TOMATO YIELD AND SOIL QUALITY AS INFLUENCED BY TILLAGE, COVER CROPPING, AND NITROGEN FERTILIZATION

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INTERPRETIVE SUMMARY

Vegetable production systems, such as tomato, require intensive management and high input of nitrogen compared with cereal production systems. Nitrogen uptake in vegetable crops is also lower than in cereal crops. As a result, soil and water quality can be degraded due to increased soil organic matter mineralization and erosion and nitrate pollution in the groundwater more under vegetables than under cereal crops. Therefore, practices that conserve soil and nutrients are needed for improved soil and water quality and sustained vegetable production.

We examined the influence of tillage (no-till, chisel, and moldboard), cover crop (hairy vetch and no hairy vetch), and nitrogen fertilization (0, 80, and 160 lb/acre) on tomato yield and nitrogen uptake, root growth, and soil carbon and nitrogen levels in central GA for two years. Chisel was used as minimum tillage and consisted of harrowing (4 to 6 in depth), followed by chiseling (8 to 10 in depth) and leveling (3 to 4 in depth). Similarly, moldboard was used for conventional tillage and consisted of harrowing, followed by moldboard plowing (8 to 10 in depth) and leveling. Hairy vetch fixes nitrogen from the atmosphere and was used to reduce N fertilization and N leaching. It was planted in the fall after summer crop harvest and killed by spraying Round-Up in no-till or incorporated into the soil in chisel or moldboard before tomato planting in the spring.

Inorganic nitrogen is the available form of nitrogen in the soil for plant uptake. Mineralizable nitrogen is a labile portion of organic nitrogen that will be mineralized and available during a growing season. Similarly, mineralizable carbon is a labile form organic carbon indicating microbial activities and can influence on N availability in the soil. Organic carbon and nitrogen are important components of organic matter where carbon and nitrogen are conserved in the soil.

Tomato yield and N uptake were lower in no-till than in moldboard but were similar in chisel and in moldboard. In contrast, tomato total number of roots from 1 to 22.5 in depth was greater in no-till than in moldboard and in no hairy vetch with 160 lb nitrogen/acre than in hairy vetch with 0 lb nitrogen/acre. Similarly, mineralizable nitrogen, mineralizable carbon, organic carbon, and organic nitrogen were greater in no-till or chisel than in moldboard at 0- to 4-in depth but were greater or similar in moldboard than in no-till or chisel at 4- to 12-in depth. Because of higher N concentration and accumulation, hairy vetch increased inorganic nitrogen, mineralizable nitrogen, tomato yield, and nitrogen uptake compared with no hairy vetch. Similarly, 80 and 160 lb nitrogen/acre increased inorganic nitrogen, mineralizable nitrogen, tomato yield, and nitrogen uptake compared with 0 lb N/acre. Inorganic and mineralizable nitrogen at 4- to 12-in depth and tomato yield and N uptake, however, were similar with 80 and 160 lb nitrogen/acre. Higher rainfall increased tomato yield and N uptake in 1997 than in 1996 but warmer weather promoted tomato root growth and mineralized more C and N in 1996 than in 1997. The results indicate that minimum tillage, such as chisel, with hairy vetch cover cropping and 80 lb nitrogen/acre should be practiced for sustained tomato productivity and improved soil and water quality.

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