Effects of Aldicarb on Fusarium Wilt-Root-Knot Nematode Disease of Cotton[1]

E. C. JORGENSON[2]

Aldicarb nematicide (2-methyl-2-(methylthio)-propionaldehyde-0-(methylcarbamoyl) oxime) may not be as effective for *Meloidogyne* spp. as for some other nematodes because its disorienting effect on males is of little use with parthenogenic species (2, 3). Even so, other sublethal effects of aldicarb on nematodes (including delayed hatching, impeded migration, and impaired feeding behavior) may be useful in root-knot nematode control on cotton (2, 3, 4).

The tests reported here were done to evaluate: 1) the effects of aldicarb on the fusarium wilt-root-knot nematode complex disease; and 2) the significance of systemic activity of aldicarb in cotton roots in relation to root-knot nematodes.

Received for publication 13 February 1978.

[1] Cooperative investigation, Science and Education Administration, United States Department of Agriculture, and California State Agricultural Experiment Station. No endorsements are implied herein.

[2] Zoologist U. S. Cotton Research Station, 17053 Shafter Avenue, Shafter, California 93263.

Soil naturally infested with *Meloidogyne incognita* (Kofoid & White) Chitwood and the fusarium wilt organism, *Fusarium oxysporum* f. sp. *vasinfectum* (Atk.) Snyder & Hansen, was mixed for homogeneity and placed in one-liter plastic containers. Containers received a logarithmic series of doses of technical aldicarb (Table 1). There were seven replications of each treatment. Aldicarb was added to each container in 25 ml of water, and thereafter only enough water was added to sustain plant growth without leaching. Five (*Gossypium hirsutum* L. 'Acala SJ-1') cotton seed were planted per container. After emergence, the plants were thinned to three per container and grown for 6 weeks. The degree of fusarium wilt-root-knot nematode disease at that time is reflected in seedling weight (Table 1). Disease of cotton was sharply reduced by aldicarb at 2.0 and 0.2 μg/g soil. At lower doses the cotton seedlings were destroyed. The two effective treatments reduced the nematode populations only a little more than 40% (Table 1). This degree of reduction in nematode populations is insufficient to account for the disease control obtained even though death to nematodes tended to increase slightly as the dose of aldicarb increased. Correlation coefficients for aldicarb vs. nematodes (r = –0.47 NS) nematodes vs. seedling weight (r = –0.63 NS) and aldicarb vs. seedling weight (r = 0.81*) give indication that behavior and pathogenicity were altered by the longer duration and increased intensity of exposure to which the nematodes were subjected at the highest doses. Thus, these sublethal doses of aldicarb caused root-knot nematodes to dysfunction as components of the fusarium wilt-root-knot nematode complex disease of cotton.

To test the systemic effect of aldicarb on root-knot nematode in cotton roots, two-week-old 'Acala SJ-1' cotton seedlings which had been grown in methyl-bromide-fumigated (6.8 kg/1.0 m^3) Hesperia sandy loam (76% sand, 17% silt, and 7% clay) were prepared for the experiment by dividing the root system of each seedling, without splitting, into two portions—an upper one and a lower one. Then the seedlings were transplanted with the upper portion of the main root and lateral roots in one plastic container and the lower in another. The two containers were cemented together, side by side. Foam rubber was fitted around the main root at the juncture between the two containers to minimize contamination and to protect the exposed portion of the root. After the plants had grown 2 weeks, technical aldicarb was applied to root portions as indicated in Table 2 in 25 ml aqueous solution at a rate of toxicant equal to 4 μg (ai/g soil). In addition, 3,000 root-knot nematode larvae, hatched from egg masses obtained from tomato (*Lycopersicon esculentum* L., 'Ace') were added as described in Table 2 to the containers. There

TABLE 1. Effect of aldicarb treatment of soil infested with *Meloidogyne incognita* and *Fusarium oxysporum* f. sp. *vasinfectum* on the nematode population level and cotton growth.

μg aldicarb per g soil	No. of nematodes per 500 cm^3 soil	Seedling weight (g)
2.0	279 bc[1]	2.93a
0.2	270 c	2.38a
0.02	303 bc	.54 b
0.002	331 bc	.85 b
0.002	509a	.69 b
0.00002	435abc	.65 b
0.0	485a	.53 b

[1]In each column averages followed by the same letter do not differ at the 5% level of significance.

TABLE 2. Infection of cotton roots by *Meloidogyne incognita* as influenced by treatment of portions of the roots with aldicarb.

Root portion	Treatment: Nematodes	Treatment: Aldicarb	Gall rating[a]
Upper	+	–	100
Lower	–	+	0
Upper	–	+	0
Lower	+	–	100
Upper	+	+	8
Lower	–	–	0
Upper	–	–	0
Lower	+	+	37
Upper	–	–	0
Lower	–	–	0
LSD .05			10

[a]0 = no galling, 100 = maximum galling; mean of seven replications.

were seven replications of each of the five treatments. The experimental design was randomized complete blocks. In a second similar experiment, aphids, *Aphis gossypii* Glover, were placed on the leaves of each plant just after transplanting and before the aldicarb was applied (4). After the aphids became established on the plants and were uniformly distributed, technical aldicarb was applied in 25 ml water at the rate of 4 μg/g soil. The following day the number of surviving aphids was counted. The low survival of aphids on plants treated with aldicarb (upper roots 7%; lower roots 18%) compared with the relatively high survival of aphids on untreated plants (85%) confirmed that aldicarb was translocated to the leaves from upper and lower roots. After two weeks there were no significant differences in average plant weights in the various treatments.

Root-knot nematodes were controlled only when aldicarb was in contact with them in the same container. There was no evidence that aldicarb moved from upper to lower roots, or vice versa, in amounts sufficient to control the nematodes (Table 2).

Relationships between nematode survival or death and dose of aldicarb are allied with the means by which aldicarb comes in contact with nematodes: In the soil, it disperses by mass transfer in the water in the direction of water movement (3). In the nematodes' environment there may be a variable concentration gradient of the toxicant, depending on the initial dose of toxicant, the amount and flow of water, and the adsorption characteristics of the soil (1, 3). The location of nematodes in relation to that gradient determines whether they are subjected to lethal or sublethal doses. Because of cost, the control which aldicarb exerts by its sublethal effects may be more useful than lethal effects in a pest management system to control root-knot nematodes and the fusarium wilt-root-knot nematode complex disease. Its role is adjunctive to other nematicides and to tolerant-resistant varieties, because the effects are temporary if not evanescent. Aldicarb is quickly taken up by cotton seedlings, as was shown by the response of the aphids, but aldicarb's systemic activity was shown to be of minor usefulness in controlling root-knot nematodes on cotton.

LITERATURE CITED

1. GRIFFIN, G. D. 1977. Effects of soil moisture on control of Heterodera schachtii with aldicarb. J. Nematol. 9:211-215.
2. HOUGH, A., and I. J. THOMASON. 1975. Effect of aldicarb on the behavior of Heterodera schachtii and Meloidogyne javanica. J. Nematol. 7:221-229.
3. HOUGH, A., I. J. THOMASON, and W. J. FARMER. 1975. Behavior of aldicarb in soil relative to control of Heterodera schachtii. J. Nematol. 7:214-221.
4. STEELE, A. E., and L. R. HODGES. 1975. In-vitro and in-vivo effects of aldicarb on survival and development of Heterodera schachtii. J. Nematol. 7:305-312.