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Corn Planting Date and Depth – Impacts on Yield

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Corn Planting Date and Depth – Impacts on Yield

Abstract

Corn growth and production is dependent on environmental conditions during the growing season. Optimal corn growth occurs between 50 and 86°F. Early-season soil temperatures may reduce corn emergence. Conversely, later-planted corn may not have adequate moisture for good pollination and grain production. This research tested the impact of planting date and planting depth on corn yield. The yield decreased with later planting dates. Earlier planting dates had better yield at lower planting depths, but yield was reduced at deeper planting depths at later planting.

Keywords

corn planting, date of planting, planting depth, corn maturity, cumulative growing degree days

Cover Page Footnote

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G.F. Sassenrath, L. Mengarelli, and X. Lin

Summary

Corn growth and production is dependent on environmental conditions during the growing season. Optimal corn growth occurs between 50 and 86°F. Early-season soil temperatures may reduce corn emergence. Conversely, later-planted corn may not have adequate moisture for good pollination and grain production. This research tested the impact of planting date and planting depth on corn yield. The yield decreased with later planting dates. Earlier planting dates had better yield at lower planting depths, but yield was reduced at deeper planting depths at later planting.

Introduction

Temperature and rainfall are important for crop growth and development. Growing degree days, or heat units, are a method of estimating the thermal time and can be related to the physiological growth of crops. Growing degree days (GDD) are calculated by subtracting a base or threshold temperature from the average daily temperature (Knapp et al., 2017), and are now available on the Kansas Mesonet website (http://mesonet.k-state.edu/agriculture/degreedays/). For corn, that base temperature is 50°F. Adding the daily GDD gives the cumulative GDD from a date, such as day of planting. Cumulative GDD is a useful tool to estimate crop development and predict crop stage for management inputs. In the early season, soil temperature is important for crop germination and emergence, and impacts stand establishment. Corn grows best between 50 and 86°F; high temperatures can limit grain filling (Ciampitti and Knapp, 2018).

Similarly, rainfall and timing of rainfall is important for crop development. Corn is a determinate crop that flowers only once. The strongly determinate nature of corn makes the flowering period (tasseling and silking) very sensitive to environmental conditions during that one growth period, as the plants cannot flower again if flowering fails due to an adverse environment. Poor environmental conditions, especially low rainfall, can reduce the fertilization of ovules, resulting in unfertilized ovules and reduced yield. If adverse weather conditions of either inadequate rainfall or temperatures that are too high or low continue, fertilized ovules may be aborted and reduce yield.

Climatic conditions cannot be managed. However, management practices can be implemented that make the best use of the environmental conditions. Corn planting in southeast Kansas begins in mid-March after soil temperatures are above 50°F. The later the corn is planted, the warmer the soil temperatures will be. However, previous research has demonstrated the need to time the flowering of corn to adequate moisture in rainfed environments (Sassenrath et al., 2016). Since our highest rainfall period occurs in late May, corn pollination ideally should be timed to occur prior to July 4.

This study was undertaken to explore the impact of planting date and planting depth on corn yield. Soil temperature and moisture change with depth in the soil profile. Planting at deeper depths may allow the corn roots to access more moisture. Conversely, shallower depths may have warmer temperatures and allow more rapid crop growth early in the season.

Experimental Procedures

Corn was planted in replicated plots at the Southeast Research and Extension Center fields in Parsons, KS, in 30 in.-rows at a rate of 23,100 seeds per acre with a Monosem planter. The field was managed with conventional tillage: chisel disk, fertilized with 180-46-60 N-P-K as urea, diammonium phosphate (DAP) and potash, and field cultivated. Weeds were controlled with a pre-emerge mix of glyphosate (2 qt/a), atrazine (1.5 lb/a), and 2,4-D (1 qt/a); and a post-emerge mix of Roundup (1 qt/a), atrazine (1 lb), and 2,4-D (1 qt/a). Roundup was sprayed as needed around V6.

Treatments included four cultivars of varying maturity: 96 day (P9697); 105 day (P0589); 115 day (P1151); and 118 day (P1862). Corn was planted at three planting dates: early (March 25, 2018); mid (April 17, 2018); and late (May 9, 2018); at planting depths of 1, 2, and 3 in.

Weather data were downloaded from the Kansas Mesonet Historical site at Parsons, KS. Growing degree days were calculated from date of planting for each of the planting dates, using a base temperature of 50°F. Daily GDD were summed to determined cumulative GDD50 for each planting date. Similarly, daily rainfall data were summed for each planting date to determine total rainfall for each planting date.

Results and Discussion

Averaged across all cultivars, the corn yield was highest at the earliest planting date. Yield also increased with greater planting depth at the early planting time (Figure 1). Yield was greatest at the 2- and 3-in. planting depths at the earliest planting date compared with the 1-in. depth. No differences in yield were observed with planting depth for the mid-planting date. Conversely, yields were reduced at the latest planting date, and decreased with planting depth. The late-planted 3 in. depth had the lowest yield.

Individual cultivars showed similar response to planting date and depth (Figure 2). The two mid-maturity cultivars performed the best at the early planting date, with yields increasing with planting depths greater than 1 in. The 105-day corn yielded the highest at 2-in. depth and early planting date, and the 115-day corn yielded the highest at the 3-in. depth and early planting date. The 118-day corn yield increased only slightly from the 1 in. to 2-3 in. planting depth. The early-maturing variety showed the strongest response to planting depth at the early planting date, increasing more than 3-fold from the 1 in. to 2-3 in. planting depth.

Yields of all varieties were less at the mid- and late-planting dates. The response to planting depth varied with the mid-planting date. Some cultivars showed increased yield at greater depths while others had lower yield at increased depth. Overall, the differences in yield between treatments at the mid-planting date were not as great as at the early planting date.

Yields of all cultivars were lowest at the late-planting date. Moreover, yields for all cultivars decreased with increasing planting depth at the late planting time. At the 3-in. planting depth and late planting date, little differences were observed between cultivars.

Corn emergence (VE) is estimated to require 120 GDD50 (DeKalb, 2015). The mid-planted corn was planted 27 days after the early-planted corn, and the late-planted corn was planted 49 days after the early-planted corn. However, the cooler temperatures in spring 2018 delayed emergence of the early-planted corn. It reached 120 GDD50 around June 11, only 2 days before the mid-planted corn reached 120 GDD50 (Figure 3). Similarly, the late-planted corn reached 120 GDD50 11 days later than the early-planted corn, even though it was planted 49 days after the early planting. The rapid warm-up in the spring greatly accelerated the accumulation of heat units in the mid- and late-planted corn.

The vegetative stage of corn is estimated to be complete at tasseling (VT), which requires approximately 1135 GDD50 (DeKalb, 2015). Again, because of the more-rapid accumulation of heat units later in the season, the late-planted corn reached VT only 11 days after the early-planted corn (Figure 3). However, the late-planted corn received more than 2 in. less rain than the early-planted corn.

Summary

Planting date had a significant impact on corn yield, with corn yielding more at earlier planting dates. Although corn yield increased at the early planting date at greater planting depths, yield was reduced at the later planting date as depth increased. There was a difference in response to planting date and depth between corn cultivars of differing maturity; however, since we did not test multiple cultivars from each maturity group, we are not sure if it was because of the maturity or the individual variety. Later-planted corn acquired heat units much faster than early-planted corn, but also received less total rainfall. This may have accounted for the observed reduction in yield with later planting.

Acknowledgment

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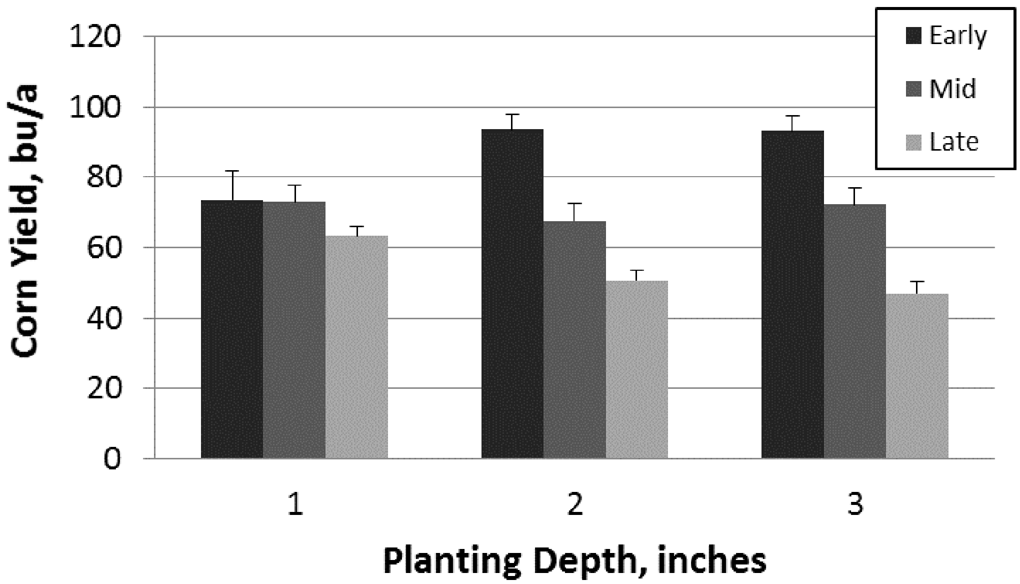

Figure 1. Impact of planting date and planting depth on corn yield.

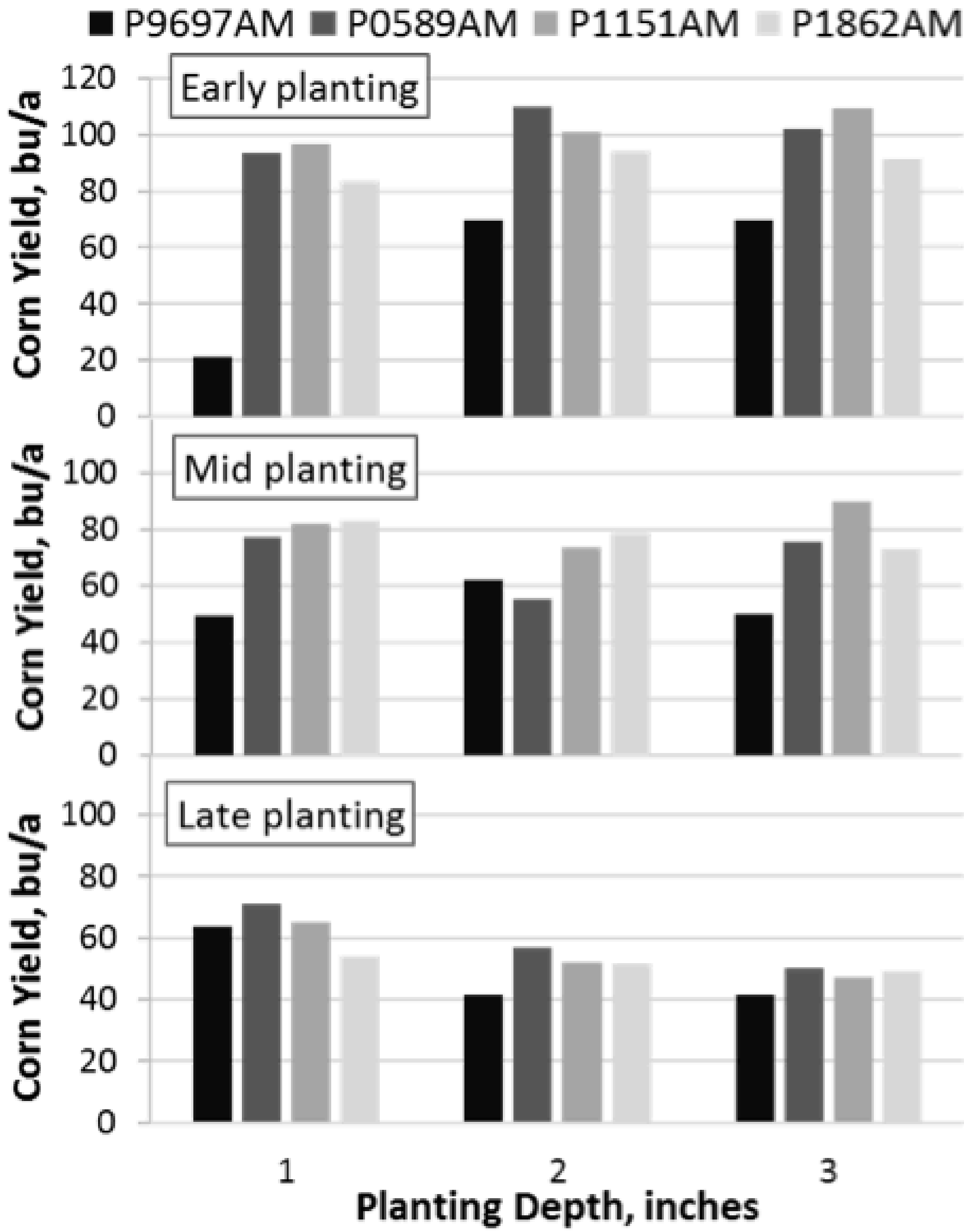

Figure 2. Change in corn yield for 96-day, 105-day, 115-day, and 118-day maturity for early (March 25), mid (April 17), and late (May 9) planting dates and at 1-, 2-, and 3-in. planting depths.

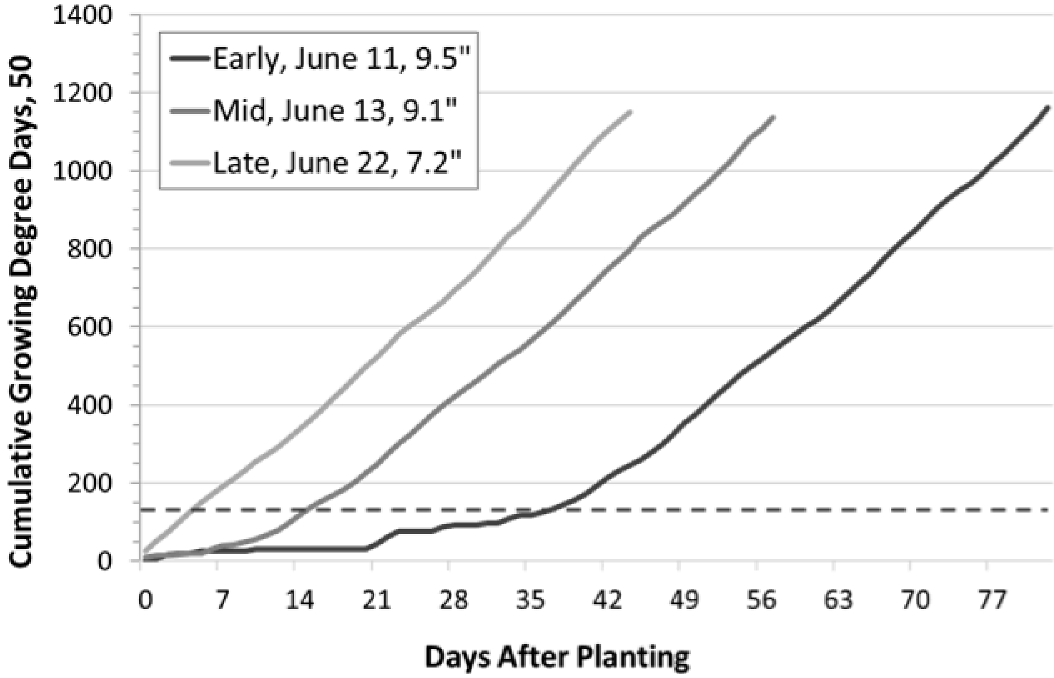

Figure 3. Cumulative growing degree day-50 (GDD50) for the early (black), mid (dark grey), and late (light grey) planting dates. Emergence requires about 120 GDD50 and is indicated by the dashed line. Estimated date of tasseling (VT) is given with total rainfall received for each planting date group.