In all cases the herbicides were applied with a knapsack boom sprayer. Chemical on one-half of the rows in each plot was incorporated 1 to 1½ inch deep with a Bye-Hoe and the other half was left undisturbed. All plots were then planted and furrow irrigated as soon as possible. Predominant weeds in the Rocky Ford tests were redroot pigweed, Venice mallow, barnyard grass, lambsquarter and Setaria spp.

Tomatoes. Following a preliminary screening trial in 1961 PEBC, diphenamid and CDEC were selected for further testing. PEBC and diphenamid both gave good weed control at rates which were not unduly toxic to the tomatoes. CEDC gave a fair measure of control against broadleaved weeds but lacked an acceptable margin of safety. Diphenamid exhibited a wide margin of safety with respect to tomatoes, however, it did not prove as effective against Venice mallow as did PEBC. Incorporation reduced the variability of PEBC and diphenamide performance from year to year as well as improving their effectiveness against the weeds. Benefits derived from incorporation were particularly obvious in 1963 (Table I) when hot, dry weather prevailed at planting time.

Onions. Several chemicals were evaluated in 1962 and of these only CIPC and DCPA were worthy of further testing. In 1963 DCPA at a rate of 16 lbs/A gave acceptable weed control with no injury to the onions. Venice mallow, however, appears to be resistant to it. CIPC has not performed well with furrow irrigation. Incorporation of the DCPA improved its performance (Table II).

Cucumbers. One test was treated and planted June 8, 1963. It received ½ inch of rain two days later. A second test was treated and planted 3 weeks later. This time no rainfall was received. In the first test all rates of NPA gave excellent weed control irrespective of the incorporation treatment. In the second test which received no moisture in the form of rainfall incorporation did enhance the action of NPA (Table III).

Table I. Direct seeded tomato pre-plant herbicide trials, Rocky Ford, Colorado 1962-1963.

		% Reduction of total weed stand						% Reduction of tomato stand					
	Rate	1962		1963		Ave.		1962		1963		Ave.	
Chemical	Lbs/A	I*	U*	I	U	I	U	I	U	I	U	I	U
PEBC	3	74	60	82	40	78	50	9	16	10	30**	10	23
"	4½	86	92	95	77	90	84	25	0	0	17	12	8
"	6	97	97	97	90	97	94	73	20	9	12	41	16
diphenamid	3	96	76	77	25	86	50	0	0	0	30**	0	15
"	6	87	90	90	70	88	80	0	0	25	2	12	1
"	9	87	94	90	82	88	88	43	0	15	30	29	15
CEDC	3	75	83	42	50	58	66	24	46	10	25	17	36
"	6	88	83	46	20	67	52	88	56	10	12	49	34
"	9	88	95	68	52	78	74	94	90	45	14	70	52
Control	-	0	0	0	0	0	0	0	0	0	0	0	0

Table II. Onion pre-plant herbicide tests, Rocky Ford, Colorado 1963.

Treat-ment	Rate lb/A	Percent Stand Reduction: Broad-leaved weeds*** I	U	Grassy Weeds I	U	Total weeds I	U	Onions I	U
DCPA	8	38	37	92	55	65	46	0	0
"	12	60	30	90	32	75	31	0	0
"	16	87	48	87	68	87	58	7	6
CIPC	2	0	35	57	2	28	18	0	6
"	4	49	55	44	11	46	33	12	29
"	6	20	20	76	46	58	33	12	45
Check	-	0	0	0	0	0	0	0	0

Table III. Cucumber pre-plant herbicide test, Fort Collins, Colorado 1963.

A. Effect of NPA treatment on percent of reduction stand of weeds and cucumbers when ½ inch of rain was received.

lbs NPA/A	Redroot pigweed I	U	Purslane I	U	Grassy Weeds I	U	Total Weeds I	U	Cucumber I	U
0	0	0	0	0	0	0	0	0	0	0
2	100	98	100	100	94	87	98	96	0	0
4	100	100	100	100	92	92	97	97	0	0
6	100	100	100	100	96	91	99	97	0	0

B. Effect of NPA treatment on percent of reduction stand of weeds and cucumbers when no rainfall was received.

lbs NPA/A	Redroot pigweed I	U	Purslane I	U	Grassy Weeds I	U	Total Weeds I	U	Cucumber I	U
0	0	0	0	0	0	0	0	0	0	0
2	70	10	82	62	-	-	86	36	10	0
4	78	64	93	63	-	-	86	64	0	0
6	94	64	91	53	-	-	92	58	2	0

* I = 1½ inch incorporation with Bye-Hoe. U = no incorporation.

** Stand reduction of tomatoes at 3 lbs/A unincorporated treatments with diphenamid and PEBC atributed to competition from weeds.

***Does not include Venice mallow which is resistant to DCPA.

Screening herbicides for use in Thompson seedless grapes. Lange, A. H. Leonard, O. A., and Lider, L. A. The response of newly rooted Thompaon seedless grape cuttings growing in sand to fifteen herbicides (soil and foliar applied) was evaluated under greenhouse conditions during the spring and summer of 1963 at Davis, California. The study included DCPA, simazine, dichlobenil, trifluralin, diuron, prometryne, atrazine, EPTC, isocil, dalapon, dicamba, 2,4-D, and Tordon at 0.005, 0.05, 0.5, and 5 ppm; amitrole and paraquat at 0.05, 0.5, 5 and 50 ppm in the nutrient solution (in sand) testing root absorption. In the second experiment DCPA, simazine, dichlobenil, trifluralin, diuron, prometryne, atrazine, EPTC, isocil, and dalapon were applied to the foliage at the rate of 0.1, 1, and 10 pounds per acre; paraquat at 0.01, 0.1 and 1 pound per acre; dicamba, 2,4-D, and Tordon at 0.001, 0.01, 0.1 and 1 pound per acre in 103 gallons of water per acre. None of the herbicide was allowed to reach the sand.

The results indicated DCPA to be the least toxic herbicide when applie to the roots or the grape foliage. Trifluralin was next showing only slight stunting when root applied at 5 ppm. There was no apparent reduction in growth from foliar applied trifluralin. Simazine, dichlobenil, diuron, prometryne, atrazine, and isocil were readily taken up by the roots and generally caused growth reductions above 0.05 ppm. Prometryne produced the least damage at this level in the root media but was nearly as toxic as atrazine and isocil when applied to the foliage.

Paraquat produced virtually no damage applied to the roots but severely burned the foliage, whereas amitrole was more severe through the roots than the foliage. Dalapon caused little damage through the roots or when applied to the foliage except a possible root reduction as a result of movement to the roots from the 10 pounds per acre foliar application.

Tordon produced extreme toxicity from the lowest level (0.005 ppm) in the root media. Root absorption of 2,4-D was not apparent in the tops in contrast to dicamba and Tordon. Dicamba was less toxic than Tordon. Foliar response to these three hormone type herbicides were quite similar with Tordon and dicamba causing a little more damage than 2,4-D. (University of California, Davis)

The effect of 15 chemicals on the growth of young grape cuttings growing in sand and 1/2 strength Hoaglands solution.

Soil Applied Average[1/]

Herbicide	Approx. Water Sol.	Height in cm ppm .005	.05	.5	5	50	Dry wt. of tops in gms. ppm .005	.05	.5	5	50	Dry wt. of roots in gms. ppm .005	.05	.5	5	50
DCPA	0.5	24	30	37	37	--	17	12	16	14	--	9	6	7	6	--
Simazine	5	45	35	25	d*	--	19	16	8	2	--	8	7	1	0	--
Casoron	10	33	39	16	d	--	20	20	6	2	--	12	10	1	0	--
Trifluralin	24	42	42	32	22	--	21	20	16	12	--	10	9	9	2	--
Diuron	42	39	33	d	d	--	20	16	2	2	--	10	9	0	0	--
Prometryne	48	42	43	35	d	--	20	19	12	3	--	10	9	5	0	--
Atrazine	70	38	32	29	d	--	20	17	5	2	--	8	6	0	0	--
EPTC	375	30	31	41	13	--	19	17	17	3	--	10	8	6	1	--
Isocil	2150	32	36	d	d	--	21	18	4	2	--	13	7	0	0	--
Dalapon	Sol.	35	38	35	41	--	19	19	19	16	--	9	10	9	11	--
Amitrole	Sol.	--	40	42	35	18	--	18	18	11	4	--	11	8	3	1
Paraquat	Sol.	--	36	40	30	30	--	19	19	19	14	--	10	8	8	7
Dicamba	Low	29	16	d	d	--	16	7	2	2	--	10	7	0	0	--
2,4-D	Low	30	34	16	d	--	19	16	6	1	--	9	9	2	0	--
Tordon	430	17	d	d	d	--	9	4	3	2	--	10	0	0	0	--
Check	--	(38)					(20)					(10)				

[1/] Average of 4 individual pot replicates (1 plant per pot); average dry wt. is represented by the total dry wt. of tops or roots from all 4 replicates, 42 days after first application.

*d = Top of plant dead and therefore could not be measured.

Foliage Applied - Average[2/]

Herbicide	Height in cm pounds per acre .001	.01	.1	1	10	Dry wt. of tops in gms. pounds per acre .001	.01	.1	1	10	Dry wt. of roots in gms. pounds per acre .001	.01	.1	1	10
DCPA	--	--	12	25	17	--	--	5	9	7	--	--	8	8	7
Simazine	--	--	19	16	13	--	--	6	6	4	--	--	6	5	2
Casoron	--	--	23	20	14	--	--	8	7	7	--	--	9	7	6
Trifluralin	--	--	15	10	20	--	--	7	5	7	--	--	8	5	6
Diuron	--	--	15	20	d*	--	--	6	3	4	--	--	6	2	2
Prometryne	--	--	16	16	d	--	--	6	4	2	--	--	7	3	2
Atrazine	--	--	19	14	d	--	--	5	5	2	--	--	9	4	2
EPTC	--	--	18	18	18	--	--	5	6	6	--	--	4	7	5
Isocil	--	--	15	d	d	--	--	5	3	1	--	--	4	2	1
Dalapon	--	--	13	15	11	--	--	4	6	4	--	--	5	6	2
Amitrole	--	--	21	16	13	--	--	8	4	6	--	--	10	8	4
Paraquat	--	17	13	15	--	--	7	5	4	--	--	8	6	4	--
Dicamba	11	10	d	d	--	4	3	2	2	--	5	2	1	2	--
2,4-D	15	14	d	d	--	6	4	2	2	--	6	3	1	1	--
Tordon	14	d	d	d	--	6	2	3	2	--	6	3	3	1	--
Check	(14)					(6)					(8)				

2/ Average of 3 individual pot replicates (1 plant per plot); Average dry wt, is represented by the total dry wt. of tops or roots from all 3 replicates, 42 days after first application.

*d = Top of plant dead and therefore could not be measured.

Progress in the development of an herbicide for the selective removal of bentgrass from bluegrass turf. Chamberlain, H. E. and Jess L. Fults. Throughout the bluegrass (*Poa pratensis* L.) area of the nation, bentgrass (*Agrostis palustrus* or *A. tenuis*) is often a "weed" in the sense that it is a plant out of place. Up until recently much of the best commercial bluegrass seed contained a small percentage of bentgrass as an allowable "other crop seed". Possibly this fact more than any other single condition has allowed a great deal of bentgrass to be randomly introduced into bluegrass turf. Bentgrass is slow to green up in the spring and goes dormant early in the fall as compared to Kentucky bluegrass. There are also distinct color and texture differences during the summer months that make bentgrass patches in bluegrass turf undesirable.

Experiments to determine the best possible herbicide to remove bentgrass from bluegrass turf were begun at this station in late August 1962 with the establishment of a bentgrass (direct seeded seaside bent) nursery for herbicide testing. A full year was used to thoroughly establish the sod and exploratory treatments were initiated in August 1963. Chemicals and rates of application which are currently being tested include: 1) Sodium salt of TCA @ 10 lb/A in 1089 gal water/A; Paraquat (California Spray Chemical Corp.) @ 0.5, 1, and 2 lb/A in 400 gal water/A; ammonium sulfate @ 10 lbs nitrogen/1000 ft^2 as a dry material; ERASE (Scott Seed Co.) containing 7.2 percent cacodylic acid @ 6.5 lb of formulation/1000 ft^2; ammonium hydroxide applied as saturated ammonia water containing approximately 24 percent ammonia (made by saturating tap water with commercial anhydrous ammonia). One quart of this solution diluted with one quart of tap water was applied to 20 ft^2. This anhydrous ammonia solution applied @ 1 qt/20 ft^2 would yield an equivalent nitrogen application of 20.7 pounds nitrogen/1000 ft^2. The sodium salt of TCA, paraquat, ammonium sulfate, Erase, and ammonium hydroxide were applied August 29, 1963, at a time when both bentgrass and bluegrass in adjoining plots were green and growing vigorously. The following chemicals were applied November 12, 1963 after the bentgrass was brown and nearly dormant. KCNO at rates of 10, 15 and 20 lb/A; Union Carbide UC20299 @ 5 and 10 lb/A; dicamba at ¼, ½, 1, and 2 lb/A; Kilz-all (O. E. Linck Div., Walco American Corp., Clifton, New Jersey) containing 30 percent dimethyl arsenic acid @ 1 1/3 oz of formulation/50 ft^2. Only one application was made with each chemical or formulation.

Fall 1963. Each chemical treatment--main plot-- was divided into 6 sub-plots to study the interaction of renovation and reseeding. The renovation and reseeding treatments following chemical treatment: 1) no renovation and no reseeding; 2) renovation and reseeding 7 days after chemical treatment; 3) no renovation but reseeded 7 days after chemical treatment; 4) renovation 7 days after chemical treatment but not reseeded; 5) renovation and reseeding to be accomplished 8 months after chemical treatment (in April 1964); 6) no renovation but reseeding 8 months after chemical treatment (April 1964). Reseeding was done or will be done with common Kentucky bluegrass seed @ a rate of 3 lb/1000 ft^2; renovation was accomplished with a "Ren-o-thin" machine with the knives set to work at a depth of ½ inch below the surface.

Results in the late fall, while preliminary, indicated that the use of ammonium hydroxide was the most promising chemical treatment. It not only gave an immediate kill of the bentgrass, but it allowed reseeding 7 days after treatment plus giving a nitrogen stimulus for the quick extablishment of blue-grass seedlings. In limited tests on established bluegrass turf, it produced only a temporary top contact kill followed by rapid recovery and stimulation of the regrowth from crown buds and rhizomes. Grass leaves treated with ammonium hydroxide solution turned black within an hour after application and were yellow and dead within 5 days. An added advantage appears to be the complete lack of any chemical residue that might be a hazard to children or pets. An obvious objection that may be overcome by further work are the strong ammonia fumes at the time of treatment.

Results with other chemicals were as follows: 1) the sodium salt of TCA did not give complete kill at the rate used; 2) ammonium sulfate did not give complete bentgrass kill at the rate used, but did allow bluegrass seedlings to become quickly established; 3) Erase (cacodylic acid) killed about 40 percent of the bentgrass; bluegrass seedlings failed to become established; 4) paraquat @ ½, 1 and 2 lb/A in 400 gal/A of water did not adequately kill the bentgrass but did allow good establishment of bluegrass seedlings--further research with larger volumes of water may do an adequate job; 5) the other treatments applied late when the bentgrass was dry and nearly dormant cannot be initially evaluated before the spring of 1964.

Removal of the dead cover by renovation and subsequent sweeping showed no advantage over planting the bluegrass seeds directly into the dead bentgrass. Grass must be in a lush actively growing condition if herbicides are to give maximum effectiveness. (Colorado Agri. Exp. Sta., Colorado State University., Fort Collins.)

<u>Chemical weed control in established shelterbelts</u>. Guenthner, H. R. and Baker, L. O. In the fall of 1961, diuron at 10 lbs/A, simazine wettable powder at 10 lbs/A, simazine granules at 5 and 10 lbs/A were applied on a 30 year old stand of Chinese Elm. On April 16, 1962 the following treatments were made; simazine granules at 5 and 10 lbs/A, simazine wettable at 5 and 10 lbs/A and diuron at 5 and 10 lbs/A. A vigorous growth of crested wheatgrass, smooth bromegrass and downy brome was present in the tree row.

In 1962, simazine wettable powder applied at 10 lbs/A was most effective early in season however after the seasonal rainfall simazine granules at 10 lbs/A was as effective as the wettable powder application. In 1963 both treatments were again the most effective. Diuron generally did not control the perennial grasses as well as the simazine treatments. Additional observations will be made in 1964. (Montana Agricultural Experiment Station, Central Montana Branch, Moccasin.)

Weed control in shelterbelts. Baker, Laurence O. Twelve tree and shrub species were transplanted into Bozeman silt loam soil in May 1962. They were spaced about 2 feet apart in the row and rows were 4 feet apart. Chemical treatments were immediately made to some plots (12 by 48 feet). Other applications have been made at intervals since for a total of 30 treatments applied in triplicate. Spray applications were made with a knapsack sprayer using care to keep the chemical off the tree and shrub plants. Granular materials were scattered by hand. Considerable mouse damage occurred during the winter of 1962-63 on those plots where weeds were not controlled. Good tree and shrub growth was made during 1962 and 63 where weeds were not allowed to compete. Where weed competition was excessive very little growth occurred.

Weeds were controlled 90% or better from the use of atrazine, simaaine, diuron, casoron (incorporated), and GC6691, all at a rate of 5 pounds per acre applied in the spring of 1963. Fall-applied casoron was less effective (77%) indicating a short period of residual effectiveness. However, fall-applied (1962) simazine and diuron gave almost 100% control at the same rate. Of the treatments applied in the spring of 1962 simazine controlled weeds 85% and diuron 62% at a 5 pound rate. At 2.5 pounds neither chemical gave satisfactory results. DCPA, sesone, falone, EPTC, amiben, OMU, CP31675, R3446, and Shell 7961 have given varying degrees of weed control but none have provided satisfactory season-long control.

Greatest tree injury occurred on the non-weeded check plots. Caragana and honeysuckle were injured by both the atrazine and simazine. Atrazine also injured cottonwood and golden willow. Of the longer lasting treatments diuron was least injurious to the woody species, and yet gave acceptable weed control. GC6691 gave good weed control but inasmuch as it was not applied until June 26 its residual effectiveness and its effect on trees is not known. In addition to the woody species named, American and Siberian elm, green ash, American plum, sand cherry, Russian olive, Douglas fir, and blue spruce were included in the planting. American elm was injured by 2,4-D, apparently from a volatile form applied approximately 1/4 mile away. Because of its sensitivity to 2,4-D this elm should not be included in any shelterbelt planting where 2,4-D is an accepted farming practice. (Montana Agriculture Experiment Station, Bozeman).

Herbicide evaluation field trial in blueberry plantings. Peabody, Dwight V., Jr. A herbicide evaluation experiment was initiated in 1963 designed to determine selective activity of certain promising herbicides in blueberry plantings. Twelve different herbicides were applied at each of three different locations in western Washington to blueberry plants during the spring of 1963. Two of these materials (2,3,6-trichlorobenzyloxypropanol + 2,4-D and 4-amino-3,5,6-trichloropicolinic acid) caused definite injury to blueberry plants. At the rates used, swep, dichlobenil, methoxy propazine, propazine, and dicryl did not result in adequate control of the many different established perennial weed species present. However, three of these herbicides, atrazine, diquat and paraquat, looked promising and were re-applied in mid-summer and again in the early fall. No growth abnormalities nor injuries (with one exception) were evident on blueberry plants one month after the final application. Control of many different annual and perennial weed species was obtained for varying lengths of time, dependent upon location. Although atrazine or paraquat (or diquat) resulted in good weed control under a wide variety of conditions, there is a possibility that atrazine and paraquat can be applied together, since the activity of one may supplement the activity of the other and equivalent control may be obtained with less total herbicide. (Northwestern Washington Experiment Station, Washington State University, Mount Vernon.)

Weed control in grapes. Lange, A. H., Hamilton, W. D., Harvey, W. A., and Leonard, O. A. Weed control was compared from the application of simazine and diuron at 2 and 4 pounds per acre sprayed in strip application in four Alameda-Santa Clara County vineyards in spring, 1963. In two of the vineyards trifluralin at 2 and 4 and DCPA at 10 and 20 pounds per acre were also compared with the simazine and diuron. Amitrole at 1 pound per acre was included in all treatments to remove standing weeds.

Simazine and diuron gave excellent comparable weed control even at 2 pounds per acre. Trifluralin and DCPA gave less but substantial weed control even though none of the chemicals were incorporated. No toxicity symptoms on grape foliage were observed from any of the herbicides. The varieties tested included Ruby cabernet, Zinfindel, Griegnolino, Sauvignon vert, and Carignane. (University of California, Davis)

Table 1. Summary of comparative weed control from field application[1/] of four herbicides at two rates in two separate tests.

Herbicide	lb/A	Average[2/] percent weed control after 5 weeks	14 weeks
Simazine	2	67	69
Simazine	4	80	89
Diuron	2	63	56
Diuron	4	86	80
Trifluralin	2	59	44
Trifluralin	4	74	57
Dacthal	10	46	26
Dacthal	20	64	56
Check	--	3	9

1/ These pre-emergence herbicides were applied (1/23/63) with 1 pound of amitrole per acre on standing weeds in 4 foot strips down the vine row of two vineyards.

2/ Average of 2 ratings of 2 experiments (one replicated 3 and the other 4 times). Herbicide applications were made 1/22/63 and 1/23/63. The weed control rating (0 = no control, 10 = 100% control) were made 3/29/63 and 6/3/63.

Pre-planting and pre-emergent contact herbicide treatments in onions. Hamson, A. R. and Anderson, J. L. Onion seedbeds were prepared in August and irrigated to induce weed germination. Paraquat and Diquat applied before onion emergence gave an excellent contact kill of weeds which germinated in the overwintering onion seedbeds. Paraquat at ½ pound per acre and Diquat at 2 pounds per acre when applied with X-77 spreader gave a better contact kill than did aromatic weed oil and showed no phytotoxicity when applied as either pre-planting or pre-emergent herbicides. Weeds present included lambsquarters, Chenopodium album L.; purslane, Portulaca oleracea L.; redroot, Amaranthus retroflexus L.; common mallow, Malva neglecta Wallr.; and stinkgrass, Eragrostis cilianensis All. At lower rates Diquat burned back the tops but gave an incomplete kill of the larger lambsquarters and mallow. (Utah Agr. Expt. Sta., Utah State University, Logan.)

Chemical weed control in onions. Anderson, W. P., and Whitworth, J. W. Two herbicides appear very promising for the control of annual grass and broadleaf weeds in spring planted Grano onions when applied either pre-emergence or at the flag-stage. These herbicides and their effective dosages are: DCPA (Dacthal) - 6 to 20 lbs/A ai; and R-4461 (Betasan) - 2 to 8 lbs/A ai. Both materials were equally effective in their control of weeds; they controlled annual grass weeds better than they did annual broadleaf weeds. Neither material, even at the highest dosages applied, caused any apparent onion injury.

The following four herbicides were also included in these test but were not effectual: SD-6623 - 5 to 20 lbs/A ai, no weed control; R-1607 - 2 to 8 lbs/A ai, no weed control; R-4518 - 2 to 8 lbs/A, no weed control; CIPC - 2, 4, 6, and 8 lbs/A ai, onions killed at dosages of 6 and 8 lbs/A, dosages of 2 and 4 lbs/A did not injure onions, no weed control at any dosage five weeks after application.

Applications were made in February pre-emergence to onions and weeds and in March when the onions were in the flag-stage and a few weeds emerging. Onions watered by furrow irrigation.

Research with DCPA and R-4461 will be continued in 1964 with yields taken. (New Mexico State University, Agricultural Experiment Station, University Park, New Mexico.)

Weed control in direct seeded broccoli. Crabtree, Garvin. Field and greenhouse studies of the use of herbicides for selective control of weeds in direct seeded broccoli were conducted at Corvallis in 1962 and 1963. Materials selected as the most promising of those tested include DCPA, trifluralin, and a combination of DCPA and CDEC herbicides. DCPA was about equally effective with shallow soil incorporation or as a surface application. Trifluralin was effective in killing weeds at lower rates of application when incorporated into the soil. Results of the 1963 field test are summarized in the table.

Differences in crop response to trifluralin in the 1962 and 1963 field trials may be a result of differences in methods used for incorporating the herbicide into the soil and would suggest that this variable may be quite critical. A greenhouse test indicated that broccoli from seeds planted one inch deep were much more sensitive to trifluralin applications mixed with the top one inch of soil than trifluralin mixed with the second inch of soil or with non-incorporated surface applications. Similating different types of irrigation did not have an appreciable effect on crop response to surface applications of this chemical. (Oregon Agricultural Experiment Station, Oregon State University, Corvallis)

Weed control in broccoli - 1963 field trial

Chemical	Application rate (lbs ai/A)	Type of 1/ application	Weed control 2/ rating	Average yield 3/ (Kg/plot)
Trifluralin	1/2	Deep inc.*	7	1.68
Trifluralin	1	Deep inc.	8	1.79
Trifluralin	2	Deep inc.	9	1.28
Trifluralin	1/2	Shallow inc.	8	2.03
Trifluralin	1	Shallow inc.	9	1.75
Trifluralin	2	Shallow inc.	9	1.61
DCPA	6	Shallow inc.	7	2.37
DCPA	9	Shallow inc.	7	1.69
DCPA	6	Surface	6	2.18
DCPA	9	Surface	6	2.46
DCPA + CDEC	6 + 4	Surface	9	1.93
Trifluralin	1	Surface	6	2.42
Trifluralin	2	Surface	9	1.94
Trifluralin	4	Surface	9	1.53
Untreated Check	-	--	2	2.08

* inc. = incorporated.

1/ Preplant applications were incorporated into the soil with a rotary tiller: deep - 3 inches, shallow - 1 inch.

2/ Weed control rating: 0 - no response, 10 - complete kill. Predominate weed species: redroot pigweed, common lambsquarters, mustard (*Brassica rapa* L.), common chickweed.

3/ Average fresh weight of four replications. Analysis of variance showed no significant differences in yields.

Application methods for EPTC and R-1910 on sweet corn. Crabtree, Garvin. EPTC and R-1910 (ethyl diisobutylthiolcarbamate) were evaluated for weed control in sweet corn in a field trial in 1963. Each material was applied at rates of 2, 3, and 4 lb ai/A and incorporated into the soil by various means as listed in the table.

Post-plant use of the sweep applicator to a considerable extent, and the rotary tiller to a lesser extent, disturbed the corn seed and some stand thinning resulted in these plots even after all plots were thinned to an 8 inch spacing. Significant stand thinning did not occur in unsprayed plots that were disturbed with the sweep applicator after planting.

When the various methods of application of the herbicides are pooled this test indicated that weed control with the 4 lb ai/A rate of R-1910 was about equal to control obtained with 2 lb ai/A of EPTC and sweet corn yields were reduced to a greater extent with the low rate of EPTC.

Weed control ratings were not greatly influenced by the method of application of the herbicides. The degree of herbicidal activity, as indicated by crop response (see table), is greatest for the sweep applications with incorporation by rotary tillage being intermediate and discing showing the least response. (Oregon Agricultural Experiment Station, Oregon State University, Corvallis)

EPTC and R-1910 on sweet corn

Type of application	Weed control 1/ rating	Yield 2/ (total lb)
Preplant, broadcase spray, disc twice to 4 in.	6	195
Preplant, broadcast spray, rotary tilled to 2 in.	7	179
Preplant, broadcast spray, rotary tilled to 4 in.	7	190
Preplant, subsurface spray with sweep applicator 3 in.	6	167
Preplant, subsurface spray with sweep applicator 3 in., followed with rotary tiller 4 in.	7	192
Post-plant, broadcast spray, rotary tilled to 1 in.	6	189
Post-plant, subsurface spray with sweep applicator 1 inch.	6	147
Post-plant, subsurface spray with sweep applicator 1 inch, followed with rotary tiller 1 in.	7	145
Untreated check	2	199

1/ Materials and application rates pooled. Weed control rating: 0 - no response, 10 - complete kill. Predominant weed species: redroot pigweed, common lambsquarters.

2/ Materials and application rates pooled. Husked, graded, fresh weight.

Weed control trials in celery. Lange, A. H., Brendler, R. A., and Lyons, J. M. Three tests were conducted in the fall and winter of 1963 in Ventura County celery grower's fields. The herbicides applied post-emergence to newly transplanted celery were dicryl, solan, FW-925, prometryne, and 4-(MCPB) at 4 pounds per acre. FW-925 and prometryne were also included at 8 pounds per acre. A second test to standing weeds on the field edge included these herbicides and rates as well as prometryne at 1 pound per acre.

In a third test the following were incorporated to a depth of 2 to 4 inches immediately after application, DCPA at 4 and 8 pounds per acre, prometryne at 2 and 4 pounds per acre and trifluralin at 2 and 4 pounds per acre.

Several herbicides applied over transplanted celery gave excellent weed control but caused some apparent crop loss in every case but the loss in the solan and FW-925 (4 pounds) treatments was not shown to be significant at the 5% level (Table 1).

None of the herbicides incorporated into the soil shortly before transplanting caused visual damage to transplanted celery. Prometryne at 4 and trifluralin at 2 pounds per acre gave excellent weed control.

Lower rates of prometryne, solan, and FW-925 will be tested further. (Department of Botany, University of California, Davis.)

Table 1. The effect of foliar applications on weed control in celery.

		Average percent				
		Weed Control			Celery	
		1 week		1 month	Toxicity	Yield
Herbicide	lb/A	young weed	old weed	all weeds	at 2 weeks	(percent of check)
Dicryl	4	85	36	74	18	81**
Solan	4	86	35	68	15	89
FW-925	4	97	81	68	0	91
FW-925	8	100	83	74	0	78**
Prometryne	1	94	49	70	--	--
Prometryne	4	94	67	100	35	76**
Prometryne	8	95	54	100	60	66**
4-(MCPB)	4	48	43	52	15	67**
Check	-	0	0	0	5	100

** Treatments reduced yield significantly at 1% level.

Pre-planting and post-planting herbicidal treatments in new strawberry plantings. Anderson, J. L. In the spring of 1962 herbicidal treatments with Amiben, Dacthal, diphenamid, Casoron, Simazine, Tillam, and Zytron were applied to a new strawberry planting. Of these, diphenamid, Dacthal, and Zytron gave the best weed control and were the least phytotoxic. Dacthal gave excellent control early in the season but allowed a few weeds to germinate in September. Diphenamid gave excellent weed control late in the season but was evidently slow in becoming activiated as weed control in June was incomplete. In 1963 dacthal at 12 pounds per acre, diphenamid at 6 pounds per acre, and Zytron at 10 pounds per acre were applied separately and in combination. A soil incorporated pre-planting treatment of Dacthal at 12 pounds per acre gave excellent weed control all season. Dacthal-Zytron and Dacthal-diphenamid combinations gave excellent weed control but were no better than Dacthal alone. Weeds persent included lambsquarters, *Chenopodium album* L.; purslane, *Portulaca oleracea* L.; redroot, *Amaranthus retroflexus* L.; common mallow, *Malva neglecta* Wallr.; and stinkgrass, *Eragrostis cilianensis* All.

In every case a soil incorporated pre-planting treatment gave better weed control and often less phytotoxicity than a post-planting treatment. Tillam at 4 pounds per acre gave excellent weed control early in the season but had little residual effect after 6-8 weeks. Tillam at 8 pounds was quite phytotoxic. Simazine and Casoron were slow in becoming activated but gave good control late in the 1962 season and showed some residual effect in the spring of 1963. (Utah State University, Logan.)

PROJECT 5. WEEDS IN AGRONOMIC CROPS

Arnold P Appleby, Project Chairman

Thirty-two reports were received for publication from personnel in seven states. These reports have been grouped into twelve categories for summarization as follows:

Small Grains. Downy brome control in Washington has been good with atrazine and simazine, particularly on sandy soils. However, wheat damage has been more severe on sandy soils than on silt loam soils. Field trials with DATC for downy brome control in Oregon gave unsatisfactory results. Bentrol gave good control of fiddleneck in grain in California and Oregon. Bentrol, as well as Tordon and dicamba also gave good control of wild buckwheat in Montana. In both Oregon and Montana, a combination of dicamba and 2,4-D was superior to either material alone. Gromwell was controlled in Montana with 2,4-D low-volatile ester. Oregon workers found no differences in weed control or crop injury between high and low volatile esters of 2,4-D. Both caused severe wheat injury when applied in November. Barban controlled rye in Washington at rates above .5 lb/A. Oregon workers found a new formulation of barban to be more effective on wild oats than the regular formulation. Washington workers found an interaction between seeding rate and wheat tolerance to atrazine and simazine. Work is continuing in Montana in selecting barley genotypes which are resistant to various herbicides.

Cotton. Several herbicides, including diuron, trifluralin, and DCPA were studied in Arizona and New Mexico on cotton. Applications were made at various times during the season with a number of compounds giving satisfactory results.

Alfalfa. New Mexico workers found EPTC and 2,4-DB to provide good weed control in seedling alfalfa while DCPA failed to control weeds satisfactorily. Atrazine, bromacil, and simazine all provided excellent control of annual weeds in established alfalfa in Oregon.

Sugar beets. Several combinations of pre-emergence herbicides gave satisfactory selective weed control in Wyoming experiments. A detailed competition study in Wyoming showed sugar beets to be severely influenced by various densities of rough pigweed and green foxtail.

Chemical Fallow. Montana workers evaluated several herbicides for chemical fallow and studied residual effects from such treatments. Several materials were effective but some reduced grain yield in the following crop. In Oregon, atrazine plus amitrol-T is proving effective as a supplement to tillage in a stubble-mulch fallow program.

Corn. Satisfactory weed control was obtained in Wyoming with a number of compounds including atrazine, Dynamin, EPTC, and atrazine-amiben mixtures.

Forage Crops. In Washington, satisfactory results were obtained in 1962 with diquat as a pre-plant contact herbicide for control of annual weeds prior to seeding forage crops. However, results were poor in 1963. Prostrate knotweed was not controlled by diquat or paraquat.

Grass Seed Crops. A dicamba-2,4-D combination provided the most effective control of annual broadleaves in a new planting of green needlegrass in Montana.

Flax. DuPont 762, atrazine, isocil, and IPC all gave good selective weed control in winter flax in Oregon.

Safflower. Trifluralin gave most satisfactory selective weed control in safflower in California, with EPTC also giving good results. Other materials either injured the crop or did not give adequate weed control.

Field beans. DCPA and EPTC gave satisfactory weed control in field beans in Wyoming. Incorporation did not significantly influence effectiveness of DCPA or amiben but did influence EPTC.

Miscellaneous. A method for estimating residual weed stands by use of a prediction equation is reported from Oregon. Greenhouse studies were carried out in California with an OMU-BiPC combination on several agronomic crops. High herbicidal effectiveness was observed with selectivity on several crops.

Downy brome (Bromus tectorum) control in winter wheat with atrazine and simazine. Rydrych, Donald J. Downy brome (cheatgrass) continues to be one of the most troublesome weeds in the dryland winter wheat areas. Yield losses of 36-86 percent were common in 1963 depending upon the density of cheatgrass stands.

Atrazine and simazine were applied at eleven locations in southeastern Washington at rates of .5, .75, 1, and 1.5 lb/A. Treatments were made during the period November 15, 1962-March 15, 1963 in replicated plots when the wheat was in the 3-4 leaf stage and in areas where cheatgrass stands were dense.

Results indicate that atrazine is more effective than simazine in low rainfall areas (below 10"). Atrazine and simazine gave 90-100 percent cheatgrass control on silt loam soils with little damage to the wheat; however, higher application rates of 1-1.5 lb/A were necessary. Both materials damaged wheat at rates in excess of .50 lb/A on sand loam soils even though cheatgrass control was good. Based on these observations it appears as if atrazine and simazine will reduce wheat yields in the low rainfall, sandy soil areas. In the high rainfall areas where the heavier silt loam soils are common, the damage to the wheat plant will be less but cheatgrass control will be more erratic, depending on the rainfall pattern, seasonal variation, and stage of growth of the cheatgrass seedling. (Washington State University Experiment Station, Pullman, Washington).

Field trials with DATC for selective downy brome control. Appleby, Arnold P. Since previous trials had shown DATC (2,3-dichloroallyl diisopropylthiolcarbamate) to be fairly selective in wheat and barley and relatively effective against downy brome, a series of 1 or 2 acre plots at three rates were established at seven locations through the Columbia Basin of Oregon in the fall of 1962. An attempt was made to locate fields which had a history of being severely infested with downy brome. Various methods of incorporation were used including springtooth harrowing, discing, and various other means. Rates used were 1.25, 1.50, and 1.75 lb/A.

In general, results from this treatment for downy brome control were quite unsatisfactory. The higher rates generally gave about 40-50 percent control with slight to moderate injury being observed at some locations. At no location was control considered satisfactory for farmer acceptance. Since this series of experiments seems to represent approximately how the farmers would be using this material, it is felt that results do not warrant further extensive work with DATC for selective downy brome control in cereals. (Oregon Agric. Expt. Station, Oregon State University, Corvallis).

Evaluation of 3,5-diido-4-hydroxybenzonitrile (bentrol) for selective control of Amsinckia spp. in small grains. Foy, Chester L. and Gibson, Orris W. Various formulations of 2,4-D have long been recommended and used for control of most annual broad-leaved weeds in cereal grains. New herbicides are continually being sought, however, which will (a) permit earlier treatment without loss of selectivity and/or (b) provide improved control of certain difficult-to-kill species, including fiddleneck (Amsinckia spp.).

A preliminary field study in 1962 comparing several postemergence herbicides on oats indicated that bentrol (formerly ACP 62-177) warranted more extensive testing. The results showed a high degree of crop tolerance, yet striking reduction in fiddleneck competition.

In 1963, foliar applications of bentrol (1/4, 1/2 and 1 lb/A) were compared with the standard 2,4-D amine (3/4 lb/A) and several experimental treatments (not included in this report). Five replicated experiments were conducted at three locations on fiddleneck-infested barley in progressive stages of crop and weed maturity (see Table).

Some contact injury and yellowing of the barley was observed following all applications, however these symptoms were quickly outgrown. Bentrol was generally less damaging to the crop yet provided more weed control than the standard application of 2,4-D which caused only moderate twisting of fiddleneck plants. Older portions of fiddleneck foliage sprayed with bentrol exhibited varying degrees of acute contact toxicity; non-necrotic portions of treated foliage became darker green after treatment, but otherwise showed little or no visible toxicity symptoms. The plants ceased growth and finally collapsed or later became understoried by the overgrowth of the barley before collapsing.

Most effective weed control was apparently obtained by applying bentrol when most of the fiddleneck had emerged but was still small (cotyledon stage to 5 inches tall). Fortunately, crop tolerance also tended to be greatest with the early applications. It is possible, of course, that on less productive soil or under less favorable growing conditions, patterns of competition might differ sufficiently to alter the above conclusions. More extensive field testing of the new (lithium salt) formulation of bentrol is justified.

Related studies (Foy, Penner and Bahadur--Plant Physiol. Supp. 38:xx-xxi, 1963) using mitochondria isolated from cucumber cotyledons have shown bentrol to be a potent inhibitor of respiration, as measured by O_2 uptake. (Dept. of Botany, University of California, Davis).

(1) Barley 3-4 leaves - Amsinckia-Cotyledon stage

Chemical	Rate lb/A	Crop Vigor	% weed control	Yield lb/A	% of Check
Bentrol	1/4	10	44.4	1329	106
Bentrol	1/2	10	97.4	1220	97
Bentrol	1	9.1	99	1361	109
2,4-D amine	3/4	7.4	0	980	78
Check	--	10	0	1252	---

(2) Barley 4-5 leaves - Amsinckia 1 to 1 1/2 inches tall

Chemical	Rate lb/A	Crop vigor	% weed control	Yield lb/A	% of check
Bentrol	1/4	10	97	2178	100
Bentrol	1/2	10	99	2033	93
Bentrol	1	10	100	1960	90
2,4-D amine	3/4	8	7	1960	90
Check	--	10	0	2178	---

(3) Barley 5-8 leaves - Amsinckia 1 to 4 inches tall

Chemical	Rate lb/A	Crop vigor	% weed control	Yield lb/A	% of check
Bentrol	1/4	10	65	1013	106
Bentrol	1/2	10	94	1198	125
Bentrol	1	10	100	1154	120
2,4-D amine	3/4	10	0	1209	126
Check	--	10	0	958	---

(4) Barley 6-8 inches (tillered) - Amsinckia 4-5 inches tall

Chemical	Rate lb/A	Crop vigor	% weed control	Yield lb/A	% of check
Bentrol	1/4	10	100	1013	74
Bentrol	1/2	10	100	991	72
Bentrol	1	10	100	1013	74
2,4-D amine	3/4	9	0	1231	90
Check	--	10	0	1372	---

(5) Barley 14 inches (tillered) - Amsinckia 15 inches tall

Chemical	Rate lb/A	Crop vigor	% weed control	Yield lb/A	% of check
Bentrol	1/4	10	10	1122	84
Bentrol	1/2	10	10	1165	88
Bentrol	1	9	63	1035	78
2,4-D amine	3/4	8.9	0	1198	90
Check	--	10	0	1329	---

Selective control of annual broadleaves in grain with bentrol. Appleby, Arnold P., Neidlinger, Thomas J., and Furtick, W. R. Previous research by various workers has shown that weeds can exert significant competitive effects on wheat during the early stages of growth and can cause reductions in final yield. In many areas, weeds emerge at the same time as the grain and seriously inhibit the crop until the growth stage is reached at which 2,4-D and other phenoxy materials can be applied safely. A herbicide that can be applied during the early stages of growth without injuring grain has been badly needed for this reason.

Research has been carried out at the Pendleton Branch Experiment Station for the past two years with bentrol (3,5-diiodo-4-hydroxybenzonitrile), formerly coded as ACP 62-177 or ACP 62-70. This material has been quite effective against a wide variety of annual broadleaf weeds in the early stages of growth. Applications to larger weeds required much higher rates and proved to be less satisfactory. Cereal grains appear to have a very high degree of tolerance, even during the seedling stages. The following table gives results from an experiment which included fall and spring applications on coast fiddleneck (Amsinckia intermedia). The fall application was made on November 14 when the Gaines wheat was in the four to five leaf stage and beginning to tiller. The fiddleneck had just emerged, the largest plants being about two inches in diameter. The spring application was made on March 25 when the wheat was well tillered but had no visible stem nodes. Fiddleneck plants ranged in size from four to seven inches in diameter and were still in the rosette stage. Degree of control was evaluated on May 27, 1963, and the plots were harvested on July 11.

Fiddleneck control and wheat yields from fall and spring applications of bentrol

Treatment	Active Material Per Acre	% Fiddleneck Control	Average Yield (Bu/A.)
Fall Application			
1. Bentrol	.25	87	58.2
2. Bentrol	.50	93	56.5
Spring Application			
3. Bentrol	.25	52	53.3
4. Bentrol	.50	62	48.3*
5. Weedy check		0	53.7

*Significantly different from check at 5% level
L.S.D. $_{.05}$ =5.02 bu/A.
C.V. = 5.94 %

It can be seen from the data above that bentrol gave excellent control of fiddleneck during the early stages of growth with no injury to the wheat. Control from the spring application was poor and some reduction in yield at the .50 pound rate was obtained.

In addition to the above experiment, two detailed tolerance trials were conducted on wheat and one on barley to test the tolerance of cereals to bentrol when applied at various stages of growth and at various rates. No injury was noted nor yield reductions found from rates up to two pounds on either cereal when applied during the seedling stages. There were some indications of slight yield reductions when applications were made during the boot stage of growth. This does not represent a serious disadvantage with this material, however, since it will necessarily be applied during the early growth stages when weeds are small.

All research conducted in 1963 was done with the ACP 62-177, a wettable powder formulation. Subsequent tests have shown other formulations to be much more effective against weeds, apparently without increasing toxicity to small grains. It is felt that this material will be of definite benefit in those years in which fall moisture causes weeds to emerge at the same time as the emergence of wheat. (Oregon Agric. Expt. Sta., Oregon State University, Corvallis, Oregon).

Wild buckwheat control in spring wheat. Guenthner, H.R., and Baker, L.O. Sixteen treatments were applied to a stand of wild buckwheat (Polygonum convolvulus) located in a field of Centana spring wheat. The wild buckwheat was in the three to five leaf stage and the spring wheat had 5 to 6 leaves. Treatments were applied across the wheat rows with a variable rate boom sprayer in 45 GPA of carrier. Half dosage distance was 20 feet.

ACP-62-177A at .5 lb/A, dicamba at .3 lb/A and Tordon at 3/4 oz/A were most effective in controlling the wild buckwheat. Both dicamba and Tordon suppressed the wheat shortly after applications and as a result the wheat was shorter in height and delayed maturity by at least two days. The ACP-62-177A did not injure the wheat.

The effectiveness of Tordon was not improved by the addition of 2,4-D, however, the combination did control the round leaf mallow (Malva rotundifolia) which were scattered throughout the area. The addition of 2,4-D to dicamba was a better treatment than dicamba alone. Both Dacamine and Emulsamine did not provide better control of wild buckwheat than the 2,4-D amine or 2,4-D ester treatments which required 1.5 lbs/A.

Another series of treatments were applied at constant rates. The most effective treatments were ACP-62-177A at .5 lb/A, dicamba at .33 lb/A, dicamba and 2,4-D combinations and Tordon at 1 oz/A. ACP-62-177A did not control the cow cockle (Saponaria vaccaria) which was present. Yield determinations showed that the handweeded check yielded 22.1 bu/A. Both dicamba at .33 lb/A and Tordon at 1 oz/A yielded significantly less than the handweeded check with 16.0 bu/A and 14.3 bu/A, respectively. The Tordon treatment with a test weight of 59.3 lbs/bu. was the only treatment which approached the test weight of 59.8 lb/bu. for the handweeded check. (Montana Agricultural Experiment Station, Central Montana Branch, Moccasin, Montana).

Combination of 2,4-D and dicamba for broad spectrum control of annual weeds in small grains. Appleby, Arnold p. and Furtick, W. R. In the wheat-producing areas of the Columbia Basin of Oregon, a gradual and steady increase is noted in the number of weeds which are semi-resistant to 2,4-D.

Some examples are corn cockle (Agrostemma githago), cowherb (Saponaria vaccaria), prostrate knotweed (Polygonum aviculare), henbit (Lamium amplexicaule), etc. Dicamba has proven to be fairly effective against many of these weeds but has been ineffective against other common annual weeds such as mustard and fiddleneck. Since most of the weeds which are not susceptible to dicamba are fairly well controlled with 2,4-D, a combination of these two materials seemed logical. Research conducted during the past year has shown that this combination does indeed increase the spectrum of weed control, and, in fact, often gives better control of a specific weed than when either material is used alone. Table I below summarizes results from a trial conducted at the Pendleton Branch Experiment Station in 1963.

Table I: Weed control from 2,4-D, dicamba, and combinations of these two materials

Treatment	Lbs. Active material/A.	% Corn cockle Control	% Fiddleneck Control
1. 2,4-D PGBE ester	1/2	52	68
2. 2,4-D PGBE ester	3/4	50	90
3. 2,4-D PGBE ester	1 1/2	80	90
4. Dicamba	1/16	65	15
5. Dicamba	1/8	85	20
6. Dicamba	1/4	99	40
7. Dicamba	1/2	99	58
8. Dicamba + 2,4-D	1/16 + 1/2	80	55
9. Dicamba + 2,4-D	1/8 + 1/2	92	85
10. Dicamba + 2,4-D	1/4 + 3/4	100	96

In this case, corn cockle was not controlled by 2,4-D and fiddleneck was not controlled by dicamba, but both weeds were controlled by the combination of herbicides. Observations on other weeds at different locations indicate that this combination is also effective against shepherdspurse, miner's lettuce, and henbit, as well as many other common annual weeds.

Two extensive tolerance trials were conducted on Gaines winter wheat and one tolerance trial on spring-planted Flynn barley to determine if this combination could be safely recommended for use on grains. Typical yield results from one tolerance trial are given below in Table 2.

Table 2: Data from Gaines wheat treated with various rates of 2,4-D, dicamba, and a combination of these materials

Treatment	lbs. Active Material/A.	Ave. Test Weight (lbs/Bu.)	Average Yield (Bu/A.)	Plant Height (Inches)
<u>1 1/2-leaf stage</u>				
1. 2,4-D PGBE ester	3/4	59.4	34.6*	26.8*
2. 2,4-D PGBE ester	1 1/2	58.7	36.4	27.3*
3. Dicamba	1/4	59.2	36.1	27.3*
4. Dicamba	1/2	58.3	32.8*	26.5*
5. Dicamba + 2,4-D PGBE ester	1/4 + 3/4	57.4*	34.6*	26.8*
<u>4-6-tiller stage</u>				
6. 2,4-D PGBE ester	3/4	60.1*	40.2	28.5
7. 2,4-D PGBE ester	1 1/2	59.0	38.8	28.0
8. Dicamba	1/4	60.2*	44.4	28.8
9. Dicamba	1/2	60.0*	43.8	27.8
10. Dicamba + 2,4-D PGBE ester	1/4 + 3/4	59.5	41.5	28.0
<u>Late boot stage</u>				
11. 2,4-D PGBE ester	3/4	59.1	41.0	29.8
12. 2,4-D PGBE ester	1 1/2	59.6	41.5	28.3
13. Dicamba	1/4	59.5	41.3	29.5
14. Dicamba	1/2	60.3*	44.3	29.8
15. Dicamba _ 2,4-D PGBE ester	1/4 + 3/4	60.6*	35.9*	29.3
16. Check (Hand-weeded)	0	58.8	40.8	29.0
17. Check (Weedy)	0	59.0	38.6	29.3
	L.S.D. .05 =	1.05	4.74	1.61
	C.V.	1.26%	8.55%	4.0 %

*Significantly different from hand-weeded check at 5%

All applications at the seedling stage reduced plant height and yield although not always significantly. Yields from applications at the tiller stage were not reduced. Dicamba significantly increased test weight even when the wheat was not injured. This is in agreement with previous results obtained at this station.

The above results and results from other tolerance trials would indicate that a combination of 1/4 lb. dicamba + 3/4 lb. 2,4-D per acre can be recommended safely for use on small grains when application is made during the correct stages of growth, ie., after the wheat is well-tillered but before jointing occurs. It appears that this rate is somewhat more likely to cause damage than 2,4-D alone when application is made during a stage of growth normally sensitive to 2,4-D. It should be pointed out, however, that for the typical weeds in the Columbia Basin of Oregon, the probable recommended rate for this combination will be approximately 1/8 lb. of dicamba + 1/2 to 3/4 lbs. of 2,4-D, depending on weed species present. (Oregon Agric. Expt. Sta., Oregon State University, Corvallis, Oregon).

The effect of certain herbicides on field gromwell in winter wheat. Stewart, Vern R. The objective of this research is to find an economical and effective means of controlling field gromwell in winter wheat in western Montana. Several herbicides were applied to a natural infestation at two locations in the spring of 1963. The gromwell was in the early bloom stage. Plots were 10 x 60 feet and applications of herbicides were made with a variable rate sprayer using a half distance rate of 20 feet. In location I the population of gromwell was low; in location II very high. The low volatile ester of 2,4-D at 3 to 1 1/2 pounds per acre was the most effective in controlling field gromwell. Some control was obtained with Dacamine and 2,4-D amine at 3 to 1 1/2 pounds per acre. Dicamba caused stunting and lodging of winter wheat alone and in combination with 2,4-D amine. Tordon was not effective in control of gromwell. The 1963 data agree with the 1962 data when the low volatile esters controlled gromwell. (N.W. Montana Branch of the Montana Agricultural Experiment Station, Montana State College, Kalispell, Montana).

Grain yield and weed control data from a herbicide study on field gromwell in winter wheat, Kalispell, Montana, 1963

Chemical	Starting Rate per acre	Yield in % of check				Estimated Weed Control 1-10[1/]			
		2ft.	20ft.	40ft.	60ft.	2ft.	20ft.	40ft.	60ft.
	Location I (low weed population)								
Dacamine	3#	110	128	148	117	9.5	10.0	9.0	9.0
2,4-D amine	3#	83	101	91	102	9.5	9.0	8.0	8.0
Certol	2#	76	81	94	69	9.5	10.0	7.0	8.5
Tordon	3 oz.	95	93	91	101	4.0	4.0	6.0	4.0
Dicamba	3#	36	46	54	90	10.0	9.5	7.0	5.0
2,4-D LV ester	3#	84	69	88	113	9.0	10.0	6.0	5.0
Dicamba + 6 oz.constant 2,4-D amine	2#	108	92	77	91	8.0	7.0	7.0	9.0
2,4-D amine 6 oz. constant dicamba	2#	53	58	58	102	9.0	10.0	8.5	9.0
Check	0	100	100	100	100	5.0	7.0	8.0	7.0
	Location II (high weed population)								
Dacamine	3#	75	126	172	286	10.0	8.0	6.0	2.0
2,4-D amine	3#	76	90	153	336	10.0	7.0	1.0	1.0
Certol	2#	61	65	110	358	10.0	2.0	1.0	1.0
Tordon	3 oz.	72	68	228	313	1.0	1.0	1.0	1.0
Dicamba	3#	96	71	133	435	10.0	5.0	5.0	4.0
2,4-D LV ester	3#	94	99	110	336	10.0	9.8	8.0	6.0
Dicamba 6 oz. constant 2,4-D amine	2#	79	81	143	398	9.8	9.0	7.0	6.0
2,4-D amine 6 oz. constant Dicamba	2#	52	74	176	470	9.8	8.0	9.0	9.0
Check	0	100	100	100	100	1.0	1.0	1.0	1.0

1/ This score based on the number of weeds estimated to be the bundle of grain harvested for yield.
1 - large number of gromwell plants
10 - no gromwell plants

Fall and spring applications of high-volatile and low-volatile esters of 2,4-D for fiddleneck control. Appleby, Arnold P. and Neidlinger, Thomas J. An experiment was established in the fall of 1962 to compare propylene-glycolbutylether and butyl esters of 2,4-D for coast fiddleneck (Amsinckia intermedia) control and wheat injury when applied in the fall and in the spring. The fall application was made on November 14, 1962, when the Gaines wheat had 4-5 leaves and 2-3 tillers. The fiddleneck was very small with the largest plants being approximately two inches in diameter. Spring application was made on March 25, 1963, when the wheat was well-tillered but had no visible stem nodes. The fiddleneck ranged in size from 4-7 inches in diameter but was still in the rosette stage. Most plots were harvested on July 11, 1963. The fall-applied 2,4-D plots were severely delayed in maturity and were harvested on July 18. Results are given in the following table.

Fall and spring treatments of 2,4-D on fiddleneck in wheat

Treatment	Lbs. Active Material/A.	% Fiddleneck Control	Average Plant Ht. (inches)	Ave. Test Weight (lbs/bu.)	Ave. Yield (Bu/A.)
Fall Application					
1. 2,4-D PGBE ester	.25	93	26.7*	61.9*	45.7*
2. 2,4-D PGBE ester	.50	100	25.7*	62.0*	43.8*
3. 2,4-D PGBE ester	.75	100	26.7*	61.6*	44.7*
4. 2,4-D butyl ester	.25	93	26.3*	61.9*	46.6*
5. 2,4-D butyl ester	.50	100	25.7*	62.0*	44.0*
6. 2,4-D butyl ester	.75	100	26.3*	61.9*	44.3*
Spring Application					
7. 2,4-D PGBE ester	.25	57	31.3	60.4	55.7
8. 2,4-D PGBE ester	.50	75	31.3	59.6	52.5
9. 2,4-D PGBE ester	.75	88	31.3	60.5*	52.5
10. 2,4-D butyl ester	.25	57	32.0	60.4	52.4
11. 2,4-D butyl ester	.50	75	31.0	59.9	53.7
12. 2,4-D butyl ester	.75	88	31.3	60.9*	57.5
13. Check	0	0	31.3	59.7	53.7
L.S.D. .05 =			1.03 in.	.71 lb/bu.	5.02 bu/A
C.V. =			2.09%	.71%	5.94%

*significantly different from check at 5 percent level.

The results of this experiment would agree with past results, that fiddleneck is much easier to kill in the seedling stage in the fall than in its later growth stages in the spring. However, the data also indicate that 2,4-D is quite likely to injure grain when applied in the fall. No consistent differences were noted between the two esters of 2,4-D, either in effectiveness or in wheat injury. Wheat injured from fall application of 2,4-D had a significantly higher test weight and significantly lower average plant height than untreated wheat. These results are consistent with results from past experiments. (Oregon Agricultural Experiment Station, Oregon State University, Corvallis, Oregon).

Rye (Secale cereale) control with post-emergent applications of barban. Rydrych, Donald J. Common rye is difficult to control in the dryland winter wheat areas of southeastern Washington because of hard seed. Volunteer rye stands often reduce wheat yields by direct competition and contaminate grain shipments. This study was undertaken to find an effective chemical control.

Barban was applied to rye in the 3-4 leaf stage in late October using a logarithmic plot sprayer. Rates of .25-4 lb/A were applied in 25 gallons of water at 30 psi. Final readings were taken in June 1963. A wheat understory was not included in this study.

The results show that rye can be controlled with barban at rates of .5-4 lb/A. Barban rates of 3-4 lb/A gave 95 percent control, 1-2 lb/A gave 85 percent control, and .5-1 lb/A gave 70 percent control. Barban was only 35 percent effective at rates below .5 lb/A. (Washington State University Experiment Station, Pullman, Washington.)

Wild oat control in spring cereals. Duke, W. B., Brown, D. A., and Furtick, W. R. Wild oats (Avena fatua) are a serious problem in many grain fields in the Willamette Valley of western Oregon. An experiment was established on the Hyslop Agronomy Farm, Corvallis, Oregon, to determine whether a special formulation of barban would be more effective for wild oat control than regular barban which is currently recommended. These two herbicides were applied to Hannchen spring barley which had been overseeded with 30 pounds per acre of wild oats. The wild oats were in the 2 1/2 leaf stage when the chemicals were applied. The results are given below.

Herbicide	Rate (lb. act/A)	No. of wild oat plants per 18 sq.ft.	% Barley Injury
Barban	1/4	15.6	0
Barban	1/3	21.0	0
Barban	1	2.0	0
S-847-QH(F)-E-4	1/8	18.6	0
S-847-QH(F)-E-4	1/4	3.6	0
S-847-QH(F)-E-4	1/3	2.0	0
S-847-QH(F)-E-4	1	1.0	0
Control		35.6	0

These data indicate the new formulation of barban is much superior to the present formulation of barban, with a several-fold factor of efficiency on a pound-per-pound basis. Similar results have been obtained in Red Houston spring wheat.

From visual observations it would appear that tolerance has not been decreased by the use of the new formulation. (Oregon Agricultural Experiment Station, Corvallis, Oregon.)

Study to evaluate the tolerance of winter wheat--at three rates of seeding--to various herbicides. Rydrych, Donald J., and Koehler, F. E. Experiments were conducted to determine the possibility of an interaction between rate of seeding in winter wheat and application of certain herbicides. Visual observations in the field (1962) in plots treated with atrazine indicated that such an interaction may exist. The semi-dwarf winter wheat variety Gaines was seeded in a silt loam soil at 30, 60, and 90 lb/A. Sixty lb/A is the normal seeding rate for this area. Four herbicides; atrazine, simazine, 2,4-D amine, and 2,4-D ester, each at .5, 1, and 2 lb/A, were applied to each seeding rate block. Atrazine and simazine were applied to wheat in the 3-4 leaf stage in early spring. The 2,4-D materials were applied in May when the wheat was well tillered and in the 5-6 leaf stage.

The results indicate that yields of Gaines wheat are significantly influenced by the interaction between seeding rate and chemical treatment. The 60 lb/A seeding rate was least affected by the herbicides, followed by 30 and 90 lb/A in that order. Wheat yields increased as seeding rate increased in the untreated controls.

Yields of the 30 lb/A seeding group were decreased most by atrazine and least by 2,4-D ester, si azine, and 2,4-D amine. Yields of the 90 lb/A seeding group were decreased most by 2,4-D ester and least by simazine, 2,4-D amire, and atrazine. This indicates that seeding rate may have a greater influence on yield than a specific chemical but that some chemical treatment is necessary to produce this effect. (Washington State University Experiment Station, Pullman, Washington).

<u>Resistance of barley genotypes to various herbicides.</u> Baker, Laurence O. A mechanical composite of about 6,000 barley genotypes from the World Barley Collection has been subjected to herbicidal selection over a 3-year period. Selection has been carried out by using seed harvested from the original treatment and then again treating with the same chemical. In 1963 seed surviving two previous year's treatment was treated May 27 in 4-row plots 250 feet long together with 2 rows of non-treated seed from the original composite. The 6 rows were treated with the following chemicals. Date or treatment and some general observations are given.

Chemical	Rate in lbs/acre	Date of treatment	Observation
DATC	5	5/24 (pre-plant incorporated)	Some stand reduction, delayed maturity, no evidence of selection for resistance.
CDAA	8	5/24 (pre-plant & incorporated)	Little or no effect.
2,4,5-T	10	7/2	Reduced height, delayed maturity, no selection for resistance.
Silvex	10	7/2	Reduced height, no selection.
MCP	10	7/2	Little or no effect.
Dicamba	3	7/2	Severely injured, little seed produced, no selection.

Chemical	Rate in lbs/acre	Date of Treatment	Observation
2,4-D amine	10	7/2	Little or no effect.
2,3,6-TBA	5	7/2	Reduced height, and considerable injury, no selection.
Zytron	12	7/2	Delayed maturity, no selection.
Barban	5	6/28	Delayed maturity, reduced height, no selection.
Tordon	4	7/8	Severely injured, no seed produced, no selection.
Premerge	15	7/2	Little or no effect at harvest time, no selection.
Check	--	---	Normal growth.
G34361	8	5/28	Stand reduced 90%, no selection.
Dalapon	5	6/28	Reduced height and stand, 2-row and black glume plants eliminated, 6-row, hooded plants have been selected.
Amitrol	5	7/2	Reduced height and stand, selection for 6-row, white glumed, long awned plants. No hooded, black glumed, or 2-rowed plants found.

At the time of the original treatment ten 2-row and ten 6-row plants that appeared to be resistant to the treatments were selected. These were increased and were planted in rows in 1963. The rows were treated with a variable rate sprayer through 3 half-rate distances. The beginning rate was the same as those given above. Dicamba, barban, G34361, premerge, and tordon were not included. They were seeded May 31 and were treated July 8, except for those applied pre-planting. Varying degrees of resistance were observed from dalapon, amitrole, DATC, 2,4,5-T, silvex, and 2,3,6-TBA. In most cases, at least some susceptible selections were also observed. The most resistant and the most susceptible selections were harvested for yield tests during 1964. (Montana Agricultural Experiment Station, Bozeman).

Pre-planting chemical weed control in cotton - 1963. Anderson, W.P., and McCaw, Larry. For the second consecutive year, diuron and DCPA (Dacthal) have given season-long control of annual grass and broadleaf weeds without injury to the cotton plants, when applied to the soil surface just prior to forming the raised seedbeds. Effective dosages were 1 and 2 lbs/A ai for diuron and 6,9, and 18 lbs/A ai for DCPA. Slight injury to cotton plants occurred with diuron at a dosage of 3 lbs/A ai, indicating that dosages as high or higher than this may be detrimental. The degree of weed control was slightly better with diuron than with DCPA. Neither herbicide gave good control of annual morning glory; DCPA did not control other broadleaf weeds as effectively as did diuron.

Applied in a similar manner, trifluralin, prometryne, and Bayer 40557 show considerable promise for the control of annual grass and broadleaf weeds. Indications are that the dosages used this year with trifluralin and Bayer 40557 are too high as some degree of cotton injury was obtained at each dosage applied. Bayer 40557 causes a characteristic chlorosis of cotton foliage as well as a stunting of growth.

At dosages of 2 and 4 lbs/A ai dichlobenil (Casoron) killed all of the cotton seedlings, all failed to emerge, as well as all annual weeds. This effect is in contrast to dichlobenil applied at time of cotton seedling emergence which shows promise for selective weed control. It would appear that dichlobenil is not a herbicide to use in proximity to germinating cotton seeds.

A delay of three weeks between the time of forming the raised seedbeds and the first irrigation did not reduce the effectiveness of these herbicides when applied to the soil surface just prior to forming the beds. (New Mexico State Univ. Agric. Expt. Sta., University Park, New Mexico).

Effectiveness of herbicides applied to the soil just prior to forming the raised seedbeds March 20, 1963, for weed control in cotton.

Chemical	lbs/acre (active)	Visual evaluation - Average of 6 replications: Weed control[2] (per cent)	Cotton injury[1] (per cent)
Diuron	1	90	0
	2	100	0
	3	100	2
DCPA	6	90	1[3]
	9	80	1[3]
	18	100	0
Trifluralin	3	100	1
	6	100	6
Prometryne	1	70	0
	2	80	0
Bayer 40557	4	90	1
	8	100	3
Casoron	2	100	10
	4	100	10

[1]Rating scale: 0-no apparent effect; 10-plants dead.
[2]Predominant weeds present: jungle rice, pigweed, annual morning glory.
[3]Injury due to high rating in one replication; no injury in other reps.

Chemical weed control in cotton with herbicide applications made as cotton seedlings were emerging. Anderson, W. P., and McCaw, Larry. Applied as a broadcast spray to the soil surface after the soil-cap had been harrowed from the seed row and the cotton seedlings were emerging, the following eight herbicides, at the indicated dosages expressed as active ingredient, gave excellent weed control with essentially no cotton injury: diuron - 3/4 to 1 1/4 lb/A; DCPA (Dacthal) - 6 to 18 lbs/A; trifluralin - 3/4 to 3 lb/A; R-4461 (Betasan) - 5 to 15 lbs/A; Shell 7585 - 1/2 to 2 lbs/A; Shell 7961 - 1/2 to 2 lbs/A; diphenamid - 5 to 15 lbs/A; and dichlobenil (Casoron) - 3/4 to 1 1/2 lbs/A.

It is of interest to note that dichlobenil is not injurious to cotton when applied to the emerging seedling; whereas, it is toxic to the germinating seedling when soil incorporated. Dichlobenil has been applied in other experiments as a soil incorporated directed spray to the seed row of established cotton without apparent cotton injury.

The following three herbicides may also have promise when applied at-emergence to cotton but they appear less promising than those mentioned above: herban--effective dosage appears to center around 4 lbs/A; prometryne--1 1/2 to 3 lbs/A, excellent weed control accompanied by erratic cotton injury--a rate of 3/4 lb/A gave only moderate control of weeds; Bayer 40557 - 3 to 9 lbs/A, chlorosis mottling cotton foliage at 3 and 6 lbs/A with cotton stunting in addition at 9 lbs/A.

The following two herbicides were also tested but gave poor control of grass and broadleaf weeds and no cotton injury: Stauffer N-3291--2 to 6 lbs/A; and Pyramin--2 to 3 1/2 lbs/A.

Cotton yields will be obtained for the more promising of these herbicides in 1964. (New Mexico State Univ., Agric. Expt. Sta., University Park, New Mexico).

Preplant applications of herbicides in cotton. Arle, H. Fred, and Hamilton, K. C. Preplant applications of 3-(3,4-dichlorophenyl)-1,1-dimethylurea (diuron), 2,6-dinitro-N,N-di-n-propyl-a,a,a-trifluoro-p-toluidine (trifluralin), and dimethyl 2,3,5,6-tetrachloroterephthate (DCPA) were evaluated in Deltapine Smooth Leaf cotton at Phoenix, Arizona, during 1963. The herbicides were applied in conjunction with the following cultural practices:

- Before disking and furrowing prior to the preplant irrigation, March 7.
- Before furrowing prior to the preplant irrigation, March 7.
- After furrowing before the preplant irrigation, March 13.
- After the preplant irrigation before harrowing to prepare the seedbed April 1.

Rates of application were diuron, 1 and 2 lb/A; trifluralin, .5 and 1 lb/A; and DCPA, 6 and 12 lb/A. On April 1, cotton was planted in moist soil under a dry mulch.

The surface soil contained 31% sand, 44% silt, and 25% clay. The most prevalent weeds were *Panicum fasciculatum* Swartz and *Physalis wrightii* Gray.

Plots were 4 rows 30 feet long. Treatments were replicated 4 times. The test area was mechanically cultivated until mid-July. Cotton stands were counted after emergence and at weekly intervals until thinning. Estimates of weed control were made several weeks before harvest. The table summarizes seedling counts, weed control, and yield data.

Emergence of cotton was not affected by any of the preplant applications of herbicides. However, on plots treated with diuron before furrowing many seedlings became chlorotic and remained stunted for several weeks. Two lb/A of diuron disked in before furrowing reduced stands of cotton. Preplant applications of diuron after furrowing did not affect survival or growth of seedlings. Applications of trifluralin before furrowing temporarily retarded normal seedling growth; however, 6 weeks after emergence, growth differences between treated and untreated plants were no longer evident. DCPA applications did not affect seedling survival or development.

All preplant treatments of diuron effectively controlled groundcherry but did not give season-long control of annual grasses. Grass developed late in the summer and did not reduce cotton yields.

Trifluralin at the rate of 1 lb/A effectively controlled grasses when applied before furrowing. Maximum grass control with DCPA was obtained when applications were made before furrowing. Trifluralin and DCPA did not give satisfactory control of groundcherry. Significant increases in seed cotton yields were obtained with 1 lb/A of trifluralin disked in before furrowing, 12 lb/A applications of DCPA, and 6 lb/A of DCPA before furrowing. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, and Arizona Agric. Expt. Sta., University of Arizona, Tucson, Arizona).

Cotton survival and yield and weed control following preplant applications of diuron, trifluralin, and DCPA.

Treatment Herbicide and Method	Rate (lb/A)	Seedlings/ft. of row April 17	Seedlings/ft. of row May 8	% Weed Control Grass	% Weed Control Broadleaf	Yield[1] as % of check
diuron:						
Check	0	5.9	5.3	0	0	100
Disked in-prefurrowing	1	5.3	5.1	65	90	149
Disked in-prefurrowing	2	5.6	3.9	60	90	135
Prefurrowing	1	4.7	4.7	50	80	137
Prefurrowing	2	5.4	5.0	35	90	132
After furrowing	1	4.7	4.8	60	90	152
After furrowing	2	5.0	5.3	70	96	162
Before harrowing	2	5.3	5.6	70	99	160
trifluralin:						
Check	0	5.2	5.4	00	0	100
Disked in-prefurrowing	.5	4.6	4.9	85	0	106
Disked in-prefurrowing	1	4.4	4.6	95	10	136
Prefurrowing	.5	4.7	5.1	65	25	112
Prefurrowing	1	5.4	5.1	90	0	127
After furrowing	.5	4.0	4.6	15	25	115
After furrowing	1	4.4	4.6	60	5	108
Before harrowing	1	4.7	5.4	40	10	84
DCPA:						
Check	0	4.9	5.4	0	0	100
Disked in-prefurrowing	6	5.2	5.0	30	10	110
Disked in-prefurrowing	12	4.7	5.0	80	10	138
Prefurrowing	6	4.7	5.1	35	50	137
Prefurrowing	12	5.1	5.2	75	20	144
After furrowing	6	4.5	4.5	40	10	118
After furrowing	12	5.3	5.2	50	30	124
Before harrowing	12	5.4	5.8	70	20	137

[1]Calculated yields of seed cotton for diuron, trifluralin, and DCPA checks were 1,800, 2,300, and 2,040 lb/A, respectively.

Layby applications of DCPA and trifluralin in irrigated cotton. Hamilton, K.C. and Arle, H.F. Control of annual weeds from layby until harvest is a major problem in irrigated cotton. Urea herbicides are used for late-season control of annual weeds but can not be used under all conditions. In 1963 two tests that were conducted at the Cotton Research Center, Phoenix, Arizona, to determine the effects of layby applications of dimethyl 2,3,5,6-tetrachloroterephthate (DCPA) and 2,6-dinitro-N,N-di-n-propyl-a,a,a-trifluro-p-toluidine (trifluralin) on Deltapine Smooth Leaf cotton and weeds.

The surface soil of the test area average 35% sand, 42% silt, and 23% clay. The most competitive weeds were *Panicum fasciculatum* Swartz, Physalis wrightii Gray, Leptochloa filiformis (Lam.) Beauv., and Echinochloa colonum (L.) Link. Herbicides were applied as directed sprays to the soil covering the middles from row to row immediately before the cultivation preceding a given irrigation. DCPA was applied May 9 before the first irrigation at rates of 5, 10, and 20 lb/A; and 5 and 10 lb/A were applied June 5 and 19 before the second and third irrigation. Trifluralin was applied May 9 at rates of 1.5, 3 and 6 lb/A before the first irrigation, 3 and 6 lb/A on June 5 before the second irrigation, and 3 lb/A on June 19 and July 15 before the third and fourth irrigation. Plots were 4 rows 38 feet long. Treatments were replicated 4 times.

The cotton stand was thinned to 8 inches between plants before the first irrigation. The rest received 5 mechanical cultivations during May, June and July. Percent weed control was estimated prior to harvest. Two center rows of each plot were hand-picked once in November.

Layby applications of DCPA and trifluralin had no effect on development of cotton plants. Both herbicides gave better control of annual grasses than broadleaved weeds. Applications of herbicide before the first irrigation gave better weed control than later applications. Few weeds had germinated prior to the first irrigation. All herbicides significantly increased the yields of hand-picked cotton. Although applications of DCPA and trifluralin did not control Physalis wrightii for the entire season both herbicides reduced its competitive ability, thus increasing seed cotton production. However, sufficient weed debris was present in all plots at harvest to interfere with mechanical picking and prevent mechanical harvest from the ground. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, and Arizona Agric. Expt. Sta., University of Arizona, Tucson).

Preplant-layby combinations of herbicides in irrigated cotton. Hamilton, K.C. and Arle, H.F. Season-long control of annual weeds is one problem delaying complete mechanization of cotton production. In 1963, a test conducted at the Cotton Research Center, Phoenix, Arizona, to determine whether combinations of preplant and layby applications of herbicides could control annual weeds in irrigated cotton for an entire season.

The surface soil contained 34% sand, 42% silt, and 24% clay. Weeds present, in order of importance, were Panicum fasciculatum Swartz, Physalis wrightii Gray, Leptochloa filiformis (Lam.) Beauv., and Echinochloa colonum (L.) Link. One lb/A of 2,6-dinitro-N,N-di-n-propyl-a,a,a-trifluoro-p-toluidine (trifluralin) and 8 lb/A of dimethyl 2,3,5,6-tetrachloroterephthate (DCPA) were applied on March 11 as broadcast sprays to the soil surface immediately before furrowing for the preplanting irrigation. Plots were 4 rows 38 feet long. Treatments were replicated 4 times. On April 1, Deltapine Smooth Leaf cotton was planted in moist soil under a dry mulch. Cotton seedlings were counted after emergence and at weekly intervals until the first cultivation.

Cotton was cultivated 4 times in May and June. On June 19, layby application of herbicides were directed to the soil covering the entire middles immediately before the cultivation preceding the third irrigation. Preplant trifluralin applications were followed with layby applications of

1.2 lb/A of 3-(p-chlorophenyl)-1,1-dimethylurea (monuron), 1.2 lb/A of 3-(3,4-dichlorophenyl)-1,1-dimethylurea (diuron), 8 lb/A of DCPA, or 3 lb/A of trifluralin. Preplant DCPA treatments were followed with 1.2 lb/A of diuron 8 lb/A of DCPA, or 3 lb/A of trifluralin. Percent weed control was estimated before harvest. In November the two center rows of each plot were hand-picked once.

Preplant applications of 1 lb/A of trifluralin caused temporary stunting of cotton seedlings for 4 to 5 weeks. Trifluralin also increased the susceptibility of cotton seedlings to the seedling disease caused by Rhizoctonia. Seedling stands were reduced 15-25% by this disease in combination with preplant trifluralin treatments.

All combinations of preplant and layby herbicide applications controlled annual grasses for the entire season. Preplant applications in combination with diuron or monuron applications at layby controlled broadleaved weeds for the entire season. Control of broadleaved weeds after midseason was not satisfactory where DCPA or trifluralin was applied at layby.

The yield of seed cotton from the 7 preplant-layby combinations averaged 3,450 lb/A. Yield of seed cotton on the untreated checks averaged 3,140 lb/A with hand picking. Weed debris on the untreated checks would have made machine picking difficult and inefficient. Treated plots did not have sufficient weeds to interfere with machine picking or ground harvest. (Cooperative investigations of Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, and Arizona Agric. Expt. Station, University of Arizona, Tucson).

Chemical weed control in new seedlings of irrigated alfalfa. Anderson, W.P. and Whitworth J.W. Annual grass and broadleaf weeds were selectively controlled in new seedlings of alfalfa with EPTC (Eptam) and 2,4-DB.

EPTC, applied pre-emergence at a dosage of 6 lbs/A (active ingredient) immediately after alfalfa seeding on October 4, 1962, controlled annual grass weeds for one year and gave short-term control of annual broadleaf weeds. EPTC caused some initial injury to alfalfa seedlings but this injury was of short duration and did not affect alfalfa yield adversely.

2,4-DB was applied as an early post-emergence spray in 40 gallons of water per acre at dosages of 1 and 2 lbs/A (active ingredient) on October 29, 1962. Annual broadleaf weeds were effectively controlled by both rates of 2,4-DB for one year with no apparent injury to the alfalfa. Tansy mustard was not controlled by 2,4-DB nor were the annual grasses.

Pre-emergence application of DCPA (Dacthal) at 8 lbs/A (active ingredient) did not control either the annual grass or broadleaf weeds nor did it cause injury to the alfalfa.

Immediately following the pre-emergence applications of EPTC and DCPA, the area was flood irrigated and subsequent waterings were also by flood irrigation. The predominant weeds present were: rescuegrass, London Rocket, careless weed, and a few tansy mustard plants. (New Mexico State University, Agricultural Experiment Station, University Park, New Mexico).

Fresh vegetative weights of alfalfa and weeds from herbicide treated plots in a new seeding of alfalfa watered by flood-irrigation.

Treatment		Average Grams per sample		Tons per acre	
Chemical	lbs/A ai	alfalfa	weeds	alfalfa	weeds
EPTC	5	786	1325	4.2	7.1
2,4-DB	1	540	1150	2.8	6.2
2,4-DB	2	700	605	3.7	3.3
Dacthal	8	130	2300	0.7	12.7

For comparison, the weights from the Dacthal treated plots may be taken as equivalent to untreated control plots. Samples were collected and weighed fresh on April 1, 1963.

Annual weed control in established alfalfa. Appleby, Arnold P. Six experiments were established to test various herbicides for the control of annual weed species, particularly downy brome (*Bromus tectorum*), in established alfalfa. These experiments were located on various soil types and included a variety of weed species. All locations were under irrigation, either by sprinkler or by flooding. At four locations, the following five materials were applied only in November: atrazine, simazine, bromacil, isocil, and diuron. At the other two locations, these same materials were applied in November, January, and late March or early April. At these latter two locations, endothal, TD-191, TD-282, and TD-283 were applied in November at 1,2, and 4 pounds per acre.

In five of the six locations excellent control was obtained with bromacil, isocil, atrazine, and simazine. Diuron was much less effective, particularly on the brome species, even at higher rates than the other four materials. The sixth location received heavy sprinkler irrigation shortly after application of the herbicides and control was poor. No injury was noted at that site, however.

At only one location was there evidence of excessive injury from the herbicides. That location was on a very light sandy soil and had received heavy sprinkler irrigation in the spring. While injury was only slight in the first cutting of the alfalfa, fairly severe injury appeared in the second cutting. In that particular case, atrazine was the most injurious of the materials followed by isocil. Bromacil and simazine appeared to be relatively comparable in damage to the alfalfa. Since bromacil gave superior weed control at lower rates than did simazine, bromacil would have been a more satisfactory treatment at that location. With this exception, bromacil and atrazine were quite comparable in both weed control efficiency and selectivity on alfalfa. Rates of .4 pounds per acre on sandy soils, and .8 pounds per acre on the heavier soils gave excellent weed control. November applications of bromacil and atrazine were comparable to simazine at rates approximately 1/2 pound per acre less than simazine. Isocil was somewhat more injurious to alfalfa and was weak on certain broadleaves.

The results obtained indicated the extreme importance of applying simazine either pre-emergence to the weeds or very shortly after the weeds had emerged. In general, the January and March applications of simazine gave very poor results. Timing on bromacil and atrazine were much less critical, the January application being nearly as good as the November applications. The March or April dates, however, were much poorer with all materials.

Endothal gave poor weed control on all species. TD-191, TD-282, and TD-283 were effective grass killers but were poor broadleaf killers and severely retarded the alfalfa. The possibility of their use for other purposes, such as chemical fallow, is suggested. (Ore. Agric. Expt. Sta., Oregon State University, Corvallis, Oregon.)

<u>Herbicide screening trials on sugar beets in Wyoming, 1963.</u> Chamberlain, E. W. and Alley, H. P. Pre-emergence and post-emergence studies were conducted at four locations in Wyoming. Three soil types were involved in this study. They were sandy loam, sandy clay loam, and clay loam. Twenty-two different chemicals and eighteen combinations of these herbicides were tested in the spring pre-emergence trials. In late summer another set of pre-emergence trials was conducted to test more herbicide combinations. The two center rows of the four-row plots (22 inch spacing) were treated on seven inch bands with the herbicides incorporated to a depth of 1-1 1/2 inches. Weed control data indicate that there is a definite potential for combination of chemicals for pre-emergence weed control in sugar beets. The combinations showing promise in Wyoming were pyramin (1-phenyl-4-amino-5-chloro-pyridazone-6)+PEBC pyramin + CP 32179, pyramin + EPTC, pyramin + DATC, DATC + PEBC + EPTC, pyramin + TD 282, pyramin + alipur - o, pyramin + endothal, and BP-3 + DATC. Individual chemicals that gave satisfactory weed control with sufficient selectivity to sugar beets were PEBC, DATC, TD 282, pyramin, TD 283, CP 32179, BP-4, BP-10, and TD 291. TD 282, TD 283, and TD 291 were particularly effective on kochia (<u>Kochia scoparia</u> L.). Pyramin in most instances gave good broadleaf control while grassy weed control was only fair. Pyramin showed the most selectivity to sugar beets of any chemical included in the test. Pyramin, when used in combination with such chemicals as PEBC, DATC, and EPTC reduced the stunting of the sugar beets while the weed control was equal to or better than when using these herbicides alone.

Post-emergence herbicides still left much to be desired. Treatments showing some promise in this study were TD 282, BP-11, TD 282, TD 291, BP-4, and pyramin + dalapon.

Yields from all promising chemical treatments were equal to or better than the hand weeded checks. Pyramin or pyramin combinations were consistently at the top in yield and sugar content.

The following tables contain data on sugar beet stand, weed control, yield, and sugar content on three soil types in Wyoming. Further information on this research is available in the 1963 Progress report (mimeograph circular No. 191) published by the University of Wyoming. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie, Wyoming.)

TABLE I. Wheatland - sandy clay loam - pre-emergence - planted and treated April 8, 1963 - beets germinated by rainfall - precipitation April 9-18 = 0.36" - April 19-30 = 0.96"

Herbicide	Rate lb/A	Sugar beet Stand % of check	Broadleaf weeds % Control	Grass weeds % Control	Yield tons/A	% Sugar
DATC + PEBC	1.6+1.6	82.4	82.6	67.4	11.6	15.3
DATC + PEBC	1.6+2.4	59.0	81.7	71.0	15.8	14.9
DATC + PEBC	1.7+3.4	55.7	77.4	86.6	11.6	14.4
Pyramin	2.0	78.8	24.0	38.5	15.4	15.6
Pyramin	4.0	86.0	84.0	52.2	19.8	14.8
CP 32179	2.0	57.9	63.2	21.3	14.8	14.5
CP 32179	4.0	44.1	77.3	93.7	12.5	13.9
Pyramin + PEBC	2.0+2.0	60.4	82.1	68.8	17.3	14.4
CP 32179+PEBC	2.0+2.0	66.9	64.5	67.5	15.3	15.3
PEBC	4.0	84.1	51.5	79.0	14.8	15.1
PEBC	3.0	82.3	46.0	53.0	13.0	15.2
Check	0	100	0	0	14.3	14.8

TABLE II. Powell - clay loam - pre-emergence - planted and treated April 5, 1963 beets furrow irrigated for germination - precipitation April 5-18 = 0.00" - April 19-30 = 1.83"

Herbicide	Rate lb/A	Sugar beet Stand % of check	Broadleaf Weeds % control	Grass weeds % Control	Yield tons/A	% Sugar
PEBC	4.0	86.8	32.9	33.8	15.1	15.7
DATC	2.5	82.0	57.6	94.2	16.1	15.9
DATC+PEBC	0.8+1.6	82.0	49.5	65.5	16.6	15.5
DATC+CP22819	1.2+2.4	90.1	53.7	90.0	16.5	15.7
CP 31675	2.0	77.3	68.0	68.5	16.2	16.0
Pyramin	4.0	88.2	50.0	38.8	16.6	16.4
Pyramin	5.0	77.6	62.7	14.7	14.2	16.2
BP-1	4.0	78.3	54.8	55.3	17.4	15.7
BP-4	6.0	77.6	100.0	83.4	14.9	16.7
BP-8	4.0	100.0	63.5	61.7	14.5	15.9
BP-3+DATC	3.0+1.0	83.1	62.2	90.3	16.9	15.6
Check	0	100.0	0	0	14.6	15.8

TABLE III. Torrington - sandy loam - pre-emergence - planted and treated April 2, 1963 beets germinated by rainfall - precipitation April 2-15 = 0.75" - April 16-30 = 1.07"

Herbicide	Rate lb/A	Sugar beet Stand % of check	Broadleaf weeds * % control	Grass weeds % control
PEBC	2.0	78.2	23.7	36.7
DATC	1.25	74.7	12.7	56.5
DATC+PEBC	0.8+1.6	64.6	31.5	45.1
Avadex BW+CP22819	0.6+1.2	86.2	45.7	85.5
Eptam	1.25	79.0	45.2	94.4
PEBC+EPTC	1.0+1.0	53.2	62.5	93.5
TD 282	3.0	96.6	77.5	62.8
Pyramin	2.0	100.0	43.4	47.6
Pyramin	4.0	56.7	52.6	57.4
Check	0	100.0	0	0

*50% of weed population was kochia (*Kochia scoparia*). No yield data available because late spring freeze destroyed plots.

<u>The competitive effects of annual weeds growing with sugar beets.</u> Brimhall, P.B., Alley, H.P., and Chamberlain, E.W. This study was conducted to determine the competitive effects of different densities of rough pigweed (*Amaranthus retroflexus* L.) and green foxtail (*Setaria viridis* L. Beauv.) on sugar beet yield, sugar beet top weight and sugar beet sucrose content in relation to weed-free sugar beets.

Weed densities consisted of one weed per 8 sugar beets, one weed per 4 sugar beets, one weed per 2 sugar beets, one weed per 1 sugar beet, and two weeds per 1 sugar beet for the individual pigweed and foxtail treatments.

Where pigweed and foxtail were combined in the same treatment the densities were one pigweed and one foxtail per 8 sugar beets, one pigweed and one foxtail per 4 sugar beets, one pigweed and one foxtail per 2 sugar beets, one pigweed and one foxtail per 1 sugar beet, and two pigweed and two foxtail per 1 sugar beet. In addition there was one check (weed-free) treatment. Weeds were hand thinned to the desired density.

Each treatment was 3 rows wide and 50 feet long. Each treatment consisted of 3 rows to permit equal competition to the middle row from each side as well as in the row itself. All data were based on 40 feet from the middle row.

The effects of the various densities of pigweed, foxtail, and the combined pigweed and foxtail on the yields of sugar beet roots, sugar beet tops, weeds, and total vegetation are summarized in the following table.

Green weight yields of sugar beet roots, sugar beet tops including beet crown, weight of weed foliage and roots, and total vegetation as affected by different densities of weeds per sugar beet

DENSITY OF WEEDS PER SUGAR BEET	TONS PER ACRE Beet roots	Beet tops	Weeds	TOTAL VEGETATION
Check (weed-free)	22.53 a[1]	23.74 a	.00 a	46.27 a
Green foxtail 1/8	21.70 a	23.03 a-b	.35 a-b	45.08 a-b
Green foxtail 1/4	20.32 a-b	21.69 a-c	.65 a-b	42.66 a-b
Green foxtail 1/2	20.35 a-b	20.91 a-c	1.28 a-c	42.54 a-b
Green foxtail 1/1	16.57 c-e	20.44 a-c	2.17 b-c	39.18 b-c
Green foxtail 2/1	14.18 e	17.07 c-e	3.08 c	34.33 c-d
Rough pigweed 1/8	18.80 b-c	22.13 a-b	1.96 b-c	42.89 a-b
Rough pigweed 1/4	17.81 b-d	15.38 d-e	4.95 d	38.14 b-c
Rough pigweed 1/2	10.63 f	12.69 e-f	5.47 d-e	28.79 d-e
Rough pigweed 1/1	6.81 g	9.49 f-g	8.65 f-g	24.95 e-f
Rough pigweed 2/1	4.31 g-h	7.43 g	9.14 f-g	20.88 f
Pigweed & foxtail 1:1/8	17.86 b-d	18.56 b-d	2.79 c	39.21 b-c
Pigweed & foxtail 1:1/4	15.16 d-e	18.34 b-d	5.06 d	38.56 b-c
Pigweed & foxtail 1:1/2	10.75 f	13.28 e	5.98 d-e	30.01 d-e
Pigweed & foxtail 1:1/1	6.84 g	9.84 f-g	7.31 e-f	23.99 e-f
Pigweed & foxtail 2:2/1	3.38 h	6.60 g	10.02 g	20.00 f

[1]Means in the same column which have the same letter are not significantly different at the .05 level.

Some of the more important conclusions drawn from this study were:

1. Green foxtail was found to have the least competitive effects.

2. Green foxtail competition of less than one plant per one sugar beet did not reduce the sugar beet yield significantly.

3. Rough pigweed and the combined rough pigweed and green foxtail competition at the lightest density, one pigweed per 8 sugar beets, and one pigweed and one foxtail per 8 sugar beets, respectively, reduced the sugar beet yield significantly.

4. Sugar beet root yields were reduced up to 80 percent by the heavy weed infestations of the combined rough pigweed and green foxtail.

5. Sugar beet top weights were consistently higher than the weight of the sugar beet roots.

6. The diameter and length of the sugar beets were significantly reduced by weed competition, the diameter being more affected than the length.

7. The percent sucrose of sugar beets was not affected by weed competition.

8. Relative dates of emergence of the sugar beets and weeds are thought to be one of the most critical factors. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie).

Evaluation of herbicides for chemical fallow with the variable rate sprayer. Guenthner, H.R., and Baker, L.O. Eleven treatments were applied on April 30, 1963 with a variable rate boom sprayer on barley stubble located on a Danvers clay loam soil. Plot size was 12 feet x 65 feet with a half-dosage distance of 20 feet employing three replications. The following treatments were made: dichlobenil (Casoron) at 6 pounds per acre, Shell-7961 at 6 lbs/A, isocil (Hyvar) at 3 lbs/A, OMU-EC at 6 lbs/A, Stauffer 3446 at 10 lbs/A, isocil at 3 lbs/A, plus TBA constant at 1 lb/A, fenuron at 3 lbs/A plus TBA constant at 1 lb/A, Tordon at 2 lbs/A, a weedy check, a cultivated check, and a chemical check. Dichlobenil and Shell-7961 were incorporated immediately after application. The chemical check was sprayed twice during the fallow season with paraquat at 2 lbs/A.

Of the herbicides evaluated, Tordon at .5 lb/A was the most effective treatment throughout the fallow season. Fenuron plus TBA application provided good control. Dichlobenil and Shell-7961 provided good control at rates of 3 lbs/A and above. OMU-EC and Stauffer 3446 were not effective. The isocil treatments were effective but provide too long of a chemical residual.

Principal weeds were volunteer grain, Russian thistle (Salsola kali), and wild buckwheat (Polygonum convolvulus). Winter wheat was seeded on one-half of each plot this fall and barley will be seeded next spring to determine the chemical residue present. (Montana Agricultural Experiment Station, Central Montana Branch, Moccasin, Montana).

Evaluation of crops grown on plots chemically fallowed in 1962. Guenthner, H.R. and Baker, L.O. Winter wheat, spring wheat and barley were planted on twenty-three chemically fallowed treatments which were applied in the fall of 1961 and spring of 1962. The soil type was a Danvers Clay loam. Plot size was 7 feet x 36 feet, three replications.

At the time winter wheat was seeded on the chemically fallowed plots in the fall of 1962, 15.48 inches of precipitation was recorded on the plots treated in the fall of 1961 and 7.26 inches on the spring seeded plots. Observations on the percent winter wheat stand showed that isocil (Hyvar) applied at .5 lb/A resulted in a ten percent stand. Atratone and atrazine at 1 lb/A resulted in a stand reductionof 20 to 70 percent. Dichlobenil (Casoron) and Shell-7961 applied at 4 lbs/A and 3 lbs/A respectively also caused a 30 to 40 percent stand reduction.

Spring wheat and barley were seeded on May 1, 1963. At the time of seeding, 24.05 inches of precipitation had been recorded on the plots treated in the fall of 1961 and 12.83 inches on the spring-treated plots (1962). There was a spring wheat and barley stand reduction on the atratone treatment (1 lb/A) and a 10 percent stand on the isocil plots treated at .5 lb/A. Dichlobenil, Shell-7961, and atrazine did not reduce the stand.

Six treatments were harvested for yield. Fenuron at 1 lb/A plus TBA at 1 lb/A was the only chemically fallowed plot which yielded as well as the cultivated check plot. (Montana Agricultural Experiment Station, Central Montana Branch, Moccasin, Montana).

Atrazine plus amitrole-T as a supplement to spring tillage in a stubble-mulch fallow program. Appleby, Arnold P., and Furtick, W.R. Stubble-mulch fallow programs are almost imperative in many erosion-susceptible areas of the Columbia Basin of Oregon. However, heavy winter growth of downy brome, volunteer grain, and other weeds make spring tillage with stubble-mulch equipment difficult. Research conducted over the past several years has shown the use of chemicals to be useful in preventing the formation of a sod condition, thus allowing the use of stubble-mulch equipment in a fallow program. When applied at rates high enough to provide complete vegetation control for the entire fallow period, these chemicals have given injury to the following crop and have proven to be too expensive for this type of operation. Recent research has been directed toward finding a chemical treatment for the best combination of 1) prevention of winter and early spring weed growth, 2) low cost per acre, and 3) safety to following crops.

Satisfactory results have been obtained with the combination of .4 lbs. of atrazine, plus .5 lbs. amitrole-T per acre. When this treatment is applied in late fall or early winter after germination of the downy brome and volunteer grain, it has provided good control of vegetation until spring and has caused no injury to grains planted the following fall. The cost of the chemicals at present prices totals less than $4.00 per acre. In most cases the growers have been able to delay their first spring tillage until soil moisture conditions are suitable for such tillage, thus increasing the effectiveness of the first tillage and reducing the number of tillage operations considerably.

The feasibility of using atrazine alone, pre-emergence to germination of weeds in the fall, is being studied at the present time. This treatment would have the advantage of lowering the cost still further. Bromacil and isocil, although excellent downy brome herbicides, have proven unsatisfactory for chemical fallow purposes because of their extreme toxicity to wheat during the following crop year. (Oregon Agricultural Experiment Station, Oregon State University, Corvallis, Oregon).

Chemical weed control in corn. Alley, H.P. and Chamberlain, E.W. A total of 14 pre-emergence treatments which included individual chemicals as well as several chemical mixtures were evaluated in 1963. The chemical mixtures were used to try to obtain a less residual treatment than atrazine but still give season long weed control. Atrazine at 1 and 2 lb/A gave 100 percent control again in 1963 at 2 locations (one a sandy loam soil and the other a clay loam soil). Other treatments which showed promise are Pyramin at 4 lb/A (80 percent control), EPTC at 1 lb/A + 2,4-D at 1 lb/A (85 percent control), and EPTC at 2 lb/A + 2,4-D at 2 lb/A (90 percent control). Several rates and ratios of amiben + atrazine were used with 85-95% weed control being obtained. Amiben-atrazine mixtures gave better control than amiben alone but were less effective than atrazine alone.

Some post-emergent treatments of atrazine on corn were applied when weeds were 1 inch in height. Atrazine at 1/2 lb/A was nearly as effective as 1 and 2 lb/A. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie, Wyoming).

Forage establishment with pre-planting contact herbicides for seedling weed control. Peabody, Dwight V., Jr. In 1962, applications of the highly active contact herbicide diquat to emerged seedling weeds in a prepared seed bed prior to planting resulted in almost 100 percent kill of annual weeds within a 24-hour period. A seeding of a grass-clover mixture was made the day following treatment application. Emergence and early growth of these pasture grasses and legumes with no weed competition resulted in the rapid establishment of the pasture sward. Dry matter yield taken at hay stage the following year (1963) reflected this control of annual weed species as an increase in production of dry matter yields.

In 1963, where the same pre-planting treatment procedure was followed as in 1962, the control of weeds was inadequate and severe growth suppression and injury to the germinating forage seeding was observed. This poor growth of forage species was due to a severe and almost uniform infestation of prostrate knotweed (Polygonum aviculare) which was not affected by the diquat or paraquat treatments. (Northwestern Washington Experiment Station, Washington State University, Mount Vernon, Washington).

Field sprayer evaluation of herbicides for controlling annual broadleaved weeds in a new planting of green needlegrass. Guenthner, H.R. Investigations have been conducted in 1961-63 to evaluate herbicides for controlling annual broadleaved and annual grassy weeds in grass planted for seed production. In 1963 seven treatments were applied with a field sprayer for annual broadleaved weed control. Plot size was 30 feet x 400 feet. Weeds present were Russian thistle (Salsola kali), rough pigweed (Amaranthus retroflexus), lambsquarters (Chenopodium album), fanweed (Thlaspi arvense), and a few wild buckwheat (Polygonum convolvulus). The following treatments were made: ACP-62-177A at .5 and 1 lb/A; dicamba (Banvel D) at .33 lb/A; dicamba at .25 lb/A in combination with 2,4-D ester at .5 and .75 lb/A; 2,4-D ester at .75 lb/A; and 2,4-D amine at .75 lb/A.

A week after application all of the treatments appeared to be effective; however, one month after application the dicamba and 2,4-D combinations were the most effective treatments. The ACP-62-177A stunted the weed growth at first but one month later all weeds were recovered and still vigorously growing. Dicamba .33 lb/A did not control the Russian thistle and the late germinated lambsquarters. Both the 2,4-D amine and ester treatments were more effective than ACP-62-177A or dicamba alone in controlling the weed species present. No grass injury was evident. (Montana Agricultural Experiment Station, Central Montana Branch, Moccasin).

Weed control in flax (Linum usitatissimum Var. Linore and Caldwell). Fechtig, Allen D., Brown, D.A., and Furtick, W.R. In the fall of 1962 four separate trials consisting of a randomized complete block design were tested at four locations throughout Western Oregon. The plots were fall-seeded with two varieties, Linore and Caldwell. Each of the 10' x 40' plots was seeded, one-half with the Linore variety and the other one-half with Caldwell. A group of the plots at each of the four locations received either pre-plant treatments, pre-emergence treatments, or post-emergence treatments. The effectiveness of the weed control, when these three different types of application were employed, was evaluated so that a follow-up program with a number of the more promising compounds could be conducted in the fall of 1963. During the winter and spring months of 1962-63, severe freezing and thawing were responsible for severe reduction in the stand of flax at three of the locations, and the initial evaluations of the various compounds were, in most instances, the only data that were recorded. However, the plots at the Southern Oregon Experiment Station at Medford were not lost due to this extreme climatic condition, and observations at the end of the season were made. The most promising herbicide appeared to be DuPont 762 (5-bromo-6-methyl-3-phenyluracil) which was applied pre-emergence. Isocil applied pre-emergence at the rate of one pound active material per acre gave excellent weed control; however, the safety margin was much narrower than with 762 at higher rates.

Another treatment that exhibited good weed control in 1962 was atrazine at four pounds active material per acre applied when the flax was approximately 6 inches high.

IPC wettable powder and IPC granular were applied post-emergence in the spring to flax that was approximately five to six inches high. Excellent grass control was observed in all plots that had received three and four pounds active IPC per acre. The terminal buds of the flax exhibited extensive injury, but the flax plants exhibited a profusion of axillary buds when compared to the check plots.

In the fall of 1963 new flax trials were initiated with primary emphasis on those herbicides that had exhibited excellent weed control during the 1962-63 season. In addition Geigy G-34698 (2-chloro-4-isopropylamino-6-(3-methoxypropylamino)-s-triazine), and CP-31393, Monsanto Chemical Company experimental were applied as pre-emergence herbicides.

Yield data for the flax plots during the current year is anticipated. Also, final evaluations of weed control and flax injury will be recorded before harvest dates. (Dept. of Farm Crops, Oregon State University, Corvallis, Oregon).

Field evaluation of several pre-plant, soil-incorporated herbicides in safflower. Foy, Chester L. Preliminary studies of several pre-plant, soil-incorporated herbicides in 1962 indicated potential for some of the newer materials for selective use in safflower.

Additional studies were conducted in 1963 involving seven soil-applied herbicides, four soil types and three incorporation methods. One of the studies also compared cross-cultivation and post-emergence chemical sprays for a direct comparison of these practices. (Only two of the studies are included in this report; due to the lack of weed competition in the remaining trials, no economic advantage for the use of any weed control practice could be demonstrated.)

The chemicals and the rates at which they were tested in replicated experiments are shown in the table. The herbicides were applied to the soil surface by knapsack sprayer and immediately incorporated to a depth of 3 to 4 inches either by rotary tilling or by cross-discing followed by spike-tooth harrowing.

Where safflower was heavily infested with weeds, all treatments provided some degree of weed control which resulted in apparent yield increases--despite considerable early injury to safflower in a few instances (see table).

Trifluralin provided the most outstanding control of barnyardgrass and broadleaved weeds (pigweed, lambsquarters, wartcress, etc.) without visible crop injury except at the very high rates. Nutsedge, swamp smartweed, annual smartweeds, cocklebur and sunflower were observed in the plots at harvest, suggesting either their biological resistance or escape from the herbicide due to imperfect incorporation. Herbicide incorporation was generally more uniform by rotary tilling than by discing and harrowing. This was evidenced by the streaked pattern of weed infestation resulting when marginal dosages of herbicides were incorporated into the soil by the latter method.

EPTC at the approximate recommended rate and upward also provided excellent control of weeds without crop injury, however, there was a wider spectrum of annual (primarily broadleaved) weed species showing incomplete control than was true for trifluralin.

Isocil and bromacil gave fair to good weed control especially in the organic soil, however, early in the season there was moderate to severe crop injury which tended to offset the benefits of weed control. Under conditions of less severe weed competition or poorer conditions for regrowth of the safflower, seed yields may well have been reduced by herbicidal rates of these compounds. There does not appear to be a high degree of inherent tolerance of safflower to the substituted uracil herbicides. In general, both isocil and bromacil appeared to be more effective against broadleaved weeds than against grasses.

Under these conditions (incorporation 3-4 inches deep), CIPC and DCPA gave some measureable weed control, but by usual criteria, control was inadequate. (Note. Under other circumstances--used either as a pre-emergence spray or incorporated very shallowly, then followed soon by rain--CIPC has provided excellent control of many annual weeds, e.g., barnyardgrass, smartweeds, etc. without significant injury to safflower. These conditions appear to be critical for the successful use of CIPC in safflower in California).

Experimental herbicide N3291 was least effective of the compounds studied, showing no visible effects on either crop or weeds under these conditions. (Department of Botany, University of California, Davis, California).

Effects of several pre-plant, soil-incorporated herbicides on weed control, crop vigor and yield of safflower.

		Rotary tilled into 15% organic soil				Cross-disced two ways into mineral soils			
		After 49 days				After 29 days			
Chemical	Rate lb/A	% weed control	crop Vigor	Yield lb/A	% of Check	% weed control	Crop Vigor	Yield lb/A	% of Check
EPTC	2	--	--	--	--	73	10	2746	147
EPTC	4	98	10	2745	178	96	10	3090	165
EPTC	6	99	10	2823	183	98	10	2900	155
EPTC	8	98	10	2906	188	--	--	--	--
N-3291	6	--	--	--	--	0	10	2132	114
CIPC	4	--	--	--	--	25	10	2494	133
CIPC	6	22	10	2058	133	43	9	2634	141
CIPC	8	45	10	2072	134	49	10	2682	143
CIPC	12	67	10	2417	156	--	--	--	--
Trifluralin	2	96	10	2599	186	99.9	--	--	--
Trifluralin	4	100	10	2668	173	99.9	10	3270	175
Trifluralin	6	100	10	2920	189	99.9	9	3173	170
Trifluralin	8	--	--	--	--	--	8	3113	166
Isocil	1/4					33	8.5	2901	155
Isocil	1/2	82	9	1969	127	94	7.5	2845	152
Isocil	1	94	10	2567	166	98	7	2841	152
Isocil	2	99	9	2470	160	--	--	--	--
Bromacil	1/4	75	10	1869	121	65	8.5	2690	144
Bromacil	1/2	80	9	2593	168	88	8	2626	140
Bromacil	1	73	9	2417	156	92	7	2482	133
DCPA	6	--	--	--	--	7	10	1968	105
DCPA	8	--	--	--	--	83	10	2812	150
DCPA	9	68	10	2473	160	--	--	--	--
DCPA	12	53	10	2063	133	92	10	3097	166
DCPA	15	77	10	2551	165	--	--	--	--
Check	--	0	10	1546	--	0	10	1871	--

Pre-emergence weed control in field beans. Alley, H.P. and Chamberlain, E.W. Pre-emergence chemical weed control plots in field beans were established May 28, 1963. The purpose was to test DCPA (Dacthal) and amiben along with EPTC which is the recommended chemical in Wyoming. The plots were 1/100 acre plots and were replicated 3 times. The chemicals were applied on a broadcast basis with 1/2 of each plot incorporated and 1/2 of each plot unincorporated. One-half inch of rain was received the day after treatment.

From this test indications were that DCPA and amiben were just as effective whether they were incorporated or not. DCPA at 8 lb/A was as effective as EPTC at 3 lb/A. Without incorporation EPTC gave little weed control. Amiben at 4 lb/A did not give satisfactory control. The table below contains weed control figures and yield data for this study. (Wyoming Agricultural Experiment Station, University of Wyoming, Laramie, Wyoming).

Comparison of pre-emergent herbicides for weed control in field beans.1/

Herbicide	Rate-lb/A2/	% Weed Control Incorporated	% Weed Control Unincorporated	Yield-lb/A
DCPA	2	83	85	2953.7
DCPA	4	90	93	2797.7
DCPA	8	98	98	3107.7
DCPA	24	99	99	2360.3
EPTC	1.5	94	25	2436.7
EPTC	3	99	62	2474.7
Amiben	1.6	43	43	2045.7
Amiben	2	72	78	2266.3
Amiben	4	33	88	2106.0
Check3/	0	0	0	1112.0

1/Figures are average of three replications.
2/Lb/A is expressed in lbs of active ingredient per acre on a broadcast basis.
3/Weeds were not removed from the check plots.

Fast, accurate estimation of residual weed stands. Newton, Michael. The use of the point frame for the estimation of herb cover is an old practice which has found little use among weed control investigators. The instrument has some problems which may be overcome to make it a useful tool for rapid and accurate estimation. An example of its use and the derivation of a prediction equation for the estimation of herb cover follow.

In an experiment in which it was desirable to estimate the influence of herbicide-treated residual vegetation, and in which it was imperative to leave the stand in an undisturbed condition, the point frame was used to record hits on seven classes of vegetation on 1/10,000 acre plots adjacent to some larger plots where yield estimates were desired. The small plots were then harvested and the dry weights of the harvest plots related to the record of hits and misses. Multiple hits were recorded; the point frame was moved in the small plot in a systematic sample. 100 points were sampled in each harvest plot; thirty harvest plots were used over the range of densities in which larger estimates were to be made.

In a preliminary estimate of the data, it was determined that the plants could be grouped into two classes, which included the single-stem grasses and forbs in one class, called class "A", and the perennial bunch grasses in class "P". When the yields of these plots were recorded with the hits in each of the vegetation classes, the correlation equation resulted in a response surface characterized by the equation:

$$y = 3.229 + 0.511P + 0.452A - 0.00128P^2 + 0.00531A^2 + 0.0142AP$$

When y is the predicted yield per acre x 10^{-4} in grams
A is the number of hits on single-stem grasses and forbs per hundred sample points, including double hits.
P is the number of hits on bunch grasses per hundred points.
($r^2 = 0.982$)

If the estimate of yield per acre is desired, y x 10 gives the yield in kilograms per acre, or y x 22.04 predicts pounds per acre.

This equation was derived from thirty points which required less than a day to sample, yet provides an accurate yield prediction for the complete range of vegetation densities without the inconvenience of gathering harvest data for each observation. Once the correlation is made, the sampling procedure simply involves the observation of a specified number of points, and the extrapolation of yield from the response surface. Precision may be increased by increasing the number of points observed without changing the quantitative estimates predicted by the equation.

The speed of sampling with the point frame was increased several-fold by the modification of the instrument with return springs to replace the bushing clamps to hold the points in position when not in use. 400 sample points were recorded in each major plot in twenty minutes, giving a standard deviation of less than five percent of the estimate. (Oregon State University, School of Forestry, Corvallis, Oregon).

Greenhouse studies with an OMU-BiPC combination on several agronomic crops. Foy, Chester L. A proprietary product of Badische Anilin- & Soda Fabrik AG (Ludwigshafen/Rhein, Germany) containing OMU(N-cyclooctyl-N',N'-dimethylurea) and BiPC (butinol N [3-chlorophenyl] carbamate) has shown considerable promise in Europe for control of annual weeds in beets and vegetables.

Two preliminary greenhouse studies were conducted, using Yolo loam soil, to determine whether similar selectivities may exist in several agronomic crops. Barley, wheat, corn, safflower, sorghum, bluegrass, alfalfa, bean, cotton and sugar beets were seeded in rows in metal trays, at their optimum depths. Barnyardgrass and rough pigweed were seeded broadcast at a high uniform rate; the seed being mixed thoroughly in the upper one inch of soil. After planting, the soil surface was sprayed with 1/2, 1 and 2 lb/A of Alipur (OMU-BiPC combination) active ingredient, using a chain-driven experimental spraying table. Immediately after treatment, the flats were either sub-irrigated (Experiment I) or sprinkler-irrigated (Experiment II.)

The herbicidal combination proved to be of high potency, being most effective when followed by sprinkler irrigation. Pigweed was eliminated at 1 and 2 lb/A and effectively controlled at 0.5 lb/A. The herbicide was less effective in preventing emergence or causing early kill of barnyardgrass but gave satisfactory control (after emergence) in the range of 1 to 2 lb/A. Bluegrass and alfalfa were eliminated at all rates. (The material might be useful for controlling these seedlings as volunteers in seed crops of the same or different species.) Wheat, sugar beets and barley showed a rather narrow margin of safety; whereas the larger, deeper seeded species, especially bean and cotton, showed little or no injury. Corn, safflower and sorghum also showed only moderate injury at high rates.

It appeared that much of the selectivity observed may be due simply to positioning, ie., escape, due to the seeds or young seedlings missing contact with toxic concentrations of the herbicide in the soil, rather than true biochemical specificity. For example, all responses were more pronounced under sprinkler-irrigation than sub-irrigation. The material exhibits high herbicidal activity but any unusual selectivity or economic advantage for use in agronomic crops in California has yet to be demonstrated.

For testing in this country (U.S. Rubber Company, Naugatuck Chemical Division), BiPC is being dropped from the formulation, in part because of the expense. OMU alone, however, appears to be less effective on grasses than was the OMU-BiPC combination. New combinations of OMU-DNBP and OMU-CIPC may warrant further testing for selective use in some larger-seeded, agronomic crop situations. (Department of Botany, Univ. of California, Davis).

PROJECT 6. AQUATIC AND DITCHBANK WEEDS

W. B. McHenry, Project Chairman

SUMMARY

Three research progress reports on the control of submersed aquatic weeds, one on the affect of aquatic herbicides in irrigation water on crops, and two on Johnsongrass control were submitted to Project 6. The six reports are summarized under three categories.

Control of submersed aquatic weeds. Field testing of aquatic soil sterilants continued in 1962-63 in Wyoming and California. Fall applications in a Wyoming canal included fenac, silvex, dichlobenil, and SD 7961 (2,6-dichlorothiobenzamide) and received 2 inches precipitation before the canal was filled. None of the treatments gave more than 5% control of sago pondweed (Potamogeton nodosus). Spring applications of dichlobenil and SD 7961 followed by 1.5 to 3.5 inches precipitation resulted in 88-92% control of chara and 63-93% of sago pondweed. Wettable powder formulations gave up to 38% control of chara and 93% of sago pondweed. Endothal was ineffective. In California, dichlobenil (wettable powder) fenac, SD 7961, and Tritac (2,3,6-trichlorobenzyloxypropanol) were tested in a canal supporting a dense stand of sago pondweed. The plots received 6 inches of rainfall. Fenac, the only effective compound reduced the weed stand 93%. Fenac, tested in the same California canal a year earlier with 1 inch rainfall, had failed to control sago pondweed.

In Wyoming, TD 191 (mono N,N-dimethyl "coco" amine) salt of endothal and TD 47 (di N,N-dimethyl "coco" amine) salt of endothal were introduced into canals at 50 ppmw over a 30 minute period. Maximum kill-back of sago pondweed was observed six weeks following treatment; regrowth of aquatic weed species was observed 12 weeks following treatment.

Affect of herbicide treated water on crops. Furrow irrigated alfalfa 8 inches high and sugar beets in 8 leaf stage were treated in Montana with dichlobenil and fenac each at 0.1, 1.0, and 10.0 ppm and endothal at 10.0 ppm in the irrigation water. Fenac at 1.0 ppm and 10 ppm and dichlobenil at 10 ppm significantly reduced alfalfa yields, and fenac at 10 ppm significantly reduced sugar beet yields.

Control of ditchbank weeds. In New Mexico, DMA, at 4 lb ai/A monosodium methylarsonate at 4 lb ai/A, and monoammonium methylarsonate at 3 lb ai/A were compared for the control of Johnsongrass. Based on observations made the year of treatment two or more applications were required for effective control. In a second Johnsongrass control trial, dalapon at 10 lb ai/A, dalapon plus surfactant, and dalapon plus surfactant plus amitrole at 3 lb/A were compared using four to five treatments per year for two years. Control of 90% or higher was achieved but with no outright eradication. The addition of amitrole reduced the incidence of encroachment by other weed species. Repeat applications of dalapon at 6 lb ai/A was as effective as higher rates.

Evaluation of herbicides applied to the soil in canal bottoms for control of sago pondweed (*Potamogeton pectinatus* L.) and Chara. Comes, R.D. Recent investigations have shown that certain herbicides are effective in controlling rooted submersed aquatic weeds when applied to the soil surface. Applications have been made during the fall or early spring when water was absent from the canal. Five compounds were applied to the bottoms of two different irrigation canals (designated A and B) in Fremont County, Wyoming, during 1962-63 to evaluate further this method of controlling rooted submersed weeds.

Treatments applied in the fall only were fenac at 10, 15, and 20 lb/A, potassium salt of silvex at 20 and 40 lb/A, and a mixture of these two herbicides at 10 lb/A each. Dichlobenil at 5, 10, and 20 lb/A and 2,6-dichlorothiobenzamide (SD-7961) at 10 and 20 lb/A were applied in both the fall and early spring. In addition, endothal was applied in the spring only at 20 and 40 lb/A. Granular and wettable powder or liquid formulations of fenac, dichlobenil, and SD-7961 were compared at equivalent rates. Treatments were replicated three times in each canal on randomized plots 30 feet long x canal width. An untreated border 20 feet long was left between each treated plot. The soil was moist in both canals when fall and spring treatments were applied. Result data presented here was obtained in October, 1963, within a few days after water was turned out of the canals for the winter. The degree of control was based upon stand reduction in comparison to the two adjacent untreated border plots.

All of the treatments applied to Canal A in the fall were destroyed by flooding. None of the fall treatments gave more than 5 percent control of sago pondweed in Canal B. A total of only 2.25 inches of precipitation was received from the time of treatment, October 27, 1962, until water was restored in Canal B, April 25, 1963. Moreover, 16 days elapsed between treatment and occurrence of the first measurable precipitation, .05 inch. A total of only .36 inch of precipitation was received during a 4-month period immediately following fall applications in Canal B.

Water was turned out of Canal A for 2 weeks in late June and sago pondweed did not develop normally after water was turned back into the canal. However, a moderate to dense stand of the attached algae, Chara, did develop. Spring applications of dichlobenil and SD-7961 granules at 20 lb/A gave 88 and 92 percent control of Chara, respectively. Other rates and formulations of these two compounds did not result in more than 38 percent Chara control and endothal was completely ineffective. A total of 3.6 inches of precipitation was received between treatment, March 29, and the time water was turned into the canal in the spring, May 20, 1963.

The granular formulation of SD-7961 at 20 lb/A gave 93 percent control of sago pondweed in Canal B and was the most effective spring treatment evaluated. Spring applications with the granular forms of dichlobenil at 20 lb/A or SD-7961 at 10 lb/A resulted in 65 and 63 percent control of sago pondweed, respectively. Endothal and all rates of the wettable powder formulation of dichlobenil were completely ineffective. All other spring treatments in Canal B gave 28 to 42 percent control of sago pondweed. Only 1.57 inches of precipitation were received between treatment, March 31, and the time water was turned into the canal, April 25, 1963. However, .30 inch was received 2 days after treatment.

Moderate to dense stands of horned pondweed (Zannichellia palustris L.) and water plantain (Alisma gramineum [Torr.] Sam. var. Geyeri) were observed in several plots where a high degree of sago pondweed control was obtained. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture and the Wyoming Agricultural Experiment Station, Laramie.)

An Aquatic soil sterilant trial for the control of American pondweed (Potamogeton nodosus). McHenry, W.B. and Jeter, R.B. A canal with a history of a dense stand of American pondweed was treated with four herbicides used as aquatic soil sterilants. The plots were 31 feet long and the width of the canal basin, 14 feet. Each plot was separated by an untreated control plot 31 feet long. All treatments were made with a knapsack sprayer February 26, 1963, some four months after the canal had been drained for the winter. The herbicides were leached into the soil by approximately 6 inches of rainfall before being covered with water when the canal was filled in the spring. Treatment affects were estimated August 27, 1963 and the average readings are given in the following table:

Herbicide	Lb ai/A	Control*
Dichlobenil wettable powder	10	0
	20	0
Fenac Na salt, liquid	10	1.0
	20	9.3
SD 7961 (Trichlorobenzonitrile)	10	0
	20	0.5
Tritac (2,3,6-trichlorobenzyloxypropanol) liquid	10	0
	20	0

*10 = 100% stand reduction.

The alternating untreated control or buffer plots used in this trial had been treated in the winter of 1962 with fenac, liquid sodium salt formulation, at 5, 10, 15, and 20 lb ai/A. One inch of precipitation fell on the 1962 trial before the canal was used in the spring. No stand reduction could be detected in 1962 in any of the treatments. This would appear again to emphasize the need for adequate leaching of aquatic soil sterilants before canal filling and the ensuing sweeping action of flowing water. (Agricultural Extension Service, University of California, Davis, California).

Evaulation of two endothal derivatives for control of sago pondweed (Potamogeton pectinatus L.) in irrigation canals. Comes, R.D. Tests conducted in the greenhouse at Denver by Dr. P.A. Frank, Agricultural Research Service, showed that applications of the mono-or di-N,N-dimethylcocoamine salts of endothal to flowing water effectively reduced topgrowth of sago pondweed. Hereafter, these two derivatives of endothal are referred to as the mono-amine salt and the di-amine salt, respectively. Two canal experiments were conducted in Wyoming during 1963 to evaluate these compounds under field conditions.

The canal in which the mono-amine salt was evaluated was 6 miles long and the other canal was 3 miles long. Both compounds were applied during the first week of July when sago pondweed was beginning to interfere noticeably with the flow of water. Prior to treatment, normal canal flows of 10 and 28 cubic feet per second (c.f.s.) were reduced to 5 and 14 c.f.s., respectively. Both compounds were applied at a concentration of 50 ppmw over a period of 30 minutes with a centrifugal pump at a pressure of 25 psi. Water in both canals was supplied from the same reservoir and at treatment time had the following characteristics: temperature - 60 to 63°F; turbidity - clear; dissolved solids - 132 to 144 ppm; pH-7.6 to 7.8; hardness - 71 to 82 ppm; and velocity - .44 to .90 ft/sec. The di-amine salt was applied in the canal with a velocity of .44 ft/sec. Water samples for residue analyses were obtained as the treated water passed sampling stations at various intervals downstream from the point of application. Red dye added to the water at time of treatment permitted location of the treated water as it passed downstream. All treated water was wasted. The canals were flushed with fresh water 12 hours after treatment and before deliveries were made to farmers. Observations of the weed infestations were made immediately preceding treatment and approximately 1,3,6, and 12 weeks after treatment.

One week after treatment neither compound had injured sago pondweed severely although the apical leaves were browned throughout both canals. A sparse stand of waterplantain (Alisma gramineum (Torr.) Sam. var. Geyeri) was present in the canals and 85 to 90 percent of the leaves were killed within 1 week by both compounds. However, the treatments did not have any effect on the waterplantain scape or corm and the plants developed new leaves very rapidly.

Within 3 weeks 98 to 100 percent of the sago pondweed leaves were killed by the mono-amine salt and 80 to 98 percent were killed by the di-amine salt. Most of the leaves remained attached to the live stems and caused the plants to slump to the canal bottoms. Three weeks after treatment, weed growth was not restricting waterflow in either canal.

After 6 weeks all sago pondweed leaves and 15 to 90 percent of the stems were dead in both canals. The degree of stem kill obtained was not related to the distance the plants were located from the point of chemical application in the canal but appeared to be related to water velocity. Ninety-eight percent stem kill was obtained 5 miles below the point of application of the mono-amine salt but only 15 percent was obtained 2 miles below the same point. Moreover, the water velocity was considerably less at the 5 mile station than at the 2 mile station.

Regrowth of sago pondweed 4 to 13 inches bng and scattered small, but dense, patches of Chara, waterplantain, and horned pondweed (Zannichellia palustris L.) were infesting the canals 12 weeks after treatment.

Water samples taken 1,2,3,4, and 6 miles below the point of the mono-amine salt application contained 22,39, 46, 38, and 35 ppm of the herbicide, respectively. There was 11, 13, and 6 ppm of the di-amine salt in the water 1,2, and 3 miles below the point of application, respectively. (Cooperative investigations of the Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture and the Wyoming Agricultural Experiment Station, Laramie, Wyoming).

The effect of aquatic herbicides in irrigation water on crops. Hodgson, Jesse M. Recent experiments involving chemical treatment of ditchbottom soil for control of submersed waterweeds have appeared quite promising. The effect of irrigation water contaminated by such treatments on irrigated crops must be determined before such treatments become practical. In this experiment sugar beets and alfalfa were furrow irrigated with water containing none and various concentrations of 2,3,6-trichlorophenylacetic acid (fenac), 2,6-dichlorobenzonitrile (dichlobenil) and 7-oxabicyclo-(2,2,1) heptane-2,3-dicarboxylic acid (endothal).

Sugar beet plots consisted of 4 rows, 1.5 feet apart and 20 feet long. Plants had 8 leaves at the time of treatment. The two center rows were harvested 12 weeks after treatment to measure the effect of the treatments on yield. Alfalfa was sown broadcast on plots 6 x 20 feet. Plants were 8 inches high when treatments were made July 15, 1963. Yield samples from a 3-foot swath lengthwise across the center of the plot were obtained 6 weeks after treatment to measure treatment effect.

A list of treatments with mean yields of both crops is given in the following table:

Treatment	Rate		Yield in tons per acre[b/]	
Chemical	PPM	lbs/A[a/]	Alfalfa	Sugar beets
Fenac	0.1	0.045	1.77a	14.92a
Fenac	1.0	0.45	1.55b	11.87bc
Fenac	10.0	4.5	0.81c	10.55d
Dichlobenil	0.1	0.045	1.68ab	13.45abc
Dichlobenil	1.0	0.45	1.73ab	12.52bc
Dichlobenil	10.0	4.5	1.33c	11.68bc
Endothal	10.0	4.5	1.72ab	13.80ab
Check	0	0	1.82a	13.12abc

[a/] Amount of actual herbicide applied per acre.
[b/] Yields having similar letters were not significantly different according to Duncan's Range test at P = .05.

Alfalfa yields were oven dried and corrected to 12% moisture. Sugar beet yields represent fresh weight of beets. Fenac at 10 ppm decreased the yield of both crops. Dichlobenil at 10 ppm reduced alfalfa yields and showed a trend toward reduced yield of sugar beets. (Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, and Montana Agricultural Experiment Station cooperating).

The control of Johnsongrass on ditchbanks with DSMA. Anderson, W.P. and McCaw, Larry. Preliminary tests with disodium methyl arsonate (DSMA) indicate that it is highly effective in controlling Johnsongrass on ditchbanks when applied as an overall spray to the foliage of Johnsongrass at a dosage of 4 lbs/A of the DSMA hexahydrate. For effective control, two or more such applications are necessary during the growing season.

A comparison of DSMA with two related compounds, monoammonium methyl arsonate (3 lbs/A hexahydrate equivalent) and monosodium methyl arsonate (4 lbs/A hexahydrate equivalent) indicate that a quicker top kill is obtained with DSMA when applied in the early summer while monoammonium methyl arsonate gives a quicker top kill of Johnsongrass when applied during the middle of the summer. However, there appears to be little or no difference in their overall control of Johnsongrass and repeat treatments are needed for both materials to obtain effective Johnsongrass control. Both materials have given good control of other weeds infesting the ditchbank as the Johnsongrass stand is reduced. The monosodium methyl arsonate has been the least effective of the three materials in controlling Johnsongrass and the other weeds on the bank. These materials were applied in 90 gallons of water per acre with 0.5% wetting agent (X-77). Except for the first applications, the Johnsongrass was treated when it was 10 to 15 inches tall. At the time of the first application the Johnsongrass was 3 to 4 feet tall. It was necessary to burn off this taller grass after it had died.

There was an indication that these materials may not control Johnsongrass along ditchbanks on ditches which carry water all summer as effectively as it does on ditches which are periodically drained, e.g. head-ditches.

These evaluations are based upon observations made during 1963, the same year in which the treatments were applied. Observations will be continued into 1964 and further evaluations made based upon subsequent growth. Research is being continued with these materials. (New Mexico State University, Agricultural Experiment Station, University Park, New Mexico).

<u>Chemical control of Johnsongrass on ditchbanks - 1962-63.</u> Anderson, W.P., Whitworth, J.W. and McCaw, Larry. During 1962 and 1963, the same segments of ditchbank, heavily infested originally with Johnsongrass, have received repeat applications, 4 to 5 each year, of dalapon, dalapon plus wetting agent, or dalapon plus wetting agent plus amitrole. Johnsongrass stands have been reduced 90 percent or better by these treatments but, in no case, has the Johnsongrass been eradicated. Where the Johnsongrass stand has been reduced other weeds tend to infest the ditchbank. For this reason, the best of the three treatments has been the one with dalapon, wetting agent, and amitrole in combination. The presence of amitrole has resulted in better control of those weeds tending to infest the ditchbank as the Johnsongrass stand is reduced, has given somewhat better inhibition of Johnsongrass regrowth and serves as well as a marker showing what has been sprayed, due to the chlorosis induced. In these treatments, dalapon was applied in each case at a dosage of 10 lbs/A ai, the wetting agent (X-77) at the equivalent of 1 1/2 pints per 100 gallons of water, amitrole at 3 lbs/A ai, and each treatment was applied using 80 gallons of water per acre. This experiment is being continued through 1964.

Additional experiments during 1962 and 1963 have shown that three or more applications of dalapon made during the same growing season are essential for the effective control of Johnsongrass; that, with repeat applications, dosages as low as 6 lbs/A ai are as effective as higher ones when applied when the Johnsongrass is 6 to 10 inches tall. (New Mexico State University, Agricultural Experiment Station, University Park, New Mexico).

PROJECT 7. CHEMICAL AND PHYSIOLOGICAL STUDIES

L. S. Jordan, Project Chairman

SUMMARY

Seventeen abstracts were received from nine experiment stations for publication in this section. A wide range of subjects is covered. The results are briefly summarized as follows: 1. Typical paraquat symptoms to corn were absent when carboxymethylcellulose polymers were added to the spary. The addition of polyaxyethylene sorbitan monalurate (Tween 20) increased the activity of dalapon and dalapon + polymer combinations and paraquat but decreased the activity of polymer + paraquat mixtures. 2. Dimethyl sulfoxide did not increase the toxic effect of dalapon or diuron to oats. 3. Combinations of latex and glycerol increased shoot growth and decreased root growth of mesquite treated with a 2,4,5-T ester if the pH was adjusted to 6.0 but not at pH 3.0. Repression of root growth was proportional to glycerol concentration. Without latex, glycerol increased shoot growth but did not repress root growth. 4. The addition of iron chelate or chelate alone did not affect simazine toxicity to beans. 5. Examination of technical avadex revealed two major components, possibly cis-trans isomers, which differ considerably in toxicity to oats and ryegrass. 6. A nucleoprotein containing C^{14} from 2,4-D-1-C^{14} was isolated. Spectra of nucleoprotein fractions from roots and tops of susceptible and resistant plants were not altered by 2,4-D treatment. 7. Considerable variation in the response of inbred lines of corn to dalapon was reported. 8. Five varieties of oats, six of barley and eight of wheat were treated with 1, 2, and 4 oz/A of 4-amino-3,5,6-trichloropicolinic acid. Yield of all barley varieties, some of the wheat varieties and none of the oat varieties was reduced, especially at the highest rate. 9. Shrub live oak treated with fenuron was not killed by starvation alone. Accumulation of a phytotoxic product is suggested. 10. Rabbit brush became increasingly susceptible to 2,4-D as the root temperature was increased from 45°F to 75°F. 11. Five different herbicides at approximately equal phytotoxic levels differed widely in their relative ability to retard geotropic response. 12. Uniform incorporation of EPTC in the soil surface was more effective than spraying in a concentrated layer and covering with soil. 13. The amount of weed control obtained with a preemergence herbicide may be influenced by method of irrigation, incorporation and application. 14. Bromacil, isocil, atrazine, simazine and diuron gave good residual control of a wide variety of weed species in the Willamette Valley of Oregon. 15. The UV spectra of several herbicides were altered most by far UV, less by middle UV and least by near UV irradiation. 16. The testing and development of preemergence soil applied herbicides are discussed.

<u>The effects of carboxymethylcellulose polymers on the herbicidal activity of dalapon and paraquat on corn.</u> Smith, L. W. and Bayer, D. E. Greenhouse trials were conducted to determine the effect of carboxymethylcellulose polymers (Hercules Powder Company CMC-7HSP, CMC-7MSP, and CMC-7LP) on

the toxicity of dalapon and paraquat to corn. Given amounts of the polymers (CMC-7HSP 1.5 g, CMC-7MSP 4g, and CMC-7LP 8 g) were added to 200 ml of the herbicide solution to give equal viscosity. The viscocity of the resulting solutions were several times thicker than water, but readily sprayable. Comparisons were made between herbicide; herbicide + Tween 20; herbicide + polymer; and herbicide + polymer + Tween 20. The rate of chemical used was dalapon 10#/A; paraquat 1/8 oz/A; and Tween 20 0.2% w/v.

The spray solution was applied at the rate of 40 gpa to corn that was 32 to 35 cm high. The soil was covered with vermiculite prior to spraying to prevent the herbicide from contaminating the soil. The vermiculite was removed as soon as the plants were dry. The plants were harvested 7 days following treatment with paraquat and 14 days following treatment with dalapon. Four replications were sprayed and the figures in the table are the totals of these replications.

Fresh weight of corn in grams

Polymer	Paraquat	Paraquat + Tween 20	Dalapon	Dalapon + Tween 20
CMC-7HSP	49.6	46.9	82.6	66.3
CMC-7MSP	35.3	40.7	86.0	44.9
CMC-7LP	34.9	45.8	74.1	45.5
Dist.water	41.3	24.8	87.0	53.4
Check	42.4		85.9	

Visual observations on the plants sprayed with paraquat plus additives revealed that only when Tween 20 was added alone did significant symptoms of paraquat action appear. No scorch or typical paraquat action was noticed at all when the polymers were included in the spray solution. It was observed that when the polymer and herbicide solutions were sprayed on the plants a white flaky deposit resulted on the leaves as the spray solution dired. This deposit tended to flake off as the plants grew. When Tween 20 was included a white deposit still resulted but it did not flake off the leaves as was the case when none was added.

The flaking of the spray deposit was not as evident with the dalapon treatments as with the paraquat treatments. This was attributed to the lowered surface tension and better coverage by the dalapon solutions.

Apparently the paraquat was held in the carboxymethylcellulose deposit thus reducing its effects. Sample CMC-7HSP appeared to have more of an inhibitory effect on the action of both paraquat and dalapon than either of the other two samples, CMC-7MSP and CMC-7LP. The addition of the surfactant, Tween 20, to the polymer + herbicide solution increased the toxic effects of the polymer + dalapon combinations but decreased the toxic effect of the polymer + paraquat mixtures. (Department of Botany, University of California, Davis).

*Tween 20 (polyoxyethylene sorbitan monolaurate)

The effects of dimethyl sulfoxide on absorption and translocation of dalapon and diuron. Bayer, D. E. and Drever, H. R. Dimethyl sulfoxide (DMSO) was tested on greenhouse grown oats as an aid in absorption and translocation of dalapon and diuron. Combinations of dalapon, diuron, DMSO, and Colloidal X-77* were used as listed in the table. (The notation, 100% following DMSO means no water was added to the solution.) The herbicide solutions were applied at 40 gpa to oats that were 8 to 12 inches tall. The soil was covered with vermiculite prior to spraying and was removed as soon as the plants were dry to prevent the herbicide from contaminating the soil. The fresh green weight, as listed in the table, was harvested 12 days following treatment.

Fresh green weight of oats in grams

DMSO (100%)	37.0
DMSO (10%)	30.0
DMSO (100%) + Colloidal X-77 (1%)	37.5
DMSO (100%) + Diuron (4 lb/100 gal)	17.7
DMSO (10%) + Diuron (4 lb/100 gal)	19.5
DMSO (100%) + Diuron (4 lb/100 gal) + Colloidal X-77 (1%)	6.8
DMSO (10%) + Diuron (4 lb/100 gal) + Colloidal X-77 (1%)	13.3
Diuron (4 lb/100 gal) + Colloidal X-77 (1%)	13.2
Check	36.0
Dalapon (4 lb/A)	35.1
Dalapon (4 lb/A) + Colloidal X-77 (1%)	14.8
Dalapon (2 lb/A) + DMSO (1%)	36.2
Dalapon (2 lb/A) + DMSO (10%) + Colloidal X-77 (1%)	25.7
Dalapon (2 lb/A) + DMSO (1%) + Colloidal X-77 (1%)	23.0
Dalapon (4 lb/A) + DMSO (1%) + Colloidal X-77 (1%)	22.6
Check	36.0

Solutions containing straight DMSO dissolved the diuron but the solutions containing 10% DMSO did not. The DMSO did not increase the toxic effect of dalapon or diuron with the possible exception of the combination of straight DMSO + Diuron + Colloidal X-77. (Department of Botany, University of California, Davis).

*Colloidal X-77 (alkylarylpolyoxyethylene glycols, free fatty acids and isopropanol)

Absorption and translocation of a 2,4,5-T ester as influenced by interactions of pH and concentrations of glycerol and latex in the carrier. Herbert M. Hull. Effective kill of field mesquite (Prosopis juliflora var. velutina) is achieved only when basipetal transport of the herbicide is sufficient to inactivate adventitious buds near the root collar. Preliminary experiments with young greenhouse seedlings involved two pH levels and several concentrations of glycerol and latex in water as carriers for 2,4,5-T (1000 ppmw butoxyethanol ester). Formulated in a 5 percent latex emulsion adjusted to pH 6.0 the 2,4,5-T did not exhibit superior absorption and translocation characteristics over the unformulated herbicide in water alone.

However, when glycerol was added in various concentrations to the latex-containing formulation, subsequent repression of root growth (fresh weight) was directly proportional to glycerol concentration. Thus, 5 weeks after applying the formulation without glycerol to only two basal leaves, the shoot/root (s/r) ratio was 0.61. When a 25 percent concentration of glycerol was added the corresponding s/r ratio was 1.43. Intermediate glycerol concentrations gave proportionately smaller s/r ratios. These marked differences were due to a combination of enhanced shoot growth and repressed root growth, the latter effect occurring at pH 6.0 but not at pH 3.0. When latex was absent the glycerol still increased shoot growth but did not repress root growth. The effects suggest a better controlled absorption and/or enhanced basipetal transport of 2,4,5-T when both adjuvants are present and the carrier is adjusted to pH 6.0. Current experimentation is designed to check these effects at varying herbicide concentrations. (Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Tucson, Arizona).

Simazine toxicity and iron chelates, Lange, A. H. and Bayer, D. E. Even though there is a similarity between iron deficiency and simazine toxicity symptoms it does not appear probable that iron chelates corrected simazine toxicity symptoms as reported from field observations. The results here are based on one greenhouse test which showed simazine at 0.5 to 1.0 ppm to be toxic to Sutter Pink bean plants grown in sand (table 1). The addition of iron chelate or chelate alone had no apparent effect on simazine toxicity.

Table 1. Average fresh weight of trifoliate leaves from 3 replications (in grams)

		Fe-chelate				Chelate only		
Herbicide	ppm	0	.5	1	5	1	5	Average
Simazine	0.1	8.2	8.9	7.0	7.9	8.5	7.4	8.0
Simazine	0.5	7.1	7.5	6.9	7.0	7.2	6.0	7.0
Simazine	1.0	3.5	4.2	3.8	2.6	3.9	3.3	3.5
Check	0	9.2			9.2		8.0	8.8
Average		7.0	7.2	5.9	6.7	6.5	6.2	

Conclusion:

1. Simazine was toxic to beans between 0.5 and 1 ppm.
2. Fe-138 chelated iron did not influence simazine toxicity as expressed by top growth between 0.5 and 5 ppm. Fe-chelate.

(Department of Botany, University of California, Davis).

Activity of the Two Geometric Isomers of Avadex. Vernetti, Jack B. and Freed, V. H. Analysis of Avadex (2,3-Dichlorallyl diisopropyl thiolcarbamate) by gas chromatography revealed the presence of two major components in the technical grade material. Examination of the structure indicated the possibility of a cis-trans configuration of the chlorine atoms. To further the study, the two components were separated and collected by means of a gas chromatograph fractionating column. Samples of the separated fractions were reinjected and the proper retention times for each component were observed, showing that the collected materials were the same as the originals. Infrared spectra of fractions displayed nearly identical scans except for minor differences. Interpretation of these differences suggested that the cis-trans forms were involved.

Herbicidal activity of the fractions were tested on rye grass and oats. The seeds were planted in flats of sandy loam soil containing 0.1 and 1.0 #/acre of the chemicals. Fraction #2 (listed in order of emergence from the chromatograph) exhibited considerably more effect than fraction #1. The results are shown on the following table:

Fraction	#/acre	(% Normal Growth*) Oats	Rye Grass
1	0.1	60.5	82.5
2	0.1	28.5	15.2
1	1.0	10.6	18.6
2	1.0	6.0	0.0

*Harvest after 23 days.

Spectrum of nucleoprotein unchanged by 2,4-D. Whitworth, J. W., McCaw, L., and Welsh, Mary Anne. C^{14} from 2,4-D-1-C^{14} was detected in both aqueous and alcoholic extracts of bindweed plants that received foliar applications of this herbicide. The radioactivity in the water extract was highest in the centrifuged fraction containing microsomes, high weight polymers and sap. Further breakdown of this fraction by electrophoresis yielded two fractions containing radioactivity--one nucleoprotein and the other with a mobility similar to that of 2,4-D, but with a different spectrophotometric profile.

The spectra of the nucleoprotein fractions from roots and tops of both the susceptible and resistant plants were not altered by 2,4-D treatment.

Alcoholic extracts of the tops and roots contained a high level of radioactivity that was not identified with any amino acid. (New Mexico State University, Agricultural Experiment Station, University Park, New Mexico).

Differential response of several inbred lines of corn to foliar sprays of dalapon. Foy, Chester L. Herbicidal selectivity among species is a well known phenomenon. Several investigations have also suggested the possibility of differential intra-species responses to herbicides. If pronounced differences do occur among such closely related organisms, this should provide an excellent basis for studying further the possible physiological and biochemical factors accounting for or contributing to herbicidal selectivity.

Two preliminary studies were made to measure differential responses of several inbred lines of corn to dalapon, if any.

Corn was grown in Yolo loam soil, thinned to 4 uniform plants per pot, then sprayed with aqueous dalapon solutions (40 gpa) after 14 days. In the first experiment, 13 inbreds were treated with dalapon at the rate of 5 lb/A; in the second, 10 inbreds with 2 lb/A dalapon plus 0.2% X-77. One set of plants (5 replications) was harvested for height and fresh green weight determination at the time of treatment; a second set (sprayed) and a third set (untreated controls) were allowed to grow 12 more days before harvest.

The results are expressed in Tables 1 and 2 so as to show (a) the total percent growth reduction due to treatement (compared with untreated checks at harvest) and also (b) the ratio of height or weight at harvest to height or weight at time of treatment. The latter gives a direct indication of the effect of dalapon on the rate of growth after treatment. Ratios may be compared in the treated and untreated columns. Also shown is (c) the comparative growth increase (untreated/treated) from spraying to harvest.

On the basis of these results, which are self-explanatory in the Tables, inbred Hy was selected for further study as generally the most susceptible; L-317 and WF-9, as the two most resistant lives--the latter two exhibiting considerably different habits of growth.

Similar and more pronounced, though not necessarily identical, intraspecies differences may also be observed in the field. (Department of Botany, University of California, Davis).

Table 1. Response of various inbred lineof corn to foliar sprays of dalapon, 5 lb/A (Results are averages of 5 replications)

Inbred line	% total reduction (compared with untreated check at harvest)		Ratio of ht.or wt.at harvest / ht.or wt.at treatment (Indicates growth increase after treatment)				Ratio of Untreated / treated (Comparative increase from spraying to harvest)	
			Treated		Untreated			
	Ht. (cm)	Wt. (g)	Ht. (cm)	Wt. (g)	Ht. (cm)	Wt. (g)	Ht. (cm)	Wt. (g)
WF-9	0	0	2.2	7.4	2.2	6.9	1.0	1.0
38-11	15	0	2.4	12.8	2.8	10.0	1.2	1.0
L-317	2	3	3.3	8.8	3.3	9.1	1.0	1.0
Hy	32	37	1.9	5.3	2.8	8.3	1.5	1.6
R-61	12	11	2.3	6.6	2.6	7.2	1.1	1.1
R-4	37	33	1.6	4.5	2.5	6.7	1.6	1.5
3846 Y	15	13	2.2	6.7	2.5	7.6	1.1	1.1
Ite-701	8	10	2.6	2.6	2.8	8.4	1.1	1.1
4346	8	9	2.2	3.6	2.4	3.9	1.1	1.1
M-14	7	25	2.7	7.5	3.0	10.0	1.1	1.3
N-6	13	19	2.2	6.9	2.5	7.4	1.1	1.1
KYS	16	28	2.3	4.9	2.8	7.7	1.2	1.6
Ia-153	15	16	2.8	10.0	3.3	11.9	1.2	1.2

Table 2. Response of various inbred lines of corn to foliar sprays of dalapon, 2 lb/A plus 0.2% X-77 (Results are averages of 5 replications).

Inbred line	% total reduction (Compared with untreated check at harvest)		Ratio of ht.or wt.at harvest / ht.or wt.at treatment Indicates growth increase after treatment) Treated		Untreated		Ratio of Untreated / treated (comparative increase from spraying to harvest)	
	Ht. (cm)	Wt. (g)	Ht. (cm)	Wt. (g)	Ht. (cm)	Wt. (g)	Ht. (cm)	Wt. (g)
Hy (Wisc.)	17	19	1.7	6.3	2.0	7.7	1.2	1.2
187R (Wisc.)	9	12	1.6	4.9	1.8	5.6	1.1	1.1
A374B (Wisc.)	8	0	1.6	6.5	1.8	6.3	1.1	1.0
WF9	2	0	1.5	5.1	1.6	5.0	1.1	1.0
L 317	1	0	2.2	9.0	2.2	8.9	1.0	1.0
Hy (local)	40	33	1.1	4.4	1.9	6.7	1.7	1.5
R4	19	0	1.3	6.6	1.6	6.3	1.2	1.0
4346	0	2	1.7	5.0	1.7	5.1	1.0	1.0
R-61	12	4	1.9	7.6	2.2	7.9	1.2	1.0
Ia-153	15	11	2.3	7.4	2.7	8.3	1.2	1.1

Response of cereal varieties to 4-amino-3,5,6-trichloropicolinic acid. L. S. Jordan, W. H. Isom, B. E. Day, J. D. Mann, and W. A. Clerx. Trials were established to determine tolerance of cereal varieties to 3,5,6-trichloropicolinic acid. Five varieties of oats, six varieties of barley, eight varieties of wheat and two varieties of rye were sprayed with the herbicide at 1,2, and 4 oz./A. Four replications were used. The stage of growth of the varieties varied from tillering to full head. Height at treatment varied among varieties. As the varieties ripened heights were determined and 36 $ft.^2$ strips were harvested. The grain was threshed and weighed to obtain yield data. Three 100-seed samples were taken from each plot and seed weight and percent germination determined. Germinations were made by rolling 100 seeds in wet paper towels and counting non-germinated seeds after 10 days storage at room temperature.

The data was processed by an electronic computer. Height and stage of treatment did not influence the tolerance of the varieties. Yield of some varieties of wheat and all varieties of barley were reduced significantly by treatments. Yield reduction increased with increased rates. The height of some wheat varieties was reduced at harvest. Seed weight of some oat varieties was reduced by the herbicide. Germination of barley was reduced by the 4 oz. treatment. (Citrus Research Center and Agr. Expt. Sta., University of California, Riverside, California).

A consideration of starvation as a direct cause of fenuron injury to plants. Davis, Edwin A. The acorn of shrub live oak constitutes a sizeable reservoir of foodstuff for the developing seedling. Consequently, if the hypothesis that visible leaf injury is the direct result of starvation is correct, young seedlings should not become visibly injured until the reserves in the acorns are exhausted. Bathing the acorns in glucose solution should then postpone starvation and further delay the onset of injury symptoms. Also, it would be expected that seedlings whose acorns had been excised would be injured soon after treatment, whereas seedlings with intact acorns would not develop injury symptoms until the acorn reserves were exhausted.

One objective of the experiments to be reported was to evaluate the hypothesis that visible leaf injury from fenuron treatments is due directly to starvation. Additional objectives were to determine the influence of fenuron on root growth of shrub live oak seedlings and to relate root growth to shoot injury.

Shoot growth was not inhibited for the first 71 days by 25 ppm fenuron, whereas root growth was markedly inhibited. Inhibition of root growth by 25 ppm fenuron commenced before emergence of shoots, and, therefore, before the appearance of visible damage to the leaves. Although root growth was retarded by 25 ppm fenuron, the roots continued to grow for 24 days after the appearance of leaf injury and while the injury increased in severity, which indicates that leaf injury occurred before the energy supply of the seedlings was exhausted. After 29 days some of the plants treated with 25 ppm fenuron developed moderate to severe leaf injury despite the fact that the food reserves of the acorns were not exhausted, as indicated by a positive starch-iodine test. In an attempt to prevent injury to other seedlings, acorns of some seedlings were bathed in 5 percent glucose solution. However, the original sets of leaves of the glucose-fed plants and their controls were killed at about the same rate. Although feeding glucose through the acorns of fenuron-treated seedlings did not prevent the development of leaf injury, it prolonged the life of the seedlings by supplying energy for additional flushes of growth, all of which became injured and died.

Leaf feeding of glucose also was attempted as a method of preventing visible injury by fenuron. Untreated leaves of both glucose leaf-fed and distilled water control plants were killed, and injury to both progressed at the same rate.

In another experiment injury to young seedlings with and without acorns was compared. Excision of the acorns of control seedlings did not reduce root growth; the shoots were capable of supplying adequate nourishment for growth. But excision of the acorns of fenuron-treated seedlings reduced root growth drastically. Leaves of the initial flush of growth of fenuron-treated seedlings with or without acorns were killed. Acorns prolonged the life of fenuron-treated seedlings by providing foodstuff for new flushes of growth but did not prevent leaf injury, whereas fenuron-treated seedlings without acorns failed to produce new growth.

The hypothesis on which this study was based is that visible leaf injury resulting from fenuron treatments is due directly to the depletion of the energy supply of the plant as a result of inhibited photosynthesis. This hypothesis is rejected on the basis of the results presented. An alternative hypothesis is that as a result of a blocked reaction in the photosynthetic mechanism, a product accumulates which is phytotoxic; and it is this toxic accumulation product which is directly responsible for injury to the leaves.

In addition to the effect of fenuron on the photosynthetic mechanism, a second type of inhibition appears to occur at high fenuron concentrations. This is evident in the reduction of root growth before the emergence of shoots and the development of visible injury to the leaves. Crops Research Division, Agricultural Research Service, U.S.D.A., Arizona State University, Tempe.)

Soil temperature and herbicidal effectiveness. Cords, Howard P. During the past two years, greenhouse trials compared rubber rabbitbrush (Chrysothamnus nauseosus) plants grown at various controlled root temperatures with respect to susceptibility to 2,4-D. In the first test, the temperatures compared were 45°, 60°, 75°, and 90°F. Using root weight as a measure, the plants grown at a 45°F root temperature appeared to be much more tolerant of 2,4-D than those grown at the other temperatures. Those grown at 75°F were the most susceptible. This latter point was most evident when plant kill was used as the criterion. At 90°F, one of seven treated plants was killed, at 75°F, six of nine died, at 60°F, two of seven died and at 45°F no plants died as a result of 2,4-D treatment. This test was repeated, using only the 45°F and 75°F soil temperatures. Results were similar. Eight of eleven 2,4-D treated plants grown at a 75°F root temperature died, whereas none of the 2,4-D treated plants grown at 45°F died. Root weights reflected these differences. These trials are being repeated with emphasis on delineating the effect of soil temperature on root growth without chemical treatment, as well as with 2,4-D treatment. Root volume change as a result of treatment is the criterion to be used. In addition, another trial is being set up to determine whether these differences are due to pre-treatment effects, post-treatment effects, or a combination of both. (Nevada Agric. Exp. Sta., University of Nevada, Reno, Nevada).

The effect of 5 pre-emergence herbicides at equal phytotoxic dosages on the geotropic response of 5 warm season grasses. May, J. W. and Jess L. Fults. The plastic box technique was used in this study. Basically, this procedure involves the growing of grass seedlings in an upright position on 1 1/2 percent, non-nutrient agar in 4 1/2 x 4 1/2 x 3/4 inch plastic boxes with fitted lids. Chemicals were incorporated into treated boxes by saturating filter paper dishes (1/2 inch diam.) with specified concentrations of the 5 chemicals studied and placing them directly in the agar. Response to chemicals was measured by determining the rate of growth and total growth of primary roots over a 6-day germination period in the controlled environment of a day-light germinator (8 hours of light at 35°C and 16 hours of dark at 20°C per day). Measurement of the effect of geotropic stimulus in the roots was determined by comparing the ability to bend downward (when boxes were turned 1/4 turn, exposing roots to the force of gravity by an angle of 90°) in the absence of and in the presence of the 5 specific chemicals. Since seedling age was a factor in the percent of seedlings able to respond to gravity, in any particular box, measurements were made at daily intervals and recorded for boxes treated with the 5 chemicals, then compared to controls with no chemical. In this manner, data were secured for a study of interaction of chemical and geotropic response. Chemicals chosen for the study were: dacthal, zytron, trifluralin, bandane, and dicamba[1/].

Equal phytotoxic dosages which reduced the total primary root growth by 1/2 of the untreated controls in hairy crabgrass (Digitaria sanguinalis) in a 6-day test were found to be: dacthal, 19 ppm; zytron, 25 ppm; trifluralin, 4.2 ppm; bandane, 181 ppm and dicamba, 62 ppm. These ED50 values (effective dose for 50% inhibition) were also arbitrarily used for side oats grama (Boutelous curtipendula), alkali sacaton (Sporabolus airoides), sand lovegrass (Eragrostis trichodes), and buffalo grass (Buchloe dactyloides).

[1/] Common names listed in 1963 Western Weed Control Conference Research Progress Report.

The 5 grass species used varied widely in their ability to respond to a geotropic stimulus. Comparisons made on 3-day-old seedlings indicated that all 5 species were able to respond 100 percent to gravity. When 6-day-old seedlings were compared, it was found that 80 percent of the hairy crabgrass, 78 percent of the side oats grama, 41 percent of the alkali sacaton, 3 percent of the sand lovegrass and 80 percent of the buffalo grass seedlings had lost their ability to respond to a gravitational stimulus. These results definitely indicate that grass seedlings of the same age from planting do differ markedly in their capacity to respond to a geotropic stimulus.

When the interacting effect of chemical and response to geotropic stimulus in hairy crabgrass was studied it was found that although 5 different chemicals were used at approximately equal phytotoxic levels (equal ED50 values) they differed widely in their relative ability to retard the geotropic response. This would suggest that their basic mechanisms of growth inhibition were quite different. These facts also suggest that possibly some other mechanism than auxin (indole-3-acetic acid) may be involved in the response of plant roots to a geotropic stimulus <u>or</u> that the several chemicals used interact with the mechanism of auxin control in quite different ways, and may have some bearing on the explanation for basic causes of synergistic, additive, and antagonistic responses of plants to mixtures of chemicals. (Colorado Agric. Exp. Sta., Colorado State University, Fort Collins, Colorado).

<u>Effect of application method on the herbicidal selectivity of EPTC in an organic soil.</u> Foy, Chester L. and Sukartaatmadja, Karhi. In earlier studies (Foy, <u>et al.</u> -- Res. Prog. Report, WWCC, pp 43-45, 1963), several herbicides were generally more toxic and less selective in corn when applied in a concentrated layer at a 3-inch depth by use of a spray blade than when uniformly incorporated to the same depth with a rotary tiller. In some instances, EPTC apparently constituted an exception, being more effective on all broadleaved species when uniformly incorporated to the 3-inch depth. The shallower depth of germination of broadleaved species, the peculiar adsorption and volatility properties of EPTC and its greater toxicity against grasses than broadleaved weeds were tentatively given as partial explanations.

Additional information was sought through replicated greenhouse studies, using Egbert muck delta soil (25.8% organic matter) in 1-gallon metal cans. Two methods of incorporating EPTC into the soil were studied: (a) mixing uniformly into a 2-inch deep band, centered 2,4 or 6 inches deep. (The first approximates shallow incorporation with a rotary tiller.); (b) surface spraying a concentrated layer, then covering with 1,3 or 5 inches of untreated soil (this simulates the use of a knife spray blade in the field at these depths). Corn was planted 3 inches deep and barnyard grass was mixed uniformly throughout the soil profile in all cases. The rates of EPTC employed were 4,8 and 16 lb/A.

In almost all cases, uniform incorporation (method a) was more effective than spraying in a concentrated layer (method b). EPTC at 4 lb/A, incorporated less than 5 inches deep was effective against barnyard grass (88.9 to 97.2% control) and caused no injury to the corn. All dosages applied 5 inches or deeper gave inadequate weed control. Rates of 8 lb/A or more, uniformly incorporated or spray-layered, 4 inches deep or less resulted in typical EPTC injury to the corn.

Barnyard grass emerged well (sometimes even from a 4 to 6-inch depth) and grew vigorously in untreated soil. For unexplained reasons, pigweed seed which showed 68% germination in petri dishes completely failed to emerge under the same conditions.

Steam sterilization materially interferred with the subbing ability of the organic soil and therefore resulted in poorer weed emergence from the shallower depths. (Department of Botany, University of California, Davis, California).

<u>Effects of methods of irrigation, incorporation, and application on activity of preemergence herbicides.</u> L. S. Jordan, B. E. Day, J. M. Lyons, W. H. Isom. Field plots were established to study effects of different methods of incorporation on liquid and granular preemergence herbicides under sprinkler and furrow irrigation. Two fields were planted with Japanese millet. One was furrowed for furrow irrigation and the other set up for sprinkler irrigation. Plots were established in three randomized blocks in each field. The treatments were: CIPC 6 lb/A, trifluralin 1 lb/A, IPC 6 lb/A, EPTC 3 lb/A, diphenamide 6 lb/A, CDEC 6 lb/A, and untreated controls. All herbicides were applied in paired plots as sprays and granules. Five methods of incorporation were used: rotary-tiller, wheel-hoe, row-wheel, cultipacker, and sub-surface blade. Nonincorporated plots were also established. The spray volume (except blade) was 50 gal/A delivered with a bicycle sprayer at 2 mph. The blade was operated at 2 mph and delivered 80 gal/A. Incorporation equipment was operated at 4 mph. The rotary-tiller, wheel-hoe, and blade were operated at a depth of 2 inches. The plots were irrigated five days after treatment and as needed for the rest of the trial. Plots were rated to determine grass and broadleaf weed control. The location and number of crop plants and weed species in the plots were determined by use of line transects and quadrants.

There was an interaction among the numerous variables in the trials. In some cases less weed control was obtained after incorporation, and in others weed control was substantially increased. Most of the herbicides performed best under sprinkler irrigation. IPC and CIPC lost effectiveness if incorporated by any method other than the roto-tiller under sprinkler irrigation. With furrow irrigation most of the herbicides were improved by incorporation. The method of incorporation required for best performance varied among herbicides and with species being controlled. Location of the weed species on the bed tops varied with herbicides, methods of incorporation and irrigation. Crop tolerance also changed with each variable. (Citrus Research Center and Agric. Expt. Sta., University of California, Riverside, California).

<u>Comparison of long period soil sterilants.</u> Brown, D.A., Duke, W.B., Furtick, W. R. Several trials were initiated at various locations in the Willamette Valley in May of 1962 to compare the uracils, triazines, and other urea-containing herbicides as soil sterilants on a long period, soil residual basis.

Atrazine, bromacil, and isocil were applied at rates of 2,4,8,16, and 32 pounds active material per acre. Other chemicals applied were diuron, simazine, alipur, and H 7175 [1-(chloro-2-norbornyl)-3,3-dimethylurea]. Each of these materials were applied at the rates of 16 and 32 pounds active material per acre.

The trials were evaluated in June, 1963. Bromacil, isocil, atrazine, simazine, and diuron all gave good residual control of a wide variety of weed species. The predominate species in these trials were Canada thistle (Cirsium arvense), dandelion (Taraxacum officinale), velvetgrass (Holcus lanatus), mayweed (Anthemis cotula), birds-foot trefoil (Lotus corniculatus), and a perennial smartweed (Polygonum spp.). Bromacil gave the best initial control of these species, followed closely by atrazine. Because of better initial control of perennials by bromacil and atrazine, they also had better residual control of weed species the second year. Weed control was quite good with isocil; however, because of its narrower species spectrum it was inferior to bromacil.

Alipur and H-7175 gave very poor results as soil sterilants. (Oregon Agricultural Experiment Station, Corvallis).

Effect of far, middle, and near ultraviolet light on herbicides. L.S. Jordan, B. E. Day, J. D. Mann, and W. A. Clerx. One ml of 1×10^{-3} molar monuron, diuron, neburon, fenuron, simazine, atrazine, isocil, and bromacil was pipetted into one inch diameter planchets and allowed to air dry. The herbicides were irradiated for 20, 40, 80, 120, 240, 480, and 720 hours with near, middle, and far UV light at $42 \pm 2^{\circ}C$. The UV absorption spectra were determined and compared with those of herbicides stored in the dark at the same temperature. The greatest change occurred during irradiation with the high-energy far UV light and the least effect occurring with near UV. (Citrus Research Center and Agr. Expt. Sta., University of California, Riverside, California).

A different approach to the testing and development of pre-emergence soil applied herbicides. Fults, Jess L. Many primary screening techniques have been described for use in discovering growth-regulating chemicals. One of these techniques, developed in this laboratory, has become known as the "Plastic box" technique. It was originally designed to be used in the search for pre-emergence crabgrass herbicides. Basically it measures the effect of chemical on the rate of growth of primary grass roots in a closed system where all the major factors of the environment are closely controlled except the soil factor which is not present. The technique has proved itself unusually valuable as a primary screen. During the period April 1, 1960 to January 1, 1964, it has been used to screen 400 different chemicals. Based on an arbitrary scale, 35 were found to be excellent, 77 very good, 32 good, 37 fair, and 219 poor.

This type of situation appears to be rather common in the field of primary screening of new chemicals for their use as herbicides. This means that secondary screening techniques have to be used to reduce the number of "excellent" chemicals to the very best. Secondary screening for pre-emergence crabgrass herbicides consists of several stages: 1) greenhouse testing, 2) first stage field tests at one location, 3) second stage field tests at several locations, and 4) third stage demonstration tests by 25 to 30 cooperators at widely distributed geographical locations. It seems obvious that one of the major areas of cost of development for any particular chemical comes during the last two stages of testing. These last two stages are also subject to tremendous uncontrolled and often unmeasured environmental variations that make interpretation of test results with any degree of confidence very difficult. The final result can be a situation where a great deal of money has been spent to develop a second or third rate material which fails completely to compete satisfactorily with other commercially available materials.

As a general policy, a great deal might be gained at a much lower final cost, if we would investigate our best candidate chemicals more intensively immediately following the greenhouse stage. The general technique proposed would involve the use of plant growth chambers. During the last 5 years there have been tremendous advances made in their design and construction. Many types are available today depending on the degree of control of the environment needed. Several are currently available commercially at very reasonable cost ($3000-$4000) per unit. In such chambers, the main plant environmental factors of soil type, soil nutritional level, soil moisture, light quality, duration and intensity, relative humidity and carbon dioxide content of the air are under close control. Candidate chemicals could rather quickly be evaluated under specified conditions and their numbers reduced to the very best. Likewise, we would have initial studies of the interaction of environment with chemical action that would serve as a solid guide to the interpretation of extensive field tests at a variety of geographic locations. For instance, it is entirely possible that certain soil-applied pre-emergence herbicides might be highly selective against certain weeds, with no crop injury in a soil with high organic matter content, under high temperatures and with relatively high amounts of available moisture on one geographic area but would not be selective against the same weeds and crop on a low organic matter soil, under low temperatures and low amounts of available moisture in the same geographic area.

Growth chamber testing cannot hope to completely replace extensive and expensive field testing and demonstrations because there are too many uncontrolled factors to be considered but they certainly could be used as a powerful tool to interpret field tests and to eliminate chemicals that might have only limited use under highly specific environmental conditions.

Technical biologists concerned with the development of new herbicides often see only one side of the problem of selecting the very best chemicals. Another equally important facet concerns the technical problems involved in organic synthesis on an industrial scale, on relative mammalian toxicity limitations, on competitive sales problems, particularly the factor of potential sales volume, on marketing and distribution details, and on the necessity of showing a net profit for any particular chemical. In the past it appears that these factors have often completely overruled any other considerations in determining the selection of specific chemicals for development. This policy seems very much like the novice gardener who planted his seed on Monday and dug it up on Friday because it just hadn't produced a crop and he wasn't about to wait for it when he had so many other interesting things to do. Product development, if not sick, is certainly ailing and needs some new stimulating ideas if we are to make the progress we should. (Colorado Agric. Exp. Sta., Colorado State University, Fort Collins, Colorado).

R-4461-Factors affecting its herbicidal activity. Anderson, W.P., Welsh, M.A., Whitworth, J.W., and Gessel, D.E. The active ingredient in R-4461 (Betasan) is N-(beta-O,O-diisopropyldithiophosphory-ethyl)-benzene-sulfonamide. This material is formulated by Stauffer Chemical Company as a 4 pound per gallon emulsifiable liquid.

By bioassay, R-4461 is volatile in the temperature range tested, 70-90°F. Ryegrass was used as the indicator plant and its shoot growth was inhibited about 90% by vapors from R-4461. This inhibition was obtained using the commercially formulated material. When the technically pure (99.5%) active ingredient was tested, no ryegrass growth inhibition was obtained, indicating that this inhibition may be due to some ingredient in the formulation or that the volatility of the active ingredient is enhanced by one or more ingredients in the formulation. The growth of the roots of ryegrass was unaffected by the vapors of R-4461 in these tests.

Using soil columns in the laboratory with ryegrass as the indicator plant, R-4461 was leached downward in dry soils following the addition of water. Indications are that greater volumes of water move R-4461 downward to greater depths in the soil and that the depth of this leaching increases as the clay content of the soil decreases. Using dry soils, the equivalent of one and two acre-inches of water added to the top of the columns leached R-4461 to a depth of about 1 and 2 1/2 cms. respectively in a heavy clay soil and to depths of 3 1/2 to about 6 cms. in a sandy clay soil. In each case, the volume of water used moved downward wetting the soil to the full depth of the soil column (15 cms.).

Eleven crop plants have been tested for their tolerance to R-4461. Four of these, alfalfa, chili, cotton, and lettuce, showed little or no growth effects when germinated and grown for 2 weeks in 400 cc. of soil into which R-4461 had been mixed at dosages as high as 64 lb/A. In contrast, barley, corn, sorghum, wheat, onions, and sugarbeets, grown similarly, were severely injured by dosages of 8 lbs/A and higher.

Preliminary soil residual studies indicate that R-4461 will remain herbicidally active in the soil for periods longer than 6 weeks.

Research is being continued on the factors affecting the herbicidal activity of R-4461. (Agriculture Experiment Station, New Mexico State University, University Park, New Mexico).

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SUPPLEMENTAL TABLE OF CONTENTS

Metabolites of radioactive n-propyl di-n-propylthiolcarbamate (R-1607) in plants. Gray, Reed A. R-1607 labeled with carbon 14 in position one of the propyl group attached to sulfur was fed to soybean and peanut plants through the roots. The CO_2 evolved from the plants in just 5 hours after treatment was highly radioactive. Two-dimensional paper chromatography of extracts of different parts of the plants three days after treatment showed that certain amino acids and organic plant acids were radioactive. The main radioactive amino acids were identified as phenylalanine, isoleucine, valine and proline. The radioactive organic plant acids were identified as fumaric, glycolic and lactic acids. The results showed that R-1607 was rapidly metabolized in soybean and peanut plants and converted into small fragments which were incorporated into many harmless naturally occurring plant constituents. (Stauffer Chemical Company, Biological Research Center, Mt. View, California).

Movement of chemicals applied to the soil. Lambert, S. M. The movement of chemicals in the soil is of prime importance when considering the application and effect of pre-emergence herbicides. The various factors affecting the fate of any chemical applied to the soil may be classified into five major categories.

A. The type of soil
   1) Makeup; clay, sand, silt, organic matter, etc.
   2) Structure; bulk density, surface, heterogeneity.
   3) Prior treatment; chemical, agricultural practice, etc.

B. The type of chemical
   Physical properties; solubility, vapor pressure, stability, etc.

C. Climatic conditions
   Rainfall, pressure, temperature, sunlight, etc.

D. Biological population
   Types, nutrient requirements, adaptability, life cycles, etc.

E. Method of application
   Wettable powder, granular, solvent, statistical distribution, etc.

A rigorous treatment would take into account all the categories and subclassifications mentioned. However, many of the above mentioned considerations are of secondary importance and tend only to complicate a mathematical treatment of the problem. This paper attempts to mathematically describe basic soil-chemical interactions.

The movement of chemicals in the soil can be treated in an analogous manner to percolation of material through chromatographic columns. Using this informative model and by proper choice of coordinates, mathematical expressions can be developed relating the concentration profile of chemical as a function of depth of penetration into the soil to the amount of eluting solvent, water.

The usefulness of these mathematical expressions can be demonstrated by a novel slotted tube test which may be thought of as a postage-stamp-size field plot. Data from this test are both quantitative and reproducible, thus allowing an inspection of the equations advanced. (Shell Development Company, Agricultural Research Division, Modesto, California).

The phytotoxicity and persistence of benzoic acid herbicides in several soils. Donaldson, T. W. The objectives of the study were 1) to determine the phytotoxicity of 2,3,6-TBA, dicamba and amiben to oats grown in nutrient solution and in four soil types, viz. Staten Island peaty muck, Stockton adobe clay, Yolo fine sandy loam and Hesperia sandy loam, 2) to relate differences in toxicity to various soil properties, and 3) to study the persistence of the chemicals in these soils with successive cropping and also following leaching with various amounts of water.

The trials were carried out in the greenhouse. For the phytotoxicity studies a range of concentrations of each of the three herbicides was added to Hoagland's nutrient solution and to cultures of the four soils. After 30 days the fresh weight of top growth of oats was determined, and ED_{50} values (estimated dose to reduce the growth of oats by 50%) calculated from graphs of the fresh weight as a percent of the control against the logarithm of herbicide concentration. For the leaching trials columns were constructed by joining end to end five juice cans and filling these with soil. Following application of the herbicide the required amount of water was added as a head of water.

In nutrient solution, 2,3,6-TBA was less toxic to oats than either dicamba or amiben. The latter two chemicals were similar in toxicity.

In soil, the initial toxicity of the herbicides varied with soil type. Dicamba was the most toxic in each of the four soils, while 2,3,6-TBA and amiben were similar in toxicity in all soils except the organic soil. In this soil amiben was less toxic than 2,3,6-TBA. With the sandy soils, the same amount of herbicide was required to reduce the growth of oats by 50% as was required in nutrient solution. Slightly higher amounts were required in the clay soil, while in the organic soil considerably higher amounts were needed. This reduction in toxicity was attributed to adsorption of the herbicides by the organic matter of the soils. Amiben showed a greater reduction in toxicity in the organic soil than 2,3,6-TBA or dicamba indicating that greater adsorption of amiben occurred than of the latter two chemicals.

In persistence studies, amiben was more subject to microbial decomposition than 2,3,6-TBA or dicamba. A slow rate of detoxification, with successive croppings, of the soil cultures occurred with 2,3,6-TBA. With dicamba, a slightly higher rate of detoxification occurred, while the most rapid detoxification occurred with amiben. Decomposition was more rapid in the organic soil than in the clay or sandy soils.

In leaching studies, the three herbicides were readily washed out of columns of the various soils. Using rates of water which did not cause water to run out the bottom of the columns, differences in movement of herbicide in these soils could be related to the rate of water movement through the soil. Little difference in movement between the three chemicals was observed within a soil type when subjected to the same leaching conditions. (Botany Department, University of California, Davis, California).

Behavior of n-propyl di-n-propylthiolcarbamate (R-1607) in soils. Gray, Reed A. and Weierich, Andre J. Vapor trapping studies showed that the principal mechanism of disappearance of R-1607 from soils was loss by vaporization to the atmosphere. The vapor coming off treated soil was trapped in cooled traps and identified as unchanged R-1607 by gas chromatography. When R-1607 was incorporated in the soil to a depth of three inches at a rate of 6 lb/acre in glass mason jars, it did not persist very long in moist soil. In open jars, 93% of the R-1607 disappeared from moist loamy sand and 86% was lost from moist clay loam in 64 days under simulated summer conditions at 80°F. Under cooler conditions at 40°F., the loss in 64 days was only one-half as great as it was at 80°F. When R-1607 was incorporated into dry soil and kept at 80°F only 14.5% loss occurred in 64 days. Although the main mechanism of disappearance of R-1607 from soils was by vaporization, soil sterilization studies showed that microbial decomposition was also responsible for part of the loss of R-1607 from soils. Since some R-1607 disappeared from sterilized soils in sealed glass jars, this offered some evidence that a third mechanism such as hydrolysis also accounted for some of the disappearance of R-1607 from soils. (Stauffer Chemical Company, Biological Research Center, Mt. View, California).

Chemical weed control with horticultural crops in Hawaii. Romanowski, R., Jr. and Tanaka, J. S. A herbicide screening program was initiated with vegetable crops at the University of Hawaii in 1962. The main intent was to evaluate chemicals which were either cleared or about to be cleared for use on mainland U.S.A. To date the pre-emergence soil application results are in general agreement with many mainland results when soil properties and environmental conditions are similar. Exceptions are noted where some soils high in organic matter or clay show little, if any, expected buffering capacity as regards crop phytotoxicity.

A majority of the discrepancies were encountered when following mainland over-the-plant spray recommendations. Island grown vegetable crops were severely injured when broadcast sprays of the following were studied: Solan and DCPA on tomatoes, DNBP (amine) on peas and NPA (sodium salt) on cucumbers.

In addition to the many varied soils and climatic conditions influencing the herbicide usefulness, the large number of weed species found on a given farm consistently present problems. It is not uncommon to find 10 to 15 prevalent weed species in a given field and on occasion as high as 20. Unfortunately, many of the weed species are foreign to the chemicals under test. Mixtures of herbicides are proving to be especially useful in controlling a broader spectrum of weeds.

Of the herbicides tested to date with horticultural crops, trifluralin consistently finds favor in most experiments when considering crop selectivity, the number of weed species controlled and duration of control under island conditions. More crop selectivity was found with surface applications of trifluralin than the soil incorporated treatments.

Bananas and papayas are presently under intensive study in the screening program. (University of Hawaii, Department of Horticulture, Honolulu, Hawaii).

Progress in tree and shrub growth inhibition research. Corkins, J.P., J.A. Wilkerson and E. L. Bradley. Following earlier work with MH-30 by various researchers elsewhere, and by encouraging work in 1962 by the Los Angeles Co. Extension Service in Cooperation with 1) Forest Lawn Cemetery Maintenance Personnel on shrubbery, and 2) the Parks Department of Long Beach, California on tree inhibition, the writers launched a wide-scale research and demonstration program in 1963.

In cooperation with various utility companies and city street department maintenance personnel, more than 1500 trees, involving some 20 species were sprayed with MH-30T at various concentrations and application dates in five states--Arizona, California, Nevada, Oregon and Washington. Interest on the part of cooperators has been very high as enormous sums are spent annually by these various agencies to mechanically prune excess tree and shrub growth which obstructs power lines, street and highway traffic, etc. Various types of dilute and concentrate sprayers were evaluated in cooperation with spray equipment namufacturers. It was successfully demonstrated that MH-30T, when properly applied, can eliminate a 6 to 12 dollar per tree per year pruning bill for approximately 75 cents per tree. Further work will be conducted in 1964, particularly in Idaho, Utah, and Colorado. (Naugatuck Chemical Division, U.S. Rubber Company, Torrance, Calif.).

The influence of several surfactants on the herbicidal action of paraquat. Smith, L. W. The influence of several surfactants on the toxicity of paraquat solutions was determined by evaluating these solutions on corn plants. Tests were also carried out with a spectrophotometer and by the use of a technique involving paraquat-C^{14} to determine if ionic or molecular interaction occurred in solution between surfactant and paraquat. Initial experiments were carried out on greenhouse grown corn to determine the rate of paraquat in solution with 0.1% w/v Tween 20 which would give approximately 50% reduction in fresh weight. This rate was determined as 1/8 oz/A.

Materials representing anionic, cationic and nonionic surfactants were chosen and sprayed alone and in combination with paraquat on corn plants 35-40 cm high. Two rates of surfactant were used, i.e. 0.1% and 1.0% w/v. The spray solutions were applied at the rate of 40 gpa and the soil was covered with vermiculite prior to spraying to prevent any soil contamination. The vermiculite was removed as soon as the plants were dry. Because the toxicity of paraquat depends on the action of light, all plants were stored in subdued light until all plants were sprayed. They were then placed in the greenhouse all at the same time.

The plants were harvested 7 days following treatment, when fresh weight measurements were recorded. The toxicity of the paraquat-surfactant solutions has been expressed as an index which was calculated by expressing the fresh weight of the treated plants as a percentage of the untreated check and subtracting this value from 100.

The paraquat-surfactant solutions were also tested for pH and those containing 1.0% surfactant were evaluated in a recording spectrophotometer together with the surfactant alone. Paraquat has a maximum absorbancy value in the optical density scale at 257 mμ in the ultraviolet region of the spectrum. Any molecular interaction of surfactant and paraquat is shown by a movement or reduction of this absorbancy peak.

The absorption of paraquat-C^{14} in the surface layers of surfactant solutions was measured by mixing 1/2 μc paraquat-C^{14} with 2 mls of 0.1% surfactant solution in a nickel coated steel planchet. The counts at the surface of this solution were recorded in a thin window G.M. tube. Preferential absorption of paraquat-C^{14} which could be called ionic attraction was measured by an increase in the counts recorded at this surface over the control without surfactant.

The results of these investigations (shown in Table 1) revealed that the toxicity of surfactant-paraquat solution to corn could not be correlated with the ionic class of the surfactant molecule. This was in spite of the fact that it appeared from the interface absorption studies that ionic interaction did occur between anionic surfactants and paraquat. There was no toxicity from solutions containing Ultrawet DS* and sodium lauryl sulfate and cloudy suspensions resulted when the surfactant solutions were added to paraquat. However, this was not observed when Sarkosyl NL* and Vatsol OT* were added to paraquat although the Vatsol OT* solution was a cloudy colloidal solution at the start.

The spectrophotometer studies revealed that definite molecular interaction occurred between sodium lauryl sulfate and paraquat and also possibly between Vatsol OT* and paraquat. No other interactions were observed by this method. However, it does appear that anionic surfactants and paraquat do undergo ionic interaction, but not in every case does this interaction suppress the toxicity of paraquat solutions. (Department of Botany, University of California, Davis, California).

*Trademark

Table 1. Toxicity index, pH and surface absorption measurements of paraquat and ten surfactants.

Surfactant	Toxicity index*				Surface absorption of paraquat-C^{14} and surfactants**		pH	
	Surfactant alone		Surfactant plus paraquat		Initial count in cpm	Increase in counts over 2 hours in cpm	Surfactants plus paraquat	
Surfactant conc.	0.1	1.0	1.0	1.0			0.1	1.0
Tween 20	2.8	11.5	53.4	72.2	1250***	443***	7.2	3.9
Surfactant WK	6.9	28.2	28.8	81.7	1262	852	7.15	4.05
T-1947	-0.8	-3.8	22.3	59.5	1325	347	7.2	4.2
Nonisol 100	8.1	8.4	24.1	64.5	1227	366	7.1	5.55
Sarkosyl NL	4.2	1.2	15.7	65.6	1536	1450	7.3	7.7
Vatsol OT	0.2	34.2	6.3	74.0	2387	2199	7.0	4.2
Ultrawet DS	0.7	2.5	7.0	10.0	2098	2683	6.4	5.7
Sodium lauryl sulfate	-0.2	0.6	15.6	16.0	----	----	6.9	8.05
Quaternary 0	6.5	3.5	42.7	74.4	1356	247	6.8	5.65
Amine 220	6.8	7.3	8.4	35.9	1319	121	6.7	9.0
No surfactant	0.0	0.0	7.7	7.7	1294	252	7.2	6.9

*Calculated by expressing fresh weight as a percentage of untreated check and subtracting this value from 100.
**Surfactant concentration 0.1% w/v.
***Average of two replications.

Translocation of labeled amitrole, 2,4-D, and monuron in grape rootings. Leonard, O.A., Lider, L.A., Glenn, R.K., and Lange, A.H. Labeled 2,4-D acid, amitrole, and monuron (all C^{14}) were applied to three different positions on the roots growing from single-bud cuttings (one bud with one internode below it). In other tests the 2,4-D and amitrole were applied to the entire root system and to certain grape leaves. Collections were made after 2 days and (in some cases) after 7 and 30 days, freeze-dried, and then prepared for autoradiography. Additional non-labeled 2,4-D and amitrole were applied in some cases in order to determine the effect of dosage upon translocation. The results of these studies may be summarized as follows: 1) 2,4-D migrated towards the root tips regardless of where the applications were made to the roots, with translocation upward in the roots being slight and only for a short distance. When applications were made to the entire root system, upward translocation did not occur except when sufficient 2,4-D was used to kill the roots; in such cases, some label did move into the wood of the single-bud cutting, but not into the growing shoot. 2) Amitrole applied to localized portions of the roots migrated upward and into the new shoots; some of the amitrole also migrated towards the root tips. 3) Monuron applied to different positions on the roots always migrated towards the shoots and not to the root tips. The greatest accumulation of label in the shoots appeared to occur from treatments made to the surfaces of the larger roots (2-3 mm diameter), while only a small amount of label migrated to the shoots from applications made to the root tips. 4) Both 2,4-D and amitrole migrated to the roots from leaf applications; however, the distribution patterns in the plants were different. In spite of these differences, both compounds were quite mobile in the grape plant from leaf applications. (University of California, Davis, California).

Screening herbicides for use in Thompson seedless grapes. Lange, A.H., Leonard, O.A., and Lider, L.A. The response of newly rooted Thompson seedless cuttings growing in sand to fifteen soil or foliar applied herbicides was evaluated under greenhouse conditions during the spring and summer of 1963 at Davis, California. The study included DCPA, simazine, dichlorobenil, trifluralin, diuron, prometryne, atrazine, EPTC, isocil, dalapon, dicamba, 2,4-D and Tordon (4-amino-3,5,6-trichloropicolinic acid) at 0.005, 0.05, 0.5, and 5 ppm; amitrole and paraquat at 0.05, 0.5, 5 and 50 ppm in the nutrient solution testing root absorption. In the second experiment DCPA, simazine, dichlorobenil, trifluralin, diuron, prometryne, atrazine, EPTC, isocil, and dalapon were applied to the foliage at the rate of 0.1, 1, and 10 pounds per acre; paraquat at 0.01, 0.1, and 1 pound per acre; dicamba, 2,4-D and Tordon at 0.001, 0.01, 0.1 and 1 pound per acre in 103 gallons of water per acre.

The results indicated DCPA to be the least toxic herbicide when applied to the soil or the grape foliage. Trifluralin was next showing only slight stunting when applied to the roots at 5 ppm. There was no apparent reduction in growth from foliar applied trifluralin. Simazine, dichlorobenil, diuron, prometryne, atrazine, and isocil were readily taken up by the roots causing severe growth reduction above 0.05 ppm. Prometryne produced the least damage at this level in the root media but was nearly as toxic as atrazine and isocil when applied to the foliage.

Paraquat produced virtually no damage when applied to the roots but severely burned the foliage whereas amitrole was more severe when taken up through the roots than through the foliage. Dalapon caused little damage when taken up through the roots or when applied to the foliage except a possible root reduction as a result of movement to the roots from the 10 pounds per acre foliar application.

Tordon produced extreme toxicity from the lowest units (0.005 ppm) in the root media. Root absorption of 2,4-D was not apparent in the tops in contrast to dicamba and Tordon. Dicamba was less toxic than Tordon. Foliar response to these three hormone type herbicides were quite similar with Tordon and dicamba causing a little more damage than 2,4-D. (University of California, Davis, California).

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