POPULATION DENSITIES OF *ROTYLENCHULUS RENIFORMIS* IN SOYBEANS BY MATURITY GROUP AND VARIETY TESTING IN ASSOCIATION WITH DYNAMICS OF POPULATION DEVELOPMENT

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Abstract

The capability of *Rotylenchulus reniformis* to sustain population densities over multiple seasons has conventionally been managed by crop rotation. In recent years as the soybean crop has again become established in many rotations across the Southeast, it has become increasingly more important to understand the effects of population development among multiple host crops. Furthermore, at what point do we begin to see a reduction in plant vigor and yield losses in response to threshold existence? Populations of the reniform nematode were inoculated into 500 cm³ of sterilized soil at levels varying from low to extreme in response to an isolated control. Inoculation levels of vermiform life stages were introduced at 5 days after planting (DAP) as follows: control (none), low (500), medium (1000), high (5000), and extreme (10,000). At 60 DAP measurements were taken and included; shoot height, shoot fresh weigh, shoot dry weight, root fresh weight, root dry weight, reniform extracted from 500cc of soil and eggs were extracted from each root system. These nematode numbers were reported in nematodes per gram of root. A reproductive factor was also assigned to each plot to analyze the population increase per pot. The reproductive factors between treatments of the lower inoculum levels of 500 and 1000 vermiform life stages were statistically greater at $P \leq 0.05$ than those of the higher levels and the control. This suggests that the potential of population densities to increase under these conditions of multiple susceptible host rotations can be substantial.

Introduction

A disease survey was conducted in 2008 over 40 fields and covering 14 counties across Alabama. This survey found that in 32% of fields surveyed, *Rotylenchulus reniformis* was the most common plant parasitic nematode present. The soybean cyst nematode (*Heterodera glycines*), root-knot nematode (*Meloidogyne spp.*), and the lesion nematode (*Pratylenchus spp.*) were present in 11-13% samples (Sikora et al, 2008). This high incidence of reniform nematode is likely explained by the recent shift from cotton acreage to soybean production in response to higher soybean prices. Since 2000, soybean prices have increased from $4.75/bushel to $10.61/bushel in 2009 (USDA). Rotations among multiple host species is sure to have an effect on population densities, how and at what rate population development occurs under this scheme is important in understanding how we need to adapt management practices to current trends.

Several factors lead to the ability of the reniform nematode to reproduce efficiently such as; soil type, crop, and environmental conditions. The objective of this study is to look at the differences, if any, among varieties and maturity groups in conjunction with different levels of reniform incidence. Understanding how increasing densities affect the population development and whether thresholds exist at which populations decline under high levels of competition within the soil profile.

Materials and Methods

Soybean varieties from each maturity group (IV-VIII) were selected from a 2008 variety trial test conducted by the Department of Agronomy and Soils at Auburn University in cooperation with the Alabama Cooperative Extension System. This variety test is representative of the varying climatic regions and soil conditions found across Alabama. Selections from North, Central, and Gulf Coast (South) regions were made based on yield performance (Table 1). The test was carried out at the Auburn University Plant Science Research Center. Seeds of each variety were germinated in pots containing 500 cm^3 of sterilized fine sandy loam soil (ca. 68 % sand, 20 % silt, 12 % clay). Inoculum was obtained from stock cultures of *Rotylenchulus reniformis* maintained on Deltapine 555 BG/RR cotton grown in the greenhouse.

Tests were arranged in a randomized complete block design, with five replications and two repetitions per variety. The experiment was conducted in a greenhouse where the ambient temperature was maintained at approximately 82 to 93°F. All pots were watered twice daily and provided adequate nutrients throughout the duration of the growing period. At 60 DAP the number of reniform nematode eggs from the roots and the numbers of vermiform life stages in the soil of each pot were recorded. The eggs were extracted from the roots using a 0.6% sodium hypochlorite solution (Hussey and Barker, 1973) and counted. A reproductive factor (RF), defined as the number of eggs and vermiform life stages at harvest divided by initial inoculation level, was calculated for each variety.

All statistical analyses were carried out using SAS (SAS Institute, Inc). Means were separated using the general linear models procedure (PROC GLM) and then compared with protected LSD of $P \leq 0.05$. Graphs were also generated in Excel using statistical outputs and standard error.

Table 1. Selections made based on yield production during the 2008 variety test (Glass et al, 2009)

Maturity Group	Variety	Yield (bu/acre)	Testing Location
IV	Croplan Genetics RC 4998RR	39.1	Belle Mina, AL
V	Dyna-Gro 33X55	41.8	Belle Mina, AL
VI	Croplan Genetics RC 6298	57.5	Shorter, AL
VII	Asgrow AG 7502	42.3	Shorter, AL
VIII	Pritchard RR	28.4	Fairhope, AL

Results and Discussion

All varieties exhibited some level of reniform reproduction. Typically final populations increased linearly as the inoculum levels increased. Some variation existed between varieties in regards to the reproductive capability (Figure 1). Under 500 life stages/ 500 cm^3 soil, the potential for population development was statistically greater as opposed to the remaining levels. Reproductive factors at 500 life stages were consistently 40-50% higher than that of any other inoculum level (Figure 2). Furthermore, at 1000 and 5000 life stages there was no difference in reproductive capacity across all treatments on average. The lowest capability to reproduce was found in the 10,000 life stage/500 cm^3 level.

Analysis on plant height, root fresh weight, and shoot fresh weight showed varying results between each variety and maturity grouping (Figures 3 and 4). However, the wide range of responses did show some statistical comparisons at the 1000 life stage level among both plant height and root weights. At 1000 life stages we begin to see an overall decline in both of these categories as compared to the control. This response suggests a possible threshold or damage level which will be verified upon yield analysis and further field testing. Inoculum levels at 1000 life stages and greater reduced plant height as compared to the control.

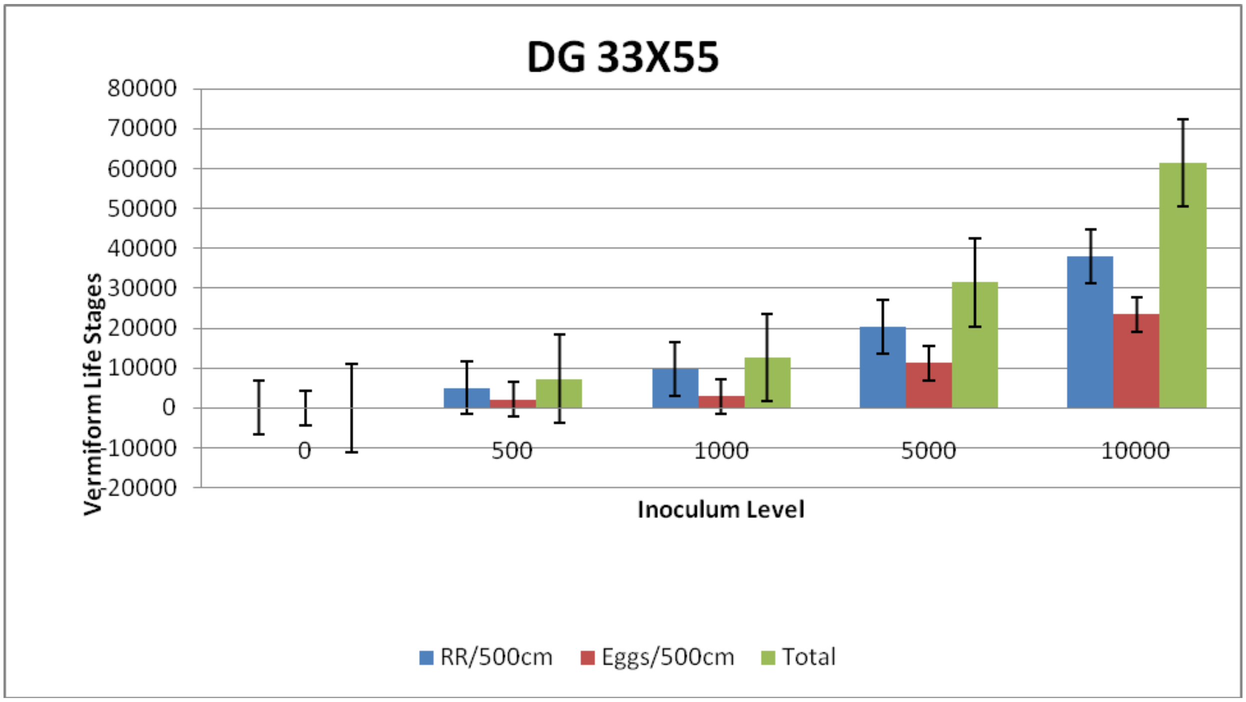

Figure 1. Reniform increasing population levels and the number of vermiform life stages, eggs and total population numbers after 60 days.

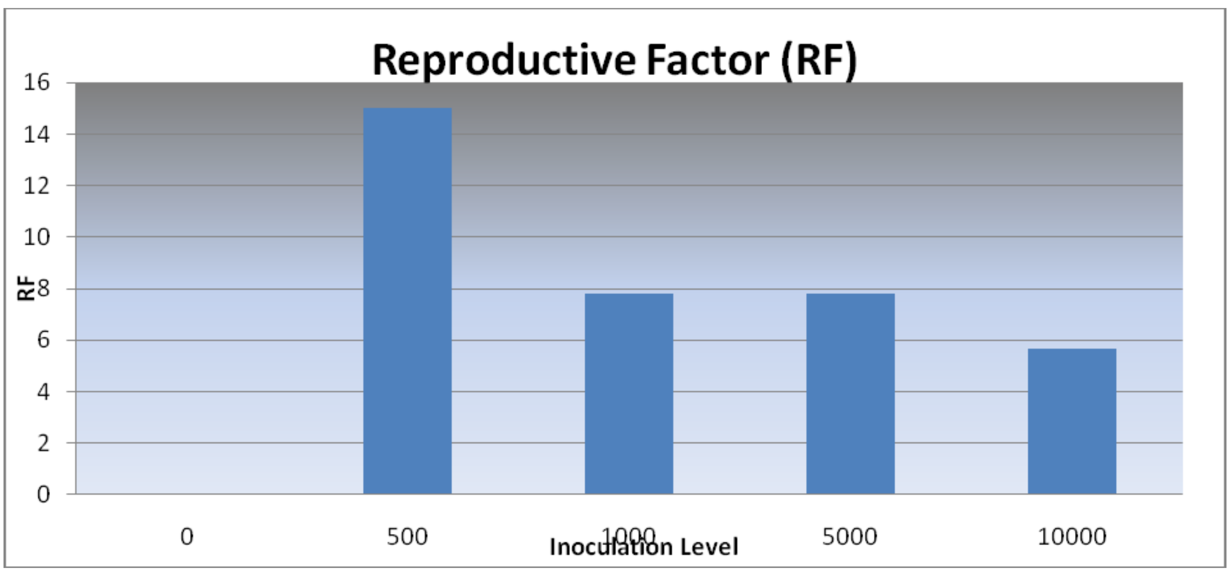

Figure 2. Reproductive factors, a ratio of the final population to the initial population level, between inoculum levels.

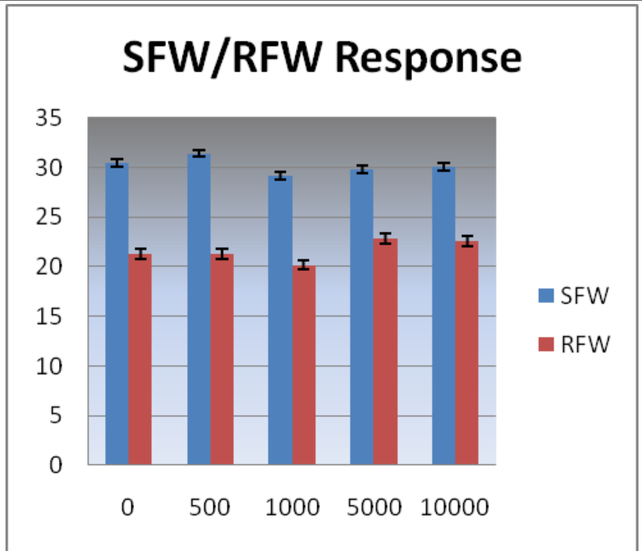

Figure 3. Shoot weights in gm and plant height in cm for each reniform inoculum level.

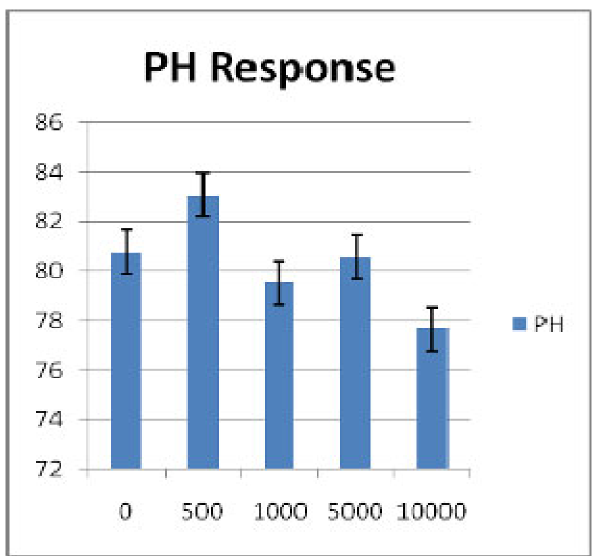

Figure4. Root weights in gm and plant height in cm for each reniform inoculum level.

Summary

Reniform populations increased on all maturity groups tested at all the inoculum levels. At lower levels of inoculums the potential for reproduction is significantly higher than those levels above 1000 life stages per 500 cm^3. No significant differences existed between the reproductive factors in 1000, 5000, and 10,000 life stages per 500 cm^3 suggesting that populations will continue to multiply and increase to levels presenting economic damage for multiple crops. Shoot and root fresh weight in response to increasing life stages was not consistently significant among any of the inoculation levels. This suggests that under even more stressful environments in which viruses or fungal pathogens are present overall plant health could potentially undergo rapid decline. To test these effects further, yield measurements must be analyzed to identify the exact damage potential.

References

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