Comparison of No-tillage Planted Tropical and Temperate Corn for Yield and Nitrogen Concentration of the Grain Based on Endosperm Type

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ABSTRACT

Much tropical corn (Zea mays L.) available for sustainable farming systems is of the flint endosperm grain type. The objective of this study was to evaluate Florida experimental tropical corn populations for yield and grain N concentration compared to commercially available tropical flint and temperate dent grain types. Four experimental populations of mixed endosperm grain types and selections of either all flint or all semident seeds from these populations were compared to 'Pioneer Brand X304C', a tropical flint hybrid; 'Pioneer Brand 3320', a temperate dent hybrid; and 'Abbe Hill', an open pollinated dent variety from Nebraska. The 15 cultivars were treatments, replicated four times in Tennessee (Ennis cherty loam, Fluventic Dystrochrept) and six times in Florida (Arredondo fine sand, Grossarenic Paleudult) in a randomized complete block design. Grain and forage yields of Florida experimentals ranged from 90 to 161 bu/acre and 17.2 to 22.6 ton/acre, respectively depending on location and were equal or better than the hybrids and better than Abbe Hill. Yields in Florida tended to be greater than in Tennessee and were likely due to higher population, irrigation management and earlier planting dates. Photoperiod response resulted in tropical corn being almost twice as tall in Tennessee compared to Florida.

INTRODUCTION

Tropical corn *(Zea mays* L.) silage is important in the southeastern USA (Wright, et al 1991). Sustainable farming for some producers may well depend upon the adaptation of tropical corn in double cropping systems (Gallaher et al., 1991). Corn grain N concentration can be used as an indicator of N fertility status (Cerrato and Blackmer, 1990) and has been shown to be genetically controlled (Kauffmann and Dudley, 1979). The objective of this study was to evaluate Florida experimental tropical corn populations for yield and grain N concentration versus commercially available tropical flint and temperate dent grain types.

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). Corn was planted on 5 May 1989 to achieve a population of 17,000 plants per acre in two row plots 30 inches wide and 15 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. A total of 15 cultivars (Table 1) were tested in a randomized complete block design with four replications. Nitrogen (180 pounds N/acre) was applied by hand in two equal split applications. 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

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Table 1. Yield, seed characteristics and nitrogen concentration, plant and ear height and plant to ear height ratio of Florida experimental corn populations, a trouical hvbrid, a temperate hybrid and an open pollinated varietv.

Cultivar	Endosperm Planted	Flint Seed	Location Fla.	Location Tenn.	Location Fla.	Location Tenn.	Location Fla.	Location Tenn.
	-Type seed-	-%-	----Seed % N-----		----- Bu/A ----		----Tons/a----	
FLPl	Mixed	77	1.76abc	1.87def	138ab	102ab	22.6a	17.1b
FLP2	Mixed	82	1.74abcd	1.78fg	123b	110ab	17.9c	18.0ab
FLP3	Mixed	72	1.73abcd	1.71gh	161a	121ab	22.2ab	19.5ab
FLP4	Mixed	66	1.62de	1.85ef	119b	136ab	18.6bc	17.7b
FLP1	Flint	81	1.77ab	2.01abc	143ab	142ab	22.1ab	20.3ab
FLPZ	Flint	82	1.58e	2.11a	131ab	127ab	20.4abc	19.9ab
FLP3	Flint	81	1.75abcd	2.04ab	134ab	111ab	19.4abc	17.2b
FLP4	Flint	81	1.69bcde	1.95bcde	133ab	148a	22.1ab	22.2a
FLPl	Semi-Dent	67	1.72abcd	1.97bcd	129b	124ab	21.9ab	18.8ab
FLPZ	Semi-Dent	67	1.75abcd	2.03ab	126b	90bc	20.6abc	16.8b
FLP3	Semi-Dent	63	1.62de	1.88de	123b	108ab	20.5abc	19.2ab
FLP4	Semi-Dent	65	1.74abcd	1.91cde	121b	120ab	17.8c	20.0ab
P.B. X304C	Flint	>95	1.63cde	1.94bcde	150ab	116ab	21.1abc	19.3ab
P.B. 3320	Dent	< 5	1.34f	1.63h	149ab	13d	19.2abc	5.3c
Abbe Hill	Dent	< 5	1.83a	2.03ab	84c	52cd	12.4d	7.5c
C.V. (%)			(4.11)	(2.73)	(17.64)	(29.13)	(13.73)	(15.38)

		Plant ht. Fla.	Plant ht. Tenn.	Ear ht. Fla.	Ear ht. Tenn.	Plant to Ear ht Fla.	Plant to Ear ht Tenn.
		------Feet-----		----Feet------		-----Ratio----	
FLPl	Mixed	8.96a	14.45bc	4.77a	7.15bc	1.89d	2.04cd
FLPZ	Mixed	8.77a	14.50bc	4.37abc	7.55abc	2.01cd	1.93cd
FLP3	Mixed	8.99a	15.00bc	4.69ab	7.80abc	1.92d	1.93cd
FLP4	Mixed	8.63a	15.08bc	4.24bc	7.90abc	2.04cd	1.92cd
FLPl	Flint	8.69a	14.53bc	4.49abc	7.40bc	1.95d	1.97cd
FLPZ	Flint	8.92a	14.13c	4.44abc	7.03c	2.01cd	2.03cd
FLP3	Flint	8.87a	15.60ab	4.36abc	8.33ab	2.05cd	1.88d
FLP4	Flint	8.89a	15.25abc	4.54ab	7.80abc	1.98cd	1.96cd
FLPl	Semi-Dent	8.54a	15.03bc	4.29abc	8.10abc	2.00cd	1.86d
FLPZ	Semi-Dent	9.02a	14.78bc	4.76a	7.65abc	1.90d	1.94cd
FLP3	Semi-Dent	8.84a	16.45a	4.55ab	8.70a	1.96d	1.90d
FLP4	Semi-Dent	8.77a	14.90bc	4.29abc	7.63abc	2.05cd	1.97cd
P.B. X304C	Flint	8.67a	15.13abc	4.04c	7.15bc	2.16c	2.12c
P.B. 3320	Dent	7.70b	10.58d	2.88d	3.90d	2.69b	2.72a
Abbe Hill	Dent	6.50c	9.95d	2.20e	4.354	2.98a	2.30b
C.V. (%)		(5.29)	(6.03)	(8.72)	(9.06)	(6.76)	(6.06)

FLP = Florida populations. P.B. = Pioneer Brand. Values in columns not followed by the same letter are significantly different at the 0.05 level of probability according to Duncan's multiple range test.

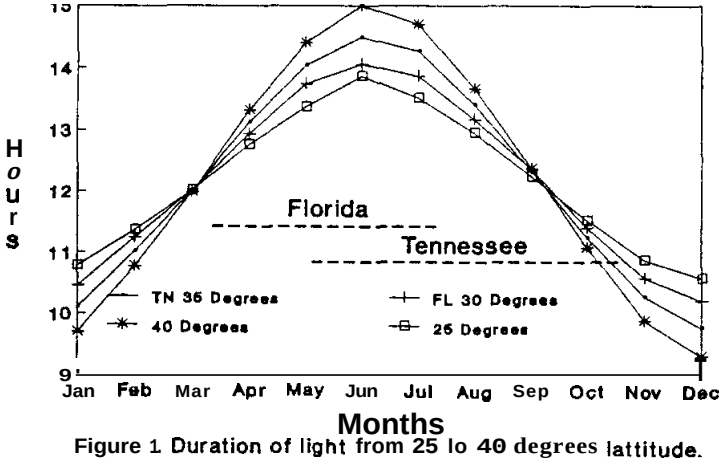

Figure 1 Duration of light from 25 lo 40 degrees lattitude.

at the Green Acres Agronomy Farm near Gainesville, Florida on an Arredondo fine sand (94%sand, 2%silt, 4% clay) (sandy, siliceous, thermic, Grossarenic Paleudult). The 15 cultivars were planted with an in-row subsoil no-tillage planter into corn residue from the previous year on 14 April 1989. The two row plots were 30 inches wide and 16 feet long to achieve 29,000 plants/acre. 'Dual' (metolachlor) 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. Water was applied every four days (1.2 inches) from tasseling through rapid grain fill depending on rainfall. Nitrogen was applied (180 pounds/acre) in three equal splits. At planting 450 pounds 0-10-20/acre and 300 pounds K-Mag/acre were broadcast. Grain and forage yields were determined at black layer. The percent flint seed was estimated at harvest. Grain was analyzed for N concentration after drying at 70° C in a forced air oven, ground to pass a 2 mm stainless steel screen in a Wiley mill and stored in air tight sterile plastic bags (Gallaher et al., 1975; Gallaher et al., 1976). Published values for duration of daylight by latitude were plotted (Fig. 1) to aid in data interpretation (List, 1971).

RESULTS AND DISCUSSION

Since simultaneous selection for grain yield and percent protein can result in significant increases in both traits (Kauffmann and Dudley, 1979), it is not surprising that differences in seed yield and protein occurred among cultivars in our study (Table 1). Pioneer Brand 3320, the dent endosperm hybrid, was lowest in percent grain N among all cultivars. Although differences in seed N existed among the other cultivars, they ranged from 20 to 35% higher than Pioneer 3320 in Florida and from 5 to 25% higher in Tennessee. Differences among cultivars in seed N within a location illustrated genetic differences due to endosperm type or within the same endosperm category. Grain N was generally lower for all cultivars in the Florida study compared to the Tennessee study. This was likely due to the less fertile and more leachable fine sand soil in Florida compared to the silt loam in Tennessee and confirms the idea that grain N could possibly be used as an indicator of corn nutrition (Cerrato and Blackmer, 1990).

Grain and forage yield of the mixed, flint or semi-dent endosperm cultivars were affected less by location compared to the two dent or temperate cultivars (Table 1). This may be due to the Florida experimentals and Pioneer Brand X304C responding more to the longer daylight hours in Tennessee, resulting in greater shading of the temperate cultivars. The corn received over one and one-half hours more daylight per day during vegetative growth in Tennessee compared, to Florida (Fig. 1).

These data show that Florida experimentals and the tropical hybrid Pioneer Brand X304C not only have potential as a silage crop in Florida but also as far north as southern middle Tennessee as well. Additional research is required to investigate tropical corn as an alternative for sustaining agricultural systems in the region.

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LITERATURE CITED

1. **Cerrato, M.E., and A.M. Blackmer. 1990.** Relationships between grain nitrogen concentrations and the nitrogen status of corn. Agron. J. 82:744-749.

2. **Gallaher, R.N., C.O. Weldon, and J.G. Futral.** 1975. An aluminum block digester for plant and soil analysis. Soil Sci. Soc. Amer. Proc. 39:803-806.

3. **Gallaher, R.N., C.O. Weldon, and F.C. Boswell.** 1976. A semiautomated procedure for total N in plant and soil samples. Soil Sci. Soc. Amer. J. 40: 887-889.

4. **Gallaher, R.N., S.A. Ford, R. McSorley, and J.M. Bennett.** 1991. Corn forage and forage sorghum double cropping yield, economics, crop nutrient removal and quality. Agron. Res. Report AY-91-05, Agronomy Department, Inst. Food and Agr. Sci., Univ. of Florida, Gainesville, FL 32611.

5. **Kauffmann, K.D., and J.W. Dudley.** 1979. Selection indices for corn grain yield, percent protein, and kernel weight. Crop Sci. 19:583-588.

6. **List, R.J.** 1951. Smithsonian Meteorological Tables. Duration of Daylight, Table 171. p. 507-508. Smithsonian Miscellaneous Collection. Publication 4014, Vol. 114. Smithsonian Institution, Washington, DC.

7. **Wright, D.L., I.D. Teare, and R.N. Gallaher.** 1991. Corn silage production in north Florida. p. 15-20. In I.D. Teare, (ed.), Southern Regional Tropical Corn Symposium. Quincy, Florida, June 27-28, 1991. Potash & Phosphate Institute and Foundation for Agronomic Research, Atlanta, GA.