NITRATE MOVEMENT IN SOUTHEASTERN COASTAL PLAIN SOILS UNDER CONSERVATION-TILLED VEGETABLE PRODUCTION

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ABSTRACT

Movement of soil nitrates by leaching was determined for conservation-tilled vegetable systems in different Southeastern Coastal Plains This study measured soil nitrate-N locations. with depth at planting and after cucumber harvest at Clinton, NC, Florence, SC, and Tifton, Residual soil nitrates were removed by GA. cover crops (both wheat and crimson clover) during the winter and spring growing season. Soil nitrates were greater below the root zone than in the root growing area after vegetable harvest, indicating that some leaching occurred during the summer. Crimson clover residue treatments produced the highest soil nitrates of the three cover treatments at all three locations. Although preliminary, soil nitrate movement affected by treatment during the course of this study has shown similarity among locations by treatment. Climatic conditions and production practices were similar in general, but different enough to affect nitrate leaching rates. Soil taxonomic similarities may predetermine nitrate leaching potential, reducing the need to duplicate nitrate leaching experiments on similar soil types.

INTRODUCTION

Cover crops have been used for recycling nutrients or for N fixation by symbiotic bacteria for cropping systems prior to synthetic N manufacturing in the 1950's (Frye et al., 1985). The use of synthetic N for vegetable production was quickly adopted and the use of cover crops was reduced or eliminated (Hoyt and Hargrove, 1986). Cover crops not only fix and recycle N and other nutrients (Hoyt. 1984). but they also reduce nitrate-N leaching below the root zone during the winter by plant accruement (Ditsch et

al., 1993; Hoyt and Mikkelsen, 1991; Morgan et al., 1942). Plant residues are then used as a surface mulch to increase water retention, organic matter, etc. and reduce evaporation, soil erosion, etc. (Gilliam and Hovt, 1987; Soika et al., 1991). Few studies have shown soil profile distribution of N fertilizer additions during or after vegetable crop production (Hubbard et al., 1991). Experiments were established to determine the production capabilities of cover crops, tillage reductions, and N rate additions under various environments of the southeastern U.S. This study specifically looked at soil profile inorganic N distribution before and after vegetable crop production over a four year period. This publication reports soil nitrate movement after cucumber harvest in the second year of this study.

METHODS AND MATERIALS

The following field sites were used to compare soil N leaching profiles by geographic and climatic differences among treatment similarities within each location.

CLINTON. NC

This experiment was located near Clinton, North Carolina at the Horticultural Crops Research Station. The field site is in the Coastal Plain on an Orangeburg loamy sand soil series (fine loamy, siliceous, thermic Typic Paleudults).

FLORENCE, SC

This experiment was located near Florence, South Carolina at the Pee Dee Research and Extension Center. The field site is in the Coastal Plain on a Norfolk loamy sand soil series (fine loamy, siliceous, thermic, Typic Paleudults).

TIFTON. GA

This experiment was located near Tifton, Georgia at the Coastal Plain Experiment Station.

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FIGURE 3. SOIL NITRATES AFTER CUCUMBER HARVEST, CLINTON, NC, SEPT. 3, 1992

SOIL NITRAJE-N, ppm



FIGURE 2. SOIL NITRATES AFTER CUCUMBER HARVEST, FLORENCE, SC, AUGUST 26, 1992

SOIL NITRATE-N, ppm



FIGURE 4. SOIL NITRATES AFTER CUCUMBER HARVEST, TIFTON, GA, JULY 16, 1992

The field site is in the Coastal Plain on a Tifton loamy sand soil series (fine loamy, siliceous, thermic Plinthic Paleudults).

Wheat and crimson clover cover crops were planted at each location in the fall of 1990 and 1991 and a bare soil control treatment. Sweetpotatoes were planted (in 1991) in rotation with cucumbers (in 1992). All locations used conservation tillage to plant the summer crop. Three rates of fertilizer at 0, 60 and 120 kg N/ha (0, 54, and 108 lbs N/acre) were applied to each vegetable crop treatment at summer vegetable planting. Soil cores were collected before planting and after final cucumber harvest the second year (Figures 2-4). One soil core was taken from each of the four replicates for each treatment.

All soil cores were taken to a depth of 150 cm using a 5 cm steel tube with a Giddings soil probe. Each soil core was sectioned into the following depths: 0-15 crn, 15-30, 30-45, 45-60, 60-75, 75-90, 90-120, and 120-150. All soil samples were kept cool in the field, then placed in a freezer until extracted. Each soil depth was extracted by weighing 10 g wet weight of thawed soil and shaken for 30 min with 30 ml of 1 N KCI solution. Dry weights (65°C) were also taken by gravimetric methods. Extracted soil were analyzed using solutions Technicon Autoanalyzer II spectrophotometer procedures (Technicon Industrial Systems, 1978 a & b).

RESULTS

Soil nitrate measurements before cucumber planting at the Florence, SC location showed that the wheat cover crop treatment removed most of the available soil inorganic-N from the 0-75 cm depth (Figure 1). Below this depth, soil nitrates in the wheat treatment remained lower than the bare treatment. Crimson clover treatment had a higher surface nitrate concentration than the wheat treatment and then a similar but slightly lower nitrate pattern with depth. The bare soil treatment had a greater soil nitrate concentration with depth for most of the soil depths measured. Spring soil nitrates showed similar patterns at the Tifton, GA and Clinton, NC locations (data not shown). Both wheat and crimson clover cover crops removed inorganic nitrogen from the soil profile during the winter and especially during the late spring growing season. The differences in soil nitrate seen between the bare soil treatment

and the two cover crops indicated the amount of nitrogen that the cover crop should have accrued into the plant.

Soil nitrates after cucumber harvest at each location showed a similar pattern of soil nitrogen movement by treatments (Figures 241. At each location, soil nitrates were greatest at 60-70 cm depth in the crimson clover treatments. Bare soil tended to have lower nitrates to the 60 cm depth than the two cover treatments. Surface nitrates were low in all locations to the 40 to 60 cm depths. Soil nitrate measurements after harvest showed that crimson clover residues decomposed during the summer and that the cucumber crop did not remove all of the available nitrogen during decomposition. Wheat cover treatments had a slight increase in soil nitrates at many depths

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