2013

Starter Fertilizer Impact on Growth, Development, and Grain Yield of Corn Hybrids and Seeding Rates

Warren L. Pierson
Iowa State University, wpierson@iastate.edu

Roger W. Elmore
Iowa State University, relmore@iastate.edu

Starter Fertilizer Impact on Growth, Development, and Grain Yield of Corn Hybrids and Seeding Rates

Abstract
Starter fertilizer often increases early-season growth of corn. However, grain yield responses to starter fertilizer are variable. Plant-to-plant variability in growth and grain has been shown to have negative impacts on total grain yield. Our objectives were to measure plant-to-plant variability as affected by starter fertilizer, hybrid, and population. We also studied the impact of starter fertilizer on growth, development, and grain yield of hybrids and populations.

Keywords
Agronomy

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences

Starter Fertilizer Impact on Growth, Development, and Grain Yield of Corn Hybrids and Seeding Rates

RFR-A12106

Warren Pierson, graduate research assistant
Roger Elmore, professor
Department of Agronomy

Introduction

Starter fertilizer often increases early-season growth of corn. However, grain yield responses to starter fertilizer are variable. Plant-to-plant variability in growth and grain has been shown to have negative impacts on total grain yield. Our objectives were to measure plant-to-plant variability as affected by starter fertilizer, hybrid, and population. We also studied the impact of starter fertilizer on growth, development, and grain yield of hybrids and populations.

Materials and Methods

Corn plots were planted at the ISU Northeast Research Farm, Nashua, Iowa, on April 13, 2011 and April 24, 2012. Soybeans were the previous crops and no tillage was performed prior to planting. Floyd loam was the major soil type with 1 to 4 percent slopes. Pre-plant and post-harvest soil samples were obtained from 0–6 in. Treatments consisted of seeding rates of 30,000, 36,000, and 42,000 seeds/acre, 3 DuPont Pioneer hybrids, and with and without 100 lb MAP/acre. Plots were 50 ft long and six 30 in. rows wide.

Ten plants were selected in rows four and five, staked, and measured at V3, V9, and R2. These plants were also hand harvested for grain yield after R6. We estimated the stage of each plant and measured plant heights from the soil surface to the tip of the highest extended leaf. Stem diameters were measured at the widest part of the elliptical stalk one-half inch above soil surface at V3 and centered between the seventh and eighth node at V9 and R2. The same measurements were taken on five plants in row two at each sampling and cut off to be dried and weighed for biomass. Equations were developed using these measurements to estimate biomass of the ten plants that were measured throughout the season and allowed to grow to maturity. These plants were hand harvested at maturity, shelled, weighed wet, dried, and weighed again. Plant-to-plant variability in estimated plant biomass and per plant grain yield was calculated using the coefficient of variation (CV, see the equation below). Sample standard deviation provides a measure of plant-to-plant variability and dividing by the sample mean standardizes the CV so that increased standard deviation associated with larger plants does not affect the measure of variability.

$$CV = \frac{\text{Sample standard deviation}}{\text{sample mean}}$$

The hybrids used were adapted to the region and selected to represent a range of root strength parameters by DuPont Pioneer. Weeds were managed using herbicides based on ISU Extension recommendations. Corn was harvested using a plot combine and yields were corrected to 15.5 percent moisture.

Results and Discussion

Soil tests for phosphorus were optimum to high pre-plant and post-harvest in 2011 and very low to low pre-plant and post-harvest in 2012. However, soil sampled post-harvest after rain in 2012 had optimum P results. Plants remained in the soil approximately 29 to 42 days before emerging in 2011, resulting in uneven stands. Late-season stand counts were not correlated to planted population.

Developmental stage advanced faster with starter fertilizer application in 2012 at V3 and V9. Also, starter fertilizer reduced grain moisture at harvest from 15.25 to 15.05 percent in 2012. These results suggest faster progression through development, which may alter the environment affecting plants during critical periods of grain determination and fill.

Starter fertilizer increased average estimated plant biomass at V3 and V9 both years and in addition at R2 in 2012 (Table 1). Average plant yield also increased with starter fertilizer application. Starter fertilizer increased total grain yield on an area basis in 2012 but did not increase yield in 2011. Plant yield response to starter fertilizer in 2011—not plot yield response—may be due to the poor and variable emergence in 2011. Also, in 2012, starter fertilizer increased grain yield by 18.6 and 25.2 bushels/acre at the 30,000 and 36,000 seeding rates, respectively, but had no effect at the 42,000 seeding rate (data not shown). The high seeding rate likely did not respond to starter fertilizer because moisture was limited in 2012.

Plant-to-plant variability in growth differed among hybrids at V3 and V9 in 2012. Increasing seeding rate from 30,000 and 36,000 to 42,000 seeds/acre in 2011 caused increased per plant yield variability.

Increasing plant-to-plant variability in per plant grain yield resulted in reduced grain yield in 2012 (Figure 1). Others have shown that high stress levels increase plant-to-plant variability. In this case, drought stress may have induced plant-to-plant variability.

Hybrids (2012) and seeding rates (2011) differed in plant-to-plant variability; however, starter did not affect it both years. Starter fertilizer increased plant growth and development, but only increased final plant size in 2012. Plant-to-plant variability is likely more important to final grain yield under high stress conditions that we experienced in 2012.

Acknowledgements

We would like to thank Ken Pecinovsky for his help during this project. We also want to thank DuPont Pioneer for funding and support of the project.

Table 1. Starter fertilizer effect on estimated plant biomass at V3, V9, and R2, and average plant yield of corn.

		Average estimated biomass ($g \cdot plant^{-1}$)*			Plant yield dry weight* ($g \cdot plant^{-1}$)	Plot yield ($bu \cdot ac^{-1}$)*
Year	Starter	V3	V9	R2		
2011	Yes	0.26 a	26.6 a	158.9 a	174.9 a	199.8 a
	No	0.22 b	23.7 b	155.8 a	165.3 b	200.1 a
2012	Yes	0.52 a	35.9 a	166.0 a	119.1 a	157.3 a
	No	0.41 b	30.0 b	155.5 b	103.6 b	143.3 b

*Means within the same column and the same year followed by the same letter are not different ($P \leq 0.05$).

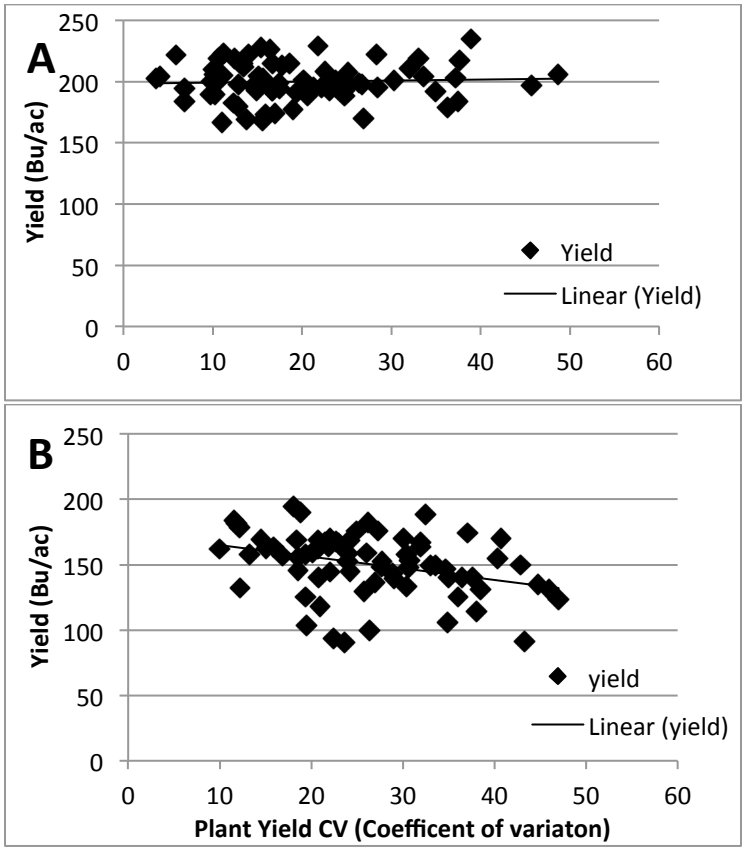

Figure 1. Grain yield in relation to the coefficient of variation of per plant grain yield. Biomass is estimated using a model to correlate plant height and stem diameter measurements to biomass of destructively sampled plants, Nashua 2011 (A) and 2012 (B).