EFFECT OF RENIFORM NEMATODES AND SILVERLEAF WHITEFLIES ON COTTONSEED QUALITY

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Abstract

Information is very limited on the interaction of reniform nematodes and silverleaf whiteflies and their effects on cotton, especially in regards to the quality and vigor of seed produced under these stresses. In 1995, studies were conducted to ascertain the single and combined effects of reniform nematodes and silverleaf whiteflies on cottonseed quality and vigor. In a split-plot design, nematode treatments (Telone II and control) were the whole plots and whitefly treatments (imidacloprid and control) were the subplots. Across the nematode treatments, seed index of the Telone II plots was 9.1 compared to 8.7 for the control. Within the Telone II treatment, seed index was reduced from 9.7 to 8.4 by the silverleaf whiteflies, while within the reniform-infested treatment, whitefly stress reduced seed index from 9.0 to 8.3. Cool germination (65°F) ragdoll tests indicated that seed produced under whitefly infestations had lower germination, less radicle growth, and more seed coat mold growth at seven days. Although several mechanisms are available for removing light weight and immature cottonseed, growers and commercial cottonseed producers should consider the potential effects of whiteflies on seed quality before saving seed produced under heavy infestations.

Introduction

Reniform nematodes (*Rotylenchulus reniformis* Linford & Oliveira) and silverleaf whiteflies (*Bemisia argentifolii* Bellows & Perring) are serious pests of cotton (*Gossypium hirsutum* L.) in the Lower Rio Grande Valley of Texas. Silverleaf whiteflies also are a serious pest in Arizona, where a large percentage of commercial cottonseed is produced. Visual symptoms of cotton parasitized by reniform nematodes include stunting, unhealthy appearing plants, and reduced lint yields (Birchfield, 1961; Jones *et al.*, 1959). Silverleaf whiteflies can damage cotton by extracting plant nutrients, which results in stunting, defoliation, and reduced yields (Toscano *et al.*, 1994). In addition, whiteflies excrete honeydew which can promote sticky cotton and sooty mold growth. Although the effects of each of these pests has been studied, information is scarce concerning the interaction of these pests on cotton lint yield, fiber quality, and seed quality. The objective of this study was to determine the single and combined effects of the reniform nematode and silverleaf whitefly on seed size, vigor, and quality.

Materials and Methods

In 1995, a field study was conducted at the USDA North Farm, Weslaco, TX. Cotton cultivar 'DES 119' was evaluated in a split-plot design, with five replications. Main plots were the reniform nematodes treatments. One treatment was fumigated with Telone II (TL) at 20.5 gal/acre and the control (RN) treatment received no nematicide. Subplots were the two whitefly treatments. In one treatment, the whitefly population was controlled with nine imidacloprid (IM) applications. The control (WF) treatment received one imidacloprid application on 16 June. Plots were 30 ft long and spaced 3.3 ft apart. Planting date was 22 March 1995. Soil samples were taken two weeks after planting to estimate the initial reniform nematode population in the TL and RN plots. Total whitefly adults, nymphs, and eggs were made weekly on the third leaf from the terminal. Seed used in this study were obtained from the 20 July 1995 harvest.

Measurements taken were seed index and percent off-color (tan to light brown versus dark brown to black) seeds. Seed index was calculated as the weight, in grams, of 100 seed. Percent off-color seed were calculated from 100 randomly selected seed from each of the four treatments. Seed index and off-color seed measurements were replicated five times. In laboratory tests, seed quality and vigor were determined with ragdolls held at 65°F for seven days. Measurements taken were percent germination, radicle length, and a seed coat mold grade of 1-4 to estimate the percent of seed surface infested with mold producing fungi, which were primarily those of *Alternaria* spp., *Fusarium* spp., *Rhizopus* spp., and *Aspergillus* spp. A grade of 1=0-10% mold, 2=11-25%, 3=25-50%, and 4>50%. The ragdoll experiment was conducted twice in a randomized complete block design, with six replications. Each replication consisted of 10 seed for each of the four treatments: Telone II + imidacloprid (TL+IM), Telone II + control (TL+WF), control + imidacloprid (RN+IM), and control + control (RN+WF). All data were subjected to an analysis of variance.

Results

Initial reniform field populations in the TL and RN plots were estimated to be 5 and 218 nematodes/lb of soil, respectively. Across the nematode treatments, mean total whitefly populations for the eight sampling dates were 298 per leaf in the IM treatment versus 805 per leaf in the WF plots. These results indicate that populations of both pests were severely reduced by chemical control.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:589-589 (1996)
National Cotton Council, Memphis TN

Seed index was reduced by both reniform nematode and silverleaf whitefly infestations (Table 1 and 2). In the TL treatment, seed index was significantly ($P<0.01$) reduced from 9.7 where whiteflies were controlled (IM) to 8.4 where there was no whitefly control (WF). A less significant ($P<0.10$) reduction also occurred in the RN treatment, where seed index was 9.0 in the IM plots compared to 8.3 in the WF plots. Percentage of off-color seed were not affected by the presence or absence of reniform nematodes. However, across the nematode treatments there were few (3%) off-color type seed where whitefly populations were controlled (IM) compared to approximately 26% off-color seeds where whiteflies were not controlled (WF).

Cool germination tests conducted in the laboratory for seven days indicated that seed quality could be affected by whitefly infestations. At seven days, seed coat mold grade was higher, germination percentage was lower, and radicle length was shorter for seed that was produced in the WF plots compared to seed produced in the IM plots (Table 3), indicating the adverse effects whiteflies may have on seed production quality. Reniform nematodes did not appear to significantly ($P<0.05$) affect seed quality or vigor. Across the nematode treatments, seed coat mold grade was 1.8 where whiteflies were controlled (1.8 and 1.9) versus 3.0 where heavy whitefly infestation occurred (3.3 and 2.7). Percentages of seed germination were 100.0% and 98.3% for the two imidacloprid treatments (RN+IM and TL+IM) versus 57.2% and 62.6% where whiteflies were not controlled (RN+WF and TL+WF). Results also indicated that radicle growth was less vigorous in seed produced under whitefly stress. At seven days, radicle length was 5.1 cm and 4.9 cm for the imidacloprid treatments (RN+IM and TL+IM) compared to 3.0 cm and 3.5 cm for the whitefly infested treatments (RN+WF and TL+WF), a reduction of approximately 35%.

Discussion

Individually, reniform nematodes and silverleaf whiteflies have been reported to reduce yields in cotton. Recent research has indicated that some interaction may occur when these two pests simultaneously attack cotton (Wolfenbarger and Cook, unpublished). Results of this study indicate that silverleaf whiteflies and reniform nematodes have the potential to reduce seed size, as indicated by seed index reduction. Laboratory studies also indicated that the silverleaf whitefly appeared to be most responsible for reduction in seed quality and vigor. Although these results are preliminary, it appears that cottonseed quality and vigor can be significantly reduced by the stresses caused by these two pests, especially the silverleaf whitefly. Several techniques are available for removing light weight and immature cottonseed. However, both growers who save seed and commercial cottonseed producers should be aware that the quality and vigor of seed produced under whitefly stress may be reduced and ultimately result in poor stand establishment, less vigorous seedlings, and lower yields.

References

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Table 1. Seed index and percent off-color seed for seed produced under reniform nematode (control) and Telone II treatments.

Treatment	Seed Index	Off-Color Seed (%)
Telone II (TL)	9.1 a	15.6 a
Control (RN)	8.7 b	14.0 a
LSD (0.05)	0.3	n.s.

Table 2. Seed index and percent off-color seed for seed produced under silverleaf whitefly (control) and imidacloprid treatments.

Treatment	Seed Index	Off-Color Seed (%)
Imidacloprid (IM)	9.4 a	3.5 a
Control (WF)	8.4 b	26.0 b
LSD (0.05)	0.3	4.9

Table 3. Laboratory seed coat mold grade, percent germination, and radicle length for seed produced under the four reniform nematode and silverleaf whitefly treatments.

Treatment	Mold Grade	Percent Germination	Radicle Length (cm)
TL+IM	1.8 a	98.3 a	4.9 a
RN+IM	1.9 a	100.0 a	5.1 a
TL+WF	2.7 b	62.6 b	3.5 b
RN+WF	3.3 b	57.2 b	3.0 b
LSD (0.05)	0.6	15.1	1.2

TL=Telone II; RN=Reniform nematode-infested
IM=Imidacloprid; WF=Silverleaf whitefly-infested