INFLUENCE OF ALDICARB AND 1,3-DICHLOROPROPENE APPLICATIONS ON COTTON YIELD AND *ROTYLENCHULUS RENIFORMIS* POST-HARVEST POPULATIONS[†]

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ABSTRACT

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A three-year nematicide study in north Florida, involving four separate cotton field trials, was conducted in loamy sand soils infested with *Rotylenchulus reniformis*. Cotton lint yield responses and post-harvest soil infestation levels of *R. reniformis* were evaluated after treatment with four single chisel application rates of 1,3-dichloropropene (1,3-D: 16, 32, 48, and 64 kg a.i./ha) and six rates of aldicarb (0.50, 0.84, 1.01, 1.18, 1.51, and 2.02 kg a.i./ha) placed in a 15-cm-wide band. All rates of 1,3-D increased ($P \leq 0.05$) lint yields of cotton in three of the four trials compared to the non-treated controls. Post -harvest soil populations of *R. reniformis* were reduced by 1,3-D treatments in only one of the tests. Aldicarb increased cotton yield ($P \leq 0.05$) at all rates in one test, and at one rate in a second test. Soil populations of *R. reniformis* were reduced in only one aldicarb treatment in one of the tests. Average cotton yield across treatments increased by 139 kg/ha with 1,3-D and 72 kg/ha with aldicarb, compared to non-treated controls. Lack of significant correlations among rates of 1,3-D or aldicarb and cotton lint yield indicated lower rates of the materials used in these tests were as effective as higher rates to manage *R. reniformis*.

Key words: aldicarb, cotton, 1,3-dichloropropene, *Gossypium hirsutum*, nematicide, reniform nematode, *Rotylenchulus reniformis*.

RESUMEN

Rich, J. R. y R. A. Kinloch. 2000. Influencia de las aplicaciones de aldicarb y de 1,3-dicloropropeno en el rendimiento del algodón y en las poblaciones post-cosecha de *Rotylenchulus reniformis*. Nematrópica 30:47-53.

Un estudio de nematicidas, que se desarrolló durante tres años en el norte de la Florida, involucró cuatro campos separados de algodón y el uso de suelos de arena suelta, infestados con *Rotylenchulus reniformis*. Se evaluaron las respuestas de rendimiento de hilachas del algodón y los niveles de infestación post-cosecha de *R. reniformis*, después del tratamiento con cuatro aplicaciones simples de 1,3-dicloropropeno (1,3-D; 16, 32, 48, y 64 kg a.i./ha), y seis niveles de aldicarb (0.50, 0.84, 1.01, 1.18, 1.51, y 2.02 kg a.i./ha), puestos en una banda de 15 cm de ancho. Todos los niveles de 1,3-D, aumentaron ($P \leq 0.05$) los rendimientos de hilacha del algodón en tres de las cuatro pruebas, en comparación con los controles no tratados. Con los tratamientos de 1,3-D, las poblaciones post-cosecha de *R. reniformis* se redujeron en solamente uno de los ensayos. En un ensayo, todos los niveles de aldicarb aumentaron el rendimiento del algodón ($P \leq 0.05$), en un segundo ensayo ésto solo ocurrió con uno de los niveles empleados. Las poblaciones de *R. reniformis* en el suelo, se redujeron en un solo tratamiento, en uno de los ensayos. El rendimiento promedio del algodón a través de los tratamien-

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tos, aumentó en 139kg/ha con 1,3-D y en 72kg/ha con aldicarb, comparado a los controles no tratados. La pérdida de correlación significativa entre los niveles de 1,3-D o aldicarb y el rendimiento de hilachas del algodón, indicaron que el uso en menor o mayor concentración de los materiales usados en estos ensayos, tuvo la misma efectividad para controlar a *R. reniformis*.

Palabras claves: aldicarb, algodón, 1,3-dicloropropeno, *Gossypium hirsutum*, nematicida, nematodo reniforme, *Rotylenchulus reniformis*.

INTRODUCTION

Upland cotton (*Gossypium hirsutum* L.) is a major agronomic crop in the northern tier of counties in Florida with 40 000 ha planted in 1997 (Anon., 1998). The reniform nematode, *Rotylenchulus reniformis* (Linford and Oliveria), occurs in 16% of Florida cotton fields, generally in the heavier soils of the western panhandle region of the state (Kinloch and Sprenkel, 1994). When detected, *R. reniformis* population densities averaged 160/100 cm^3 during mid-winter. Management of *R. reniformis* consists of crop rotation and use of nematicides since no resistant cotton varieties are available (Dunn and Noling, 1997). Other crops commonly grown in northern Florida such as peanut (Baird *et al.*, 1996) and maize (Lawrence *et al.*, 1991) are non-hosts of *R. reniformis* and useful in rotation systems. Peanut, however, has a limited hectarage due to allotment constraints, and maize production in the region has been reduced in recent years due to low prices. Conversely, cotton hectarage has increased 334% over the past 10 years due to relatively high commodity prices (Anon., 1998). Thus, many growers monoculture cotton, resulting in increased *R. reniformis* damage. The remaining management option for these growers is limited to use of nematicides. Recommended practices in Florida cotton include applications (10-15 cm band) of aldicarb at rates from 0.59 to 1.68 kg a.i./ha or single chisel row applications of 1,3-dichloropropene (1,3-D) at rates from 34 to 128 kg a.i./ha, both based on rows 91 cm apart (Dunn and Noling, 1997). These use rate recommendations were obtained from company registrations with only limited research conducted in Florida to verify efficacy.

The objectives of the following tests were to determine the responses of cotton yield and post-harvest *Rotylenchulus reniformis* soil population densities to 1,3-D and aldicarb to more accurately define use rates of these materials.

MATERIALS AND METHODS

Three field trials were conducted at adjacent sites in *R. reniformis*-infested soil at the University of Florida NFREC in Gadsden County, and one trial on the Godwin Farm in Santa Rosa County, Florida, U.S.A. Soil at the test sites was a sandy loam (80% sand, 8% silt, 12% clay) in Gadsden County and a loamy sand (82% sand, 10% silt, 8% clay) at the Santa Rosa site. All sites had been planted to cotton the previous year. Prior to treatment, each randomly assigned plot was assayed for *R. reniformis* by removing six soil cores (2.54-cm diam and 22-cm deep). Cores from the individual plots were mixed and a sub-sample of 100 cm^3 soil was removed for nematode extraction using the modified centrifugation-sugar flotation technique (Jenkins, 1964). Pretreatment nematode population densities in the samples were 1 115, 1 426, 1 205, and 1 423/100 cm^3 soil in the 1995

Gadsden, 1995 Santa Rosa, 1997 Gadsden, and 1998 Gadsden tests, respectively.

Nematicide treatments were applied to plots two rows wide and 7.6-m long on 91-cm wide centers. Treatments were arranged in a randomized complete block design containing six replicates in the two 1995 tests, and five replicates in the 1997 and 1998 tests. The trials included replicated control plots, and all experimental sites were bordered by non-treated cotton. The fumigant 1,3-D was applied 30-cm-deep with a single chisel beneath the row at rates of 16, 32, 48, and 64 kg a.i./ha, 14 to 17 days prior to planting. Granular aldicarb was applied during the planting operation in a 15-cm-wide band and incorporated at rates of 0.50, 1.01, 1.51, and 2.02 kg a.i./ha in the 1995 tests and at 0.50, 0.84, 1.18, and 1.51 kg a.i./ha in the 1997 and 1998 tests. Since soil treatment with aldicarb is recommended to manage thrips, control plots and those treated with 1,3-D received an at-plant treatment of phorate at 1.13 kg a.i./ha to manage this seedling-damaging insect. The planting date of cotton cv. Chembrand 407 in 1995 was 8 May and 15 May at the Gadsden and Santa Rosa County sites, respectively. Planting of cotton cv. Delta and Pineland 5415RR was on 6 May and 15 May in the 1997 and 1998 tests, respectively. Harvest dates were 15 December (Gadsden County), 14 November (Santa Rosa County), 3 December, and 16 October in 1995, 1997, and 1998 tests, respectively. Soil fertility, weed, and insect management were in accordance with standard practices (Sprenkel, 1995). Entire plots were harvested manually for seed cotton yield and converted to lint yield by multiplying by 0.4. Within two weeks following harvest, all plots were sampled for *R. reniformis* as described above. Data were analyzed using ANOVA and CORR programs in MSTAT-C (Michigan State University).

RESULTS

Cotton lint yield was not increased by any of the aldicarb treatments in the 1995 or 1997 Gadsden County tests (Table 1). All aldicarb rates in the 1995 Santa Rosa County test increased lint yield, and the 0.84 kg a.i./ha rate increased yield in the 1998 Gadsden trial. A positive correlation ($r = 0.55$, $P \leq 0.05$) between lint yield and aldicarb rates was found only in the 1995 Santa Rosa trial and was expressed as:

$$Y = 425 + 105X$$

where Y is the cotton lint yield in kg/ha and X is the rate of aldicarb in kg a.i./ha. Aldicarb treatments did not reduce post-harvest soil populations of *R. reniformis* ($P > 0.05$) compared to the control plots. Only in the 1998 Gadsden trial and with a single aldicarb treatment (1.51 kg a.i./ha) were nematode numbers lower than the control plots. No correlations ($P > 0.05$) between aldicarb rates and post-harvest *R. reniformis* populations were found in the four tests.

Cotton lint yield was increased ($P \leq 0.05$) in three of the four tests where 1,3-D was applied (Table 2). All treatments in these tests increased lint yield over the control plots, but no differences in yield were found among 1,3-D rates. In the remaining test (Gadsden 1995), all treatments numerically increased yields over the control plots. In this test, a positive correlation ($r = 0.40$, $P \leq 0.05$) was found between lint yield and rates of 1,3-D. It was expressed as:

$$Y = 1145 + 7.53X$$

where Y is the cotton lint yield in kg/ha and X is the rate of 1,3-D in kg a.i./ha. With 1,3-D treatment, post-harvest soil population densities of *R. reniformis* were only reduced ($P \leq 0.05$) in the 1998 Gadsden test. All 1,3-D treatments in this test

Table 1. Cotton lint yield and post-harvest *Rotylenchulus reniformis* soil populations following applications of aldicarb in four Florida field tests.

	Gadsden, 1995		Santa Rosa, 1995		Gadsden, 1997		Gadsden, 1998	
Aldicarb kg a.i./ha	Lint kg/ha	Nematodes/ 100 cm^3 soil	Lint kg/ha	Nematodes/ 100 cm^3 soil	Lint kg/ha	Nematodes/ 100 cm^3 soil	Lint kg/ha	Nematodes/ 100 cm^3 soil
Control	516 a[z]	3 781 a	193 b	3 785 ab	1 003 a	3 166 a	430 b	3 416 a
0.50	617 a	4 763 a	253 a	3 981 ab	1 017 a	3 035 a	436 b	3 151 a
0.84	—	—	—	—	1 112 a	3 933 a	502 a	3 155 a
1.01	580 a	4 607 a	253 a	3 081 b	—	—	—	—
1.18	—	—	—	—	1 169 a	3 052 a	450 b	2 168 b
1.51	615 a	4 348 a	265 a	4 855 a	1 127 a	3 962 a	458 b	3 120 a
2.02	576 a	5 411 a	246 a	4 640 a	—	—	—	—

[y]Data are averages of six replications in the two 1995 tests and five replications in the 1997 and 1998 tests.
[z]Column means followed by the same letter are not significantly different ($P \leq 0.05$) according to Least Significant Difference test.

Table 2. Cotton lint yield and post-harvest *Rotylenchulus reniformis* soil populations following applications of 1,3-dichloropropene in four Florida field tests.[y]

	Gadsden, 1995		Santa Rosa, 1995		Gadsden, 1997		Gadsden, 1998	
1,3-D kg a.i./ha	Lint kg/ha	Nematodes/ 100 cm^3 soil	Lint kg/ha	Nematodes/ 100 cm^3 soil	Lint kg/ha	Nematodes/ 100 cm^3 soil	Lint kg/ha	Nematodes/ 100 cm^3 soil
Control	516 a[z]	3 781 a	193 b	3 785 ab	1 003 b	3 166 a	430 b	3 416 a
16	578 a	4 073 a	277 a	5 108 ab	1 192 a	2 536 a	546 a	2 459 b
32	632 a	4 452 a	287 a	4 633 ab	1 256 a	2 503 a	505 a	1 627 bc
48	633 a	4 507 a	284 a	5 463 a	1 202 a	3 121 a	506 a	1 247 c
64	672 a	5 369 a	284 a	2 883 b	1 236 a	2 534 a	508 a	1 033 c

[y]Data are averages of six replications in the two 1995 tests and five replications in the 1997 and 1998 tests.
[z]Column means followed by the same letter are not significantly different ($P \leq 0.05$) according to Least Significant Difference test.

reduced nematode populations compared to the control plots, and a negative correlation ($r = -0.715$, $P \leq 0.05$) between rate and nematode numbers was found. The relationship was expressed as:

$$Y + 3152 - 37.36X$$

where Y is the post-harvest soil population density of *R. reniformis*/100 cm^3 soil and X is the rate of 1,3-D in kg a.i./ha. Correlations were not significant in the other three tests.

When data from all tests were combined, no significant correlations ($P > 0.05$) were found between aldicarb or 1,3-D rates and cotton lint yield or post-harvest *R. reniformis* soil population densities.

DISCUSSION

The 1995 Santa Rosa test suffered from extreme rainfall (98 cm) from 4 August to near cotton harvest. Extensive lodging also was present on the cotton plants, but yield in the 1,3-D treatments in this test were greater than those of the control plots. Weather conditions, however, may have masked higher yields that may have accrued from the 1,3-D treatment. Consequently, with data from this test removed, an average lint yield increase in the other three tests was 139 kg/ha across 1,3-D treatments. In the 1995, 1997, and 1998 Gadsden tests, the average relative lint yield increases with 1,3-D (all doses) was consistent at 22, 22, and 20%, respectively, over the control plots. The general absence of rate effects indicate that the lower rates of 16-32 kg a.i./ha were sufficient to manage *R. reniformis* in these tests, confirming a previous report (Gazaway *et al.*, 1994). These data are unlike the continued yield increases obtained from 0-64 kg a.i. /ha of 1,3-D in tests to manage the southern root-knot nematode in Florida cotton fields (Kinloch and Rich, 1998).

Aldicarb provided less cotton yield increase than 1,3-D treatments. Excluding the weather-effected data from the 1995 Santa Rosa test, combined yield data indicated an average lint increase of 72 kg/ha. The average relative lint yield increases with aldicarb (all doses) was 7, 10, and 16% over the control plots in the 1995, 1997 and 1998 Gadsden County tests, respectively. Our cotton yield response data from aldicarb are similar to those of Gazaway *et al.* (1994) but less than found by Lawrence and McLean (1996). Performance of non-fumigant nematicides may vary due to initial nematode populations, rainfall and soil types. While 1,3-D application increased cotton yield more than aldicarb, the latter nematicide may be economically viable where the added advantage of thrips control is considered.

Post-harvest densities of *R. reniformis* generally were not reduced by applications of either aldicarb or 1,3-D. The rapid reproductive rate of the nematode probably masked the early effects of these nematicides (Gazaway, 1993). Earlier population assessments may prove more definitive in discerning nematicide effects on populations (Lorenz *et al.*, 1996).

Data from these tests indicate greater efficacy of 1,3-D compared to aldicarb to improve cotton yields in *R. reniformis*-infested fields. Additionally, use rate recommendations for both materials can be lowered in Florida cotton production recommendations.

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