No-tillage Planted Tropical Corn Yield Response to Nitrogen Fertilizer

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ABSTRACT

The widespread use of tropical corn *(Zea mays* L.) in sustainable farming systems necessitates the continued study of its requirements of N fertilizer. The objective of this research was to determine the inorganic N requirements of tropical corn hybrid, 'Pioneer Brand X304C' in no-tillage management systems under environmental conditions at one location in Tennessee and one location in Florida. Leaf analysis showed that N fertilizer provided sufficient concentrations in tissue for the Tennessee study but apparently N leaching in the Florida experiments resulted in deficiency levels in the leaves. Highest grain (about 100 bu/acre) and forage yields (about 20 tons/acre) were achieved with about 120 pounds N/acre in Tennessee but even 180 pounds N/acre was not adequate in Florida. More efficient use of N should occur with four or more split applications in Florida, but this will require additional research to verify.

INTRODUCTION

Tropical corn (Zea mays L.) was estimated to have been grown, mostly for silage, on over 50,000 acres in the southeastern USA in 1991 (Wright et al., 1991). Gallaher et al. (1991) found that double cropping of tropical corn for silage could provide both profits and high quality forage. Precise inputs of N fertilizer are important not only *to* reduce pollution of surface and ground water but also to the economic well being of tropical corn producers (Lord and Gallaher, 1991). One way to monitor N fertilizer needs is by leaf analysis followed by comparisons with sufficiency concentration ranges (Jones, 1974). The objective of this research was to determine the inorganic N requirements of tropical corn in no-tillage management systems under environmental conditions at one location in Tennessee and one location in Florida.

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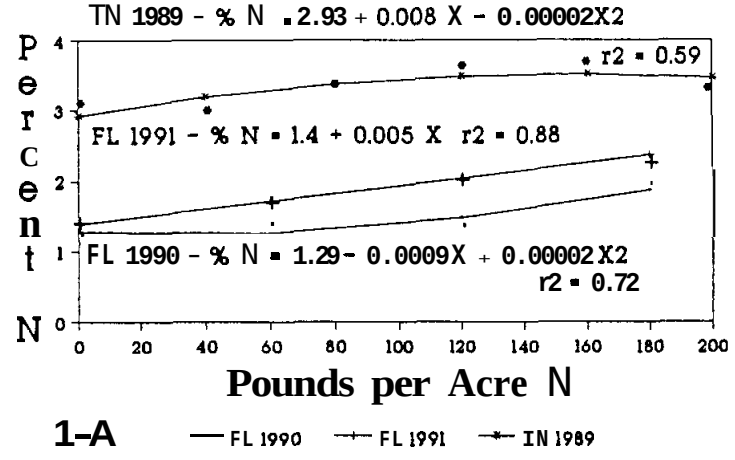
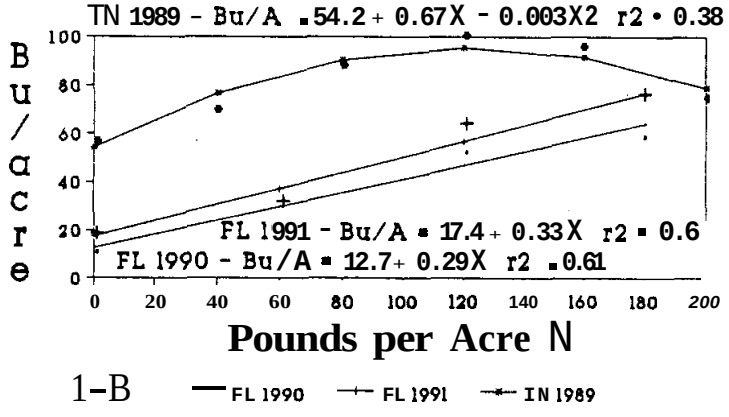
MATERIALS AND METHODS

One experiment was conducted at the Gallaher Angus Farms, Waynesboro, Tennessee on an Ennis cherty loam (46% sand, 34% silt, 20% clay) (Fine-loamy, siliceous, thermic, Fluventic Dystrochrept). 'Pioneer Brand X304C was planted on 5 May 1989 to achieve a population of 17,000 plants per acre in four row plots 30 inches wide and 30 feet long. Rows were laid off using a no-tillage planter in a 25 year-old fescue (Festuca arundinacea Schreb) pasture and planted by hand using a crowbar to punch equally spaced holes in the sod. Seed were dropped in the holes and covered with a mallet. Preemergence herbicides were Gramoxone (paraquat) plus X77 surfactant and atrazine. Six N rates of 0, 40, 80, 120, 160, and 200 pounds N/acre were applied in a randomized complete block design with four replications. Split applications of the N were at planting and at 12 inches. Youngest mature leaves were collected two weeks before tasseling for N analysis. Plant dry matter and grain yield were determined at black layer. Based upon soil test and Florida recommendations no additional fertilizer was applied. However, the fescue pasture had been fertilized with 45 lbs. N, 45 lbs. P_2O_5 and 45 lbs. K_2O per acre three months prior to planting the corn.

The second experiment was conducted for 2 yr at the Green Acres Agronomy Farm near





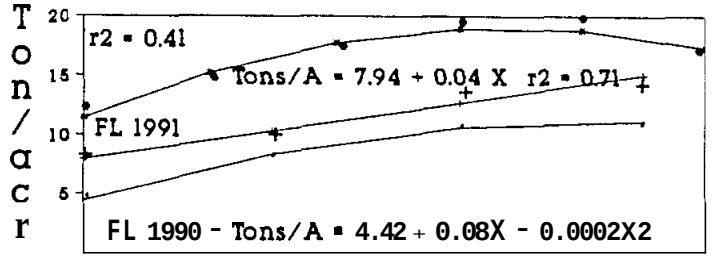


Fig. 1. No-tillage tropical corn for 1989 in Tennessee and for 1990 and 1991 in Florida: 1-A is leaf N concentration; 1-B is grain yield at 15.5% moisture; and 1-C is forage yield at 35% dry matter.

Gainesville, Florida. The soil was an Arredondo fine sand (94% sand, 2% silt, 4% clay) (sandy, siliceous, thermic, Grossarenic Paleudult). Pioneer Brand X304C was planted with an in-row subsoil no-tillage planter into no-tillage drilled rye (Secale cereale L.) residue on 20 May 1990 and 18 May 1991. The four row plots were 30 inch wide and 16 feet long to achieve 31,000 plants/acre. Four N rates were 0, 60, 120, and 180 pounds N/acre in a randomized complete block design replicated five times. Nitrogen was applied in two equal splits in 1990 and in three equal splits in 1991. Dual (metolachior) plus atrazine was applied to corn at planting. Gramoxone plus X77 surfactant was sprayed preplant. Furadan (#15g) (carbofuran) was applied at the rate of 2 pound a.i./acre at planting. Lannate (methomyl), at the labeled rate, was sprayed overtop corn one time to control insects. Water was applied every four days (1.2 inches) from tasseling through rapid grain fdl depending on rainfall. Soil samples were collected from the top 3 inches depth. Each year 450 pounds of 0-10-20/acre plus 300 pounds of K-Mag were broadcast at planting. Ear leaf samples were taken at early tasseling and silking for diagnostic N analysis. Grain yield forage yields were determined at black layer.

Leaf samples were dried at 70 °C in a forced air oven and ground to pass a 2 mm stainless steel screen in a Wiley mill and stored in air tight sterile plastic bags. Micro-Kjeldahl techniques were used to determine leaf N levels (Gallaher et al., 1975; Gallaher et al., 1976).

RESULTS AND DISCUSSION

Based on sufficiency ranges for N in corn leaf just below the whorl 3.00% N would be low and >3.50% N would be high (Jones, 1974). Leaf N from the Tennessee study was below 3.00% in the control plots and slightly above 3.50% with 160 pounds N/acre (Fig. 1-A). Based on sufficiency ranges for N in corn ear leaf, values below 2.60 % would be low and >4.00 % would be high. Ear-leaf N for both years of the Florida study was low at all N rates. Only at the highest N fertilizer rate of 180 pounds/acre in 1991 did ear-leaf N even approach the lowest value for sufficiency. Data show that in all studies leaf N concentration increased from increasing rates of fertilizer N except at the highest rate of N in the Tennessee study. Leaching of N was likely the reason for the low concentration of N in the ear leaf in the Florida studies. Applying the N in more than three splits should help overcome N losses and enhance N level in corn leaf.

Grain and forage yield response were positively related to increasing rates of fertilizer N application as well as N concentration in the corn leaf tissue (Fig. 1-B and 1-C). The no-tillage corn yield at the Tennessee location was greater at a lower rate of fertilizer N as compared to the Florida studies. It appears that best grain yields were obtained at about 120 pounds N/acre for Tennessee and at about 180 pounds N/acre or more for the Florida research. Since N concentration was low in ear leaf at Florida and leaf N concentration and whole plant and grain yields continued to increase at the highest N fertilizer rate, fertilizer N should be applied in more than three split applications in order to achieve optimal yield of tropical corn. This should reduce the potential for leaching and help obtain greater N use efficiency.

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