THE IMPORTANCE OF NEMATODES IN EARLY GROWTH AND DEVELOPMENT OF COTTON

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The effects of plant-parasitic nematodes on the growth and productivity of host plants including cotton have been a topic of research for many years. Nematodes are obligate parasites that generally result in suppression of yield but seldom result in death of the host. Mobility of plant-parasitic nematodes is low, and rate of population increase is relatively slow. These factors have formed the basis for development of predictive models and forecasting systems to estimate crop yield loss (Barker et al., 1985; Seinhorst, 1979). However, the main focus of this research has been related to plant yield or yield suppression due to nematodes rather than actual effects on plant growth or development. Various methods have been used to describe and quantify the relationship between nematode population density, generally preplant, and crop performance (yield). Critical point damage functions that relate yield data collected under controlled conditions to preplant nematode population densities, or models that relate the ratio of final (harvest) population density and preplant density to yield loss (Ferris, 1985; Seinhorst, 1965) have been most often used (Duncan, 1991). These models have allowed development of nematode advisory programs in many areas and with numerous crops to assist farmers in decision-making relative to nematode control strategies (Imbriani, 1985), but they have generally not been descriptive of effects of nematodes on young plants early in the growing season.

The perennial nature of the cotton plant may create certain unique concerns in management of the crop and in pest management strategies. For profitable cotton production, root mass must increase rapidly during the early vegetative period of growth, because growth slows significantly as fruiting begins (McMichael, 1980). Consequently, by necessity early root health is vital to establishment of a root system that is capable of supporting the aboveground portion of the plant during periods of stress or other adverse conditions once a boll load is achieved (McMichael, 1986). In addition, early-maturity of the crop is an important aspect of profitable cotton production. Earliness, or the achievement of an acceptable yield potential in the shortest time from planting (Munro, 1971), may be influenced by numerous factors including vigor of vegetative growth and initiation of first fruiting branches at lower nodes (Mauney, 1986). Edaphic and environmental factors, including pest effects, that affect the rapid development and health of cotton root systems are fundamental to overall productivity.

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In a cotton seedling, the primary tap root may grow for several days after germination before branching. Lateral root primordia develop behind the primary root apex with tertiary roots developing behind the secondary root apex (Mauney, 1986). The depth of penetration of the tap root and secondary roots as well as the efficiency of the root system are influenced by various edaphic factors including soil temperature, strength, and moisture content (Mauney, 1986). In addition to physical and abiotic factors, cotton root growth and health may be affected by various pathogens and nematodes (Watkins, 1981).

Nematode parasitism of cotton roots may cause significant changes both in root morphology and in function. The sting nematode, *Belonolaimus longicaudatus*, may cause lesions to form on infected roots, which may either advance laterally to girdle the roots or may advance lengthwise resulting in numerous shrunken, discolored secondary roots (Graham and Holdeman, 1953). The lance nematode, *Hoplolaimus columbus*, penetrates the cortex of cotton roots, resulting in considerable damage to cortical tissue. Both the reniform nematode, *Rotylenchulus reniformis*, and the root-knot nematode, *Meloidogyne incognita*, induce giant cell formation in the pericycle, which may inhibit the formation of secondary roots (Sasser, 1972). In addition to giant cell formation, the root-knot nematode also induces root galls to form, significantly altering both the morphology of the cotton root (Shepherd and Huck, 1989; Tang et al., 1994) and the water relations of the plant (Kirkpatrick et al., 1996). The results of these changes in cotton roots have not been documented in relation to cotton growth or performance. However, because nematodes are present at relatively high frequencies in cotton fields across the U.S. Cotton Belt an understanding of the effects of nematodes in early seedling development may lead to the development of more effective pest management programs in cotton.

Although not specifically designed to evaluate effects of nematodes on cotton seedlings, studies conducted during the past few years in field microplots to quantify the effects of *M. incognita* on the growth and development of the cotton plant may provide some insight into their effects. This nematode appears to be capable of significant suppression of early cotton seedling growth and development. An initial infestation rate of 5,000 *M. incognita* eggs and juveniles resulted in a significant decrease in plant dry weight at both 2 and 4 weeks after planting and in greater seedling mortality (Kirkpatrick et al., 1994). Infected plants grew more slowly during the first few weeks after emergence and main stem node development was delayed. Since the life cycle of the nematode is completed in approximately one month, the initial population of nematodes in the soil at planting were likely responsible for much of the effects seen during the first four weeks. Although effects on plant growth and development that may occur later in the growing season are likely due to increases in nematode populations, it appears

that initial invasion and parasitism of seedlings shortly after emergence causes a significant delay in plant development and suppression of growth. As profit margins for cotton continue to narrow and management of the crop for optimum yield becomes more sophisticated, a thorough evaluation of the significance of early season nematode damage to cotton seedlings in overall productivity will be necessary.

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