Control of *Tylenchulus semipenetrans* on Citrus With Aldicarb, Oxamyl, and DBCP[1]

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Abstract: Soil application of DBCP (1,2-dibromo-3-chloropropane) and foliar applications of oxamyl (methyl *N′,N′*-dimethyl-*N*-[(methylcarbamoyl)oxy]-1-thiooxamimidate) were compared for control of *Tylenchulus semipenetrans* in a grapefruit (*Citrus paradisi*) orchard. DBCP reduced nematode populations and increased fruit growth rate, fruit size at harvest, and yield compared to the untreated controls in the 2 years following treatments. Foliar applications of oxamyl reduced nematode populations and increased fruit growth rate slightly the first year, but not in the second. Foliar applications of oxamyl did not improve control attained by DBCP alone. Soil application of aldicarb [2-methyl-2-(methylthio)propionaldehyde-0-(methylcarbamoyl)oxime] or DBCP to an orange (*C. sinensis*) orchard reduced *T. semipenetrans* populations in the 3 years tested and increased yield in 1 of 3 years. Aldicarb treatment reduced fruit damage caused by the citrus rust mite, *Phyllocoptruta oleivora.* Aldicarb, applied at 5.7 or 11.4 kg/ha, by disk incorporation or chisel injection, was equally effective in controlling nematodes, improving yields, fruit size, and external quality. In a grapefruit orchard, chisel-applied aldicarb reduced nematode populations and rust mite damage and increased yields in both years and increased fruit size in one year. The 11.4-kg/ha rate was slightly more effective than the 5.7-kg/ha rate. Aldicarb appears to be an adequate substitute for DBCP for nematode control in Texas citrus orchards and well-suited to an overall pest management system for Texas citrus. *Key Words:* citrus nematode, grapefruit, oranges, citrus rust mite, *Phyllocoptruta oleivora.*

The citrus nematode, *Tylenchulus semipenetrans* Cobb, is a serious pest in Texas citrus orchards (5). Application of DBCP (1,2-dibromo-3-chloropropane) in flood irrigation systems at 55–70 kg/ha provided long-term control of *T. semipenetrans* on sandy loam soils (5) but was less effective on finer-textured soils (13). Control of *T. semipenetrans* with DBCP in many citrus areas has frequently increased yield and fruit size (5, 7, 9, 11, 13). However, DBCP has been implicated as the cause of health problems in production workers and is no longer manufactured in the United States. It is still registered for use on citrus in Texas, but the high cost of imported DBCP and stringent environmental protection requirements have discouraged its use. The relative unavailability of DBCP and the need for a nematicide which can be applied easily to unlevel orchards and to orchards under drip irrigation has stimulated interest in the nonfumigant nematicides.

Several soil-applied nonfumigant nematicides have proved effective for citrus nematode control (2, 4, 5, 6). Soil-applied aldicarb [2-methyl-2-(methylthio)propionaldehyde-0-(methylcarbamoyl)oxime] controlled citrus nematode and increased yields of oranges (4, 5), but the rates used were much higher than would be economically feasible. Foliar-applied oxamyl (methyl *N′,N′*-dimethyl-*N*-[(methylcarbamoyl)oxy]-1-thiooxamimidate) controlled citrus nematode and increased yields and fruit size in some cases (8, 12, 13), but, in others, repeated foliar applications have had no effect on nematode populations or yields (3, 12, 13).

The purposes of this study were: 1) to determine if foliar applications of oxamyl alone or in combination with soil application of DBCP would provide economic control of *T. semipenetrans;* and 2) to determine appropriate rates and methods of

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application of aldicarb on oranges and grapefruit and its suitability in a pest management program for citrus.

MATERIALS AND METHODS

DBCP-oxamyl experiment: Control of *T. semipenetrans* and citrus yields were compared in a 10-year-old red grapefruit (*Citrus paradisi* Macf.) orchard on sour orange (*C. aurantium* L.) rootstock on a 4.6 × 6.1-m spacing using the following treatments: i) soil application of DBCP (Nemagon 12.1 EC); ii) foliar application of oxamyl (Vydate 2E); iii) DBCP plus oxamyl; and iv) untreated control. The DBCP was applied by metering 65 kg(a.i.)/ha into 15 cm of water in a flood irrigation system on 31 December 1975. Oxamyl was applied as a foliar spray with a John Bean Speed Sprayer using about 2,400 liters/ha at 2.3 kg(a.i.)/ha on 25 March and 23 April and at 1.15 kg/ha on 10 August 1976. Applications at 1.15 kg/ha were made on 12 April, 13 May, 1 July, and 20 September 1977. Citrus spray oil or a spreader-sticker was added to all but the last oxamyl application.

Treatments were arranged in a randomized complete block design and replicated twice on plots with three rows of 37–43 trees each. Nematode, yield, and fruit-size data were collected from the center row of each plot. Soil samples for nematode counts were taken at three equally spaced sites within each plot (six samples/treatment/sample date). Average fruit diameter was determined at about 3-week intervals throughout the 1976 and 1977 seasons by measuring 5–6 fruit from each of three equally spaced trees within each replication of each treatment, i.e., 30–36 fruits/treatment. Yield was determined by weighing the fruit from 11 individual trees in each replication in December of each year. Fruit size was determined by sorting fruit with a commercial sizer, and data are expressed as percent of total fruit weight composed of fruit 9.2 cm in diameter or larger, i.e., fruit salable on the fresh market.

Aldicarb-DBCP experiment on oranges: Rates and methods of application of aldicarb were evaluated in a 10-year-old orchard of 'Marrs Early' orange [*C. sinensis* (L.) Osb.] on sour orange rootstock planted on a 7.6 × 7.6-m spacing. Granular aldicarb (Temik 15G) was applied at 5.7 and 11.4 kg(a.i.)/ha on 26 February 1976, 16 March 1977, and 20 March 1978. Untreated plots served as controls. Treatments were arranged in a randomized complete block experiment with four replications. Rates of aldicarb are expressed as amounts/ha of orchard rather than/ha of treated area. Each plot consisted of two rows of 6 trees each, i.e., 24 trees/treatment. Plots were split, and aldicarb was applied by chisels in one row and by disk incorporation in the other. For chisel application, material was applied 5–10 cm deep with a fertilizer applicator with shanks set about 40 cm apart in a 1.2-m swath on each side of the tree row. For disk application, aldicarb was spread uniformly on the surface in a 1.2-m swath on each side of the row and disk-incorporated to 5–10 cm. All plots were flooded with about 15 cm of irrigation water within 48 h of application. The number of replications was reduced to three after 1976, and aldicarb plots were treated by the chisel injection in 1978. For comparison, an additional two rows of 12 trees each, adjacent to the randomized test, were treated by metering DBCP into the irrigation water at 56 kg/ha on 1 March 1976 and on 23 March 1978.

For nematode counts, two soil samples were taken from each replication of each treatment on each sample date, one from the area treated by chisel application and the other from the area treated by disk application. Four samples were collected from the DBCP-treated area. Fruit from all trees was harvested, weighed, and sized in November of each year by methods described in the previous experiment. Rust mite damage caused by *Phyllocoptruta oleivora* (Ashmead) was rated as none, mild, moderate, or severe, and data expressed as the percentage of 40-fruit sample with moderate or severe damage. Fruit with mild or no damage can be marketed fresh, whereas fruit with moderate or severe damage is only useful for processing.

In 1976, foliar applications of acaricide were made to two of the four replications of the control and to the DBCP-treated area early in the season for control of the citrus rust mite, *P. oleivora*. All plots were sprayed with acaricide late in the season after aldicarb had ceased to control rust mite. In 1977, none of the plots received acaricide applications until late in the season. In 1978, the control and DBCP plots were split, with half of the trees receiving early-season acaricide treatments and the other half receiving only late-season applications.

Aldicarb experiment on grapefruit: Aldicarb, applied at 5.7 and 11.4 kg(a.i.)/ha, was compared with an untreated control in a 16-year-old 'Webb Redblush' grapefruit orchard on sour orange rootstock planted on a 4.9 × 6.7-m spacing. Treatments were arranged in a randomized complete block design with four replications, each consisting of two rows of 5–6 trees each, i.e., 40–44 trees/treatment. Aldicarb was applied on 17 March 1977 and 20 March 1978 by chisel injection followed by irrigation as in the experiment on oranges. Two soil samples for nematode counts were taken from each replication of each treatment on each sample date. Fruit yields, size, and rust mite damage were determined for the center six trees in each plot in December or January of each year. Early-season acaricide applications were made to two of the four replications, and late-season acaricide treatments were applied to all plots in both seasons.

Nematode counts and statistical analysis: Soil samples for nematode counts in all experiments were taken from the treated areas at the dripline of the tree at a depth of about 15 cm. Samples were collected from an area with active feeder roots. Each sample consisted of a composite of three subsamples of about 1 liter each. Soil was mixed thoroughly and screened to remove roots and debris, and 50 cm^3 was sampled for nematode counts. Larvae were extracted by using a modified Baermann funnel technique (10), counted, and reported as number/100 cm^3 of soil.

Data on nematode counts, yield, fruit size, and rust mite damage from most experiments were subjected to analysis of variance and means separated by Duncan's multiple-range test. Data from the DBCP-oxamyl test were analyzed by Student's "t" test.

RESULTS

DBCP-oxamyl experiment: A single application of DBCP in the irrigation water reduced nematode populations to low levels for the entire 2 years of the study (Table 1). Early in 1976, oxamyl reduced nematode

TABLE 1. Effect of soil applications of DBCP and foliar applications of oxamyl on populations of *Tylenchulus semipenetrans* and grapefruit yield and fruit size.

	1976							
	No. of larvae (in 1000's)/100 cm^3 soil							
Treatment	Pre-treatment Nov 75	Apr	Jun	Jul	Oct	Post-treatment av.	Yield (kg/tree)	Fruit size[w] (% >9.2 cm)
DBCP[x]	12.6a[y]	1.2c	0.1b	1.6b	0.2b	0.8c	155a	83.5a
Oxamyl[z]	12.7a	11.6b	15.0a	5.5a	7.7a	10.0b	102b	88.2a
DBCP + Oxamyl[z]	9.6a	1.8c	1.0b	0.5b	0.2b	0.9c	139a	88.3a
Control	11.5a	31.8a	18.5a	6.8a	9.7a	16.7a	110b	79.9a

	1977							
	No. of larvae (in 1000's)/100 cm^3 soil						Yield	Fruit size[w]
Treatment	Feb	May	Jun	Sep	Nov	Av.	(kg/tree)	(% >9.2 cm)
DBCP[x]	0.5b	0.2b	3.5b	0.8a	2.1a	1.4b	161a	65.0a
Oxamyl[z]	16.6a	15.3a	9.2ab	1.3a	2.4a	9.0a	140b	17.1d
DBCP[x] + Oxamyl[z]	1.6b	4.9ab	4.6b	1.2a	2.7a	3.0b	172a	54.2b
Control	25.3a	9.7ab	14.2a	3.8a	3.5a	11.3a	136b	32.8c

[w]% of total fruit weight composed of fruit 9.2 cm in diam or larger.
[x]DBCP (1,2-dibromo-3-chloropropane) metered into about 15 cm of water in a flood irrigation system at 65 kg/ha on 31 Dec 1975.
[y]Mean separation in columns and groups by Student's "t" test (P = 0.05).
[z]Oxamyl applied as a foliar spray in about 2400 liters/ha at 2.3 kg/ha on 23 Mar 1976 and 23 Apr 1976 and at 1.15 kg/ha on 10 Aug 1976; 12 Apr 1977; 13 May 1977; 1 Jul 1977; 20 Sep 1977.

populations, and the average annual population was significantly lower in the oxamyl-sprayed plots than in the untreated control. Application of oxamyl to DBCP-treated plots did not affect larval counts in either year.

Treatment with DBCP significantly increased yields in both years, but foliar applications of oxamyl did not. Fruit size was not affected by any treatment in 1976, but DBCP treatment significantly increased fruit size in 1977 (Table 1).

Fruit growth measurements taken during the season (Fig. 1) were strongly related to the percentage of large fruit as determined by sizing the fruit at the end of the season (Table 1). Analysis of variance of fruit diameter measurements at specific dates indicated that, in 1976, fruit from the oxamyl and the DBCP-plus-oxamyl plots grew significantly faster than fruit from the DBCP and control plots. In 1977, fruit from the DBCP and the DBCP-plus-oxamyl plots grew significantly faster than fruit from the control or oxamyl plots. Toward the end of the season, fruit was significantly larger in the control plots than in the oxamyl plots.

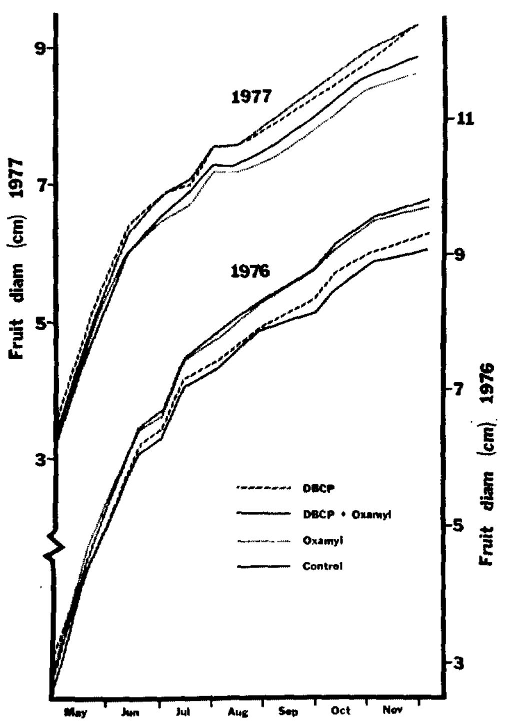

FIG. 1. Growth of grapefruit in plots treated with a single soil application of DBCP in late 1975, repeated foliar application of oxamyl during 1976 and 1977, or both, compared with an untreated control.

Aldicarb-DBCP experiment on oranges: Annual application of aldicarb in the 'Marrs Early' orange orchard significantly reduced citrus nematode populations below that of the control at most sample dates (Table 2). Control of *T. semipenetrans* with aldicarb was not significantly greater with 11.4 kg/ha than with 5.7 kg/ha. No differences in control were observed between the disk and chisel methods of application except in 1976, when larval counts were lower where aldicarb was disk-incorporated than where it was chisel-applied at the low rate. DBCP applied in 1976 reduced *T. semipenetrans* populations to low levels until March 1978 when it was reapplied. DBCP generally reduced larval counts more than did aldicarb.

In the 'Marrs Early' orange orchard in 1976 (Table 3), no increase in yield was observed in spite of significant reductions in nematode populations with aldicarb and DBCP. The percentage of large fruit was greater in the aldicarb-treated plots, but the increase appeared to be attributable primarily to control of citrus rust mite. Rust mite damage was mild in the aldicarb plots where aldicarb provided rust mite control early in the season without foliar acaricide applications. Damage was moderate in the sprayed control and in the DBCP plot where foliar applications of acaricides were used to control rust mites early in the season. In the unsprayed control, rust mite damage was severe and fruit size was small.

In 1977, yields were higher in the aldicarb and DBCP plots than in the untreated control (Table 3). Aldicarb treatment significantly increased fruit size and reduced rust mite damage. DBCP treatment increased yield as much as the aldicarb treatment, but lack of rust mite control in the DBCP plot in 1977 resulted in mite damage and fruit sizes comparable to those of the unsprayed control.

In 1978, neither aldicarb nor DBCP treatment increased yield or fruit size compared with the sprayed control. Failure to control rust mite, either by means of aldicarb or early-season applications of foliar acaricides, resulted in severe fruit blemish, reduced yield, and reduced fruit size in 1978.

No significant differences were observed

TABLE 2. Effect of soil applications of aldicarb and DBCP on *Tylenchulus semipenetrans* populations in a 'Marrs Early' orange orchard.

Treatment	Rate [kg (a.i.)/ha]	Method of application	No. of larvae (in 1000's)/100 cm^3 soil					
			Mar 76	Apr 76	May 76	Oct 76		Av.
Aldicarb[x]	5.7	disk	1.7b[y]	3.0bc	1.6b	0.7b		1.7d
Aldicarb	5.7	chisel	2.6b	8.5b	4.6b	1.0b		4.2b
Aldicarb	11.4	disk	3.0b	1.4c	2.7b	0.7b		2.0cd
Aldicarb	11.4	chisel	2.2b	6.1bc	0.5b	1.4b		2.6c
Control	—	—	7.8a	19.1a	14.4a	5.6a		11.7a
DBCP[z]	55	irrigation water	0.1	0.4	0.1	0.1		0.2
			Feb 77	May 77	Jul 77	Sep 77	Nov 77	Post-treatment av.
Aldicarb	5.7	disk	2.5a	3.1b	2.1b	0.3a	1.7b	1.8b
Aldicarb	5.7	chisel	4.5a	4.0b	2.9b	0.6a	1.0b	2.1b
Aldicarb	11.4	disk	4.9a	1.7b	0.5b	0.4a	0.5b	0.8b
Aldicarb	11.4	chisel	9.5a	2.0b	1.8b	1.0a	2.1b	1.7b
Control	—	—	11.6a	15.9a	12.6a	1.4a	4.9a	8.7a
DBCP	None applied		0.2	—	—	—	1.9	1.1
			Mar 78	May 78	Jun 78	Aug 78	Oct 78	Post-treatment av.
Aldicarb	5.7	chisel	7.4a	4.0b	2.5b	4.4a	6.0ab	4.2b
Aldicarb	11.4	chisel	6.4a	1.7b	8.1ab	5.9a	3.0b	4.7b
Control	—	—	3.2a	12.9a	19.4a	7.0a	19.3a	14.7a
DBCP	55	irrigation water	5.0	0.1	0.2	0.1	0.1	0.1

[x]Aldicarb applied on 26–27 Feb 1976; 16 Mar 1977; and 20 Mar 1978. For disk application, aldicarb (Temik 15G) spread in a 1.2-m swath on each side of the tree and disk-incorporated. For chisel application, aldicarb injected on both sides of the tree 5–10 cm deep with four shanks spaced 40 cm apart. All plots flood-irrigated with 15 cm of water following treatment.
[y]Mean separation in columns and groups by Duncan's multiple-range test ($P = 0.05$).
[z]DBCP metered into 15 cm of water in a flood irrigation system on 1 Mar 1976 and 23 Mar 1978.

between the chisel and disk application methods in yield, fruit size, or rust mite damage. Except for a possible small increase in fruit size in 1977, the high rate of aldicarb was not significantly more effective than the low rate.

Aldicarb experiment on grapefruit: Chisel application of aldicarb at 5.7 and 11.4 kg/ha provided control in the 'Webb Redblush' grapefruit orchard similar to that attained in the orange orchard (Table 4). No differences in nematode populations were observed between the low and high rates of aldicarb.

The high rate of aldicarb significantly increased grapefruit yields above the untreated control in 1977 (Table 5). Both rates significantly increased fruit size and reduced rust mite damage. In 1978, both rates of aldicarb significantly increased yield and reduced rust mite damage. Because fruit numbers were so much lower on control than on treated trees, fruit on control trees grew to larger size. Differences

TABLE 3. Effect of aldicarb and DBCP treatment on yield, fruit size, and quality of 'Marrs Early' oranges.

			1976			1977			1978		
Treatment[t]	Rate [kg (a.i.)/ha]	Method of application	Yield (kg/tree)	Fruit size[u] (% >6.2 cm)	%[v] russet	Yield (kg/tree)	Fruit size[u] (% >6.2 cm)	%[v] russet	Yield (kg/tree)	Fruit size[u] (% >6.2 cm)	%[v] russet
Aldicarb[w]	5.7	disk	136a[x]	78a	15bc	143a	44b	5b	—	—	—
	5.7	chisel	142a	78a	13bc	146a	38b	3b	157ab	95ab	7b
Aldicarb	11.4	disk	138a	83a	7c	136a	56a	1b	—	—	—
	11.4	chisel	126a	88a	4c	144a	47ab	1b	150ab	94ab	8b
Sprayed control[y]	—	—	130a	84a	25b	—	—	—	161a	97a	9b
Unsprayed control[w]	—	—	137a	33b	70a	99b	23c	65a	138b	92b	37a
DBCP	55	irrigation water	134	82	24[y]	135	11	47[w]	166	95	19[z]

[t]See footnotes in Table 2 for rates, methods, and dates of application.
[u]% of the total fruit weight composed of fruit 6.2 cm in diam or larger.
[v]% of the fruit with moderate to severe damage caused by the citrus rust mite, *Phyllocoptruta oleivora*.
[w]Foliar applications of acaricides made only in late season after aldicarb no longer controlled citrus rust mite.
[x]Mean separation in columns by Duncan's multiple-range test (P = 0.05).
[y]Foliar applications of acaricides made early in the season.
[z]Average of trees receiving early-season foliar acaricide sprays and those receiving only late-season sprays.

TABLE 4. Effect of soil application of aldicarb on *Tylenchulus semipenetrans* populations in a 'Webb Redblush' grapefruit orchard.

Treatment	Rate [kg (a.i.)/ha]	No. of larvae (in 1000's)/100 cm³ soil: Pre-treatment Feb 77	May 77	Jul 77	Sep 77	Nov 77	Post-treatment av.
Aldicarb[y]	5.7	23.2a[z]	8.9ab	4.2a	1.1b	4.4ab	4.7b
Aldicarb	11.4	17.8a	6.0b	5.5a	1.6b	1.7b	3.7b
Control	—	17.6a	14.6a	4.7a	8.1a	11.2a	9.6a
		Mar 78	May 78	Jun 78	Aug 78	Oct 78	Post-treatment av.
Aldicarb	5.7	2.7a	2.2b	1.0b	4.1ab	2.2b	2.4b
Aldicarb	11.4	2.7a	1.5b	2.1b	0.5b	1.7b	1.5b
Control	—	4.7a	11.9a	16.1a	12.9a	9.1a	12.5a

[y]Aldicarb (Temik 15G) was chisel-applied on 17 Mar 1977 and 20 Mar 1978, 5–10 cm deep in a swath on each side of the tree row with four shanks spaced about 40 cm apart and plots flooded with 15 cm of irrigation water.
[z]Mean separation in columns and groups by Duncan's multiple-range test (P = 0.05).

TABLE 5. Effect of aldicarb treatments on yield, fruit size, and quality of 'Webb Redblush' grapefruit.

Treatment	Rate [kg (a.i.)/ha]	1977 Yield (kg/tree)	1977 %[w] >9.2 cm	1977 %[x] russet	1978 Yield (kg/tree)	1978 %[w] >9.2 cm	1978 %[x] russet
Aldicarb[y]	5.7	81ab[z]	64b	29b	145a	68.9b	25b
Aldicarb	11.4	95a	72a	16c	156a	76.4b	31b
Control	—	70b	39c	85a	75b	92.9a	52a

[w]% of total fruit weight composed of fruit 9.2 cm in diam or larger.
[x]% of the fruit with moderate-severe damage caused by the citrus rust mite, *Phyllocoptruta oleivora*.
[y]See footnotes in Table 4 for rates, method, and dates of application.
[z]Mean separation in columns by Duncan's multiple-range test (P = 0.05).

between replications receiving early-season acaricide sprays and those receiving late-season applications were small, and data in Table 5 represent averages of all replications.

DISCUSSION

As in past studies (5, 7, 9, 11, 13), application of DBCP resulted in excellent long-term control of *T. semipenetrans* which usually resulted in yield and fruit size increases. Three to four applications of oxamyl annually reduced citrus nematode populations only slightly and did not increase yields. Even when foliar applications of oxamyl followed soil treatment with DBCP, oxamyl did not prevent a gradual increase in *T. semipenetrans* populations. Considering the present results and the erratic performance of oxamyl in the past (3, 8, 12, 13), it does not appear to be an adequate substitute for DBCP.

Soil application of aldicarb at both rates and by both methods reduced citrus nematode populations about 70–90% in orange and grapefruit orchards. A significant increase in yield of oranges was observed in only 1 of 3 years, but similar results were obtained with DBCP. Although nematode control may result in increases in fruit size (13), most of the size increases in oranges appeared to be due primarily to reduction of rust mite damage. Severe rust mite damage has also been found to reduce the growth rate of citrus fruit in Florida (1). In the grapefruit orchard, aldicarb applications increased yield and fruit size and reduced rust mite damage. In this case, it was difficult to separate the effects of citrus nematode and rust mite on yield and fruit size.

Aldicarb at the rates used was not as effective as DBCP in reducing citrus nematode populations. However, since samples in this study were taken only in the areas actually treated and only at the 15-cm depth, it is difficult to assess the effects of these materials on the total population. DBCP applied in a flood irrigation system nearly eradicates citrus nematode near the surface, but penetrates fine-textured soils poorly (13) so that populations may remain high at greater depths. Aldicarb is applied to only a portion of the orchard surface and does not provide a high degree of control of nematodes outside the area actually treated (6). Yield increases following aldicarb treatment are comparable to those following DBCP treatment, and both materials may have a similar effect on the total population.

Aldicarb appears well-suited to a pest management system in Texas citrus orchards. In addition to providing control of *T. semipenetrans*, aldicarb generally controls citrus rust mite for 90–120 days and eliminates the need for postbloom and early-summer acaricide applications (French and Timmer, unpublished). Aldicarb also controls other mites, mealybugs, aphids, and whiteflies but is not highly effective against armored scale (French, unpublished). Since aldicarb treatment eliminates the need for foliar sprays of insecticides and acaricides, it should prove to be less detrimental to beneficial insects and mites. The only disadvantages are that aldicarb must be soil-incorporated and the orchard flood-irrigated following application. Soil incorporation disrupts the nontillage chemical weed-control systems used in most Texas citrus orchards, and a preemergent herbicide must usually be applied following aldicarb incorporation. Since DBCP and aldicarb require flood irrigation for proper application, no adequate means is presently available for nematode control in orchards with drip irrigation.

Aldicarb applied at 5.7 kg/ha controls citrus nematode and rust mite at costs comparable to the costs of DBCP for nematode control and foliar acaricides for mite control. The slight added benefits attained from the 11.4-kg/ha rate appear to be economically unjustified.

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