AGRONOMIC Spotlight

Technology Development by MONSANTO ®

A Closer Look at Corn Pollination

Corn pollination and fertilization is arguably the most important phase of crop development, next to planting and stand establishment. Although much of the yield potential of the corn plant (particularly ear length and row number) has been established earlier in the season, successful pollination can help determine the extent to which yield potential is met. Unfortunately, pollination is also one of the least controllable aspects of corn production since its success or failure is primarily influenced by environmental conditions. Better understanding the process; however, is the first step in learning to manage for a successful kernel set and grain fill.

Parts of the Corn Flower

Corn is monoecious, which means that both male and female reproductive structures are present on each plant. However, unlike many other monoecious grasses and dicots, male and female flowers 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. Although pollen shed and silking are temporally (somewhat) and spatially separated on a given plant, a small percentage (<5%) of kernels may be fertilized by pollen from the same plant.

Figure 1. Pictured, a corn tassel, the male reproductive structure of a corn plant. The duration of the pollen shed can last up to 2 weeks.

The Tassel

The corn tassel is the male flower, or inflorescence, of corn. This male 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. There are three anthers for each floret, each producing several thousand pollen grains. Thus an individual plant may produce several million grains of pollen. The tassel has been developing deep in the whorl of the plant since approximately V5. Severe stress, particularly chilling at tassel initiation can potentially reduce tassel branching and spikelet formation.

The Ear

Beginning at about the V5 stage, potential ears are initiated at each node up to about the 12th to 14th leaf node, but it is normally only this uppermost ear that fully develops. Depending on hybrid genetics 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 located in paired rows along the surface of the ear. A primary ear may develop up to 1000 ovules, of which only around 400-700 are usually harvested. Row number is determined shortly after ear initiation, but ear length is not completely set until just before tasselling. Therefore, severe stress from environmental 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 progressing 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 Process: Pollination and Fertilization

Pollen shed (anthesis) begins shortly after the corn tassel is fully emerged from the whorl (VT stage). Spikelets near the main axis of the tassel are the first to open, exposing the anthers that bear pollen grains. Flowering progresses upward and downward, then throughout the lateral branches. Pollen shed may occur for up to 2 weeks, but usually lasts for 5-8 days, with peak shed by about 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 environmental stresses. However, very hot, dry conditions may reduce pollen viability and decrease length of pollen shed.

Silks from the base of the ear are the first to emerge from the husk, followed by those progressively closer to the ear tip. Most silks are exposed within 2-3 days, but unusually long ears may exhibit poor pollination at the tip because of delayed silking. Silks can grow as much as 1-1.5 in/day, with maximum growth rate occurring by the 3rd or 4th day after first silk. Silks will continue to elongate to some extent until pollinated, or until they senesce. Silk longevity is around 10 days under typical growing conditions, but because not all silks are exposed simultaneously viable silks may be present for around 14 days. In addition to natural senescence, heat or moisture stress can desiccate the silks prematurely. This will normally appear as a somewhat erratic

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pattern of fertilization along the ear, with most fertilized ovules located at the base.

Under normal conditions, silking often does not occur until 2-3 days after pollen shed has begun. This is actually somewhat inconsequential since nearly all the ovules on that ear will be fertilized as a result of cross-pollination. Although pollination is dependent on minute variances in flowering between plants, highly variable flowering dates in a given 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.

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, producing 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 will generate 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. 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.

Kernel Abortion

Successful fertilization does not necessarily translate to kernel set. 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. Aborted kernels can be distinguished from unfertilized ovules by the accumulation of starch in the aborted kernel.

Figure 2. Pictured is a corn plant in silking stage. A strand of silk can grow 1 to 1.5 inches per day until pollination of the individual silk occurs.

Management Considerations

Water use requirements for corn is at its maximum during pollination. Where available and when necessary, irrigation can mitigate pollination problems and enhance grain fill.

- Because nitrogen and phosphorous uptake are rapid during pollination and grain fill, proper fertility is necessary for optimum kernel set and reducing mobilization of nutrients from the stalk.
- Select corn hybrids that are adapted to the area, and exhibit proper heat and drought tolerance for your growing conditions. Spread risk by diversifying your mix with hybrids that pollinate at different times/different maturities.
- Avoid late planting which could result in pollination occurring during the hottest (and possibly driest) part of the summer.
- Manage fields, when possible, to reduce variability in corn growth stages, and subsequent variability in flowering.
- Monitor fields for corn rootworm adults that may feed on silks.

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