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# Evaluation of Variety Tolerance and Chemical Management of Root-Knot Nematode
# Seminole, TX - 2009


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**Summary:**

The southern root-knot nematode, *Meloidogyne incognita*, is an economically important parasite of cotton in Gaines County, Texas. The objectives of this research were to evaluate the performance of ST 5458B2F and FM 9063B2F planted in conjuction with Aeris, Avicta Complete Cotton, Temik 15G at 3.5 lbs/ac, or Temik 15G at 5lbs/ac. Adult and immature thrips whole plant counts, *M. incognita* gall counts, second-stage juvenile and eggs counts per 500cm$^3$ soil, and plant height and number of node counts provided further information on the impact of root-knot nematodes. Plots were machine harvested and yield, gin turnout, fiber quality, and economics of treatments were determined. ST 5458B2F had significantly fewer galls per root and significantly fewer second-stage juveniles and egg counts per 500cm$^3$ soil than FM 9063B2F. Plants from plots treated with Temik 15G at 3.5 lbs and 5lbs had significantly fewer galls per root than plants from seed treated with Aeris, Avicta, and the untreated check. ST 5458B2F had significantly higher lint yield per acre than FM 9063B2RF which resulted in a significantly higher net value per acre. Net value of 5 lbs of Temik 15G was not significantly different from 3.5 lbs of Temik 15G, and Aeris. Based on these results, planting tolerant varieties was the most economical and effective method in the management of root-knot nematodes.


**Objective:**

The southern root-knot nematode, *Meloidogyne incognita*, is an economically important parasite of cotton in Gaines County, Texas. Higher populations of this pest tend to occur in sandier fields that have had consecutive cotton crops and very little rotation to a non-host, such as peanuts (Kirkpatrick, 2001). Management decisions are dependent on the level of nematode infestation and the estimated nematode-induced yield loss (Kirkpatrick, 2001). Planting partially resistant varieties is one of the most effective tools in managing this pest (Zhou et al., 2003). Seed treatments are another option for the management of nematodes. Therefore, cotton production may be optimized by planting partially resistant cotton varieties in conjunction with the use of seed treatments or Temik 15G. The objectives of study were

to evaluate the impact of two cotton varieties planted in conjunction with chemical treatments on southern root-knot nematode populations and the resulting effect on plant development, and to compare net returns between varieties, chemicals, and the interaction between varieties and chemicals.

**Materials and Methods:**

| | |
|---|---|
| Treatments: | See Table 1 |
| Cropping History: | 5 year crop history of cotton, peanuts, cotton, cotton, cotton |
| Field Soil Texture: | 93% sand, 3% silt, and 4% clay |
| Experimental design: | randomized complete block design with 3 replications |
| Seeding rate: | 3.8 seed/row-ft in 40-inch row spacing |
| Plot size: | 8-rows wide and 400 ft in length |
| Planting date: | 7 May in terminated wheat |
| Irrigation: | This location was under LESA center pivot |
| Irrigation & Rainfall: | Pre-bloom irrigation and rainfall totaled ~5.72 inches<br>Bloom to harvest rainfall totaled ~9.16 inches |
| Weed Management: | 8 oz of Trifluralin was banded on pre-plant. Roundup was applied twice during the season. |
| Fertilizer Management: | First application: 25 gallons of a 4-10-10 acid fertilizer<br>Second application: 85 units of Nitrogen and 15 units of sulfur |
| Plant Growth Regulators: | No plant growth regulators were applied to this trial. |
| In-Season Data Collection: | The number of adult and immature thrips was counted by visually inspecting 10 whole plants per plot on 20 May, 27 May, 3 June, and 10 June. The number of galls caused by *M. incognita* was counted by visually inspecting 10 plant roots per plot on 10 June. Soil samples were taken on 16 July to count *M. incognita* second-stage juveniles (J2) and eggs per 500cm$^3$ soil. Plant height, number of nodes, and Nodes Above White Flower (NAWF) were counted on ten plants per plot on 14 August. |
| Harvest: | Plots were harvested on 19 October using a commercial stripper harvester with field cleaner. Harvested material was transferred to a weigh wagon with integral electronic scales to determine individual plot weights. Plot yields were subsequently adjusted to lb/acre. |
| Gin turnout: | Grab samples were taken by plot and ginned at the Texas AgriLife Research and Extension Center at Lubbock to determine gin turnouts. |

Fiber analysis: Lint samples were submitted to the Texas Tech University - Fiber and Biopolymer Research Institute for HVI analysis, and USDA Commodity Credit Corporation (CCC) loan values were determined for each variety by plot.

Ginning cost and seed values: Ginning costs were based on $3.00 per cwt. of bur cotton and seed value/acre was based on $160/ton. Ginning costs did not include checkoff.

Seed and technology fees: Seed and technology costs were calculated using the appropriate seeding rate (3.6 seed/row-ft) for the 40-inch row spacing and entries using the online Plains Cotton Growers Seed Cost Comparison Worksheet available at: http://www.plainscotton.org/Seed/PCGseed10.xls .

**Results and Discussion:**

ST 5458B2F had significantly fewer galls per root than FM 9063B2F (*Table 2*). Temik 15G at 3.5 lbs and Temik 15G at 5 lbs had significantly fewer galls per root than Aeris, Avicta, and the untreated (*Table 3*). There was no significant interaction between variety and chemical, indicating that the response was consistent with both varieties. ST 5458B2F had significantly fewer egg per 500 $cm^3$ soil than FM 9063B2F (*Table 2*). There was no significant effect by chemical (*Table 3*) or by the interaction between variety and chemical.

Plant height did not significantly differ between FM 9063B2RF and ST 5458B2RF on 14 August (*Table 4*). However, FM 9063B2F had significantly more nodes per plant than ST 5458B2RF (*Table 4*). Plant height and number of nodes did not significantly differ between chemical treatments (*Table 5*). Nodes Above White Flower (NAWF) had a significant interaction between variety and chemical ($P$ = 0.05). Due to the variety by chemical interaction, NAWF data is reported as interaction means (*Table 6*).

ST 5458B2RF had significantly higher lint yield per acre and lint turnout than FM 9063B2F which resulted in a significantly higher net value per acre. However, FM 9063B2F had a significantly higher seed turnout per acre (*Table 7*).

Net value of 5 lbs of Temik 15G was not significantly different from 3.5 lbs of Temik 15G and Aeris (*Table 8*). However, Aeris did not significantly differ from Avicta, and Untreated (*Table 8*).

The untreated plots had significantly more adult thrips on 20 May and immature thrips on 3 June than the other treatments (*Table 12*). Avicta seed treatment immature thrips did not significantly differ from the untreated plots on 3 June (*Table 12*). On 10 June the 5 lbs Temik 15G had significantly more adult thrips than the other treatments (*Table 12*). Thrips were not a limiting factor since treatments never reached the thrips threshold of 1 per true leaf.

**Summary:**

*Meloidogyne incognita,* is one factor that can significantly impact variety performance. FM 9063B2F had significantly more galls early-season and second-stage juveniles & eggs mid-season. This likely decreased crop potential and contributed to a lower yield at the end of the season. Therefore, based on this trial, planting tolerant varieties is the most economical

and effective method in the management of nematodes. Chemical management also resulted in some increased control of nematodes. However, differences in chemical control were not as clearly defined as the variety effect. More research is needed in order to determine optimal variety and chemical management for nematodes across years.

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**Disclaimer Clause:**

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**References:**

Kirkpatrick, T. L. and C. S. Rothrock, ed. Compendium of Cotton Diseases, second Edition. APS Press, 2001.

Zhou, E. and J. L. Starr. 2003. A comparison of the Damage Functions, Root Galling, and Reproduction of Meloidogyne incognita on Resistant and Susceptible Cotton Cultivars. Journal of Cotton Science. 7:224-230.

*Table 1*. Treatments

| |
|---|
| ST 5458B2RF[1] Untreated |
| ST 5458B2RF[1] & Aeris seed treatment (insecticide & nematicide) |
| ST 5458B2RF & Avicta Complete Cotton seed treatment (insecticide, nematicide, and fungicide) |
| ST 5458B2RF[1] & 3.5 lbs/acre of Temik 15G[2] |
| ST 5458B2RF[1] & 5 lbs/acre of Temik 15G[2] |
| ST 5458B2RF[1] & 3.5 lbs/acre of Temik 15G[2] & Vydate C-LV[3] |
| FM 9063B2RF[1] Untreated |
| FM 9063B2RF[1] & Aeris seed treatment (insecticide & nematicide) |
| FM 9063B2RF & Avicta Complete Cotton seed treatment (insecticide, nematicide, and fungicide) |
| FM 9063B2RF[1] & 3.5 lbs/acre of Temik 15G[2] |
| FM 9063B2RF[1] & 5 lbs/acre of Temik 15G[2] |
| FM 9063B2RF[1] & 3.5 lbs/acre of Temik 15G[2] & Vydate C-LV[3] |

[1] Trilex Advance (fungicide) seed treatment was applied to all seed (with the exception of the Avicta seed treatment plots)
[2] Temik 15G was applied in-furrow at planting. Temik boxes were calibrated prior to planting the trial.
[3] Vydate C-LV was applied in a band at a rate of 17 oz per acre on 22 June

*Table 2*. Average number of root galls caused by *Meloidogyne incognita* on 10 June and average number of *M. incognita* second-stage juveniles and eggs per 500 $cm^3$ soil on 16 July by variety

| Variety | Average No. of Galls | Average No. of J2 | Average No. of Eggs |
|---|---|---|---|
| FM 9063B2RF | 30.5 | 639 | 5720 |
| ST 5458B2RF | 24.8 | 333 | 3298 |
| Test average | 26.2 | 486 | 4509 |
| CV % | 27.6 | 96.1 | 74.2 |
| OSL | 0.054 | 0.06 | 0.04 |

CV – coefficient of variation
OSL – observed significance level, or probability of a greater F value

*Table 3*. Average number of root galls caused by *Meloidogyne incognita* on 10 June and average number of *M. incognita* second-stage juveniles and eggs per 500 $cm^3$ soil on 16 July by chemical

| Variety | Average No. of Galls | | Average No. of J2 | Average No. of Eggs |
|---|---|---|---|---|
| Untreated | 35.6 | ab | 500 | 5460 |
| Avicta | 38.9 | a | 700 | 4760 |
| Aeris | 29.2 | b | 200 | 3120 |
| 3.5 lbs of Temik 15G | 18.1 | c | 483 | 4253 |
| 3.5 lbs of Temik 15G plus 17 oz Vydate C-LV | - | | 667 | 4280 |
| 5 lbs of Temik 15G | 15.6 | c | 367 | 5180 |
| Test average | 26.2 | | 486 | 4509 |
| CV % | 27.6 | | 96.1 | 74.2 |
| OSL | <0.0001 | | 0.46 | 0.86 |

Means within the same column with the same letter are not significantly different
CV – coefficient of variation
OSL – observed significance level, or probability of a greater F value

*Table 4.* Average plant height and number of nodes on 14 August by variety

| Variety | Average Plant Height (inches) | Average No. of Nodes |
|---|---|---|
| FM 9063B2RF | 18.1 | 16.7 |
| ST 5458B2RF | 18.6 | 15.5 |
| Test average | 18.4 | 16.1 |
| CV % | 5.9 | 3.6 |
| OSL | 0.21 | <0.0001 |

CV – coefficient of variation
OSL – observed significance level, or probability of a greater F value

*Table 5.* Average plant height and number of nodes on 14 August by chemical

| Variety | Average Plant Height (inches) | Average No. of Nodes |
|---|---|---|
| Untreated | 17.9 | 16.1 |
| Avicta | 17.7 | 16.0 |
| Aeris | 18.3 | 15.8 |
| 3.5 lbs of Temik 15G | 19.6 | 16.7 |
| 3.5 lbs of Temik 15G plus 17 oz Vydate C-LV | 18.3 | 15.9 |
| 5 lbs of Temik 15G | 18.6 | 15.9 |
| Test average | 18.4 | 16.1 |
| CV % | 5.9 | 3.6 |
| OSL | 0.09 | 0.11 |

CV – coefficient of variation
OSL – observed significance level, or probability of a greater F value

*Table 6.* Average Nodes Above White Flower (NAWF) on 14 August for variety by chemical interaction means

| Variety | Chemical | Average No. NAWF | |
|---|---|---|---|
| ST 5458B2F | Untreated | 2.4 | ab |
| ST 5458B2F | Aeris | 2.8 | a |
| ST 5458B2F | Avicta | 1.9 | c |
| ST 5458B2F | 3.5 lbs of Temik 15G | 2.5 | ab |
| ST 5458B2F | 3.5 lbs of Temik 15G plus 17 oz Vydate C-LV | 2.5 | ab |
| ST 5458B2F | 5 lbs of Temik 15G | 2.5 | ab |
| FM 9063B2RF | Untreated | 2.6 | a |
| FM 9063B2RF | Aeris | 2.2 | bc |
| FM 9063B2RF | Avicta | 2.4 | ab |
| FM 9063B2RF | 3.5 lbs of Temik 15G | 2.6 | a |
| FM 9063B2RF | 3.5 lbs of Temik 15G plus 17 oz Vydate C-LV | 2.2 | bc |
| FM 9063B2RF | 5 lbs of Temik 15G | 2.6 | a |
| Test average | | 2.4 | |
| CV % | | 11.9 | |
| OSL | | 0.0736 | |

CV – coefficient of variation
OSL – observed significance level, or probability of a greater F value

*Table 7*. Harvest results by variety

| Variety | Lint turnout | Seed turnout | Bur cotton yield | Lint yield | Seed yield | Lint loan value | Lint value | Seed value | Total value | Ginning cost | Seed and Technology cost | Net Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ---------%--------- | | ----------lb/acre---------- | | | $/lb | ----------$/acre---------- | | | | | |
| ST 54548B2F | 36.2 | 48.0 | 3183 | 1152 | 1529 | 0.5647 | 650.32 | 152.87 | 803.20 | 95.49 | 67.57 | 620.57 |
| FM 9063B2F | 33.3 | 50.8 | 2341 | 778 | 1188 | 0.5688 | 442.45 | 117.66 | 560.12 | 70.23 | 67.57 | 402.75 |
| Test average | 34.7 | 49.4 | 2762 | 965 | 1359 | 0.5668 | 546.39 | 135.27 | 681.66 | 82.86 | - | 511.66 |
| CV % | 3.7 | 2.32 | 8.9 | 8.4 | 9.0 | 2.03 | 8.8 | 9.49 | 8.8 | 8.9 | - | 10.42 |
| OSL | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.30 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | - | <0.0001 |

CV – coefficient of variation
OSL – observed significance level, or probability of a greater F value

Assumes:
$2.45/cwt ginning costs
$150/ton for seed
Value for lint based on CCC loan value from grab samples and FBRI HVI results
Net Value was determined by subtracting ginning cost, seed and technology cost and treatment cost ($19.57/acre, data not shown) from total value.

*Table 8*. Harvest results by chemical

| Chemical | Lint turnout | Seed turnout | Bur cotton yield | Lint yield | Seed yield | Lint loan value | Lint value | Seed value | Total value | Ginning cost | Treatment cost | Net Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | --------%-------- | | ----------lb/acre---------- | | | $/lb | ----------$/acre---------- | | | | | |
| 5 lbs of Temik 15G | 35.0 | 49.4 | 3023 a | 1062 a | 1490 a | 0.5679 | 602.97 a | 149.03 a | 752.00 a | 90.70 a | 25.11 | 568.63 a |
| 3.5 lbs of Temik 15G | 35.2 | 50.0 | 2930 ab | 1034 ab | 1457 a | 0.5636 | 583.48 ab | 145.65 a | 729.13 a | 87.88 ab | 20.16 | 553.52 ab |
| 3.5 lbs of Temik 15G* | 34.9 | 49.8 | 2720 bc | 957 bc | 1345 abc | 0.5697 | 545.79 abc | 134.47 abc | 680.26 ab | 81.60 bc | 30.52 | 500.58 bc |
| Aeris | 34.7 | 49.4 | 2822 abc | 979 ab | 1384 ab | 0.5583 | 544.21 bc | 138.40 ab | 682.61 ab | 84.66 abc | 17.33 | 513.06 abc |
| Untreated | 34.4 | 49.2 | 2551 c | 880 c | 1248 bc | 0.5711 | 502.05 c | 124.80 bc | 626.84 c | 76.53 c | 8.61 | 474.14 c |
| Avicta | 34.5 | 48.7 | 2527 c | 878 c | 1228 c | 0.5700 | 499.83 c | 119.28 c | 619.11 b | 75.80 c | 15.70 | 460.04 c |
| Test average | 34.7 | 49.4 | 2762 | 965 | 1359 | 0.5668 | 546.39 | 135.27 | 681.66 | 82.86 | - | 511.66 |
| CV % | 3.7 | 2.32 | 8.94 | 8.4 | 9.0 | 2.03 | 8.8 | 9.49 | 8.8 | 8.9 | - | 10.42 |
| OSL | 0.87 | 0.42 | 0.01 | 0.002 | 0.005 | 0.39 | 0.006 | 0.004 | 0.005 | 0.01 | - | 0.01 |

*Plus 17 oz Vydate C-LV
Application cost for Vydate was not included in Treatment cost because we assumed that the Vydate application was combined with a Roundup application
Means within the same column with the same letter are not significantly different
CV – coefficient of variation
OSL – observed significance level, or probability of a greater F value

Assumes:
$2.45/cwt ginning costs
$150/ton for seed
Value for lint based on CCC loan value from grab samples and FBRI HVI results
Net Value was determined by subtracting ginning cost, seed and technology cost ($67.57/acre, data not shown) and treatment cost from total value.

*Table 9*. HVI fiber property results by variety

| Variety | Micronaire | Staple | Uniformity | Strength | Elongation | Leaf | Rd | +b |
|---|---|---|---|---|---|---|---|---|
| ST 5458B2F | 4.7 | 36.0 | 80.5 | 30.0 | 8.0 | 2.1 | 80.3 | 8.1 |
| FM 9063B2F | 4.3 | 37.8 | 81.6 | 31.3 | 7.0 | 2.1 | 83.3 | 7.1 |
| Test average | 4.6 | 36.9 | 81.0 | 30.6 | 7.5 | 2.1 | 81.8 | 7.6 |
| CV % | 3.8 | 2.3 | 0.7 | 2.2 | 4.4 | 41.0 | 1.4 | 3.7 |
| OSL | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 1.0 | <0.0001 | <0.0001 |

CV – coefficient of variation
OSL – observed significance level, or probability of a greater F value

*Table 10*. HVI fiber property results by chemical

| Chemical | Micronaire | Staple | Uniformity | Strength | Elongation | Leaf | Rd | +b |
|---|---|---|---|---|---|---|---|---|
| 5 lbs of Temik 15G | 4.6 | 36.9 | 81.3 | 30.6 | 7.6 ab | 2.0 | 81.4 | 7.6 |
| 3.5 lbs of Temik 15G | 4.3 | 36.3 | 81.0 | 30.5 | 7.8 a | 1.8 | 81.4 | 7.8 |
| 3.5 lbs of Temik 15G * | 4.6 | 37.0 | 81.2 | 30.9 | 7.3 b | 2.3 | 82.0 | 7.6 |
| Aeris | 4.6 | 36.8 | 80.7 | 30.4 | 7.6 ab | 2.8 | 81.6 | 7.5 |
| Untreated | 4.6 | 37.0 | 80.8 | 31.0 | 7.2 b | 2.0 | 82.3 | 7.7 |
| Avicta | 4.6 | 37.1 | 81.3 | 30.4 | 7.5 ab | 1.7 | 82.2 | 7.5 |
| Test average | 4.6 | 36.9 | 81.0 | 30.6 | 7.5 | 2.1 | 81.8 | 7.6 |
| CV % | 3.8 | 2.3 | 0.7 | 2.2 | 4.4 | 41.0 | 1.4 | 3.7 |
| OSL | 0.06 | 0.61 | 0.29 | 0.61 | 0.05 | 0.26 | 0.63 | 0.49 |

*Plus 17 oz Vydate C-LV
Means within the same column with the same letter are not significantly different
CV – coefficient of variation
OSL – observed significance level, or probability of a greater F value

*Table 11*. Average number of adult (A) and immature (I) thrips 20 May, 27 May, 3 June, and 10 June by variety

| | Date | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 20 May | | 27 May | | 3 June | | 10 June | |
| Variety | A | I | A | I | A | I | A | I |
| FM 9063B2F | 0.04 | 0.02 | 0.04 | 0.00 | 0.07 | 0.01 | 0.10 | 0.07 |
| ST 5458B2F | 0.05 | 0.01 | 0.06 | 0.01 | 0.07 | 0.08 | 0.06 | 0.11 |
| Test average | 0.04 | 0.01 | 0.05 | 0.00 | 0.07 | 0.04 | 0.08 | 0.09 |
| CV % | 172.6 | 374.3 | 146.3 | 600.0 | 117.4 | 146.1 | 95.2 | 124.9 |
| OSL | 0.67 | 0.35 | 0.52 | 0.33 | 0.84 | 0.006 | 0.14 | 0.32 |

CV – coefficient of variation
OSL – observed significance level, or probability of a greater F value

*Table 12*. Average number of adult (A) and immature (I) thrips 20 May, 27 May, 3 June, and 10 June by chemical

| | Date | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 20 May | | 27 May | | 3 June | | 10 June | |
| Variety | A | I | A | I | A | I | A | I |
| Untreated | 0.15 a | 0.05 | 0.05 | 0.00 | 0.05 | 0.12 a | 0.07 b | 0.07 |
| Avicta | 0.05 b | 0.00 | 0.02 | 0.00 | 0.08 | 0.08 ab | 0.02 b | 0.12 |
| Aeris | 0.02 b | 0.00 | 0.07 | 0.00 | 0.08 | 0.03 cb | 0.07 b | 0.07 |
| 3.5 lbs of Temik 15G | 0.05 b | 0.01 | 0.08 | 0.00 | 0.10 | 0.00 c | 0.07 b | 0.13 |
| 5 lbs of Temik 15G | 0.00 b | 0.00 | 0.03 | 0.00 | 0.07 | 0.00 c | 0.18 a | 0.03 |
| Test average | 0.04 | 0.01 | 0.05 | 0.00 | 0.07 | 0.04 | 0.08 | 0.09 |
| CV % | 172.6 | 374.3 | 146.3 | 600.0 | 117.4 | 146.1 | 95.2 | 124.9 |
| OSL | 0.02 | 0.53 | 0.70 | 0.44 | 0.74 | 0.03 | 0.03 | 0.56 |

Means within the same column with the same letter are not significantly different
CV – coefficient of variation
OSL – observed significance level, or probability of a greater F value