Agronomic Responses of Corn Hybrids to Plant Density in Central Louisiana

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Abstract

Increased seed costs make it important to know if the optimum plant density for corn grain yield differs with hybrid relative maturity. In 2016, a study was conducted to evaluate the agronomic response of three corn hybrids differing in relative maturity at eight different plant densities ranging from 20,000-55,000 plants per acre. The study was conducted under dryland conditions in a Coushata silt loam. Experimental design was a factorial arrangement in a randomized complete block with four replications. Plant height, ear height, stalk diameter, lodging, grain yield, test weight, grain moisture, and net dollar return were evaluated. Optimum plant density across hybrids or RM for grain yield and net return was observed at the 30 to 35K seeding rates. The objectives of this study were to characterize the agronomic responses of regionally adapted hybrids of differing relative maturities to plant density and the subsequent impact on corn grain yield and net returns.

Introduction

Increased corn (*Zea mays* L.) seed costs and hybrids with greater stress tolerance than in the past make it important to know if the optimum plant density for corn grain yields differs with hybrid relative maturity (RM) (Van Roekel et al., 2012). Also, recent increases in grain prices have stimulated interest in agronomic practices that could enhance crop yields. Hybrid RM has been shown to influence the response of corn grain yield to plant density being higher for early-RM hybrids. Hybrids in the 101-108, 109-113, and > 133 day RM groups had optimum plant densities of 36,00, 35,000, and 34,500 plants per acre (Paszkiewicz and Butzen, 2007). Such differences in optimum plant densities among RM groups have been tied to differences in biomass plasticity and reproductive partitioning, which were found to be greater with late RM maturity groups in Argentina (Sarlangue et al., 2007). Seed costs, however, have risen which has caused growers to become more concerned about whether the economically optimum plant density differs for varying production practices.

Objectives

1. Evaluate the agronomic responses of regionally adapted hybrids of differing relative maturities under different plant densities.
2. Evaluate corn gran yields and net returns of corn hybrids with differing relative maturities under different plant densities.

Materials/Methods

This study was conducted at the Dean Lee Research and Extension Center located near Alexandria, Louisiana. Soil type for this site was a Coushatta silt loam. The previous crop was soybeans. The study was designed as a randomized complete block with a factorial arrangement with four replications. Three hybrids with differing agronomic characteristics (Table 2) and eight plant densities were evaluated and represented in this study. Plot sizes were four rows by 28 feet in length. Corn hybrids were planted on March 22, 2016 on 38-inch row centers. For each hybrid, densities of 20,000, 25,000, 30,000, 35,000, 40,000, 45,000, 50000, and 55,000 were planted. Viable plants were counted after emergence to determine actual plant densities for each of the eight density treatments. At Tassel, plant heights were measured on ten plants in each plot. Stalk diameter was measured on the first internode above the brace roots on 10 plants from the center portion of the center two rows in each plot with an electronic caliper at the silking stage. Prior to harvest, the percentage of plants that were root and stalk lodged was recorded form the center two rows of each plot. Plants were counted as root lodged if the stalk was >45° from vertical and stalk lodged if the stalk was broken below the ear. Harvest date was September 2, 2016. Corn grain yield and moisture content were measured with a plot combine by harvesting the entire length of the center two rows of each plot. Yield was adjusted to 15.5% moisture. Dollar return per acre was calculated by multiplying bushels per acre by $4.30 minus seed cost ($4.31/1000 seed) per acre. Data were analyzed using the Mixed procedure of SAS (SAS Institute, 2003). Mean comparisons were made using Fisher's protected LSD test (α=0.05)

Results

Corn emerged on March 30 and black layer was reached during the later part of July. Rainfall was abundant and temperatures were moderate from planting through the black layer stage (Table 1). There were no hybrid by plant density interactions for any of the variables measured (Table 3). For hybrid effect, differences in plant height, ear height, stalk diameter, percent lodging, grain yield, test weight, grain moisture, and dollar return per acre were found (Table 4). There were no differences in root lodging (not shown). Grain yield and net returns per acre were less for the 112 day hybrid.

For plant density affect, differences in plant height, ear height, stalk diameter, grain yield, grain moisture, and net return were found. Stalk lodging and test weight were not significantly different (Table 5). There were no differences in root lodging (not shown). Grain yields for the 50 and 55K seeding rates were higher when compared to the 20, 25, 30, and 35K seeding rates. No differences in grain yield were found between the 40, 45, 50, and 55K seeding rates. However, net returns were the same for the 30, 35, 40, 45, 50, and 50K seeding rates. Therefore, it would be difficult to recommend planting more than 30 to 35K seed per acre.

In conclusion, optimum net returns per acre were found to be at the 30 to 35K seeding rates.

References

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Table 1. Growing conditions

Month	Rainfall-inches	Avg. Temp. °F
March	9.04	63.86
April	3.31	68.32
May	2.65	73.58
June	5.81	79.56
July	4.46	82.12
August	13.73	80.77

Table 2. Hybrid characteristics

Hybrids	RM	Ear Type	Ear Placement	Height	Leaf Orientation	Stalk[1] Strength	Root[1] Strength
DKC62-08	112	Flex	M	M	Semi-erect	3	2
DKC64-69	114	Semi-flex	M	M	Semi-erect	4	3
DKC66-87	116	Semi-flex	M	M-T	Semi-erect	3	3

[1] 1=excellent and 9=poor.

Table 3. Summary of ANOVA p-values

Variable	Hybrid	Density	H X D
Plant height	0.0001	0.0293	0.3269
Ear height	0.0001	0.0001	0.6805
Stalk diameter	0.0089	0.0001	0.0973
Stalk Lodging	0.0054	0.2436	0.5097
Grain Yield	0.0038	0.0001	0.3275
Test weight	0.0001	0.0767	0.7003
Grain moisture	0.0001	0.0001	0.7689
Net dollar return	0.0038	0.0001	0.3275

Table 4. Hybrid effect across plant densities

Hybrid	RM	Plants (actual)	Plt. ht.	Ear ht.	Stalk diam.	Stalk lodging	Yield	Test wt.	Grain moistur	Net return
	days	acre	in.	in.	mm	%	bu/ac.	lbs.	%	$/acre
DKC62-08	112	32,962 a	77.25 c	37.8 a	23.1 a	.78 a	164 b	58.2 b	14.1 b	544.26 b
DKC64-69	114	33,529 a	79.50 b	36.8 b	22.3 b	.18 b	172 a	59.4 a	14.6 a	578.38 a
DKC66-87	116	32,729 a	84.00 a	35.4 c	22.5 b	.17 b	176 a	58.9 a	14.2 b	593.74 a

Table 5. Plant density effect across hybrids

Seeding Rate	Plants (final)	Plant ht.	Ear ht.	Stalk diam.	Stalk lodging	Yield	Test wt.	Grain moisture	Net return
acre	acre	in.	in.	mm	%	bu/ac.	lbs.	%	$/acre
55,000	48,964 a	80.6 ab	38.1 a	19.6 f	.5441 a	190 a	59.1 a	14.60 ab	581.36 ab
50,000	44,645 b	79.6 bc	37.3 ab	20.1 ef	.1392 a	187 a	58.9 a	14.66 a	590.37 ab
45,000	39,405 c	80.7 ab	37.4 ab	20.8 e	.8423 a	182 ab	59.3 a	14.44 abc	588.68 ab
40,000	35,832 d	80.7 ab	36.9 bc	21.9 d	.4471 a	180 ab	58.8 a	14.39bc	603.63 a
35,000	30,193 e	80.3 abc	36.2 cd	22.8 c	.0694 a	171 b	58.7 a	14.31 cd	584.59 ab
30,000	26,570 f	81.7 a	37.2 ab	24.2 b	.0725 a	174 b	59.1 a	14.24 cd	617.59 a
25,000	21493 g	79.5 bc	35.6 d	25.0 b	.2892 a	151 c	58.8 a	14.09 d	543.29 b
20,000	17,484 h	78.9 c	34.6 e	26.9 a	.6038 a	129 d	57.9 a	13.80 e	467.49 c