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Improving Corn Production in Southeast Kansas

Gretchen Sassenrath
Kansas State University, gsassenrath@ksu.edu

D. E. Shoup
Kansas State University, dshoup@ksu.edu

X. Lin
Kansas State University, xlin@ksu.edu

See next page for additional authors

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Abstract

Corn performance and yield varies as a function of the growing environment and soil properties. Components contributing to yield in corn were examined through on-farm measurements of soil properties in southeast Kansas. Environmental variability between the 2013, 2014, and 2015 growing seasons contributed to changes in yield. Management can also impact the amount of harvested yield.

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Authors

Gretchen Sassenrath, D. E. Shoup, X. Lin, J. Coltrain, J. Geren, and D. Helwig

Improving Corn Production in Southeast Kansas

G.F. Sassenrath, D. Shoup, X. Lin, J. Coltrain, J. Geren, D. Helwig

Summary

Corn performance and yield varies as a function of the growing environment and soil properties. Components contributing to yield in corn were examined through on-farm measurements of soil properties in southeast Kansas. Environmental variability between the 2013, 2014, and 2015 growing seasons contributed to changes in yield. Management can also impact the amount of harvested yield.

Introduction

Optimizing corn production in southeast Kansas requires attention to detail, especially during planting and harvesting operations. Deciding when to plant corn is often dictated by when we can get in the field because of wet soils. Even so, there are a few things that should be taken into consideration in deciding when to plant corn for optimal yield. Corn production is also sensitive to environmental conditions during the growing season that determine the pollination efficiency and grain fill. Operations during harvest also impact total harvested yield.

Experimental Procedures

Plant samples were collected from production fields in collaboration with cooperating farmers in 2013, 2014, and 2015. Two-row-wide line-transects were established through the fields, and multiple sampling locations were taken along each transect. At each sampling location, plants were hand-harvested from 3 ft^2, dried, and plant parts were separated for determination of yield components (plants per area, pods, cobs or heads per plant, seeds per area, average seed size, etc.). The yield components (number of seed per cob; number of cobs/plant; number of plants/acre, etc.) were calculated to delineate factors contributing to yield and identify yield losses. After harvest, kernels were counted at multiple locations within production fields to determine efficiency of harvest.

Results and Discussion

Planting

Corn yield is determined by the efficiency of pollination, kernel set, and grain filling. Research indicates that poor pollination and kernel set can significantly limit corn yield. Poor pollination is seen as missing or random kernels set (Figure 1). Poor kernel set is seen as small kernels that have been aborted. Corn is a determinate crop, meaning that vegetative growth stops once it has flowered and the plant only flowers once. This is

in contrast to more indeterminate crops, such as cotton or soybeans. Experiments to explore flowering have shown that if flowers of soybeans are removed, the plant will continue to grow. This allows soybeans to somewhat compensate for the loss of flowers. The determinate nature of corn makes the crop very sensitive to environmental conditions during and immediately after the flowering period. High temperatures and lack of water can disrupt pollination, greatly reducing corn yield.
We can somewhat manage the pollination sensitivity of corn by timing the planting date and the corn maturity so that flowering coincides with the period of time during the growing season most likely to have adequate moisture. On average, the rain received in southeast Kansas comes early in the growing season, prior to July 1 (Figure 2). So, in order to improve the yield of corn, we should time flowering to occur prior to July 1.

Based on variety trial data of corn cultivars, days to silk in southeast Kansas range from 60 to 80 days after planting. The actual days to silk may vary with year and variety. To improve the corn yield, pollination should be completed during the period of adequate moisture. This would target pollination to occur around June 10 to 17 for southeast Kansas. This is based on historical weather data collected at the Parsons Mesonet weather station. Working back 60 to 80 days, this gives us a range of planting dates from March 20 to April 18 (Figure 3).

Using corn maturity, we can target pollination timing by planting longer-maturing varieties (80 days to silk, for example) for the earlier planting date (March 20). Shorter maturing varieties (60 days to silk) can be selected for later planting dates (April 18). Another key factor to consider in timing of planting and variety selection is the moisture holding capacity of the soil. Under ideal planting conditions, bottom ground can be planted later with a fuller maturity to capitalize on the yield potential of the good soil. Thinner soils, with lower moisture holding capacity, can use earlier planting and early maturing varieties to beat the heat and drought that commonly hit by mid- to late-July.

The final important factor to consider in planting corn is soil temperature. Corn needs a minimum soil temperature of 50°F for adequate germination and early season growth. Research results suggest that when corn plants germinate over a short period of time, the stand is more consistent and yield is improved. Corn germination improves as soil temperature rises above 60°F. Over the past five years, the average soil temperature at 2" depth has increased above 50°F from an early date of March 7 in 2012, to a late date of March 31 in 2014. Minimum and maximum soil temperatures at 2" and 4" are reported at multiple locations around Kansas, including Parsons, Columbus, Sedan and Woodson County in southeast Kansas. This information can be retrieved from the Kansas Mesonet site at http://mesonet.k-state.edu/weather/historical/. It is best to delay corn planting until average soil temperatures remain consistently above 50°F for several days.

In summary, optimal time for corn planting is determined by consistent soil temperature in excess of 50°F. Increased soil temperature ensures a good plant stand, and minimizes seedling disease. Corn maturities can be used to time pollination to coincide with the historical period of good moisture in southeast Kansas – targeting early to mid-June as the pollination window. Longer maturing varieties should be planted earlier, while shorter maturing varieties will do well at later planting times. This can be modified for soil moisture holding capacity, as noted above. Ideally, pollination should be complete by the end of June to avoid water stress. The traditional approach of "Short to silk; long to fill" works well for southeast Kansas.

Harvesting

Another factor that contributes to the total yield harvested from a field is the efficiency of harvest. Harvest inefficiency results in a "second crop" of corn that germinates from kernels spilled or lost during the harvest operation (Figure 4). While this may be useful by increasing soil organic matter, the plants represent yield lost.

Several factors may contribute to poor harvest efficiency, including mechanical errors in the combine, speed of the combine operation, and crop moisture. Measurements made on-farm indicate that the losses are not dependent on the productivity. In other words, the high-yielding areas of a field do not have higher yield losses and conversely, poorly performing areas do not have lower losses. Rather, yield losses tend to be consistent across the field. Some obvious yield loss occurs during transfer events. While this may look substantial, it is usually not very high across the entire field.

An estimate of the yield loss can be made by counting the number of kernels in a square-foot of area, and dividing by 2 (Figure 5). While this corn has already been lost, changes can then be made in the harvest operation to improve the harvest efficiency. And while harvest efficiency will never be 100%, and it is more important to get the harvest completed, paying attention to details during harvest could increase the overall amount harvested.

Figure 1. Corn cob with poor pollination. Areas of unfertilized and pollinated but aborted kernels are observed at the tip. Some poorly-filled kernels are also present in the rest of the cob.

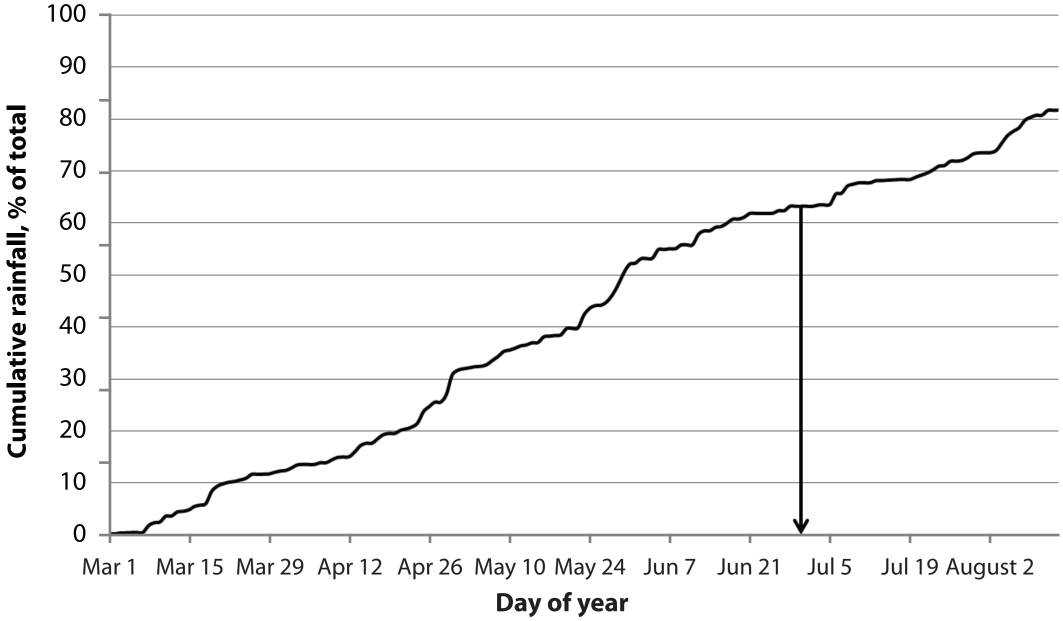

Figure 2. Five-year average cumulative rainfall during the early growing season in southeast Kansas.

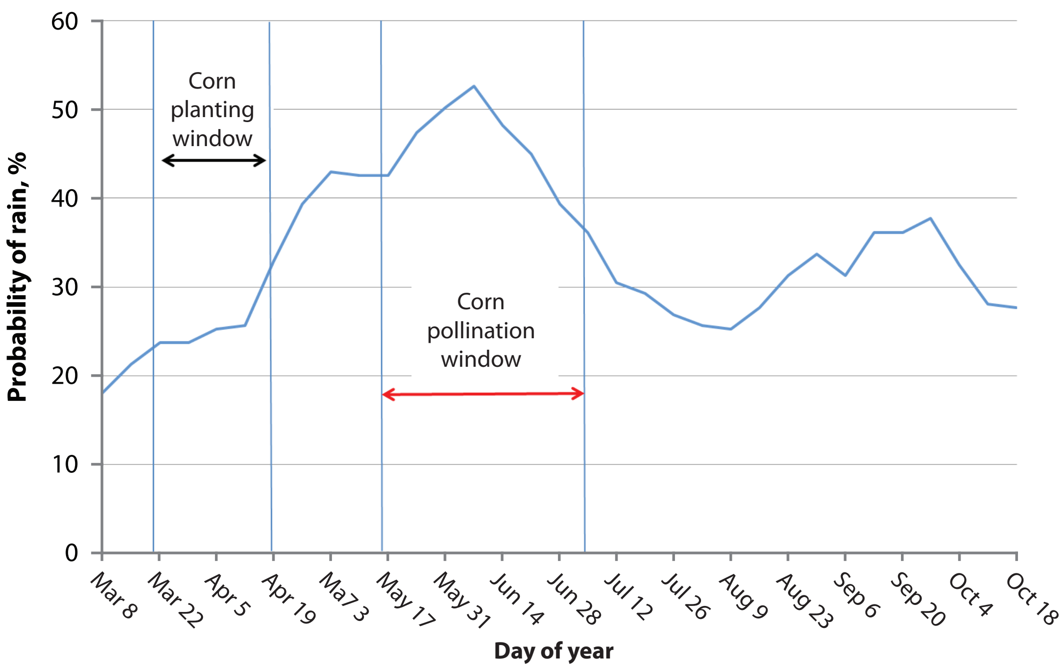

Figure 3. Timing of corn planting and cultivar selection to increase yield potential, based on potential for rain during the spring in southeast Kansas.

Figure 4. Corn lost during harvest operations has plenty of time to sprout.

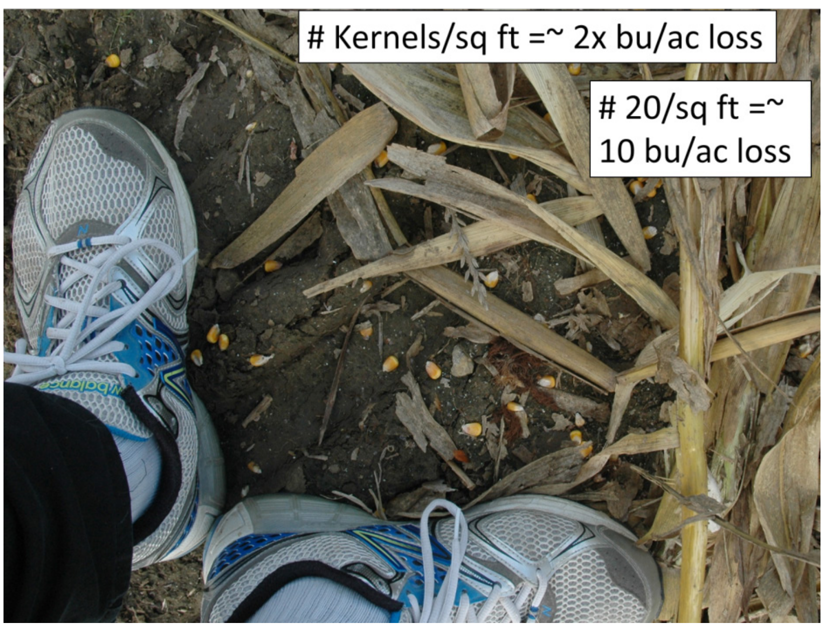

Figure 5. Counting the number of kernels in a square-foot area can provide an estimate of the harvest inefficiency. The number of kernels per square feet is approximately double the bushels per acre. If 20 kernels per square foot are lost, that would equal 10 bu/ac lost during harvest.