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The Effect of Aldicarb On Growth of Young Citrus Trees

Julian W. Sauls

Professor and Extension Horticulturist

Texas Agricultural Extension Service, 2401 East Highway 83, Weslaco, TX 78596, USA

ABSTRACT

Aldicarb was applied to young navel orange trees [*Citrus sinensis* (L.) Osbeck] zero, two or three times per year during April and June or April, June and August of 1986, 1987 and 1988. Each application was 45 g (1.6 oz.) per tree. Trunk cross-sectional area was increased in each of three years by the use of aldicarb, although there was no difference between the two aldicarb rates. Canopy volume after one year was greater as a result of aldicarb use, but only the triple application was superior to the control after three years. Additional pest control was not required on any trees receiving aldicarb but the control trees were sprayed twice annually for pest control. In another test involving aldicarb, there was no difference in growth whether aldicarb was applied to both sides or to just one side of the tree.

RESUMEN

Se aplicó aldicarb a árboles jóvenes de naranja ombligona [*Citrus sinensis* (L.) Osbeck] durante cero, dos o tres veces por año durante abril y junio o abril, junio y agosto de 1986, 1987 y 1988. Cada aplicación consistió de 45 g (1.6 onzas) por árbol. El área transversal del tronco se incrementó en cada uno de los tres años debido al uso del aldicarb, aunque no hubo diferencia entre las dos dosificaciones del producto. Después de un año, el volumen de la canopia fue mayor como resultado del uso del aldicarb, pero después de tres años, solamente el tratamiento de aplicación triple fue superior al testigo. No se requirió de un control de plagas adicional en ninguno de los árboles que receibieron aldicarb pero los árboles testigos fueron asperjados dos veces por año para el control de plagas. En otro experimento en el que se incluyó aldicarb no hubo diferencia en el crecimiento, indistintamente de si el aldicarb se aplicó en ambos lados o sólo en un lado del árbol.

Aldicarb [2-methyl-2-(methylthis) propionaldhyde 0-(methyl carbamoyl) oximene] is an effective nematicide-miticide that few citrus growers consider to be economically beneficial during orchard establishment, inasmuch as there is no fruit to be protected from citrus rust mite damage. Also, existing equipment is not adapted to the non-continuous application necessary to incorporate the material only at the base of a young tree. Consequently, no definitive work has been reported on the use of aldicarb for pest control during the establishment years of a citrus orchard, although its role in mature, bearing orchards has been well documented (French and Timmer, 1979; Timmer and French, 1979; Davis et al, 1982) and is an option in the Texas citrus pest management program (Browning and Cartwright, 1988). At the time this study was initiated, Union Carbide was considering equipment that could be used to effectively apply aldicarb to the root zone of young citrus trees, so it was essential to determine the effect of aldicarb on young tree growth. In addition, because it would be more economical to apply aldicarb to only one side of the trees, there was a need to know if single-side application would be as effective as double-side application. These studies were initiated to determine the effect of aldicarb on young tree growth and to compare single-side to double-side application.

MATERIALS AND METHODS

Container-grown trees of N33E navel orange on sour orange rootstock (*Citrus aurantium* L.) were planted in October, 1985, on Hidalgo sandy clay loam soil near Santa Rosa, Cameron County, Texas. Orchard spacing was 2.44 x 7.31 m (8x24 feet) for a population of 560 trees per hectare (227 trees per acre). In March, 1986, nine adjacent rows of 30 trees each were selected for this study; there were three whole-row replications of each treatment, with five subsamples in each row identified for data collection.

The orchard site had been planted to citrus for over four decades, although the land was fallow between tree removal in June, 1984, and replanting in 1985. After planting, the orchard was maintained under trunk-to-trunk herbicidal weed control.

Other cultural practices followed standard orchard procedures as conducted by the grower.

Treatments included aldicarb at 0, 91 and 136 g (0, 3.2 and 4.8 ounces) per tree per year, which were applied in equal rates of 45 g (1.6 ounces) in either April and June or April, June and August of 1986, 1987 and 1988. The material was dispensed uniformly around the tree using a drop tube from a Perfect-A-Feed® portable dispenser/applicator (Oregon Grower and Garden Supply, Canby, OR 97013). Flood irrigation was applied immediately following application.

Trunk circumference was measured at 20 cm (8.0 inches) above ground in March, 1986, and thereafter in April of the next three years. Circumference was converted to cross-sectional area by a standard mensuration formula ($0.07958\ C^2$) (Gaboury, 1949). Tree height and in-row and cross-row diameters were measured in April of each year following treatment and canopy volume was calculated using the formula for oblate spheroids (0.5236 HDD) (Turrell, 1946).

An additional test was initiated in the same orchard in 1987 to compare the placement of aldicarb to either a single side or both sides of young trees, with one, two or three applications per year for two years. The experimental setup

Table 1. The effect of aldicarb on cumulative growth of young navel orange trees, 1986-89.

Aldicarb treatment	Trunk cross-sectional area (cm^2) 1986	1987	1988	1989
Control	0.75 a[z]	2.07 a	10.72 a	24.65 a
Double application[y]	0.81 a	3.28 b	14.29 b	30.16 ab
Triple application	0.73 a	3.28 b	15.15 b	31.85 b
	Canopy volume (m^3)			
Control[y]	-[x]	0.22a	1.34 a	3.36 a
Double application	-	0.31 b	1.57 a	3.83 ab
Triple application	-	0.48 b	2.05 b	4.62 b

[z]Mean separation within columns by Duncan multiple range test, p = 0.05.

[y]Aldicarb was applied at the rate of 45 g (1.6 oz.) per tree per application, either twice or three times during the season.

[x]Canopy volume was not measured in 1986 because of small tree size.

was a factorial design involving three application and two placement treatments, with five single-tree replications of each treatment combination. Placement was the main factor.

Experimental plots were monitored biweekly from March through October by scouts for the Texas citrus integrated pest management program.

The data in both studies were subjected to one-way analysis of variance; means were separated by Duncan's multiple range analysis.

RESULTS AND DISCUSSION

There was no difference in trunk cross-sectional area at the start of this study, but the use of aldicarb resulted in larger trunks one and two years after treatment began (Table 1). The two aldicarb rates did not differ from each other throughout the study, but only the triple application was superior to the control at the end of the study.

Canopy volume was larger after one year as a result of aldicarb use (Table1). The triple application of aldicarb produced a larger canopy than either double application or control in 1988, but it was superior only to the control at the end of the study.

It is an accepted principle of citriculture that yield is directly related to canopy volume, i.e. a larger tree produces more fruit. Thus, it would be advantageous to develop a larger citrus tree during the establishment years to enhance production in the early years. Leyden and Timmer (1978) reported that larger 'Redblush' grapefruit trees produced a far greater number of fruit in the third season postplanting. Maxwell and Rouse (1980, 1984) reported 'Redblush' grapefruit yield differences for larger trees only in years five, eight and nine, although there was no difference in cumulative yields. In the latter works, however, tree size measurements were reported only for the seventh and eleventh year.

The first production in this study occured in 1988 and averaged 1.3, 2.6 and 5.0 kg (2.8, 5.7 and 11.0 pounds) per tree for the zero, double and triple applications, respectively. At harvest, the volume of fruit did not appear to justify statistical analysis, so production was pooled by treatment to provide a per-tree average, The parallel between production and tree size is similar to that reported by Leyden and Timmer (1978).

Boling and Dean (1968) reported on the effectiveness of aldicarb on Texas citrus mite, false spider mite and chaff scale in mature trees, whereas Hart and Ingle (1967) reported its efficacy against brown soft scale on potted citrus. Other workers have reported the efficacy of aldicarb on rust mites (French and Timmer, 1979) and nematodes (Timmer and French, 1979; Davis et al, 1982).

Pests were not a problem in the aldicarb plots throughout the three years of this study; the control plots, however, required twice-annual applications of chlorpyrifos [0,0-diethyl 0-(3,5,6-trichloro-2-pyridinyl phosphorothioate] to control ants and brown soft scale in the trees. The fruit produced in 1988 were completely free of citrus rust mite damage in the aldicarb plots whereas all fruit in the control plots were severely russetted as a consequence of citrus rust mite feeding. However, no effort was made to quantify the damage. These results are similar to those obtained in 1987 by Leon Smith (personal communication) and in 1988 by Harold Browning (personal communication).

In the second study, there was no interaction between number of applications and placement, so the data are presented for placement at all levels of application (Table 2). There were no differences in trunk cross sectional area or canopy volume as a result of single-side versus double-side application at the end of one and two years (Table 2). Production in 1988 averaged 4.7 and 4.5 kg (10.3 and 9.9 lbs) per tree for single-side and double-side placement, respectively.

Table 2. Comparison of single-side to double-side placement of aldicarb on young navel orange tree growth [1].

	Trunk cross-sectional area (cm^2)		Canopy volume (m^3)	
Placement	1988	1989	1988	1989
Single side	20.66	45.57	1.34	4.25
Double side	20.27	41.32	1.36	4.29

[1] There were no significant differences between the two application placements.

According to citrus IPM scouting reports, pest populations did not reach economic thresholds in any treatment in Experiment 2 throughout the course of this study, so no additional pest control was provided. Aldicarb normally provides mite control for 90 to 120 days, although longer durations have been noted personally and in the citrus IPM program (Leon Smith, personal communication). Economic thresholds are based in part on the volume of fruit present, but there was no production in this test in 1987 and only limited, non-commercial production in 1988.

The rates of aldicarb used in these studies were equivalent to 25 (single application), 51 (double application) and 76 (triple application) kg per ha (23,45 and 68 lbs per acre), the highest of which barely exceeds the maximum labelled rate (at that time) of 76 kg per hectare (67 lbs per acre). While these studies were conducted in a high density orchard, the per-tree rates used should be relevant at other densities, providing that the maximum rate per acre is not exceeded. The single application rate of 45 g (1.6 oz.) per tree equates to 16 to 17 kg per hectare (14 to 15 lbs per acre) at 346 to 370 per hectare (140 to 150 trees per acre), which is less than half the current labelled rate of aldicarb of 37 kg per hectare (33 lbs per acre).

These studies indicate that the use of aldicarb at one-third to one-half of the current labelled rate of 37 kg per hectare (33 lbs per acre) will increase tree size during the establishment years, and that the product is equally effective in single-side and double-side placement. Also, pest problems were minimized by aldicarb use in young trees, while non-treated trees required at least two sprays annually to control pests, and would have benefitted from additional treatment to control citrus rust mite damage to fruit in the 1988 season, had there been a commercially viable volume of fruit.

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