Weed control in nonbearing CITRUS

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WEED CONTROL IN CITRUS nurseries is one of the most expensive cultural practices in citrus tree production. Earlier research has shown Simazine (Princep), diuron (Karmex), bromacil (Hyvar X), terbacil (Sinbar), and paraquat can be used effectively around bearing citrus. However, very few herbicides are usable on the 67,000 acres of young non-bearing citrus in California. The object of the studies reported here was to evaluate several herbicides for pre- and post-emergence weed control in citrus nurseries.

Study series

A series of studies (pre- and post-plant incorporated, pre-emergence, and post-emergence tests) were initiated, starting in the spring of 1964 in Kern, Orange and Fresno counties, and continuing into the spring of 1968 in Riverside and San Diego counties. Uniform rows of recently planted Troyer citrange, trifoliate orange, Cleopatra mandarin and *Citrus macrophylla* liners (in often heavily weed infested nurseries) were treated with a number of herbicides and with different combinations of herbicides.

The nursery soils studied ranged in organic matter content from 0.3 to 2.3 per cent. The soil particle size distribution varied: sand from 46 to 89 per cent, silt from 8 to 32 per cent, and clay from 4 to 28.5 per cent. Herbicides were applied pre-plant in small plots, or post-plant as directed sprays down the liner row, wetting the lower 4 to 6 inches of the newly planted seedlings and wetting a 33 to 36-inch band of weeds down the liner row. Irrigation was by furrow, flood-furrow and sprinkler.

Fresno County tests

The feasibility of using a number of selective herbicides in citrus seedbeds was clearly demonstrated in a number of trials in Fresno County. Most herbicides effectively controlled weeds when sprayed on the soil and sprinkled in after seeding.

Both bromacil and terbacil effectively controlled weeds. However, a large percentage of the seedlings treated with bromacil died and survivors were severely retarded. Veinal chlorosis was also observed on the young Troyer citrange seedlings treated with terbacil, but most recovered and developed normally.

Trifluralin and bensulide were highly selective in controlling grassy weeds without causing injury to the citrus. They controlled annual grasses (crabgrass, barnyardgrass and diffuse lovegrass), but they failed to control red clover and wild lettuce. This was true whether herbicides were incorporated prior to planting, or whether they were surface-applied and sprinkled-in after planting. A slight temporary abnormality in leaf development was observed on seedlings growing where treated with trifluralin at 1 lb. per acre.

DCPA (Dacthal) and bensulide (Prefar) applied on the soil surface and sprinkler-irrigated, gave good weed control and had no adverse effect on a stand of direct-seeded Troyer citrange.

Trifluralin and nitralin incorporated prior to planting gave good weed control at 1 and 2 lbs per acre on young Troyer citrange liners with no effect on growth. Both were weak on a number of species of weeds such as red clover, datura (tolguacha), groundsel, wild lettuce, black mustard, pineapple weed, red maids and shepherds purse.

Orange County tests

The herbicides generally gave good early control of winter annuals; however, the test area was also heavily infested with bindweed. Although the ratings of annual weed control were not high, competition from annual weeds was reduced by most of the herbicides with the exception of EPTC and the low rates of DCPA. Bindweed was noticeably stunted and exhibited slight chlorosis in the high rates of DCPA and terbacil. Bindweed was relatively unaffected by any of the other herbicide treatments.

None of the herbicides in this test was markedly toxic to the young citrus liners. Height and diameter measurements showed that growth was related to weed control. For example, terbacil at 1 lb per acre gave commercial annual weed control and resulted in the best growth in terms of tree diameter. Only the high rate of DCPA appeared to cause any degree of stunting in this test but the difference was not significant.

Black polyethylene mulch gave outstanding weed control and growth of young Troyer citrange liners was good. Salt accumulation was not a problem. All mulched treatments outgrew the unmulched checks. Weed control with trifluralin was not satisfactory under clear plastic in one test because of the presence of mustard, a resistant species.

San Diego County tests

The herbicides simazine and terbacil controlled winter annual weeds including mustard, London rocket, groundsel and pigweed. Competition from weeds severely reduced liner growth in the untreated check plots. Trifluralin was weak on London rocket, groundsel and some other weeds. It was applied in granular form and was not incorporated with sprinkler irrigation until later in the season. The effectiveness of herbicide combinations depended on the amount of simazine and terbacil used. The dichlobenil gave good control with no plant injury.

Riverside County tests

Varying degrees of spotted spurge control were achieved at 157 days after application. The most effective herbicide was DCPA. Terbacil was markedly weak especially when incorporated pre-plant. Since the area had a very sandy soil, large amounts of irrigation water were used which may have leached the terbacil from the shallow layer of soil in which spotted spurge germinated. The 2-lb rate of trifluralin gave good spurge control when

incorporated. No injury was noted from any of the treatments in this test.

In another test, trifluralin incorporated at ½ to 2 lbs per acre reduced the nurse crop of barley and allowed maximum growth of young Mexican lime seedlings in the seedbed. However, there was some early stunting of the lime seedlings at 38 days.

Post-emergence

In a post-emergence trial in Orange County, cacodylic acid was by far the most toxic herbicide after the first spraying (during the first spray the trees were semidormant and grew very slowly). The slow growth of the citrus may explain why paraquat at the 1- and 2-lb rates did not injure the trees initially, while succeeding treatments applied the next spring and in early summer resulted in severe phytotoxicity in the form of trunk burn. Cacodylic acid was more toxic than paraquat the first season even while the liners were semidormant; consequently, cacodylic acid would be expected to be more toxic during rapid growth, although this investigation has not yet been made.

Paraquat at ½ lb per acre controlled young standing weeds with no significant effect on young growing seedlings; however, the margin of safety appeared narrow since rates of 1 and 2 lbs per acre resulted in trunk burn (as previously mentioned) accompanied by noticeable stunting.

MSMA was effective in controlling Johnsongrass, nutsedge and several other perennial weeds, and showed considerable safety on young citrus at the 4-lb-per-acre rate. There was, however, some injury at 16 lbs per acre. Since repeated 4-lb applications for the control of perennial weeds are effective on non-crop land, it will be necessary to test MSMA further with smaller repeated applications and shielded sprays for maximum safety in cirtus.

The herbicide treatment yielding the best post-emergence annual weed control with the greatest safety, was diuron plus non-phytotoxic oil. This combination is also being tested further to confirm these results.

Low rates of simazine, diuron and terbacil have given selective weed control in citrus nurseries in these tests, some of which were conducted in very sandy soils under flood irrigation. One test conducted in desert sands resulted in no injury even though great amounts of water were flooded over the treated areas during irrigation.

Weed competition, both annual and perennial, was severe in the early stages of citrus seedling growth in some trials. Pre-emergence herbicides, supplemented with early applications of post-emergence herbicides therefore offer the citrus nurseryman the possibility of a new inexpensive experimental tool to control weeds in citrus.

Judging from the injury produced by high rates of the post-emergence herbicides used in these trials and by pre-emergence herbicides in these and other tests, it is clear that applications of chemicals for weed control in young citrus must be made with precision.

Several additional uniform weed control trials are now underway in citrus nurseries in a number of different environments throughout California's citrus belt. Results from these trials should offer sufficient information for the formulation of weed control recommendations for citrus nurseries, when labels become available. Information discussed in this article is not to be considered a recommendation of University of California. Local farm advisors should be consulted for specific herbicide recommendations.

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TABLE 1. THE EFFECT OF SIX PRE-EMERGENCE HERBICIDES ON WEED CONTROL AND GROWTH OF TROYER CITRANGE LINERS AS MEASURED BY VISUAL RATINGS AND HEIGHT AND DIAMETER MEASUREMENTS

Herbicide	lb/A	WEED CONTROL MONTHS AFTER INITIAL TREATMENT*				GROWTH†	
		1	3	6	10	DIAMETER (mm)	HEIGHT (cm)
Simazine	1	7.0	6.5	3.2	6.7	13.5 ab	81
Simazine	2	10.0	5.0	5.0	7.7	13.8 a	83
Diuron	1	9.5	7.0	4.7	8.2	12.8 ab	79
Diuron	2	7.2	4.5	4.2	6.2	13.2 ab	80
Terbacil	1	6.0	4.2	3.2	9.0	14.2 a**	85
Terbacil	2	9.0	6.2	4.0	9.0	13.6 ab	86
Terbacil	4	9.5BW	7.0	5.2	10.0BW	13.2 ab	80
Trifluralin (incorp)	1	5.5	4.5	3.2	4.7	12.7 ab	78
Trifluralin (incorp)	2	6.5	3.5	3.0	4.2	12.8 ab	77
Trifluralin (incorp)	4	7.5BW	5.2	4.0	5.7BW	12.8 ab	79
DCPA (incorp)	8	3.5	3.0	3.2	2.2	12.8 ab	78
DCPA (incorp)	32	7.5BW	7.5	6.7	6.7BW	12.0 a	76
EPTC (incorp)	4	5.5	4.0	11.7	1.2	12.7 ab	77
EPTC (incorp)	16	6.7	5.2	4.0	6.7	12.8 ab	79
Check weedy	0	6.2	4.7	3.2	00.0	12.8 ab	78
Weeded check	0	6.0	3.2	3.0	7.5	13.7 a	78
L.S.D. .05						(S)	NS
Coeff. of Var.						7.2%	7.3%

* Average of four replications; ratings made on the basis of 0 = no weed control, 10 = 100% weed control
† Average of four replications (13 trees per plot)
BW These rates of Terbacil, Trifluralin and DCPA showed a degree of bindweed control approaching commercial acceptance
Soil : Sand = 54%, Silt = 24.0, Clay = 22% and OM = 1.1%

TABLE 2. THE EFFECT OF FIVE POST-EMERGENCE HERBICIDES ON WEED CONTROL, VIGOR AND GROWTH OF TROYER CITRANGE LINERS AS MEASURED BY VISUAL RATINGS AND HEIGHT AND DIAMETER MEASUREMENTS

Herbicide	lb/A	WEED CONTROL* ANNUAL and BINDWEED MONTHS			VIGOR MONTHS AFTER INITIAL TREATMENTS				GROWTH	
		1		8	1	3	6	10	DIAMETER (mm)	HEIGHT (cm)
			A	BW						
Paraquat	0.5	10	9.7	3.5	9.0	7.0	6.2	5.7	12.0 abc	78 abc
Paraquat	1	10	10.0	8.0	9.5	7.5	7.2	5.0	9.8 cd	74 bc
Paraquat	2	10	10.0	6.2	8.7	7.2	6.2	4.0	8.8 d	63 d
Cacodylic acid (y)	4	10	..	..	10.0	9.2	7.2	6.2	13.5 a	86 ab
Cacodylic acid (y)	16	10	..	..	4.2	3.2	3.7	5.0	10.6 cd	68 cd
MSMA	4	10	4.7	6.5	10.0	8.0	7.0	7.2	13.0 abc	89 a
MSMA	16	10	8.7	6.7	9.2	6.7	6.7	5.7	11.1 bc	77 abc
Diuron + oil	1	10	6.7	6.5	8.5	7.5	6.7	6.7	13.3 ab	84 ab
Diuron + oil	4	10	9.7	8.5	9.0	6.7	7.5	7.5	13.2 ab	84 ab
Weedy check	0	0	1.0	3.5	9.2	7.5	7.2	6.5	12.9 ab	80 ab
Weeded check	0	10	7.0	5.5	8.7	8.0	7.2	6.2	12.9 ab	81 ab
L.S.D. .05									(S)	(S)
Coeff. of Var.									12%	10%

* Average of four replications; ratings on basis of 0 = no control, 10 = 100% control; A = Annual, BW = Bindweed.
Soil (See table 1)
(y) = not sprayed during second season because of severe injury the first season.