A Closer Look at Corn Pollination

- Next to planting and stand establishment, corn pollination and fertilization are among the most important phases of crop development.
- While successful pollination and fertilization depends greatly on growing conditions, there are several management considerations that can help optimize the process.
- Understanding the components and factors involved in pollination is the first step in managing for successful kernel set and grain fill.

Anatomy of the Corn Reproductive Parts

Corn is monoecious, meaning that it contains both male (tassel) and female (ear) reproductive parts on each plant. However, unlike many other monoecious grasses and dicots, male and female reproductive structures are separated on the corn plant. Given the separation of the ear and tassel on individual plants (and considering the vast amounts of pollen transported within a production field), it is understandable why corn is cross-pollinated. Only a small percentage (<5%) of kernels are fertilized by pollen from the same plant.

The Ear and Tassel

Beginning at about the V5 growth stage, potential ears are initiated at each node up to about the 12th to 14th leaf node; however, typically only the uppermost ear fully develops. Depending on the genetics of a particular corn product and growing conditions, a secondary ear may develop at the next lower node. The female florets, containing the ovules that will become kernels upon successful fertilization, are in paired rows along the surface of the ear. A primary ear may develop up to 1000 ovules, of which about 400 to 700 are usually fertilized. Row number is based on the genetics of the product. However, growing conditions determine the final amount or rows and is determined shortly after ear initiation. Ear length (kernels/row) is not completely set until just before tasseling. Therefore, severe stress from growing conditions or herbicide injury can interfere with ear formation or row length beginning at around V5.

Silks develop and elongate from the surface of each ovary on the ear. The silk functions as the stigma and style of the female flower. Silks begin growing from the ovaries at the base of the ear first, then progress toward the ear tip. Consequently, silks from the base are the first to emerge from the husk, usually a couple of days after pollen shed has begun.

The tassel starts developing deep in the plant whorl around V5 growth stage. The tassel, the male flower or inflorescence consists of many spikelets, which are located along the main spike and lateral branches of the tassel. The spikelets enclose two small flowers, or florets. Each floret contains the male reproductive structures, referred to as the stamen. The pollen grains are held on the anthers, which are located at the end of a thin stem called the filament (Figure 1). There are three anthers for each floret and each anther produces several thousand pollen grains. Thus, an individual plant may produce several million grains of pollen. Severe stress, particularly cold temperatures at tassel initiation (V5), can potentially reduce tassel branching and spikelet formation.[2]

Figure 1. Unopened anthers holding pollen grains.

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Pollen shed (anthesis) begins shortly after the corn tassel is fully emerged from the whorl (VT growth stage). Spikelets near the main axis of the tassel are the first to open, exposing the anthers that bear pollen grains (Figure 2). Flowering progresses upward and downward, then throughout the lateral branches. Pollen shed may occur for up to two weeks, but usually lasts for five to eight days, with peak shed by the third day.[3] Flowering typically occurs in the morning and may be delayed during rain or excessive humidity. Generally, pollen shed, and pollen viability are minimally affected by growing conditions. However, very hot, dry conditions may reduce pollen viability and decrease length of pollen shed.

Figure 2. Tassels beginning to emerge from whorl with anthers starting to open.

Most silks are exposed within two to three days (Figure 3). Unusually long ears may exhibit poor pollination at the tip because of delayed silking. Silks can grow as much as 1 to 1.5 inches per day, with maximum growth rate occurring by three or four days after first silk.[4] Silks continue to elongate to some extent until pollinated, or until they senesce. Silk longevity is around ten days under typical growing conditions, but because not all silks are exposed simultaneously, viable silks may be present for around 14 days.[1] In addition to natural senescence, heat or moisture stress can desiccate the silks prematurely. This normally appears as a somewhat erratic pattern of fertilization along the ear, with most fertilized ovules located at the base (Figure 4).

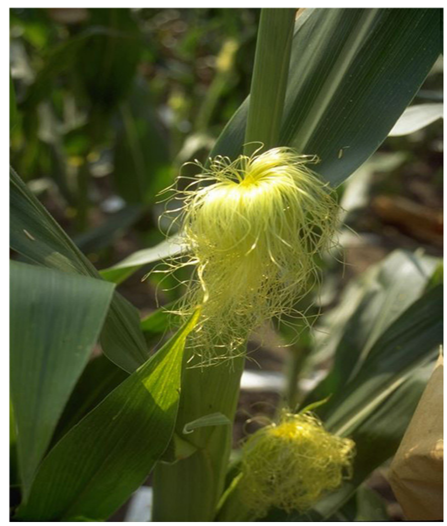

Figure 3. Corn silking.

Under normal conditions, silking often does not occur until two to three days after pollen shed has begun. This is somewhat inconsequential since nearly all the ovules on that ear are fertilized because of cross-pollination. Although pollination is dependent on minute variances in flowering between plants, highly variable flowering dates because of a variable stand in each field can reduce total pollen available to receptive silks. In addition to field variability, severe heat or moisture stress may delay silking and hasten pollen shed to the extent that little pollen remains when silks become receptive. Poor pollination resulting from asynchronous pollen shed and silking can result in barren ears or unfertilized ovules occurring mainly toward the tips of the ears (Figure 3).

Figure 4. Poor kernel set due to drought conditions.

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Pollen that lands on a silk is captured by small hairs, or trichomes, present on the surface of the silk. The pollen grain germinates immediately and produces a pollen tube that grows down the length of the silk, resulting in fertilization of the ovule within 12 to 28 hours. Although many pollen grains may germinate along the surface of the silk, only one grain generates a pollen tube resulting in fertilization. Over the next day or two, pollinated silks will desiccate and gradually turn brown. Normally, pollination is a continuous process with fertilization occurring gradually along the ear as silks emerge. A mass of long, green silks is an indication that pollination has not occurred (Figure 5). This could be the result of silk emergence after most pollen has shed, or delayed pollen shed due to extended rainy, cloudy conditions. The latter should be of little consequence if flowering resumes prior to silk senescence. However, anything that interferes with the optimum window for pollination could potentially reduce fertilization and kernel set. Additionally, the presence of extra silk tissue under these conditions could physically shield some silks from exposure to pollen.

Figure 5. Long silks are an indication that ovule fertilization has not occurred.

Kernel Abortion

Successful fertilization does not necessarily translate to a harvestable kernel. For several weeks following fertilization, reduced photosynthate caused by cloudy conditions, moisture stress, heat stress, or any factor reducing photosynthetic activity can cause fertilized ovules to abort. This normally occurs with the youngest kernels, located at the tip of the ear (Figure 6). Aborted kernels can be distinguished from unfertilized ovules by the accumulation of starch in the aborted kernel. Kernel abortion can also be the result of a nitrogen deficiency.

Figure 6. Aborted kernels at the ear tip. (TDA Image)

Management Considerations

Pollination is one of the least controllable aspects of corn production because its success or failure is primarily influenced by environmental conditions. However, taking steps to reduce variability in corn growth stages and subsequent variability in flowering can increase the likelihood of pollen shed and silking occurring at the proper time. Additional management considerations to help promote successful pollination and fertilization include:

- Irrigation. Water use requirements for corn are highest during pollination. Where available and when necessary, irrigation can help mitigate pollination problems and enhance grain fill.

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- Fertility. Nitrogen and phosphorous uptake are rapid during pollination and grain fill; therefore, proper fertility is necessary for optimum kernel set and reducing the mobilization of nutrients from the stalk.
- Product Selection. Select corn products that are adapted to the area and exhibit proper heat and drought tolerance for your growing conditions. Spread risk by selecting products with a range of maturities that pollinate at different times.
- Insects. Monitor fields for corn rootworm beetles and Japanese beetles feeding on silks. Consider an insecticide application if economic thresholds are met.

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Web sources verified 06/20/2023.

Legal Statement

ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. Performance may vary, from location to location and from year to year, as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on the grower's fields.