A COST-EFFECTIVE PRESCRIPTION MANAGEMENT STRATEGY UTILIZING FERTILIZERS AND NEMATICIDES TO COMBAT YIELD LOSSES FROM *ROTYLENCHULUS RENIFORMIS* ON COTTON

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Abstract

Rotylenchulus reniformis can cause significant damage to cotton crops in the United States, by reducing boll size, cotton seed yield and lint percentages. In 2019, there was an estimated 188,900 bales and 66 million dollars lost due to *R. reniformis.* The objective of this study was to find a cost- effective management strategy utilizing a combination of fertilizers and nematicides to combat yield loss. Field trials were conducted using the cotton cultivar Deltapine 1646 B2XF. Combinations of Aeris (thiodicarb and imidacloprid), $(NH_4)_2SO_4$, 28-0-0-5, Max-In Sulfur (0-0-19) and Vydate (oxamyl) were used in all treatments. Vydate and fertilizers were applied at pinhead square (PHS) and/or repeated at first bloom (FB). A combination of Aeris, $(NH_4)_2SO_4$, KTS and Vydate applied at PHS significantly ($P \leq 0.05$) reduced reniform eggs/g of root when compared to all other treatment combinations. An application of Aeris, $(NH_4)_2SO_4$, Max-In Sulfur and Vydate, applied at PHS and FB significantly increased seed cotton yield by 21% when compared to the control treatments $(NH_4)_2SO_4$ and 28-0-0-5, with no nematicides. A combination of Aeris and $(NH_4)_2SO_4$ at PHS and FB proved to be the most cost-efficient management strategy when calculating lint yield revenue and chemical input costs to determine overall profit.

Introduction

The reniform nematode (*Rotylenchulus reniformis*) is a common pathogen in the Southern United States and can cause significant damage to upland cotton varieties (Lawrence et al. 2019). The subtropical environment in the southeastern United States provides ideal conditions for the reproduction of this plant parasitic nematode. Typical symptoms include reduced yield, boll size and lint percentages, (Weaver et al. 2007). Infested cotton fields can also display wave-like movement across the canopy. Current management strategies focus on crop rotation and chemical control, due to the lack of reniform nematode resistant cotton varieties. An effective way to reduce the damaging effects of nematodes in a field is to reduce the stress on the crop, (Whitaker et al. 2018). By increasing nutrients available to the plant and creating a more prosperous environment there is greater opportunity to reduce yield loss. The objective of this study was to find a cost-efficient combination of nematicides and fertilizers to reduce nematode population density and support plant health to combat reniform induced yield loss. By applying commercially available fertilizers and nematicides, cotton growers can utilize a management strategy that best fits current agricultural and financial practices.

Materials and Method

Field trials were conducted at Tennessee Valley Research and Extension Center in Belle Mina, AL. The soil was a Decatur silt loam (24% sand, 49% silt and 28% clay). The field was inoculated reniform nematode and is continuously supplemented to maintain populations at 5000 vermiform reniform/100 cm^3 of soil. Test plots were arranged in a RCBD with five replications and the entire test was repeated in the same field. Plots consisted of 2 rows that were 25ft long with 40 in row spacing and a 20 ft. wide alley separated blocks. Irrigation through a lateral irrigation system was applied as needed to all plots. Trails were planted on April 30th and harvested October 3$^{rd, 2019}$. All trials were planted with the cotton cultivar DP 1646 B2XF. Aeris seed treatment was applied at planting to select treatments at a rate of 25.6 oz/cwt. $(NH_4)_2S0_4$ was applied by hand, directly to the plant base at a rate of 150 lb./A. 28-0-0-5 was knifed into the soil 2 in beside and 2 in below the plant at a rate of 128oz/a. Max-In Sulfur and Vydate were applied as foliar sprays at rates of 32 oz/A and 17 oz/A. All chemicals were applied at different plant growth stages; pinhead square (PHS) and/or first bloom (FB). Treatments applied at PHS were administered 37 days after planting (DAP). Treatments applied at FB were administered 87 DAP. Plant samples were collected by digging 4 randomly selected plants from each plot 87 DAP to record plant parameters and nematode egg data. Reniform population density was determined as the ratio of number of eggs per gram of root fresh weight. Data on plant height, root fresh weight, eggs/g of root, seed cotton yield, and lint weight were analyzed with SAS 9.4 using PROC GLIMMIX. LS-means were compared using the Tukey-Kramer method with a significance value of $P \leq 0.05$. Revenue was determined using the USDA upland cotton announcement of the adjusted world price of 53.90 cents/lb. on October 10, 2019. Profit was calculated by subtracting chemical input costs from revenue.

Results and Discussion

Field trials showed that an application of Aeris seed treatment plus $(NH_4)_2SO_4$, Max-In Sulfur and Vydate at PH significantly ($P \leq 0.05$) reduced reniform eggs/g of root when compared to all other treatment combinations and by 80% when compared to the $(NH_4)_2SO_4$ at PHS control (Table 1). The fertilizer nematicide combination of Aeris seed treatment, plus $(NH_4)_2SO_4$, Max-In Sulfur and Vydate, applied at PHS and FB, increased seed cotton yields by 21% or an extra 626 lbs./A when compared to the $(NH_4)_2SO_4$ at PHS control (Table 2). Lint yields were increased by 241 lb./A (18%) and 236 lb./A (17%) with the combination of Aeris, $(NH_4)_2SO_4$ at PHS and FB and the combination of Aeris, $(NH_4)_2SO_4$, and Vydate, Max-In-Sulfur at FB when compared to the $(NH_4)_2SO_4$ at PHS control (Table 2). The most cost-efficient management strategy was fertilizer nematicide combination Aeris and $(NH_4)_2SO_4$ applied at PHS and FB. This treatment yielded 2815 lb./A of seed cotton and required $60.32/A of chemical input costs, giving it the largest overall profit of $653.95/A (Table 3). This treatment provided an additional $92.38/A when compared to the $(NH_4)_2SO_4$ control at PHS.

Table 1. Average number of reniform eggs/g of fresh root weight per treatment in Bella Mina, AL 2019.

No	Treatments	Reniform Eggs/g Root[y] 87 DAP
1	$(NH_4)_2SO_4$ - PHS	125 a[z]
2	28-0-0-5 - PHS	220 a
3	Aeris + $(NH_4)_2SO_4$ - PHS	86 ab
4	Aeris + 28-0-0-5 - PHS	60 ab
5	Aeris + $(NH_4)_2SO_4$ – PHS + FB	100 ab
6	Aeris + 28-0-0-5 – PHS + FB	103 a
7	Aeris + $(NH_4)_2SO_4$ + Vydate - PHS	35 ab
8	Aeris + 28-0-0-5 + Vydate - PHS	113 a
9	Aeris + $(NH_4)_2SO_4$ + Vydate + Max-In-Sulfur - PHS	24 c
10	Aeris + 28-0-0-5 + Vydate + Max-In-Sulfur - PHS	55 ab
11	Aeris + $(NH_4)_2SO_4$ + Vydate + Max-In-Sulfur – PHS + FB	42 ab
12	Aeris + 28-0-0-5 + Vydate + Max-In-Sulfur – PHS + FB	45 ab

[z] Values followed by the same letter are not significantly different at $P \leq 0.05$ as determined by the Tukey Kramer method.

Table 2. Seed cotton and lint yield per treatment in Belle Mina, AL 2019.

No	Treatments	Seed Cotton Yield (LB/A) 157 DAP	Lint Yield (LB/A) 157 DAP
1	$(NH_4)_2SO_4$ - PHS	2301 b	1082 ab
2	28-0-0-5 - PHS	2302 b	1036 b
3	Aeris + $(NH_4)_2SO_4$ - PHS	2482 ab	1142 ab
4	Aeris + 28-0-0-5 - PHS	2444 ab	1124 ab
5	Aeris + $(NH_4)_2SO_4$ – PHS + FB	2815 ab	1323 a
6	Aeris + 28-0-0-5 – PHS + FB	2659 ab	1197 ab
7	Aeris + $(NH_4)_2SO_4$ + Vydate - PHS	2711 ab	1274 ab
8	Aeris + 28-0-0-5 + Vydate - PHS	2494 ab	1122 ab
9	Aeris + $(NH_4)_2SO_4$ + Vydate + Max-In-Sulfur - PHS	2766 ab	1273 ab
10	Aeris + 28-0-0-5 + Vydate + Max-In-Sulfur - PHS	2487 ab	1119 ab
11	Aeris + $(NH_4)_2SO_4$ + Vydate + Max-In-Sulfur – PHS + FB	2928 a	1318 a
12	Aeris + 28-0-0-5 + Vydate + Max-In-Sulfur – PHS + FB	2676 ab	1204 ab

[z] Values followed by the same letter are not significantly different at $P \leq 0.05$ as determined by the Tukey Kramer method.

Table 3. Profit and chemical input costs per treatment.

No	Treatments	Profit/ A[z]	Chemical Price/A
1	$(NH_4)_2SO_4$ - PHS	$560.56	$22.5
2	28-0-0-5 - PHS	$543.85	$14.5
3	Aeris + $(NH_4)_2SO_4$ - PHS	$577.79	$37.82
4	Aeris + 28-0-0-5 - PHS	$576.19	$29.82
5	Aeris + $(NH_4)_2SO_4$ – PHS + FB	$652.95	$60.32
6	Aeris + 28-0-0-5 – PHS + FB	$600.67	$44.32
7	Aeris + $(NH_4)_2SO_4$ + Vydate - PHS	$633.78	$53.12
8	Aeris + 28-0-0-5 + Vydate - PHS	$559.82	$45.12
9	Aeris + $(NH_4)_2SO_4$ + Vydate + Max-In-Sulfur - PHS	$628.29	$57.62
10	Aeris + 28-0-0-5 + Vydate + Max-In-Sulfur - PHS	$553.77	$49.62
11	Aeris + $(NH_4)_2SO_4$ + Vydate + Max-In-Sulfur – PHS + FB	$610.31	$99.92
12	Aeris + 28-0-0-5 + Vydate + Max-In-Sulfur – PHS + FB	$565.14	$83.92

[z] Revenue was determined using the USDA upland cotton announcement of the adjusted world price of 53.90 cents/lb. on October 10, 2019. Profit was calculated by subtracting chemical costs from ling yield revenue

Conclusions

While the combination of Aeris seed treatment, plus $(NH_4)_2SO_4$, Max-In Sulfur and Vydate, applied at PHS and FB had the highest yield and the second largest lint weight, it required the largest chemical input expense which greatly impacted overall profit. The combination of Aeris and $(NH_4)_2SO_4$ applied at PHS and FB was the most cost-efficient management strategy with the largest lint yield and moderate chemical input expenses, resulting in the largest overall profit. In these tests, a management strategy that focused on nematode suppression and reduced application input expenses was beneficial in reducing losses from reniform nematode induced damage.

References

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