LS95-060.1

**IN NEMATODE COMMUNITY STRUCTURE AND COTTON PRODUCTIVITY AS AFFECTED BY POULTRY-LITTER AMENDMENTS.** **S. R. Koenning[1], K. R. Barker[1] & K. L. Edmisten[2], Plant Pathology Department[1] and Crop Science Department[2], North Carolina State University, Raleigh, NC 27695 U.S.A.** - Experiments conducted at two locations focused on the impact of poultry-litter amendments on cotton yield and the population densities of plant-parasitic, fungivorous, bacterivorous, omnivorous, and predacious nematodes in cotton fields infested with the Columbia lance nematode, *Hoplolaimus columbus*. Plots were aranged in a split-plot design with four levels of poultry litter (0, 6.7, 13.4, and 20.1 metric tons/ha) as whole plots and growth-regulator treatments (PIX®) as subplots. Poultry litter was added to the soil surface and incorporated 2-4 weeks before cotton was planted in May. Soil samples for nematode assays were taken prior to the addition of poultry litter, at midseason, and at cotton harvest. Growth-regulator treatments generally did not affect nematode numbers in this study. Midseason population densities of Columbia lance nematodes decreased linearly with increasing levels of poultry litter ($P$=0.10) at one location. Numbers of bacterivorous nematodes at midseason were positively related ($P$=0.10) to the amount of poultry litter applied in the spring at both locations, but numbers of fungivorous, omnivorous or predaceous nematodes were not. *Helicotylenchus dihystera* population densities generally were not affected by pre-season litter applications. Only fungivorous nematodes were significantly greater ($P$=0.10) in plots amended with poultry litter at cotton harvest. Application of poultry litter effected significant cotton-yield increases at both locations.

## INTRODUCTION

Plant-parasitic nematodes frequently limit cotton yields by 15% and may even result in crop failure. Important nematode pathogens of cotton in the USA include the root-knot nematode, *Meloidogyne incognita*, the reniform nematode *Rotylenchulus reniformis* and the Columbia lance nematode (CLN) *Hoplolaimus columbus*. The poor plant growth caused by these pathogens results in an array of other negative impacts, including a crop unable to utilize available soil moisture and nutrients (Fig. 1). Restricted plant growth also may lead to increased leaching and/or run-off of pesticides and soil-applied nutrients such as nitrogen and potassium.

Management of plant-parasitic nematodes relies on only a few tactics, including resistant varieties, nematicides, rotations, and other cultural practices that effectively control these pests. Many nematicides currently are under review because of high toxicity, and potential to contaminate water supplies. Rotation usually is not a viable option for the Columbia lance nematode since most crops are hosts for this parasite, and cotton varieties resistant to this nematode have not been developed.

Cultural practices often are neglected as an option for nematode management in cotton. Use of animal wastes, other organic amendments or green manure crops have promise for controlling many plant-parasitic nematodes. Additonally, the application of animal waste or other organic ammendments to soil also can reduce or eliminate the need for chemically based fertilizers - another source of non-point water pollution. A shift from chemically intensive to biologicaly intensive agricultural systems likely will impact soil biota. Nematode communities are considered to be good biological indicators of soil and (or) ecosystem health.

An experiment was conducted in two farmers' fields in Hoke and Scotland Counties, NC, USA to evaluate the effects of poultry litter on communities of soil inhabiting nematodes and cotton yield.

## MATERIALS AND METHODS

The experiment was a 3 X 4 factorial evaluating three systems for managing cotton growth (applications of PIX® growth regulator) and soil applications of poultry litter at four rates (0.0, 6.7, 13.4, and 20.1 metric tons/ha).. Experiments at two locations were arranged in a split-plot design with growth regulator treatments as subplots and six replications. Chicken (Scotland, Co.) or turkey (Hoke, Co.) litter was applied in April 1995. Each site was disced to incorporate the litter within 1 week of application and cotton planted in May. Plots not receiving poultry litter were fertilized with traditional chemical-based fertilizer after planting, according to recommendations of a soil chemical analyses. A side-dress application of nitrogen was made to all treatments in July because of excessive rainfall in June.

All plots were sampled for nematodes prior to litter application, midseason (September) and at cotton harvest in October or November, 1995. Soil and root samples for nematode assays were processed by elutriation and centrifugation and Seinhorst mist. Plant-parasitic nematodes were identified to species and all nematodes were identified to trophic group (plant-parasites, predators, omnivores, bacterivores, and fungivores). Statistical analyses consisted of analysis of variance (ANOVA) with orthogonal polyonomial contrasts.

## RESULTS AND DISCUSSION

There was a linear decrease ($P$=0.05) in numbers of Columbia lance nematode at midseason with increasing amounts of litter added at the Scotland County site (Figs. 2, 3).

Population densities of *Helicotylenchus dihystera, Paratrichodorus minor,* and *Tylenchorhynchus claytoni,* were unaffected at midseason (Fig. 2) or at cotton harvest (data not included) by litter applications. Harvest numbers of Columbia lance nematode were not influenced by soil ammendments (Fig. 4). Similar results were obtained at a site in Hoke County, NC, although plant-parasitic nematodes were below the damage threshold at this location.

Midseason numbers of bactivores were positively related ($P$=0.05) to the rate of litter application at both sites (Fig. 3 - data for Hoke County not included), whereas numbers of fungivorous nematodes at cotton harvest were proportional to the amount of manure applied (Figs. 4, 5). There were greater ($P$=0.10) numbers of predatory nematodes at midseason in plots with high rates of litter than the controls at the Hoke County site (Fig. 5). The soil application of poultry litter effected a shift in the relative abundance of nematodes in various trophic groups (Fig. 5). The percentage of fungivorous and bactivorous nematodes increased relative to the percentage of phytophagous nematodes at both sampling dates at the Hoke County location. Similar results were obtained at the Scotland County site.

The 13.4 and 20.1 metric ton/ha rates of chicken litter effected an increase ($P$=0.10) in cotton lint yield (Fig. 6) associated with midseason suppression of CLN at the Scotland County location. Similarly, there was a linear increase in cotton lint yield related to the rate of litter applied at the Hoke County site, even though preplant population densities of *H. columbus* were below the damage threshold.

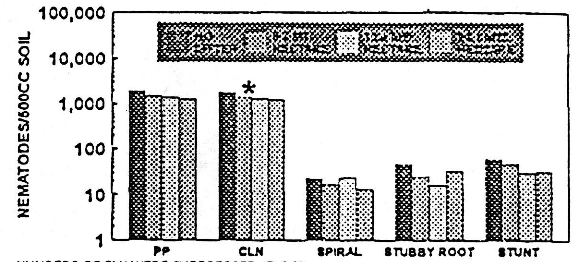
The use of biological waste products, especially poultry litter, to manage plant pathogenic nematodes shows considerable promise. In addition to possible nematicidal and nutritional effects of these materials, the increase in the relative abundance of free-living nematodes associated with the addition of poultry litter suggest enhanced species diversity in the soil microbial community. The increase in population levels of non-parasitic "microbivorous" nematodes may be important in nutrient cycling and general "soil health".

## CONCLUSIONS

1. Addition of poultry litter enhanced cotton yield and suppressed population densities of Columbia lance nematode in field experiments.
2. Relatively high rates of poultry litter must be applied to soil to achieve a measurable effect on the population density of *Hoplolaimus columbus*.
3. Enhanced numbers of fungivorous and bactivorous nematodes associated with addition of poultry litter to soil indicate an increase in soil microbial activity.

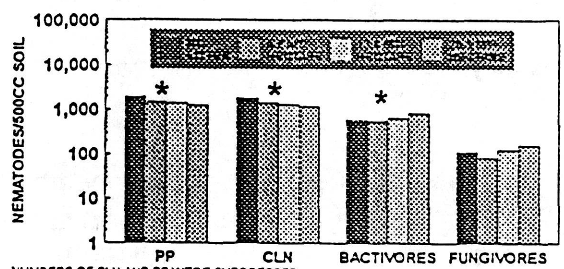
**FIG. 1. A COTTON CROP DAMAGED BY *HOPLOLAIMUS COLUMBUS* IN SCOTLAND COUNTY, NC, USA.**

FIG. 2. MIDSEASON NUMBERS OF TOTAL PLANT-PARASITIC (PP), COLUMBIA LANCE - *HOPLOLAIMUS COLUMBUS*(CLN), SPIRAL -*HELICOTYLENCHUS DIHYSTERA*, STUBBY ROOT - *PARATRICHODORUS MINOR*, AND STUNT - *TYLENCHORHYNCHUS CLAYTONI* NEMATODES, AS INFLUENCED BY APPLICATIONS OF CHICKEN LITTER IN 1995 IN SCOTLAND CO.



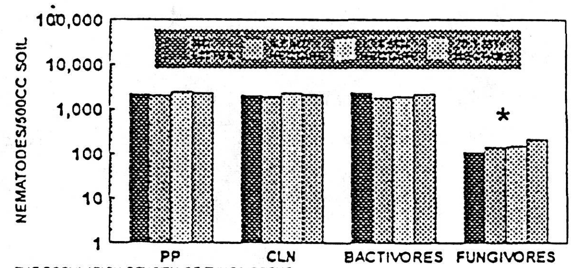

NUMBERS OF CLN WERE SUPPRESSED (P=0.08) RELATIVE TO THE RATE OF LITTER APPLIED. OTHER PLANT-PARASITES WERE UNAFFECTED.

FIG. 3. MIDSEASON NUMBERS OF PLANT-PARASITIC (PP), COLUMBIA LANCE (CLN), BACTERIVOROUS, AND FUNGIVOROUS NEMATODES, AS INFLUENCED BY APPLICATIONS OF CHICKEN LITTER IN 1995 IN SCOTLAND CO.




NUMBERS OF CLN AND PP WERE SUPPRESSED BY THE AMOUNT OF LITTER, BUT NUMBERS OF BACTERIVORES WERE ENHANCED (P=0.10).

FIG. 4. HARVEST NUMBERS OF PLANT-PARASITIC (PP), COLUMBIA LANCE (CLN), BACTERIVOROUS, AND FUNGIVOROUS NEMATODES, AS INFLUENCED BY APPLICATIONS OF CHICKEN LITTER IN 1995 IN SCOTLAND CO.




THE POPULATION DENSITY OF FUNGIVORCUS NEMATCCES WAS POSITIVELY RELATED TO THE AMOUNT OF CHICKEN LITTER APPLIED (P=0.036).

FIG. 5. PROPORTIONS OF NEMATODES IN DIFFERENT TROPHIC GROUPS AT MID-SEASON AND COTTON HARVEST IN RESPONSE TO APPLICATION OF TURKEY LITTER AT HOKE COUNTY.

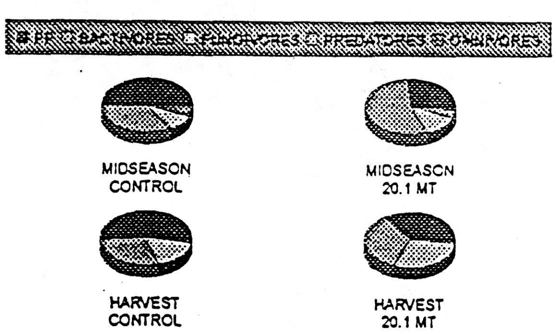
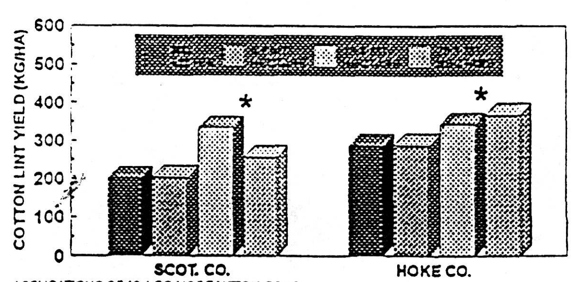



FIG. 6. COTTON LINT YIELD AT TWO LOCATIONS AS AFFECTED BY APPLICATION OF DIFFERENT RATES OF POULTRY LITTER IN FIELDS INFESTED WITH COLUMBIA LANCE NEMATODE, *HOPLOLAIMUS COLUMBUS*, IN 1995.




APPLICATIONS OF 13.4 OR MORE METRIC TONS OF POULTRY LITTER PER HECTARE RESULTED IN SIGNIFICANT YIELD INCREASES (P=0.05).