FE318

UNIVERSITY OF FLORIDA
IFAS EXTENSION

Use of Telone II and Temik 15G to Improve Yields and Returns of Cotton Grown in Northwest Florida Fields Infested with Root-Knot Nematodes[1]

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Introduction

Upland cotton (*Gossypium hirsutum* L.) is a major agronomic crop in the northern tier of counties in Florida, with an estimated harvest of 91,000 acres in the year 2000 (USDA-FASS, 2001). The southern root-knot nematode (*Meloidogyne incognita*) is found in 61% of Florida cotton fields (Kinloch and Sprenkel, 1994). Management of this pest is accomplished through the use of nematicides, crop rotation, or a combination of the two practices. In Florida, nematicides are the most viable nematode management option because many growers only produce monoculture cotton and the low prices of other agronomic crops in the state make crop rotation expensive. The two primary nematicides used and recommended in Florida are Telone II and Temik 15G (Kinloch and Rich, 2000). Nematicide recommendations for root-knot nematode management in Florida cotton include single-chisel row applications of Telone II at 3 gallons per acre or 4- to 6-inch banded applications of Temik 15G at 7 pounds per acre. These recommendations have been based solely upon improvements in cotton yields in root-knot infested fields because of the lack of data on the economic returns value of nematicides. The present study was conducted to determine the economic value for growers at several rates of Telone II and Temik 15G use. To do this, incremental cost per pound of increased lint yield due to nematicide addition, net return per pound of increased lint yield, and partial net return per acre were calculated for the different treatments (Boehlje and Eidman, 1984).

Materials and Methods

A three-year nematicide study involving four separate test sites, all in farmer fields infested with root-knot nematode, was conducted in loamy sand soils of northwest Florida. Three of the sites were in Santa Rosa County (82% sand, 8% silt, and 6% clay) and the fourth site was in Jackson County (85% sand,

1. This is EDIS document FE 318, a publication of the Department of Food and Resource Economics, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL. Published November 2004. Please visit the EDIS website at http://edis.ifas.ufl.edu.

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6% silt, and 9% clay). These are typical soils for the cotton production areas of Florida.

Six soil cores (1 inch in diameter and 9 inches in depth) were taken from each plot and assayed for *M. incognita* second-stage infective juveniles before planting and one week after harvesting the cotton. Nematode population data and test methods are explained in more detail elsewhere (Kinloch and Rich, 1998).

Four rates of Telone II and five rates of Temik 15G were used in these tests. Each treatment was replicated five times in the Jackson County test and six times in the three Santa Rosa County tests. The trials included replicated plots of non-treated checks.

The Telone II treatments were applied to randomized plots. The fumigant was applied to a depth of 12 inches via a single chisel 14 to 17 days prior to planting using application rates of 1.5, 3, 4.5 and 6 gallons per acre. Thimet 20G was added to all Telone II treatments, including the related non-treated checks, at a rate of 5 pounds per acre to manage thrips (*Frankliniella occidentalis* and *F. fusca*). The cost of Thimet was $7.38 per acre (no application cost was assumed because Thimet was applied at planting time). Per acre lint yield increases, incremental cost calculations, and partial net returns were calculated for Telone II treatment rates.

Temik 15G, applied to randomized plots, was incorporated on a 4-6 inch wide band over the open seed furrow at planting using application rates of 3, 6, 7, 9, and 12 pounds per acre. The Temik 15G application cost was assumed to be negligible since it was applied at planting. Because Temik 15G functions as a thrips management agent, additional management for this pest was not required. Lint yield increases, incremental cost calculations, and partial net returns were calculated for different Temik 15G treatment rates.

Chembrand 407 cotton was planted in the two 1995 tests and Delta Pine 5415-RR cotton was used in the 1996 and 1997 tests. In 1995, the planting and harvest dates were April 25 and November 20, respectively, at the Jackson County test site, and May 15 and November 14, respectively, at the Santa Rosa County test site. The planting and harvest dates for the 1996 and 1997 tests at the Santa Rosa County test site were June 6 and November 14, and May 6 and November 20, respectively. Soil fertility, weed control, and insect management at all sites were as recommended for each of the areas (Sprenkel, 1995). Seed cotton was harvested from entire plots and then converted to lint yield by multiplying by 0.40.

The cost per pound of incremental lint yield is a major criterion for evaluating economic efficiency of treatment. The cost per pound of incremental lint yield is defined as the cost of producing additional lint yield compared to the non-treated check divided by the additional yield. For Telone II and Temik 15G treatments, the cost per pound of incremental lint yield is equal to the nematicide price times the application rate of the nematicide plus the cost per application divided by the lint yield increase. Thimet 20G was added at a rate of 5 pounds per acre to manage thrips in all of the Telone II treatments, including the non-treated check. Because Thimet 20G was added to the non-treated check, it was not considered as an incremental cost when comparing costs within the Telone II treatments only. Because Temik 15G does not require any thrips management agent, the Thimet 20G cost is considered an incremental cost for Telone II when Telone II and Temik 15G are compared for cost effectiveness. Net return per pound increase is the sales price per pound (60 cents for purposes of this analysis) less the cost per pound increase associated with the nematicide. Partial net return is the additional return from incremental lint yield due to the treatment effect. It is defined as the net return per pound increase in lint yield times the lint yield increase associated with a given application rate. All partial net returns are expressed on a per acre basis.

Results and Discussion

Telone II Rates

Mean lint yield increases for the Telone II treatments were significantly greater than the non-treated check in the 1995 Jackson County and the 1996 and 1997 Santa Rosa County tests (Kinloch and Rich, 1998). The 1995 Santa Rosa County test showed no significant yield differences relative to the non-treated check for any of the Telone II application

rates; however, all of the Telone II treatments had a higher numerical lint yield than the non-treated check. The mean lint yield increased by 128 pounds per acre for the 1.5 gallons per acre application rate and reached a maximum of 237 pounds per acre for the 4.5 gallons per acre application rate. The 6 gallons per acre treatment did not show any incremental lint yield increase over the 4.5 gallons per acre application rate.

Calculated economic values for Telone II included average increase in lint yield, cost per pound of incremental lint yield, net return per pound increase in lint yield, and partial net return per acre for each Telone II application rate relative to the non-treated check (Table 1). The 4.5 gallons per acre treatment exhibited the highest lint yield as well as the greatest partial return (Table 1).

Temik 15G Rates

Cotton lint yield increase was significantly greater than the non-treated check for the 9 pounds per acre Temik 15G application rate in the 1997 Santa Rosa County test (Kinloch and Rich, 1998). The 1995 Jackson County and the 1995 and 1996 Santa Rosa County tests showed no significant yield increases relative to the non-treated check for any of the Temik 15G application rates. Although the lint yield increases relative to the non-treated check were not statistically significant, there were increases in lint yield for all Temik 15G application rates, with the 7 pounds per acre rate demonstrating the greatest increase.

Positive net returns were found for all application rates of Temik 15G. The 7 pounds per acre rate had the largest partial net return at $33.67 per acre (Table 2). The 3 pounds per acre rate had the lowest cost increase and the highest partial net return per unit of lint yield increase.

Telone II and Temik 15G Comparisons

The additional benefit of thrips management associated with Temik 15G must be taken into account to compare costs and returns on an equivalent basis. The per acre cost of Thimet 20G ($7.38) to manage thrips was added to the cost of Telone II (Table 3). Costs and returns of Telone II rates in Table 3 reflect the additional cost of Thimet 20G used to place the two nematicides on an equivalent benefit basis.

A comparison of lint yield increases, application costs, cost per unit increase, and net returns for Telone II with Thimet 20G and Temik 15G alone show that treatment costs are substantially higher for Telone II with Thimet 20G than for Temik 15G alone, adding $26 to $76 per acre to the base cost for Telone II (Table 3). The increased lint yield realized from using Telone II, however, more than offsets the higher costs. Partial returns for Telone II ranged from $51 to $83 per acre, with the greatest partial return associated with the 4.5 gallon per acre application rate. Using a less costly thrips management agent than Thimet 20G may further improve the partial net returns of Telone II.

Although Temik 15G alone had significantly lower chemical costs (ranging from $9 to $36 per acre) than Telone II with Thimet 20G, it also had much lower lint yield increases and partial net returns (ranging from $18 to $34 per acre) than Telone II with Thimet 20G (Table 3). The best partial return of the various Temik 15G treatments was associated with the 7 pounds per acre application rate. Partial net returns for both nematicides show that Telone II with Thimet 20G yields superior partial net returns than does Temik 15G alone in all cases for achieving a 60 cents per pound cotton price (Table 3). A decline in cotton prices will cause a change in the partial net return structure. The partial net return of 4.5 gallons per acre Telone II with Thimet 20G treatment is superior to all the other Telone and Temik treatments evaluated for achieving cotton prices of 60 cents per pound. However, if the cotton price declined to 40 cents per pound, there would be little difference in partial net returns among the 1.5, 3, or 4.5 gallons per acre Telone with Thimet 20G treatments. Cotton prices would have to decline to 32 cents per pound before Temik 15G alone and Telone II with Thimet 20G treatments would have equivalent partial net returns. Partial net returns and lint yield increases clearly favor the use of Telone II combined with Thimet 20G over Temik 15G alone to manage root-knot nematode infested fields in northwest Florida.

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Table 1. Increases in lint yield, Telone II cost, cost per pound, net return per pound, and partial net return on cotton grown with different application rates of Telone II in root-knot nematode-infested soils in northwest Florida.

Telone II Rate *gallons/acre*	Lint Yield Increase *pounds/acre*[a]	Application Cost Increase *dollars/acre*[b,c,d]	Cost Increase *dollars/acre*[e]	Net Return Increase *dollars/pound*[f]	Partial Net Return *dollars/acre*[g]
0.0	0	N/A	N/A	N/A	N/A
1.5	128	18.84	0.1472	0.4528	57.96
3.0	169	35.34	0.2091	0.3909	66.06
4.5	237	51.84	0.2187	0.3813	90.36
6.0	233	68.34	0.2933	0.3067	71.46

[a] Lint yield increase is the average of all tests for a given treatment minus the mean of non-treated checks (Kinloch and Rich, 1998).
[b] 1,3 D cost = $11.00 per gallon.
[c] 1,3 D is added 14 to 17 days prior to planting, with an application cost of $2.34 per acre.
[d] Telone II cost increase = Telone II cost times Telone II treatment rate plus Telone II application cost. (Thimet was not considered part of the Telone II cost increase because it was added to the non-treated check as well as to each treatment.)
[e] Cost increase (dollar per pound) = application cost increase divided by lint yield increase.
[f] Net return increase (dollar per pound) = 60 cents minus cost increase (60 cents per pound cotton price.)
[g] Partial net return = net return increase times lint yield increase.
N/A = not applicable.

Table 2. Increases in lint yield, Temik 15G cost, cost per pound, net return per pound, and partial net return on cotton grown in different rates of Temik 15G in root-knot nematode-infested soils.

Temik 15G Rate *pounds/acre*	Lint Yield Increase *pounds/acre*[a]	Cost Increase *dollars/acre*[b,c,d]	Cost Increase *dollars/pound*[e]	Net Return Increase *dollars/pound*[f]	Partial Net Return *dollars/acre*[g]
00.0	N/A	N/A	N/A	N/A	N/A
03.0	60	08.97	0.1495	0.4505	27.03
06.0	73	17.94	0.2458	0.3542	25.86
07.0	91	20.93	0.2300	0.3700	33.67
09.0	94	26.91	0.2863	0.3137	29.49
12.0	89	35.88	0.4031	0.1969	17.52

[a] Lint yield increase is the average of all tests for a given treatment minus the mean of non-treated checks. (Kinloch and Rich, 1998).
[b] Temik 15G cost per pound = $2.99
[c] Temik 15G application cost is negligible due to addition at planting time.
[d] Temik 15G cost increase = cost of Temik 15G times Temik 15G rate.
[e] Cost increase (dollar per pound) = Temik 15G cost increase divided by lint yield increase.
[f] Net return increase = 60 cents minus cost increase (60 cents per pound cotton price.)
[g] Partial net return = net return increase times lint yield increase.
N/A = not applicable.

Table 3. A comparison of increases in lint yield, nematicide cost, and partial net return per acre for different rates of Telone II and Temik 15G on cotton grown in a root-knot nematode-infested soil in northwest Florida.

Telone II Rate *gallons/acre*	**Lint Yield Increase** *dollars/acre*	**Telone II Cost Increase** *dollars/acre*[a,b]	**Revenue Increase** *dollars/acre*[d]	**Partial Net Return** *dollars/acre*[e]
00.0	0	N/A	N/A	N/A
01.5	128	26.22	076.80	50.58
03.0	169	42.72	101.40	58.68
04.5	237	59.22	142.20	82.98
06.0	233	75.72	139.80	64.08
Temik 15G Rate *pounds/acre*	**Lint Yield Increase** *pounds/acre*	**Temik Cost Increase** *dollars/acre*[c]	**Revenue Increase** *dollars/acre*[d]	**Partial Net Return** *dollars/acre*[e]
00.0	N/A	N/A	N/A	N/A
03.0	60	08.97	36.00	27.03
05.0	73	17.94	43.80	25.86
07.0	91	20.93	54.60	33.67
09.0	94	26.91	56.40	29.49
12.0	89	35.88	53.40	17.52

[a] The cost of Thimet ($7.38 per acre) was added to Telone II application costs from Table 1 for thrips management in order to match the Temik 15G thrips management benefits.
[b] Telon II cost increase = cost of Telone II ($11.00 per gallon) times Telone II rate plus application rate ($2.34 per acre) plus Thimet cost ($7.38 per acre).
[c] Temik 15G cost increase = cost of Temik 15G ($2.99 per pound) times Temik 15G rate.
[d] Revenue increase = 60 cents times lint yield increase (60 cents per pound cotton price).
[e] Partial net return = revenue increase minus cost increase.
N/A = not applicable.