FOLIAR AND SOIL APPLIED HERBICIDES FOR BINDWEED CONTROL

A Progress Report

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A PROGRESS REPORT

Earlier work has shown foliar applied 2,4-D, dicamba and MSMA to be partially effective in controlling bindweed (2). Like with all foliar applications results can be erratic. Of these three, dicamba has given the most consistent results (tables 1, 2, 3, 5, and 6).

Much of dicamba's consistent performance is due to its residual soil activity which controls both subsequently germinating seeds and late growing or deeper rhizomes. Further, dicamba leaches readily (1) which probably accounts for deeper more lasting control than 2,4-D or MSMA. While the control with dicamba has never been as good as with picloram, the residual problem on subsequent crops has been much less with dicamba.

While maleic hydrazide caused reduction in growth of some perennial weeds it did not give increased control at the levels used in these trials. Nor did the addition of cacodylic acid (as Broadside®) greatly improved control with MSMA.

In one trial, barley planted subsequently to an application of dicamba, showed severe loss of both stand and vigor above a 1 lb./A. level of application (table 2). A second location substantiated the results of the first trial (table 3). In addition, a new compound, glyphosate, showed excellent early bindweed control. However, with a single application this control diminished by the end of summer.

Milo, safflower, and tomatoes planted after application of dicamba indicated some residual activity 2 months after application of the herbicide (tables 4 and 6). The crops were erratic because of insufficient moisture, weed competition, etc. The rates of dicamba above 1 lb./A. caused a reduction of safflower (very sensitive to dicamba). Treated with 2 lb./A. of dicamba, tomatoes were likewise affected. Milo appeared to be stunted at 1 lb./A. and above. The poor stand in the check was due largely to the severe bindweed infestation. The stands and vigor in the glyphosate plots were probably closer to what a weed free check would have produced for soil residual herbicides, since bindweed was controlled in these plots early in the season.

A similar trial at a third location substantiated the results of the previous trials with dicamba (table 5). Low rates of dicamba showed substantial bindweed control even down to 1 lb./A., however, the vigor of barley was also lacking at this rate when seeded less than 1 month after herbicide application. More results on the residual activity of dicamba have been summarized elsewhere (3).

Eight pounds of 2,4-D had no apparent detrimental effects on the vigor of barley. The poor vigor in the untreated plots, the maleic hidrazide plots, the MSMA, and the Broadside® plots as well as in the plots treated with low rates of 2,4-D, was undoubtedly due to the poor bindweed control. This can be seen by the vigor of barley in the glyphosate plots where bindweed control was excellent (table 5).

®Registered trade name.

Glyphosate has also shown good results in a number of other bindweed control trials (tables 7, 8, 9, 10, and 11). Rates of 2 to 4-lb./A. gave better bindweed control when applied in the fall and spring than when applied in one summer application. A second summer location (table 11) was showing good control. This location was the same as the first fall application (table 7) and may be related to a location or stand of bindweed. This aspect must be studied further, along with the effects of repeated treatments of glyphosate.

Combinations of glyphosate with 2,4-D and MSMA looked interesting, suggesting compatibility with these 2 compounds. Neither nonphytotoxic oil, nor Vistik®, a water thickening agent, greatly increased the activity of glyphosate at ½ lb./A. The lack of a reduction of activity with the drift-retardant, Vistik®, may be important in the selective use of this herbicide.

Foliar applications of 2,4-D and MSMA, made in Napa County vineyards (2) showed good long-term bindweed control when evaluated, about 1 year after treatment (table 12). Again the addition of cacodylic acid, paraquat, ATA, and maleic hydrazide did not substantially alter the control with 2,4-D. The addition of two pre-emergence herbicides controlled seedling growth and increased slightly the control, thus allowing good control with only a single application.

Non-phytotoxic oils (Orchex 795®, Viskorhap®, and Vistik®) failed to affect long-term bindweed control (table 12).

An excessive rate of RP 17623 (Ronstar®) gave some small degree of control. In orchard tests (tables 12 and 13) this compound has given a substantial amount of bindweed repression (4).

Drift Studies

Several herbicides were compared using a wind tunnel made of 14-inch cement pipes with spaces provided every 10 feet for potted plants. A fan was the source of air movement. The herbicide was sprayed at 30 psi with a 8002 orifice for 10 seconds; the air was allowed to move through the 100-foot tunnel for 1 minute. The degree of drift was read from the foliage response of young, fast growing, broadleaf crops such as tomatoes, beans, and cotton.

The first test compared MSMA, glyphosate, 2,4-D, and dicamba (table 14). Neither MSMA nor glyphosate showed much drift in this test. 2,4-D symptoms were apparent for about 30 feet, whereas dicamba symptoms were noted on both beans and tomatoes for 100 feet.

In the second test, carbon applied after the drift did not protect tomatoes from symptoms of 2,4-D and dicamba (table 15). In this study the drift from 2,4-D and dicamba were comparable.

In a third test the drift from 2,4-D and dicamba were comparable on beans and cotton (table 16). Dicamba was harder on beans, and 2,4-D produced more symptoms on cotton.

In a fourth test (table 17) the initial effect of glyphosate at 0 distance (on the test plants) was as toxic as that of 2,4-D and appeared to drift as far as 2,4-D or further. Glyphosate appeared to be equally toxic on beans and on cotton; 2,4-D was harder on cotton than on beans.

Carbon Deactivation Studies

When activated carbon was incorporated into the soil by power tiller before application of dicamba and irrigation, it protected all the crops except beans (table 18). This was particularly noticeable where 1 inch of water was applied immediately after the herbicide.

When carbon was applied before and after dicamba and sprinkler irrigation, differences in deactivation occurred (table 19). Dicamba without carbon proved consistently to be the most toxic to direct-seeded indicator plants. When dicamba was applied before irrigation and activated carbon at 400 lb./A. was subsequently added, some deactivation of dicamba occurred. Less deactivation occurred when the carbon was applied, then irrigated, and finally the herbicide added. Here perhaps the activated carbon was partially deactivated by water or some other factor causing only a partial dicamba deactivation.

When the soil was irrigated and then the carbon and herbicide applied concurrently, the dicamba was deactivated resulting in virtually no injury to Chenopodium species of weeds, beets and spinach. Other less sensitive crops such as broccoli showed no difference due to carbon or irrigation.

SUMMARY

Repeated fall applications of 2,4-D at 1 lb./A. gave excellent bindweed control. No residual activity was noted even at very high rates.

Dicamba at rates of 1 to 8 lb./A. gave bindweed control but rates above 1 lb./A. showed residual activity barely 4 months after application. After 8 months most activity was gone from low rates of dicamba even with some sensitive crops. However, residual characteristics varied somewhat from location to location.

Single sprays of glyphosate Roundup® at rates near 2 lb./A. gave adequate bindweed control with no apparent residual effects on subsequently planted crops. In some trials very high rates gave poorer control than rates of 2 to 4 lb./A. It is clear that repeated applications of glyphosate will be necessary for bindweed control.

The drift from dicamba was equivalent to that of 2,4-D or greater. The drift from glyphosate appeared to be less than that of dicamba and 2,4-D. More work is required. On the other hand the drift from MSMA was limited, creating only mild symptoms 10 to 20 feet from the source. This was generally less than 2,4-D or dicamba.

The deactivation of dicamba with activated carbon appeared feasible with either the mechanical incorporation of activated carbon or with its incorporation by sprinkler irrigation on newly worked soil.

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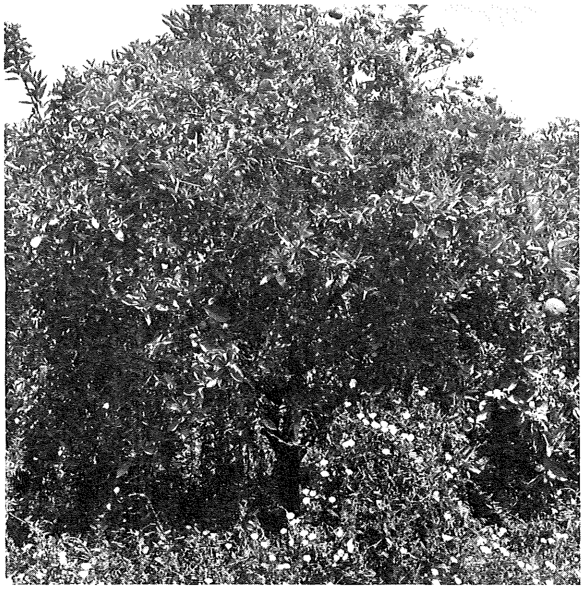

Figure 1. Perennial bindweed infesting a citrus orchard.

Figure 2. Perennial bindweed infesting a vegetable crop.

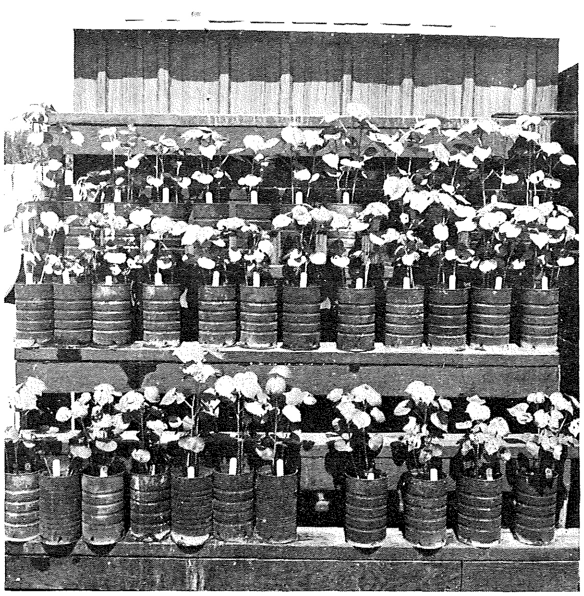

Figure 3. Results of a drift study using beans and cotton placed 10 feet apart in a 100-foot wind tunnel.

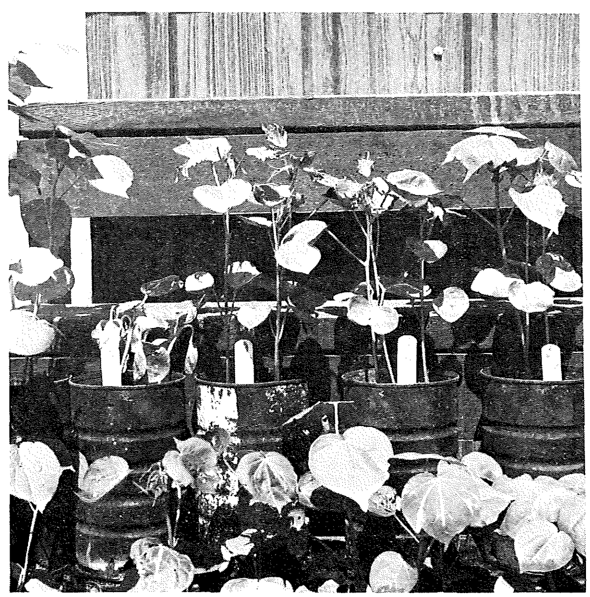

Figure 4. A close-up of symptoms from 2,4-D (above), and dicamba (Banvel®), on cotton (below).

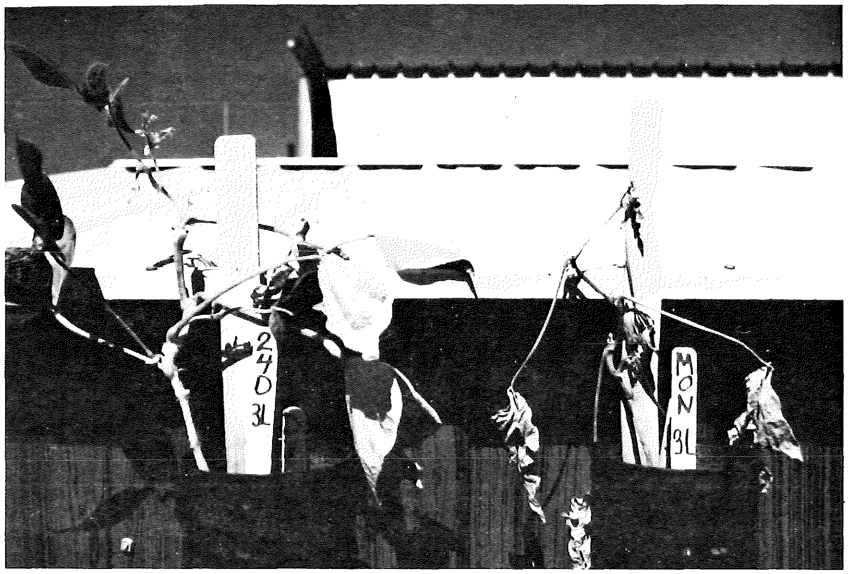

Figure 5. A comparison of the movement of 2,4-D (left, three leaves painted with 2 lb./100 gals.) and glyphosate (right) same treatment as with 2,4-D.

Table 1. Average Bindweed Control Eight Months After Application.

Herbicide	lb/A	Average[1/]
2,4-D	4.0	3.7
Dicamba	4.0	7.0
Picloram + 2,4-D	0.25 + 4.0	5.5
" "	1.0 + 16.0	9.0
Check	--	1.5

1/ Average of 3 replications where 0 = no effect; 10 = complete control. Applied 9/17/71, evaluated 5/10/72.

Table 2. Comparison of Foliar Sprays Applied Early Fall to Recently Irrigated Bindweed.

Herbicide	lbs. ai/A	Bindweed Average 1/ Evaluation Dates 10/20/71	5/11/72	8/21/72	Barley 2/ Vigor 5/11/72	Weight lbs/plot
2,4-D amine	1.0	8.5	6.2	6.2	3.7	1.5
2,4-D	2.0	9.5	5.8	5.5	4.5	1.5
"	4.0	9.1	7.2	6.0	3.7	0.8
Dicamba (Banvel-D®)	0.5	8.0	3.5	6.0	3.2	2.6
"	1.0	8.4	5.0	4.7	2.7	1.0
"	2.0	9.0	7.5	5.2	1.5	0.1
"	4.0	9.3	8.2	7.2	0.5	0.0
"	8.0	9.7	9.0	8.2	0.0	0.0
MSMA	2.0	3.5	2.0	7.5	4.0	1.5
"	4.0	5.8	3.0	8.0	6.0	2.8
"	8.0	7.0	3.5	5.0	5.2	1.7
Broadside®	4.0	8.2	3.8	5.7	6.0	1.9
2,4-D maleic hydrazide	0.5 2.0	8.9	6.0	5.0	5.7	1.4
2,4-D maleic hydrazide	2.0 2.0	9.8	7.2	5.0	4.2	1.1
Dicamba (Banvel-D®) maleic hydrazide	2.0 2.0	9.4	8.2	5.0	1.0	0.0
MSMA maleic hydrazide	4.0 2.0	5.5	4.5	6.7	5.0	1.7
Broadside® maleic hydrazide	4.0 2.0	8.2	4.2	6.7	3.7	0.9
Untreated	-	1.8	0.2	6.2	1.7	1.2
Untreated	-	1.8	1.0	3.5	1.2	0.6
Untreated	-	1.2	0.5	1.7	3.0	1.0

1/ Average of 4 replications where 0 = no effect, 10 = complete kill with no regrowth.

2/ Barley seeded 12/15/71

Notes: Non-toxic oil was added to all treatments by 0.5% by volume.
Treatments were applied with a CO_2 back-pack sprayer using 8004 size nozzles at 40 psi
Bindweed had a 10" to 14" surface growth with light flowering at application date.

Table 3. Comparison of Foliar Sprays Applied Early Fall to Recently Irrigated Bindweed.

Herbicides[2/]	lbs. ai/A	Average[1/] Evaluation Dates 12/12/71	3/6/72	5/10/72	8/22/72
2,4-D	1.0	7.5	9.2	4.8	1.0
"	2.0	9.2	9.7	5.0	3.0
"	4.0	8.2	7.0	3.5	2.5
Dicamba (Banvel-D®)	0.5	8.5	9.5	5.8	1.7
"	1.0	9.0	9.0	6.8	3.7
"	2.0	7.0	9.5	6.5	7.0
"	4.0	8.2	10.0	9.0	7.7
"	8.0	9.7	10.0	10.0	9.2
MSMA	2.0	9.7	0.7	1.5	1.2
"	4.0	7.7	5.2	3.5	0.7
"	8.0	3.2	1.5	1.2	1.5
Broadside®	4.0	8.0	1.2	1.0	4.0
2,4-D	0.5	7.0	9.5	6.0	2.2
maleic hydrazide	2.0				
2,4-D	1.0	8.7	10.0	6.8	2.7
maleic hydrazide	2.0				
2,4-D	1.0	7.7	8.7	4.8	3.2
maleic hydrazide	4.0				
MSMA	4.0	7.7	5.5	3.8	1.7
maleic hydrazide	4.0				
Glyphosate	1.0	9.7	4.2	1.0	0.2
"	4.0	1.7	7.5	4.8	3.7
"	16.0	7.5	9.5	6.2	3.5
Untreated	-	2.2	0.0	1.0	1.5

1/ Average of 4 replications.

2/ Treatments were applied with a CO_2 back-pack sprayer using 8004 nozzles at 40 psi
Application date - 10/13/71
Soil type - Panoche clay

Table 4. Comparison of Fall Applied Postemergence Herbicides to Bindweed on Subsequently Planted Crops.

Herbicides[2/]	lb/A	Milo	Average[1/] Safflower	Tomatoes
2,4-D	1	3.5	3.8	6.0
"	2	4.3	10.0	2.0
"	4	7.0	5.0	10.0
Dicamba	½	5.8	5.0	5.2
"	1	7.3	10.0	6.7
"	2	7.8	8.5	10.0
"	4	8.5	8.3	9.8
"	8	9.0	10.0	10.0
MSMA	2	5.0	-	-
"	4	6.8	8.0	7.8
"	8	5.5	2.5	3.3
Broadside ®	4	6.0	2.0	5.0
2,4-D + maleic hydrazide	½+2	5.7	7.5	10.0
" " "	1+2	5.5	6.2	5.8
" " "	1+4	5.0	9.3	3.2
MSMA + maleic hydrazide	4+4	6.0	3.5	9.0
Glyphosate	1	3.7	5.0	5.0
"	4	5.0	5.0	3.3
"	16	5.2	7.7	5.2
Check[3/]	-	6.7	7.0	8.3

1/ Average of four replications where 0 = no effect; 10 = complete control or crop kill.

2/ Herbicides applied 10/13/71, seeded 12/15/71 and evaluated 5/10/72.

3/ The check was unweeded. Some crop injury is due to weed competition.

Table 5. Comparison of Bindweed Control; Perennial Established and Seedling Including the Relative Vigor of Barley Seeded 2 Months After Treatment.

Herbicides[2/]	lbs. ai/A	Seedling[3/] Bindweed	Barley Vigor	Average[1/] Evaluation Dates 12/31/71	3/9/72	5/11/72	8/21/72
2,4-D	1.0	0.8	5.2	8.5	7.2	5.0	2.2
"	4.0	2.0	7.5	10.0	9.5	7.0	2.5
"	8.0	3.0	8.8	10.0	10.0	8.0	4.2
Dicamba (Banvel-D ®)	1.0	0.0	3.2	7.7	10.0	8.5	5.0
"	4.0	4.0	0.5	9.7	10.0	9.5	7.5
"	8.0	6.8	0.0	10.0	10.0	10.0	8.5
MSMA	1.0	0.0	3.2	3.0	6.2	3.2	4.2
"	2.0	0.0	2.8	4.2	0.5	1.2	5.2
"	4.0	1.2	4.3	5.2	0.5	2.2	5.0
"	8.0	0.0	4.7	8.5	1.0	3.2	4.7
Broadside ®	4.0	0.0	3.2	10.0	0.2	1.2	4.2
"	8.0	0.0	5.5	10.0	1.5	1.8	4.5
2,4-D	1.0	2.3	5.5	9.0	7.0	3.2	3.0
maleic hydrazide	2.0						
2,4-D	2.0	1.5	4.5	7.0	7.5	5.2	1.7
maleic hydrazide	4.0						
Dicamba	1.0	2.0	1.8	10.0	10.0	9.0	5.7
maleic hydrazide	2.0						
Dicamba	2.0	0.8	0.8	9.0	10.0	9.5	6.0
maleic hydrazide	4.0						
MSMA	2.0	1.8	6.0	2.0	0.7	1.8	6.2
maleic hydrazide	2.0						
MSMA	4.0	0.0	4.2	3.0	2.0	1.8	5.7
maleic hydrazide	4.0						
Broadside ®	4.0	1.5	6.2	9.2	3.7	3.2	6.0
maleic hydrazide	4.0						
Maleic hydrazide	2.0	0.0	1.2	3.0	0.2	0.0	0.0
" "	4.0	0.0	4.8	2.5	4.0	1.5	0.0
" "	8.0	1.2	5.2	0.5	6.0	3.8	0.5
Glyphosate	4.0	0.0	9.0	7.0	8.5	7.8	6.2
Untreated	-	0.0	2.0*	7.7	0.0	0.2	0.0

1/ Average of 4 replications evaluated 6 months after application, where 0 = no effect, 10 = complete kill.

2/ Bindweed had a 14" to 18" surface growth with light flowering during application. Application date - 11/24/71.

3/ Seeded 12/15/71

* Poor barley vigor due to bindweed competition.

Soil type - Oxalis silty clay.

Table 6. Residual Effect of Herbicides on Milo Planted 8-10 Months After Treatment at Three Locations.

		Average Vigor[1/]		
Herbicide	lb/A	Location #2 8 months	Location #3 9 months	Location #1 10 months
2,4-D	1	7.8	7.5	7.0
"	2	-	8.8	7.5
"	4	7.5	7.5	8.2
"	8	6.8	-	-
Dicamba	0.5	-	8.8	8.0
"	1.0	7.5	7.8	7.8
"	2.0	-	8.8	9.0
"	4.0	8.8	10.0	6.2
"	8.0	8.8	6.0	5.2
Untreated	-	6.2*	7.0	6.5*

1/ Average of 4 replications where 0 = no milo, 5 = half stand or half stunted, 10 = best growth.
* Poor growth due to competition from bindweed.

Table 7. Effect of Rate of Glyphosate on the Control of Bindweed.[1/] Herbicides Sprayed in the Fall.

		Average[2/] Evaluation Dates				
Herbicide	lbs. ai/A	11/12/71	2/19/72	4/25/72	5/10/72	8/16/72
Glyphosate	2.0	7.0	9.6	9.0	8.3	8.0
"	4.0	8.6	10.0	9.0	8.3	9.3
"	8.0	9.0	10.0	9.0	8.7	8.3
Untreated	-	0.0	0.6	0.0	0.0	0.0

1/ Bindweed surface growth was 14" to 18" with moderate flowering. Application date - 10/13/71.

2/ Average of 4 replications where 0 = no effect, 10 = 100% control. Soil type - Oxalis silty clay.

Table 8. Comparison of Bindweed Control From Fall Application.

Herbicide	lb/A	Average[1/] Control
Glyphosate	4	8.0
"	8	6.8
2,4-D Formula 40	4	2.0
Untreated	-	1.3

1/ Average of 3 replications where 0 = no effect, 10 = all bindweed foliage dead (7/12/72).

Table 9. Comparison of Bindweed Control From Spring Applications.

Herbicide	lb/A	Average[1/] Control
Glyphosate	½	3.0
"	1	5.0
"	2	5.3
"	4	7.3
Glyphosate + Vistik	½	3.3
Glyphosate + N.P. oil	½+2	4.3
Glyphosate + MSMA	½+2	7.7
MSMA	2+2	8.3
Paraquat	1+1	1.7
Glyphosate + 2,4-D	½+½	8.0
2,4-D	1	8.3
Untreated	-	1.7

1/ Average of 3 replications, where 0 = no effect, 10 = all bindweed foliage dead (7/12/72).

Table 10. Comparison of Bindweed Control 2 Months After Treatment.[1/]

Herbicide[2/]	lbs. ai/A	Evaluation Date 8/21/72 Average
Glyphosate	0.5	3.2
"	1.0	5.5
"	2.0	6.2
"	4.0	7.7
2,4-D amine	0.5	6.0
"	1.0	6.7
"	2.0	6.5
"	4.0	6.5
Untreated	-	6.5

1/ Bindweed was at full bloom when plants were sprayed.

2/ Application date - 6/6/72
Soil type - Oxalis clay loam

Table 11. Comparison of Bindweed Control From Summer Application.[1/]

Herbicide[2/]	lbs. ai/A	Evaluation Dates 7/13/72 Average	8/16/72 Average
Glyphosate	2	7.0	8.0
"	4	8.2	10.0
"	6	9.0	10.0
"	8	9.7	9.7
Glyphosate + maleic hydrazide	2+2	6.0	5.2
Untreated	-	0.2	0.2

1/ CO_2 back-pack sprayer: 8008 nozzles at 20 psi. Bindweed - 16" - 20" surface growth with a full bloom. Russian Knapweed - 12" - 15" height with light bloom.

2/ Application date - 6/29/72
Soil type - Oxalis silty clay

Table 12. Control of Bindweed by Several Herbicides and Combinations Evaluated 1 Year After the First Application.

Herbicide	lb/A	Evaluation Dates 4/15/72 Average 1/	5/11/72 Average 1/	7/30/72 Average 1/
2,4-D	1+1+1+1*	6.0	6.8	8.3
MSMA	4+4+4+4*	5.8	6.8	8.1
MSMA + Cacodylic acid	4+4+4+4*	4.2	4.8	6.6
MC 3761	4	2.5	0.5	3.7
MC 4379	4	2.2	1.8	4.5
"	16	1.0	0.0	4.0
RP 17623	4	1.2	1.2	5.2
"	16	2.5	4.0	6.6
2,4-D + Paraquat	1+1+1+1*	3.2	5.2	7.2
" "	3/4+3/4+3/4+3/4*	2.8	3.0	6.0
2,4-D + ATA (Cytrol)	½+2	4.3	3.2	5.2
" " "	2+2	3.2	4.2	6.0
2,4-D + MH	½+4	4.5	5.8	7.8
" "	2+4	5.0	6.0	8.0
ATA + MH	1+4	1.0	1.5	5.0
" "	2+4	1.8	1.2	4.5
Nitralin + 2,4-D	2+2	4.0	5.2	7.6
" "	8+2	4.8	6.5	7.8
EL 119 + 2,4-D	2+2	4.8	5.0	7.5
" "	8+2	6.2	6.8	7.8
Asulam®	2	2.5	0.5	4.0
"	8	2.0	2.0	5.3
MCPA	2+2	5.5	6.8	8.1
2,4-D + Orchex 795®	2+2	7.0	8.2	8.7
2,4-D + Viskorhap®	2+2	5.5	7.5	8.3
2,4-D + Vistik®	2+2	5.0	7.8	8.3
2,4-D (Dacamine®)	2+2	6.5	7.8	8.5
Untreated	-	1.8	1.5	3.8

1/ Average of 4 replications where 0 = none, 10 = complete control.

* repeated application

Table 13. Weed Control in Young Pears at Three Months After Herbicide Application.

Herbicide	lb/A	Average[1/] Bindweed	Annual Grass
Simazine	2	7.0	6.0
VCS 438	2	4.0	5.0
"	8	7.0	6.0
RP 17623	2	5.0	4.2
"	8	9.0	8.5
SAN 6706	2	6.8	4.2
"	8	2.2	9.5
EL 119	2	8.8	4.2
EL 119 + simazine	2+2	5.0	9.2
Nitralin + simazine	2+2	9.5	8.2
R7465	2	7.8	5.5
"	8	4.2	8.2
R7465 + simazine	2+2	5.0	9.0
Linuron + diuron	2+2	6.2	5.8
Untreated	-	4.2	5.0

1/ Average of 4 replications.

Table 14. Comparison of Symptoms of the Drift of Four Herbicides on Tomato and Beans.

Distance from spray nozzle in feet	Air Speed MPH	Average 1/ Tomatoes Mon 2139 2 #/A	2,4-D 2 #/A	MSMA 2 #/A	Dicamba 2 #/A	Beans Mon 2139 2 #/A	2,4-D 2 #/A	MSMA 2 #/A	Dicamba 2 #/A	Check
10	6.0	0.0	8.0	2.0	9.0	1.7	7.5	0.3	10.0	0.3
20	5.0	-	-	-	-	1.5	2.5	1.0	7.0	2.0
30	5.2	0.0	5.0	0.0	5.0	-	0.3	1.5	4.7	0.3
40	5.2	-	-	-	-	1.0	1.3	1.0	1.3	0.3
50	5.2	1.0	2.0	0.0	3.0	2.0	0.7	1.0	-	1.3
60	5.0	-	-	-	-	0.0	-	0.0	2.7	1.3
70	4.5	0.0	2.0	1.0	2.0	-	0.0	0.3	2.0	0.7
80	4.5	-	-	-	-	0.0	0.0	0.6	3.0	0.0
90	4.0	0.0	2.0	0.0	3.0	0.0	0.0	0.0	3.0	-
100	4.0	-	-	-	-	0.0	-	0.3	4.3	-

1/ Beans: average of 3 plants per replication
Tomato: 1 plant at each distance from the nozzle.
Air temperature was 88° F. at the beginning of the experiment falling to 84° F. at the end.
The untreated check was run in the tunnel after the treatments.

Table 15. Drift Studies With 2,4-D and Dicamba Applied at 2 lbs/A.[1/]

Distance from spray nozzle in feet	Air Speed MPH	Average[2/] Tomato[3/] -Carbon Dicamba	Tomato -Carbon 2,4-D	Tomato +Carbon Dicamba	Tomato +Carbon 2,4-D	Bean[4/] -Carbon Dicamba	Bean -Carbon 2,4-D	Allysum[5/] -Carbon Dicamba	Allysum -Carbon 2,4-D
0	10	7	6	8	6	-	-	-	-
10	7	3	5	3	4	2	5	0	0
20	5.5	4	1	4	3	-	-	-	-
30	4.0	4	3	5	4	3	3	0	0
40	3.2	3	2	4	3	-	-	-	-
50	2.5	1	2	2	2	0	0	0	0
60	Trace	1	1	0	0	-	-	-	-
70	Trace	1	3	1	0	0	2	0	0
80	Trace	0	1	0	0	-	-	-	-
90	Trace	1	1	2	1	0	0	0	0
100	Trace	2	1	0	0	-	-	-	-
X	-	1	1	2	0	0	0	0	0

1/ The results of this trial show no deactivation from activated carbon applied after the plants were sprayed. The drift from dicamba and 2,4-D were comparable.

2/ Average evaluation of 2 plants per pot where 0 = no effect, 5 = badly twisted with proliferation of the stem tissue, 10 = plants dead.

3/ Tomatoes were rooted cuttings about 6 to 10 inches tall.

4/ Beans were ½ expanded true leaves.

5/ Allysum plants were 3" high and flowering but growing very slowly.

Table 16. Comparison of the Drift Characteristics of Dicamba and 2,4-D Applied at 2 lbs/A.

Distance from spray nozzle in feet	Air Speed MPH	Average[1/] Phytotoxicity on New Foliage[2/] 2,4-D Bean	Cotton	Dicamba Bean	Cotton	Untreated Bean	Cotton
0	9.0	10.0	10.0	10.0	10.0		
10	4.0	3.0	8.0	8.0	3.0	0.3	0.4
20	3.5	5.5	7.0	10.0	2.0		
30	3.0	10.0	3.3	7.0	1.0		
40	2.5	2.0	1.5	4.5	1.0		
50	1.0	0.5	0.3	4.0	0.0		
60	Trace	0.0	0.0	10.0	1.0		
70	Trace	0.0	0.0	3.0	0.0		
80	Trace	0.0	0.0	3.0	0.0		
90	Trace	1.0	0.0	2.0	0.0		
100	Trace	0.0	0.0	1.5	0.0		

1/ Average of 2 plants per pot where 0 = no effect, 3 = definite hormone-like symptoms, 5-9 = increasing distortion, 10 = no new foliage or entire plant dead.

2/ Treated 8/18/72, Evaluated 9/6/72.

Table 17. Comparison of 2,4-D and Glyphosate Applied at 2 lbs/A Under Wind Tunnel Conditions, as Measured by the Symptoms on the New Trifoliate Leaves, 12 Days After Treatment.[2/]

Distance from Spray nozzle in feet	Air Speed MPH	Average[1/] Phytotoxicity 2,4-D Bean	Cotton	Glyphosate Bean	Cotton	Untreated Bean	Cotton
0	9.0	10.0	10.0	10.0	10.0	0.3	0.3
10	4.0	3.3	8.7	6.0	5.0		
20	3.5	0.0	3.3	3.7	5.3		
30	3.0	0.0	3.7	2.0	1.7		
40	2.5	1.7	2.0	0.3	4.0		
50	1.0	0.7	1.7	-	0.7		
60	T	0.0	0.7	1.3	0.3		
70	T	0.0	0.0	0.5	3.0		
80	T	0.7	0.7	0.7	2.3		
90	T	0.0	1.0	0.0	1.7		
100	T	1.3	0.0	0.0	4.0		

1/ Average of 3 plants per container.

T = trace not measureable with simple equipment.

2/ Treated in a wind tunnel 8/25/72. New foliage rated 9/6/72 where 0 = no effect, 3 = definite symptoms, 5-9 = severe symptoms, 10 = no new growth, plant badly twisted or dead.

Table 18. Activity of Three Herbicides With and Without Activated Carbon With and Without Irrigation.

Herbicides	Beans 5/31	Beans 6/13	Milo 5/31	Milo 6/13	Safflower 5/31	Safflower 6/13	Barley 5/31	Barley 6/13
	Average[1]							
Dicamba + Carbon + No Water	9.0	10.0	4.0	7.5	8.5	9.7	8.0	9.2
Dicamba + Carbon + 1" Water	9.0	10.0	0.5	0.0	5.0	8.5	5.5	8.5
Dicamba + No Carbon + No Water	9.0	9.5	4.5	3.5	9.0	10.0	7.0	10.0
Dicamba + No Carbon + 1" Water	6.0	9.2	7.0	6.5	9.5	10.0	9.0	10.0
Check + Carbon + No Water	2.0	6.5	1.0	0.5	2.5	0.5	2.0	7.5
Check + Carbon + 1" Water	1.0	4.0	0.0	0.5	3.0	4.5	1.0	1.5
Check + No Carbon + No Water	7.0	8.7	1.6	1.0	3.5	3.5	3.5	6.0
Check + No Carbon + 1" Water	3.5	6.5	1.0	2.5	3.0	4.0	4.5	6.2

[1]Average of four replications where 0=no effect and 10=complete kill of the crop.
[2]Dicamba applied at 2 lb/A. Activated carbon applied at 400 lb./A.

Table 19. Effect of Sprinkler Irrigation Sequence and Carbon on the Activity of Dicamba

Herbicide[1/] Carbon-Water treatments[2/]	Average Phytotoxicity: Dicamba 1 lb/A Chenopodium	Beets	Spinach	No Herbicide Chenopodium	Beets	Spinach
No carbon	6.5	5.8	6.5	1.8	1.2	2.0
Herbicide-water-carbon	3.2	0.0	1.0	1.2	1.0	0.8
Carbon-water-herbicide	3.8	3.5	6.2	1.8	1.2	1.8
Water (herbicide-carbon)	0.5	0.0	1.8	1.8	1.0	2.5

1/ Dicamba at 1 lb/A was applied to soil over preseeded crops on 4/21/72.

2/ The activated carbon from "Grow Safe" was applied at 400 lbs/A. Two inches of water were applied, one half before and one half after treatments.

Table 20. Several Important Herbicides Listed by Vapor Pressure.[1/]

Herbicide	Water Solubility (ppm)	Vapor Pressure (mm Hg)
methyl bromide	17,500	1420
1,3 D	2,700	22
2,4-D	600	0.4
dicamba	4,500	3.8×10^{-3}
picloram	430	$.2 \times 10^{-7}$
glyphosate		
RP 17623	1	low
MSMA		
simazine	5	6.1×10^{-9}

1/ Vapor pressure at temperatures closest to field conditions listed in technical literature.