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

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Abstract

In 2018, an estimated 204,700 bales of the total cotton crop in the United States was lost due to the reniform nematode *(Rotylenchulus reniformis)*. While this is down from 264,000 bales in 2017 and 205,300 bales in 2016 (Lawrence et. al. 2018), 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 seven cotton cultivars currently available on the market during the growing seasons of 2017 and 2018. 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 both fields, Velum Total (fluopyram + imidacloprid) was evaluated as an in-furrow spray at 14 ounces per acre. The first parameter analyzed was yield loss due to the reniform nematode. In 2017, reniform reduced cultivar yields by an average of 42% between the field without reniform (3659 lb/A seed cotton), and the reniform infested field (2132 lb/A seed cotton). The application of Velum Total increased yields in the reniform field by 55%, from 1513 lb/A seed cotton to 2752 lb/A seed cotton, and in the non-reniform field no yield increase occurred. In 2018, reniform reduced cultivar yields by an average of 43% between the field without reniform (4480 lb/A seed cotton) and the reniform infested field (2576 lb/A seed cotton). The application of Velum Total increased yields by an average of 6% in the reniform field, from 2502 lb/A seed cotton to 2651 lb/A seed cotton, and an average of 8% in the non-reniform field (4304 lb/A to 4657 lb/A). Velum Total reduced reniform eggs per gram of root by an average of 92% in 2017 and 78% in 2018 across all cotton cultivars. Across all years and locations, yield increased by an average of 633 lb/A from 2017 to 2018, making 2018 a more favorable year for cotton production at this location.

Introduction

Over the past decade, 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 1.5% 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. 2018). The reniform nematode has been described as a semi-endoparasitic sedentary nematode with a very wide host range, including 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 geographic area for the nematode population to increase. In most situations, reniform can be found in heavy soil types, primarily those 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, nematode control consists of combining the implementation of a crop rotation, nematicides, and the use of resistant cultivars. However, there are no cultivars available with resistance to *R. reniformis* on the market, causing this method to not be beneficial 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 + Imidacloprid) was evaluated along with multiple cotton cultivars for its efficacy in reniform management and yield improvement.

Materials and Method

Data collected for this research took place over the two growing seasons of 2017 and 2018. The trials were set up in the same fashion over both years. Seven commonly grown upland cotton cultivars were evaluated for their performance in the presence and absence of *Rotylenchulus reniformis.* Velum Total (fluopyram, 1.5 lb/gal + imidacloprid, 2.17 lb/gal) was added as an in-furrow treatment for evaluation of the added yield benefit as well as the ability to decrease reniform egg proliferation. In 2017, the trial was planted on May 9, 2017 and harvested on November 10, 2017. In 2018, the trial was planted on May 8, 2018 and harvested on October 5, 2018. 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, and 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. Four plants were randomly selected per plot for reniform egg numbers per gram of root at 44 days after planting (DAP) in 2017 and 36 DAP in 2018. 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 185 DAP in 2017 and 150 DAP in 2018, and reported as seed cotton. Data analysis occurred by ANOVA using Proc Glimmix via SAS 9.4 (SAS Institute, INC., Cary, NC), and means were separated using Tukey Kramer's HSD test at the ± d 0.05 level.

Results and Discussion

Reniform populations were high during the 2017 and 2018 growing seasons, and nematode presence was a significant factor on yields for both seasons (Table 1). On average in 2017, reniform eggs per gram of root were decreased by 92% with the addition of the Velum Total when compared to the untreated seed in the reniform infested field (Table 2). A yield loss of 2167 lb/a seed cotton (42%) was recorded in the reniform infested field when no nematicide was applied, and a loss of 886 lb/a seed cotton (25%) was recorded in the reniform infested field when a nematicide was applied (Table 2). Velum Total increased yield in the reniform field by 1239 lb/a seed cotton (55%). There was no yield increase with the addition of Velum Total in the non-reniform infested field. Phytogen 444 was the highest yielding variety in the non-reniform field in both with and without nematicide data, but was not significantly higher than any other variety in both columns (Table 3). In the reniform infested field, Deltapine 1522 had the highest yield, across both the nematicide and no nematicide data, but was not significantly higher than any other variety (*P* d 0.05).

In 2018, reniform population densities were high again, as there was a significant difference between the yields of the nematode infested field, and the non-nematode infested field (Table 1). Variety also was a significant factor on yield differences in the 2018 growing season as well (Table 1). On average, reniform eggs per gram of root were decreased by 78% with the addition of Velum Total when compared to the untreated seed in the reniform field (Table 2). A yield loss of 1802 lb/a seed cotton (41%) was recorded in the reniform infested field when no nematicide was applied, and a loss of 2006 lb/a seed cotton (37%) was recorded in the reniform infested field when a nematicide was applied (Table 2). Velum Total increased yield in the reniform field by 151 lb/a seed cotton (6%), and increased yield in the non-reniform infested field by 353 lb/a seed cotton (8%). Deltapine 1522 was the highest yielding variety in the non-reniform infested field, and was statistically higher than one variety in the no nematicide plots, and statistically higher than one variety in the nematicide treated plots.

Table 1. Source of variation for seed cotton yield in both 2017 and 2018 at Auburn University's Tennessee Valley Research and Extension Center.

Seed Cotton Yield (lb/A)	2017		2018	
Source of Variation	F Statistic	P-value	F Statistic	P-value
Nematode	156.61	**<0.0001**[z]	730.32	**<0.0001**
Nematicide	24.09	**<0.0001**	12.64	**0.0006**
Variety	1.32	0.2556	8.25	**<0.0001**
Nematode x Nematicide	27.55	**<0.0001**	2.09	0.1514
Nematode x Variety	1.62	0.1478	5.07	**0.0001**
Nematicide x Variety	0.19	0.9801	0.81	0.5672
Nematode x Nematicide x Variety	0.32	0.9229	0.27	0.9477

[z] Significance present at the *P* d 0.05 level.

Table 2: Average number of reniform nematode eggs/g of root and seed cotton yields in the reniform and non-reniform fields for both the 2017 and 2018 growing season in Belle Mina, AL.

	Reniform Field		Non-reniform Field
2017	Eggs/g root[z]	LB/A	LB/A
Untreated	6491 a[y]	1513 b	3680
Velum Total[x]	698 b	2752 a	3638
2018	Eggs/g root	LB/A	LB/A
Untreated	1432 a	2502	4304
Velum Total	304 b	2651	4657

[z] Reniform nematode eggs/g root were only collected from the reniform infested field, and not the control field.
[y] Values present are LS-means separated using Tukey-Kramer method at *P*d 0.05, and values followed by different letters differ significantly. No letters present means that no significance difference was observed.
[x] Velum Total was applied at planting as an in-furrow spray at 14 oz/a.

Table 3: 2017 cotton cultivar seed cotton yields in the non-reniform and reniform fields in Belle Mina, AL.

	Non-Reniform Field		Reniform Field	
	No Velum Total	Velum Total[z]	No Velum Total	Velum Total
Cotton Variety	LB/A	LB/A	LB/A	LB/A
Croplan 3885 B2XF	3309[y]	3409	1838	2839
Deltapine 1522 B2XF	3676	3791	1871	3165
Deltapine 1646 B2XF	3841	3145	1008	2382
Phytogen 333 WRF	3490	3634	1264	2667
Phytogen 444 WRF	4195	4249	1364	2572
Phytogen 487 WRF	3563	3626	1688	2907
Stoneville 6182 GLT	3683	3611	1557	2731

[z] Values present are LS-means separated using Tukey-Kramer method at *P*d 0.05, and values followed by different letters differ significantly. No letters present means that no significance difference was observed.
[y] Velum Total was applied at planting as an in-furrow spray at 14 oz/a.

Table 4: 2018 cotton cultivar seed cotton yields in the non-reniform and reniform fields in Belle Mina, AL.

	Non-Reniform Field		Reniform Field	
	No Velum Total	Velum Total	No Velum Total	Velum Total
Cotton Variety	LB/A	LB/A	LB/A	LB/A
Croplan 3885 B2XF	3997 bc	4389 ab	2551 ab	2720 ab
Deltapine 1522 B2XF	4749 a	4869 a	3237 a	3302 a
Deltapine 1646 B2XF	4655 ab	5021 a	2262 b	2624 ab
Phytogen 333 WRF	4457 abc	4854 a	2270 b	2445 b
Phytogen 444 WRF	4263 abc	4807 a	1929 b	2438 b
Phytogen 487 WRF	4221 abc	4556 ab	2709 ab	2707 ab
Stoneville 6182 GLT	3788 c	4101 b	2556 ab	2319 b

[z] Values present are LS-means separated using Tukey-Kramer method at *P*d 0.05, and values followed by different letters differ significantly. No letters present means that no significance difference was observed.
[y] Velum Total was applied at planting as an in-furrow spray at 14 oz/a.

Summary

In summary, Velum Total as an in-furrow spray at 14 oz/A had a significant impact on reniform nematode eggs per gram of root in both the 2017 and 2018 growing season. In 2017, eggs were reduced by an average of 92% eggs per gram of root, and in 2018 eggs were reduced by an average of 78% eggs per gram of root across all cotton cultivars screened. While the average increase in yield with Velum Total in the reniform field for 2018 was not as large as the average increase in yield for 2017, both years did see an increase. 2017 had a 55% average increase in seed cotton, and 2018 had an average of 6% increase in seed cotton yield. These come out to an estimated 1239 lb/acre increase and 151 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 58% in 2017, and 41% in 2018 when no nematicide was applied. When a nematicide was applied, reniform reduced yields by an average of 25% in 2017, and 37% in 2018. While it is clear that cotton yields in heavily infested reniform fields cannot reach yield levels achievable in a non-reniform infested field, the use of a chemical nematicide can help boost yields and limit impact of the nematode damage.

References

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