EVALUATION OF COTTON CULTIVARS IN THE PRESENCE AND ABSENCE OF RENIFORM NEMATODE AND THE EFFICACY OF VELUM TOTAL

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Abstract

In 2014, 333,000 bales were lost due to the reniform nematode, *Rotylenchulus reniformis*. This represents 2.1% of total yield loss pertaining to diseases and is a 72% increase from 2013 where 193,900 bales were lost (Lawrence, et al 2014). The objective of this research was to determine the yield loss of cotton due to the reniform nematode. Two different fields were used in this experiment. One, absent of reniform and the other with a known reniform infestation. The latter will amalgamate another parameter into the trial, the Velum Total (imidacloprid + fluopyram) nematicidal seed treatment. First, yield loss directly attributed to *R. reniformis* was evaluated by utilizing the two fields. *R. reniformis* reduced yield by an average of 39% across 10 different cultivars ranging from 26-45% reduction. Velum Total increased yield by an average of 5%, and reduced egg production per gram of root by an average of 67% across 10 cultivars.

Introduction

Reniform nematode, *Rotylenchulus reniformis*, has recently surpassed root-knot nematode, *Meloidogyne incognita,* as the most problematic cotton nematode in Mississippi, Louisiana, and Alabama, and neighboring states have seen an increase in heavily infested fields (Robinson, 2007). Over the past decade, cotton producers in the United States have seen an average of 1.8% annual yield loss, where producers in Mississippi, Louisiana, and Alabama suffered higher losses at an average of 5% annual yield loss (Lawrence, et al 2014). *R. reniformis* is a semi-endoparasitic nematode that can reproduce on a wide range of hosts with the most notable agronomic crops being cotton and soybean. It inhabits tropical and sub-tropical regions worldwide. There, they reside in fine-textured soils predominant in the silt and clay particle sizes. Common symptoms of infested cotton include thinning of the root system, reduced feeder roots, stunting, and irregular growth patterns. It induces stress upon the plant making it more susceptible to unfavorable environmental conditions. Management of plant-parasitic nematodes, in general, consists of the utilization of nematicides, resistant cultivars, and crop rotations. However, there are currently no available cultivars with resistance to *R. reniformis.* Crop rotations are accomplished by planting non-host crops such as corn, grain sorghum, and rice. Nematicides are the most direct form of management, and Bayer CropScience's Velum Total (imidacloprid + fluopyram) was the nematicide evaluated for efficacy in this trial. Further evaluation of cultivar performance in infested reniform fields and yield loss contributed to *R. reniformis* feeding was performed.

Materials and Methods

Ten commonly grown upland cotton cultivars were evaluated for their performance both in the presence and absence of *Rotylenchulus reniformis*. Additionally, Velum Total (imidacloprid, 12.8 oz/cwt + fluopyram, 8.5 oz/cwt) seed treatment was evaluated for added yield benefit and a decrease in egg proliferation. The cotton cultivars (listed in Table 1) were planted on May 5, 2105 at the Tennessee Valley Research and Extension Center near Belle Mina, AL. Here, two fields were utilized. One without reniform, and one that has been artificially inoculated. The latter was inoculated in 1997 and has incurred continuous supplements since then. These two fields are adjacent to one another but are separated by a corn buffer during the growing season to prevent contamination. Both fields are identical in regards to soil texture being a Decatur silt loam (24% sand; 49% silt; 28% clay). Lateral irrigation was utilized to ensure a closely identical water supplement between the two fields. The test was arranged in a randomized complete block design with five replications and plots were laid out as four, 25 foot long rows with 40 inch row spacing. The four row plots were split into two rows serving as checks and two rows where Velum Total seed treatment was applied. Each replication was separated by a twenty-foot wide alley. Data assessments were made 35 days after planting for

total reniform eggs per plot and total reniform eggs per gram of root per plot. Each plot sampling consisted of four randomly selected plants from each plot. Eggs per gram of root were calculated by taking the ratio of root fresh weight and total eggs per plot. Yields were mechanically harvested at 168 days after planting (October 20, 2015) for seed cotton yield. All data was analyzed by ANOVA using Proc Glimmix and utilizing SAS 9.4 (SAS Institute, INC., Cary, NC). Means were separated using Tukey's HSD test at the $\alpha \leq 0.05$ level.

Results and Discussion

The average percent decrease of reniform nematode egg production with the Velum Total seed treatment compared to untreated seed was 64% on total reniform eggs and 67% on eggs per gram of root among all cultivars (Table 1.). Phytogen 487 WRF sustained the highest reniform population at 1641 total eggs without the seed treatment, and was significantly greater than all but two cultivars (Cropland 3885 B2XF and Nexgen 3406 B2XF). Furthermore, Phytogen 487 WRF showed the biggest reduction with the addition of the seed treatment at 77%. Without the seed treatment, Phytogen 499 WRF supported the fewest total reniform eggs and Phytogen 333 WRF supported the fewest reniform eggs per gram of root, and both were statistically lower than PHY 487 WRF. Also, Phytogen 333 WRF had the lowest total egg production with the addition of the seed treatment. The data reciprocates the importance of cultivar selection as an important factor in nematode management.

Table 1. Effects of cotton cultivar and nematicide in the reniform nematode infested field as measured by reniform total eggs per four plants and reniform eggs per grams of root at 35 days after planting as well as seed cotton yield at harvest.

Cultivar	Reniform eggs		Reniform eggs per gram of root	
	without nematicide	with nematicide	without nematicide	with nematicide
Cropland 3885 B2XF	1023 ab	270 ab	1151 ab	238 abc
Deltapine 1454 NR B2RF	637 b	212 ab	604 bc	174 abc
Deltapine 1558 NR B2RF	618 b	270 ab	513 bc	232 abc
Nexgen 3406 B2XF	811 ab	289 ab	848 abc	263 ab
Phytogen 333 WRF	405 b	115 b	206 c	95 bc
Phytogen 487 WRF	1641 a	366 a	1284 a	250 abc
Phytogen 499 WRF	289 b	154 ab	293 c	100 bc
Stoneville 4747 GLB2	618 b	289 ab	405 bc	187 abc
Stoneville 4946 GLB2	675 b	135 ab	510 bc	87 c
Stoneville 6448 GLB2	540 b	347 ab	578 bc	341 a

[z]Observations followed by same letter within a column are not significantly different according to Tukey's HSD test at the $\alpha \leq 0.05$ level.

The seed treatment (imidacloprid, 12.8 oz/cwt + fluopyram, 8.5 oz/cwt) averaged a 5% increase on seed cotton yield in the field infested with reniform in comparison to without the seed treatment (Table 2). The percent increase ranged from 0-22% where Nexgen 3406 B2XF had the highest increase at 22%. Stoneville 4946 GLB2 and Nexgen 3406 B2XF had statistically larger yields than three of the other cultivars with the addition of the seed treatment in the presence of reniform. Cropland 3885 B2XF, Phytogen 333 WRF, Stoneville 4946 GLB2, and Stoneville 6448 had a statistically greater yield than the root-knot nematode resistant cultivar Deltapine 1454 NR B2RF in the presence of reniform without the seed treatment. Reniform nematode reduced yield by an average 39% across all cultivars and ranged from 26-45% decrease. Phytogen 499 WRF saw the greatest reduction in yield at 44.6%, and Nexgen 3406 B2XF had the least reduction in yield at 26%.

Table 2. Effects of cotton cultivar and nematicide in the reniform infested field and uninfested clean field as measured by seed cotton yield at harvest

Cultivar	Yield lb/A		
	without nematicide[z]	with nematicide	without Reniform
Cropland 3885 B2XF	2541 a	2719 ab	3442 cd
Deltapine 1454 NR B2RF	1617 b	1755 d	3273 d
Deltapine 1558 NR B2RF	2211 ab	2461 abc	3738 abcd
Nexgen 3406 B2XF	2329 ab	2996 a	4203 ab
Phytogen 333 WRF	2857 a	2805 ab	4208 ab
Phytogen 487 WRF	2310 ab	2745 ab	4150 abc
Phytogen 499 WRF	2197 ab	2257 bcd	3971 abcd
Stoneville 4747 GLB2	2336 ab	2587 abc	4145 abc
Stoneville 4946 GLB2	2798 a	2923 a	4303 a
Stoneville 6448 GLB2	2600 a	2072 dc	3558 bcd

[z]Observations followed by the same letter within a column are not significantly different according to Tukey's HSD test at the a ≤ 0.05 level

Summary

In conclusion, the Velum Total seed treatment, imidacloprid, 12.8 oz/cwt + fluopyram, 8.5 oz/cwt, had a significant impact on egg production decreasing eggs by 64% on total egg production, and 67% on total eggs per gram of root. The effect the seed treatment had on final yield was not as significant as the effect on reniform egg production, however, it did increase yield by an average of 5% across all cultivars. This, coupled with the dramatic decrease in egg production, shows that there is an economical benefit gained with the application of the Velum Total seed treatment. Yield was increased by 152 lbs/A or $40 per acre on $0.65 cotton. The field without reniform nematode, and the field infested with reniform exemplifies the detrimental effect that a reniform infestation can have on yield. It reduced yield by an average of 39% across all cultivars.

References

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