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 2015, 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. In conclusion, plant height increased as hybrid relative maturity increased but was not impacted by plant density. Ear height increased as hybrid relative maturity and plant density increased. Stalk diameter increased as hybrid relative maturity increased and decreased as plant density increased. Stalk lodging increased as hybrid relative maturity increased and was not affected by plant density possible due to abundant soil moisture and moderate temperatures during the growing season. Test weight increased as hybrid relative maturity increased and was not affected by plant density. As expected, grain moisture increased as hybrid relative maturity increased and there were no differences across the plant densities. Optimum plant density across hybrids or RM for grain yield and net return was observed at the 32,000 plant density. 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 25, 2015 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 August 14, 2015. Corn grain yield and moisture content were measured with a plot combine by the harvesting the entire length of the center two rows of each plot. Yield was adjusted to 15.5% moisture. Grain samples were dried in a forced-air oven at 60°C until 0% moisture and the kernel weight was then determined by weighing a sample of 300 kernels. 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 April 2 and black layer was reached during the middle part of July. Rainfall was abundant and temperatures were moderate from planting through the black layer stage (Table 1). A significant hybrid X plant density interaction was found for seed weight. This observed interaction on seed weight appears to be due to the ear type or flexing ability differences of the hybrids. For hybrid effect, differences in plant height, ear height, stalk diameter, percent lodging, test weight, grain moisture, and seed weight were found. Grain and net return were not significantly different (Table 3). Plant height for the 112 RM hybrid was less than the 116 and 119 RM hybrids. Ear height, stalk lodging, test weight, and grain moisture for the 119 RM hybrid was higher than the 112 and 116 RM hybrids. Stalk diameter for the 119 RM hybrid was larger than the 116 and 119 RM hybrids (Table 4). There were no differences in root lodging (not shown).

For plant density affect, differences in ear height, stalk diameter, grain yield and net return were found. Plant height, stalk lodging, test weight, and grain moisture were not significantly different (Table 3). For the two lowest plant densities, ear height was less than the other densities with the exception of the 39,000 density. Stalk diameter for the 49,000, 46,000, and 39,000 plant densities were less than the other densities with the exception of the 34,000 density. Grain yield and net return was less for the 18,000 and 21,000 plant densities compared to the six higher plant densities (Table 5). There were no differences in root lodging (not shown).

In conclusion, plant height increased as hybrid RM increased but was not impacted by plant density. Ear height increased as hybrid RM and plant density increased. Stalk diameter increased as hybrid RM increased and decreased as plant density increased. Stalk lodging increased as hybrid RM increased and was not affected by plant density possible due to abundant soil moisture and moderate temperatures during the growing season. Test weight increased as hybrid RM increased and was not affected by plant density. As expected, grain moisture increased as hybrid RM increased and there were no differences across the plant densities. Optimum plant density across all three hybrids or RM for grain yield and net return was observed at the 32,000 plant density.

References

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Table 1. Growing conditions

Month	Rainfall-inches	Avg. Temp. °F
March	7.12	60.6
April	9.04	68.9
May	6.33	74.3
June	5.43	79.7
July	1.83	83.7
August	1.64	81.9

Table 2. Hybrid characteristics

Hybrids	RM	Ear Type	Ear Placement	Height	Leaf Orientation	Stalk Strength	Root Strength
DKC62-08	112	Flex	M	M	Semi-erect	3	2
DKC66-87	116	Semi-flex	M	M-T	Semi-erect	3	3
DKC69-31	119	fixed	M-L	M	Erect	3	3

Table 3. Summary of ANOVA p-values

Variable	Hybrid	Density	H X D
Plant height	0.0001	0.4122	0.8428
Ear height	0.0001	0.0011	0.9433
Stalk diameter	0.0001	0.0001	0.2671
Stalk Lodging	0.0159	0.2879	0.8397
Grain Yield	0.1802	0.0001	0.9881
Test weight	0.0022	0.1633	0.0647
Grain moisture	0.0001	0.6917	0.3859
Seed weight	0.0001	0.2294	0.0188
Net dollar return	0.1802	0.0001	0.9881

Table 4. Hybrid effect across plant densities

Hybrid	Plants (actual)	Plt. ht.	Ear ht.	Stalk diam.	Stalk lodging	Yield	Test wt.	Grain moistur	Seed wt.	Net return
days	acre	in.	in.	mm	%	bu/ac.	lbs.	%	g	$/acre
112	33,888 a	63.04 b	30.7 b	21.92 b	0.073 b	149 a	58.5 b	13.1 c	97.3 b	490 a
116	33,284 a	70.97 a	29.7 b	21.17 b	0.164 b	158 a	57.9 b	13.7 b	93.4 c	524 a
119	34,067 a	71.66 a	32.7 a	24.57 a	0.478 a	159 a	59.7 a	14.9 a	101 a	523 a

Table 5. Plant density effect across hybrids

Plants (actual)	Plant ht.	Ear ht.	Stalk diam.	Stalk lodging	Yield	Test wt.	Grain moisture	Seed wt.	Net return
acre	in.	in.	mm	%	bu/ac.	lbs.	%	g	$/acre
18,259 g	67.4 a	29.5 c	25.4 a	.000 a	119 c	57.8 a	13.7 a	99.5 a	391 c
21,616 f	67.3 a	29.5 c	24.7 ab	.258 a	130 c	57.8 a	14.0 a	97.8 a	428 c
27,716 e	69.5 a	31.4 ab	25.1 a	.068 a	155 b	59.6 a	13.7 a	94.9 a	512 b
32,465 d	69.0 a	31.2 ab	22.7 bc	.131 a	164 ab	59.1 a	14.0 a	97.3 a	543 ab
34,594 d	69.2 a	31.6 ab	21.7 cd	.249 a	159 b	59.3 a	14.0 a	95.2 a	524 b
39,384 c	68.4 a	30.5 bc	21.0 cde	.280 a	162 b	59.1 a	14.0 a	97.8 a	535 b
46,069 b	69.4 a	32.8 a	20.4 de	.318 a	184 a	59.0 a	13.9 a	97.4 a	607 a
49,864 a	68.4 a	31.8 ab	19.5 e	.603 a	169 ab	57.9 a	13.9 a	98.6 a	558 ab

Acknowledgements

Appreciation is expressed to Monsanto/DeKalb for providing the seed for this study.