YIELD LOSS OF COTTON CULTIVARS DUE TO THE RENIFORM NEMATODE AND THE ADDED BENEFIT OF VELUM TOTAL

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Abstract

In 2016, 1.43% of the total cotton crop in the United States was lost due to the reniform nematode *(Rotylenchulus reniformis)*. This percentage is estimated to be 205,300 bales lost. While this is up from 111,200 bales in 2015 and down from 333,000 bales in 2014 (Lawrence et. al. 2016), it is a significant problem regardless. With large losses reported to reniform in cotton year after year, this study took place in order to investigate yield loss to reniform over multiple cotton cultivars currently available on the market. Data took place over two growing seasons in 2015 and 2016. Ten cultivars were evaluated in 2015, and twelve cultivars were evaluated in 2016. The trial was set up in two separate fields. One field, infested with 5000 vermiform reniform/100 cm^3 of soil at planting, and the other absent of reniform. In the reniform infested field, Velum Total (Fluopyram + Imidacloprid) was evaluated as a seed treatment at 18 oz /cwt in 2015 and an in-furrow spray applied at planting at 14 oz/acre in 2016. The first parameter analyzed was yield loss due to the reniform nematode. In 2015, reniform reduced cultivar yields by an average of 39% between the field without reniform (3899 lb/A seed cotton), and the reniform infested field (2379 lb/A seed cotton). The application of Velum Total increased yields by 6%, from 2379 lb/A seed cotton to 2532 lb/A seed cotton in the reniform infested field. In 2016, reniform reduced cultivar yields by an average of 46% between the field without reniform (4198 lb/A seed cotton) and the reniform infested field (2252 lb/A seed cotton). The application of Velum Total increased yields by an average of 23%, from 2252 lb/A seed cotton to 2914 lb/A seed cotton. Velum Total reduced reniform eggs per gram of root by an average of 67% in 2015 and 90% in 2016 across all cotton cultivars. In the reniform infested field, Velum Total increased yields by an average of 6% in 2015 and 23% in 2016.

Introduction

In recent years, the reniform nematode (*Rotylenchulus reniformis*) has quickly become the largest and most commonly found plant pathogenic nematode on cotton in not only Alabama, but in states such as Mississippi and Louisiana as well. Over the past ten years, the cotton production industry has seen an estimated 1.8% yield loss per year due to the reniform nematode. In the states of Alabama, Louisiana, and Mississippi, the annual yield loss has been estimated at 5% (Lawrence et. al. 2016). The reniform nematode has been described as a semi-endoparasitic sedentary nematode with a very wide host range. This host range includes the important agronomic crops cotton and soybean. Reniform has been known to inhabit both tropical and sub-tropical regions of the world, making the southeastern United States a very good area for the nematode population to rise. Typically, reniform can be found in heavy soil types with a high concentration of silt and clay. Symptoms of reniform damage include stunting and wilting of the plant that may be seen as a wave-type pattern of the cotton canopy, a reduction of feeder roots, and interveinal chlorosis. In general, a three pronged approach is taken for nematode control. This consists of implementing a crop rotation, nematicides, and the use of resistant cultivars. Since there are currently no cultivars with resistance to *R. reniformis* available on the market, this method is not used for reniform control. A successful crop rotation involves the planting of a non-host crop such as corn, sorghum, rice, or peanut. Currently, nematicide use is the most common form of nematode management. Thus for this trial, the nematicide Velum Total (Fluopyram + ImidaclopridF) was evaluated along with multiple cotton cultivars for its efficacy in reniform management.

Materials and Methods

Data collected for this research took place over the two growing seasons of 2015 and 2016. The trials were set up in a similar fashion, except for a few minor changes. In 2015, ten commonly grown upland cotton cultivars were evaluated for their performance in the presence and absence of *Rotylenchulus reniformis.* Velum Total (Fluopyram, 8.5 oz/cwt + Imidacloprid, 12.8 oz/cwt) was added as a seed treatment for evaluation of the added yield benefit as well as the ability to decrease reniform egg proliferation. This trial (cultivars listed in Table 1) was planted on May 5, 2015 and harvested on October, 20 2015. In 2016, twelve commonly grown upland cotton cultivars were evaluated for their performance in the presence and absence of *Rotylenchulus reniformis.* Velum Total was added as an in-furrow spray at a rate of 14 oz/acre at planting. This trial (cultivars listed in Table 2) was planted on May 4, 2016 and harvested on October 5, 2016. Both trials were planted at the Tennessee Valley Research and Extension Center near Belle Mina, AL. Two adjacent fields were utilized for this research, one field that does not contain a reniform population and one that has been artificially inoculated. The inoculated field was originally inoculated in 1997 and has had continuous supplements of inoculum added to maintain populations. Both fields have a similar soil texture, Decatur silt loam (24% sand, 49% silt, 28% clay). Lateral irrigation was used throughout the growing season to maintain similar water supply for both fields. The test was arranged in a Random Complete Block Design with five replications. Plots were set up with four, 25 foot long rows with 40 inch row spacing. The four row plots were set up with two rows serving as checks and the other two rows having the Velum Total treatment applied. A 20-foot wide alley separated every replication. At 35 days after planting (DAP), four plants were randomly selected per plot for reniform egg numbers per gram of root. The number of eggs per gram of root was calculated by taking the ratio of root fresh weight and total eggs per plot. Yields were mechanically harvested at 168 DAP in 2015 and 154 DAP in 2016. Yields were reported as seed cotton. Data analysis occurred by ANOVA using Proc Glimmix via SAS 9.4 (SAS Institute, INC., Cary, NC). Means were separated using Tukey Kramer's HSD test at the $\alpha \leq 0.05$ level.

Results and Discussion

On average in 2015, reniform eggs per gram of root were decreased by 67% with the addition of the Velum Total seed treatment when compared to the untreated seed in the reniform infested field (Table 1). When no seed treatment was present, Phytogen 487 WRF had the highest reniform egg per gram of root at 1284, followed by Cropland 3885 B2XF at 1151 eggs/g root. Phytogen 487 had statistically higher eggs/g root than all but two varieties, Cropland 3885 and Nexgen 3406. Phytogen 487 also had the greatest decrease in eggs/g root with the addition of Velum Total at 77%. When looking at yield, reniform reduced yield by 39% if Velum Total was not added, and 35% when Velum Total was added compared to the non-reniform field. The Velum Total seed treatment also averaged a 5% increase in seed cotton yield in the reniform infested field when compared to the non-Velum Total treated seed (Table 1). Nexgen 3406 had the highest increase in yield with the addition of the Velum Total seed treatment at 667 lb/acre seed cotton. In the presence of reniform and no Velum Total, Phytogen 333 produced the maximum seed cotton yield, but was not statistically greater than any other cotton cultivar tested. In the presence of the reniform nematode with the addition of Velum Total, Nexgen 3406 had the highest seed cotton yield, and was statistically greater than three of the cotton cultivars screened.

In 2016, reniform eggs per gram of root were reduced an average of 90% with the addition of an in-furrow Velum Total spray when compared to the untreated seed in the reniform infested field (Table 2). Phytogen 495 supported the highest population density of reniform when no Velum Total was added at 20182 eggs per gram of root. This was statistically higher than all but one cotton cultivar tested, which was Phytogen 312, with a reniform population density of 10318 eggs per gram of root. Phytogen 487 also had the greatest decrease in eggs/g root with the addition of Velum Total, decreasing eggs/g of root from 20182 eggs per gram of root down to 154 eggs per gram of root. This was a 99% reduction of reniform egg density. Seed cotton yield was significantly affected by the reniform nematode. Seed cotton yield was 46% lower in the reniform infested field without a Velum Total application (2252 lb/A) compared to the seed cotton yield in the reniform absent field (4198 lb/A). With the addition of Velum Total, this yield was increased by 23%, or 806 lb/acre of seed cotton (Table 2). In the presence of reniform with no Velum Total, Phytogen 312 had the highest yield at 2750 lb/acre of seed cotton, followed by Nexgen 3522 at 2530 lb/acre of seed cotton. When looking at yield with the addition of Velum Total in the reniform field, Phytogen 312 also had the highest yield, at 3364 lb/acre of seed cotton. Nexgen 3522 at 3316 lb/acre followed this.

Table 1. 2015 effects of cotton cultivar and nematicide in the reniform nematode infested field measured in reniform eggs per gram of root at 35 days after planting and seed cotton yield at harvest.

	No Velum Total Reniform Absent	No Velum Total Reniform Present		Velum Total Reniform Present	
Cotton variety	lb/A seed cotton	Eggs/g root	lb/A seed cotton	Eggs/g root	lb/A seed cotton
Cropland 3885 B2XF	3442 cd[z]	1151 ab	2541 a	238 abc	2719 ab
Deltapine 1454 NR B2RF	3273 d	604 bc	1617 b	174 abc	1755 d
Deltapine 1558 NR B2RF	3738 abcd	513 bc	2211 ab	232 abc	2461 abc
Nexgen 3406 B2RF	4203 ab	848 abc	2329 ab	263 ab	2996 a
Phytogen 333 WRF	4208 ab	206 c	2857 a	95 bc	2805 ab
Phytogen 487 WRF	4150 abc	1284 a	2310 ab	250 abc	2745 ab
Phytogen 499 WRF	3971 abcd	293 c	2197 ab	100 bc	2257 bcd
Stoneville 4747 GLB2	4145 abc	405 bc	2336 ab	187 abc	2587 abc
Stoneville 4946 GLB2	4303 a	510 bc	2798 a	87 c	2923 a
Stoneville 6448 GLB2	3558 bcd	578 bc	2600 a	341 a	2072 cd

[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.

Table 2. 2016 effects of cotton cultivar and nematicide in the reniform nematode infested field measured in reniform eggs per gram of root at 35 days after planting and seed cotton yield weighed at harvest at 154 days after planting.

	No Velum Total Reniform Absent	No Velum Total Reniform Present		Velum Total Reniform Present	
Cotton variety	lb/A seed cotton	Eggs/g root	lb/A seed cotton	Eggs/g root	lb/A seed cotton
Phytogen 312 WRF	4881 a[z]	10318 ab	2750 a	1310 ab	3364 a
Phytogen 444 WRF	4636 ab	7306 b	2236 bcd	2446 a	3077 abc
Phytogen 495 WRF	4623 ab	20182 a	1969 d	154 b	2649 cd
Phytogen 552 WRF	4034 cd	4873 b	2104 cd	222 b	2905 bcd
Deltapine 1553 B2XF	3593 d	5391 b	2271 bcd	244 b	2755 cd
Deltapine 1614 B2XF	4130 bcd	5800 b	1996 cd	288 b	2919 bcd
Deltapine 1639 B2XF	3909 cd	5929 b	2273 bcd	735 b	2742 cd
Deltapine 1646 B2XF	4299 abc	7875 b	2344 bc	418 b	3051 abc
Dynagrow 3526 B2XF	3895 cd	2682 b	2245 bcd	201 b	2521 d
Nexgen 3522 B2XF	4194 bc	3202 b	2530 ab	298 b	3316 ab
Stoneville 4848 GLT	4278 bc	5438 b	2135 cd	1055 ab	2695 cd
Stoneville 6182 GLT	3913 cd	3303 b	2175 bcd	407 b	2981 abc

[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.

Summary

In summary, both the Velum Total seed treatment in 2015 (Fluopyram, 8.5 oz/cwt + Imidacloprid, 12.8 oz/cwt), and the Velum Total in-furrow (Fluopyram + Imidacloprid) in 2016 had a significant impact on egg production. In 2015, eggs were reduced by an average of 67% eggs per gram of root, and in 2016 eggs were reduced by an average of 90% eggs per gram of root across all cotton cultivars screened. While the average increase in yield for 2015 was not as large as the average increase in yield for 2016, both years did see an increase. 2015 had a 5% average increase in seed cotton, and 2016 had an average of 23% increase in seed cotton yield. These come out to an estimated 152 lb/acre increase and 806 lb/acre increase in seed cotton respectively. By comparing average yields

from the field without the reniform nematode and the infested field with the reniform nematode, it is clear that the reniform nematode is causing a significant effect on cotton yields. Reniform reduced yields by an average of 39% in 2015, and 46% in 2016.

References

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