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MANAGEMENT OF *MELOIDOGYNE INCOGNITA* IN COTTON WITH NEMATICIDES[7]

by
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Summary. Four field trials were conducted in Georgia, U.S.A. over two years to compare rates of 1,3-dichloroproprene (1,3-D), aldicarb and their combinations on the growth of cotton in producer fields infested with *Meloidogyne incognita.* 1,3-D was injected 30-cm-deep with a single in-row chisel two weeks prior to planting. Three rates of aldicarb were applied in-furrow during the planting operation. In three of the tests, an additional sidedressing application of aldicarb was placed into the soil at 2.5-cm-deep and 15 cm on either side of the cotton plants at 24 to 28 days after planting. Cotton lint yields varied by location and year but were improved with 1,3-D (32 kg a.i./ha) + aldicarb (0.59 kg a.i./ha), aldicarb (1.17 kg a.i./ha), and aldicarb (0.87 kg a.i./ha) + aldicarb sidedress (1.17 kg a.i./ha). The 1,3-D (32 kg a.i./ha) + aldicarb (0.59 kg a.i./ha) treatment provided the most consistent and greatest yield improvement over controls, while relative cotton yield in specific aldicarb treatments varied among tests. Plant stands, plant height, and root-knot nematode numbers generally did not differ among treatments. Based on data from these tests, 1,3-D and aldicarb, alone or in combination, can be recommended for management of *M. incognita* in Georgia cotton production systems.

Nematode management has become an increasingly important aspect of cotton production in the United States. Based on a national survey conducted in 1996, 3.7% (762,520 bales) of cotton production was lost due to plant-parasitic nematodes (Blasingame, 1997). An extensive survey in Georgia revealed that 45% of all fields had at least one potentially damaging nematode species in cotton and approximately 15% of the infested fields were above threshold levels (-Baird *et al.*, 1996). However, in areas of the state with a tradition of cotton production 25 to 66% of the fields had damaging thresholds levels resulting in yield losses of up to 30% (Baird *et al.*, 1998). The three major nematode species responsible for these losses are southern root-knot

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(*Meloidogyne incognita* Races 1 and 3), Columbia lance (*Hoplolaimus columbus*) and reniform (*Rotylenchulus reniformis*) nematodes (Rich, pers. comm.).

The nematicides 1,3-dichloroproprene (1,3-D) and aldicarb are registered for the control of plant-parasitic nematodes in cotton. Baird *et al.* (2000) reported that 1,3-D plus aldicarb or aldicarb alone at several rates increased cotton yield in reniform nematode-infested soil. Other studies have shown varying levels of effectiveness with aldicarb for the control of the major cotton nematodes (Gazaway and Rush, 1995; Lawrence and McLean, 1995; Baird and McDaniel, 1996). In these studies the recommended rate for thrips control, 0.6 kg a.i./ha, was compared with 0.8 and 1.2 kg a.i./ha rates; with the latter two higher rates resulting in greater yields. Often, however, the 0.8 kg a.i./ha rate would produce higher yields than the 1.2 kg a.i./ha rate, perhaps indicating a phytotoxic response to high in-furrow rates of aldicarb as has been reported previously (Baird and Herzog, 1997; Baird and McDaniel, 1997). Even with applications of aldicarb at planting, yield losses of cotton still occur in heavily infested fields. Consequently, an additional application of aldicarb as a post-emergence sidedressing has been studied and shown to be efficacious (Baird and Herzog, 1999).

Few published reports verify efficacy or rates of 1,3-D or aldicarb to manage the southern root-knot nematode in cotton. 1,3-D is recommended and used extensively in crops such as tobacco for root-knot nematode management (Rich *et al.*, 1989) and has been found to be effective on southern root-knot nematodes in cotton grown in Florida (Kinloch and Rich, 1998). Aldicarb is routinely used for thrips (*Frankliniella* spp.) control on cotton and recommended at higher rates for nematode control (Brown *et al.*, 1997).

Effective nematicide treatments are important to cotton growers who are unable to rotate crops or follow a short-term rotation system. Therefore, the objective of this study was to determine the efficacy of 1,3-D and aldicarb for the management of *Meloidogyne incognita* (Kofoid *et* White) Chitw., on cotton (*Gossypium hirsutum* L.).

Materials and methods

During 1997 and 1998, four field trials were conducted on farms in two cotton production areas of Georgia. Tests in 1997 were established in Tift County (Trials A and B) and Colquitt County, and in 1998 in Tift County (Trial C). Experimental methods were similar at all sites, and fertilization and herbicide practices were according to recommendations for cotton production in the state of Georgia (Brown *et al.*, 1997). Soil at the four test sites was a Tifton fine-loamy sand, siliceous, thermic Plinthic Kandiudult with a pH of 6.0-6.2. Plots were prepared by discing to incorporate residual plant residue and subsoiling in early April. Plot sizes were: Tift County Trial A-12 rows wide x 91.4 m long, Tift County Trial B-4 rows wide x 15.3 m long, Tift County C-8 rows wide x 15.4 m long, and Colquitt County Trial-4 rows wide x 323.8 m long. Plot row width was 91.4 cm wide. Each test was arranged in a randomized complete block design containing four replicates. The 1,3-D treatments were injected 30-cm below the final planting surface with a single in-row chisel, and all test plots were bedded at this time (Table I). A minimum of 14 days was allowed for fumigant dissipation. Aldicarb was applied in-furrow at planting and as sidedressing applications 24 to 28 days after planting. The sidedressing applications were placed at 2.5 cm deep and 15 cm on either side of the plants. In-furrow applications of either phorate or disyston were made at planting for thrips management since aldicarb is active against this cotton seedling pest. Cotton was planted at the rate of 10-12 seed/m of row (Table I). Cultivars used in the test included Delta and Pine Land (DPL) 90 at Tift County Trials A and B, NuCotn 33B at Colquitt County, and DPL 5415 at the Tift County C Trial.

Data collection from each plot included cotton plant stand from 6.1 m of row, heights of 10 randomly selected plants, and seed cotton and nematode populations. Individual plots were mechanically harvested and lint yields determined by multiplying with a factor of 0.35. Soil samples for nematode analysis from each plot were collected before planting and at mid-season at all locations. Twenty soil cores (2.5 cm diam. x 25 cm deep) were randomly collected within rows from each plot and composited. Nematodes were extracted from 100 cm^3 soil subsamples by a centrifugation-sugar flotation method (Jenkins, 1964); root-knot nematode juveniles were counted. Dates of specific activities for each trial are listed in Table I.

Data were subjected to analysis of variance procedures and differences among means were separated by Waller-Duncan's k-ratio t-test ($P \leq 0.05$).

Results and discussion

Preplant root-knot nematode counts averaged 122, 87, 235, and 97 juveniles/100 cm^3 of soil at Tift County Trials A and B, Colquitt County, and Tift County Trial C, respectively. Midseason population densities of the southern root-knot nematode were also similar in these tests, and population levels were not reduced ($P \leq 0.05$) by nematicide treatment (Table II). Root-knot nematode juvenile densities were low in two of the trials and averaged 82, 15, 110, and 17 juveniles/100 cm^3 soil for Tift County Trials A and B, Colquitt County Trial, and Tift County Trial C, respectively. These low numbers, and lack of differences in nematode populations among treatments, may reflect the large size of the field plots and the extremely dry conditions when the samples were collected. Previous studies reported that low soil moisture can be directly correlated with low juvenile populations (Goodell and Ferris, 1989; Windham and Barker, 1993). These variations in nematode population densities within plots, and sample timing, make it difficult to evaluate the direct effect of nematicides on nematode populations (Noe, 1990). In an earlier study, a *M. incognita*-infested field treated with aldicarb had postharvest population densities similar to the control plots but with yield increases (Johnson *et al.*, 1998). Kinloch and Rich (1998) reported that post-harvest population densities of *M. incognita* were reduced with 1,3-D compared to the control, but aldicarb did not similarly reduce *M. incognita* levels. Conversely, other studies with the reniform nematode on cotton have shown that different rates of aldicarb or 1,3-D significantly lowered population densities which corresponded with increased yields (Burmester *et al.*, 1997; Lawrence *et al.*, 1997).

TABLE I - *Dates of nematicide application and data collection in cotton from four field trials conducted in 1997 and 1998.*

Activity	1997 Tift Co. Trial A	1997 Tift Co. Trial B	1998 Tift Co. Trial C	1997 Colquitt Co.
1,3-D application	4 May	21 May	21 May	26 April
Aldicarb at-planting	4 June	4 June	4 June	10 May
Aldicarb sidedressing	27 June	2 July	1 July	4 June
Stand counts	10 July	20 June	1 September	23 June
Plant height	1 July	1 July	1 September	17 July
Harvest	18 November	4 November	5 October	17 October
Preplant samples	9 May	9 May	13 May	25 March
Mid-season samples	30 July	30 July	21 July	31 July

Cotton stand counts and plant heights varied little among treatments or controls at the four locations in this study, and no differential plant growth trends were observed. Unlike a previous study to evaluate nematicides for *R. reniformis* control, stand counts or plant heights were not significantly different among nematicide treatments, locations, or years (Baird *et al.*, 2000). In three of the four tests, cotton lint yields were increased (P≤0.05) in plots treated with 1,3-D (32 kg ai.i./ha) + aldicarb (0.59 kg a.i./ha) or aldicarb alone (1.17 kg a.i./ha) compared to the

TABLE II - *Effect of nematicide treatments on population levels (J2/100 cm³ of soil) of* Meloidogyne incognita *(midseason) in infested cotton fields in Georgia.*

Treatment	Rate kg a.i./ha	1997 Tift Co. Trial A	1997 Tift Co. Trial B	1998 Tift Co. Trial C	1997 Colquitt Co.
Phorate	1.56	–	–	–	89 b
Disulfoton[a]	1.17	82 a[b]	21 a	18 a	–
Aldicarb	0.59	90 a	22 a	13 a	84 b
Aldicarb	0.87	–	10 a	20 a	139 a
Aldicarb	1.17	104 a	28 a	25 a	96 ab
Aldicarb + aldicarb[c]	0.87 1.17	73 a	– a	15 a	–
1,3-D + aldicarb	32.0 0.59	60 a	16 a	26 a	122 a

[a] Disulfoton and phorate treatments served as non-treated controls and were added for thrips management since aldicarb is active against early season insect pest.
[b] Numbers followed by the same letters are not significantly different (P≤0.05) according to Waller-Duncan's k ratio T-test.
[c] Aldicarb was applied 24 to 28 days after planting as a sidedressing application at 2.5 cm deep and 15.2 cm on either side of the planted row center.

TABLE III - *Effect of nematicide treatments on lint yields (kg/ha) in cotton fields infested with* M. incognita *in Georgia.*

Treatment	Rate kg a.i./ha	1997 Tift Co. Trial A	1997 Tift Co. Trial B	1998 Tift Co. Trial C	1997 Colquitt Co.
Phorate	1.56	–	–	–	518 c
Disulfoton[a]	1.17	626 c[b]	684 a	601 b	–
Aldicarb	0.59	701 bc	750 a	688 b	625 c
Aldicarb	0.87	–	748 a	871 a	698 bc
Aldicarb	1.17	785 b	742 a	864 a	720 ab
Aldicarb + aldicarb[c]	0.87 1.17	788 b	748 a	846 a	–
1,3-D + aldicarb	32.0 0.59	885 a	792 a	906 a	737 a

[a] Disulfoton and phorate treatments served as non-treated controls but were added to manage thrips since aldicarb is active against this early season insect pest.
[b] Numbers followed by the same letters are not significantly different (P≤0.05) according to Waller-Duncan's k ratio T-test.
[c] Aldicarb was applied 24 to 28 days after planting as a sidedressing application at 2.5 cm deep and 15.2 cm on either side of the planted row center.

control (Table III). The 1,3-D (32 kg a.i./ha) + aldicarb (0.59 kg a.i./ha) produced the highest yields while aldicarb at 0.59 kg a.i./ha did not increase cotton lint yield over that of the control plots. Both findings agree with previous results (McGriff *et al.*, 1997; Kinloch and Rich, 1998). The sidedressing application of aldicarb did not improve yields over the at planting applications of the material alone. Use of the sidedressing application and at planting rates of aldicarb at 0.59 and 0.87 kg a.i./ha should be further studied due to variable results in cotton yield responses. The 1,3-D + aldicarb and aldicarb alone (1.17 kg a.i./ha) treatments consistently increased yields in these tests. These materials and rates are now recommended for the control of the southern root-knot nematode in Georgia cotton.

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