A Closer Look at Corn Pollination

- The processes of corn pollination and subsequent fertilization are among the most important phases of crop development.
- Although much of the yield potential of the corn plant (particularly ear length and row number) is established earlier in the season, successful pollination can help determine the extent to which yield potential is met.
- Understanding the process is the first step in learning how to manage for 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 in separate locations 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 primarily cross-pollinated. Only a very small percentage (<5%) of kernels may be fertilized by pollen from the same plant.[2]

The tassel is the male flower of corn. Each tassel is comprised of a central tassel stalk and several lateral branches. Around 1000 spikelets are formed on each tassel and each bears 2 small florets. Contained within each floret are 3 anthers, each producing several thousand pollen grains. The anther and attached filament comprise the stamen, or male reproductive structure. The tassel develops deep in the whorl of the plant, beginning at approximately V5 growth stage.

The ear is the female flower of corn. Also beginning at about the V5 stage, potential ears are initiated at each node up to about the 12th to 14th leaf node, but 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 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 tasseling. Therefore, severe stress from environmental conditions or herbicide injury can interfere with ear formation or row length beginning at around V5 growth stage.

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 providing a pathway for the male reproductive cells to reach the ovule. Silks begin growing from ovaries at the base of the ear first, then progress toward the tip.

Pollination and Fertilization

Pollination is the process by which pollen grains are transferred from the tassel to the silks. Fertilization does not occur until the male reproductive cells from the pollen actually unite with female reproductive cells from the ovule. Therefore, successful pollination does not always result in fertilization.

Figure 1. A corn plant at silking stage. A strand of silk can grow 1 to 1.5 inches per day until pollination of the individual silk occurs.

Pollen shed (anthesis) begins shortly after the corn tassel is fully emerged from the whorl (VT growth stage). Pollen shed may occur for up to 2 weeks, but usually lasts for 5 to 8 days, with peak shed by the third day.[2] Flowering typically occurs in the morning and may be delayed during rain or excessive humidity. Very hot, dry conditions can 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. 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.[1] In addition to natural senescence, heat or moisture stress can desiccate the silks prematurely.

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Highly variable flowering dates in a given field can reduce total pollen available to receptive silks. Also, 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 called 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.

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.

Within a few days of successful fertilization, silks will detach from fertilized ovules. This can be observed by performing the "ear shake test".[3] Make one long cut through the husk leaves from the base of the ear to the tip. Slowly and carefully unwrap the husk leaves being careful not to pull any silks away. When holding the ear from the base end, you will notice that silks either drop away from the cob or remain attached (Figure 2). When most of the silks easily drop away from the cob, you can be assured of successful pollination. Pollination progress can be determined by estimating the percentage of silks that fall away from the ear and random sampling can help indicate progress for an entire field.

Figure 2. After gently removing husks, observe to see if silks are attached or drop away. Fertilization has not yet occurred in ovules that still have silks attached.

Successful fertilization does not always result in a harvestable kernel. For several weeks following fertilization, reduced photosynthate caused by cloudy conditions, moisture stress, heat stress, or any factor reducing photosynthetic rate can cause fertilized ovules to abort. This normally occurs in the youngest kernels that are located at the tip of the ear.

Management Considerations

- Water use requirements for corn are highest during pollination. Where available and when necessary, irrigation can mitigate pollination problems and enhance grain fill.
- Nitrogen and phosphorous uptake are rapid during pollination and grain fill; therefore, proper fertility is necessary for optimum kernel set and reducing mobilization of nutrients from the stalk.
- Corn products that exhibit proper heat and drought tolerance for your growing conditions should be selected. Spread risk by diversifying your mix with products that pollinate at different times/different maturities.
- If considering an insecticide application for silk clipping insects, make sure that you have not missed the pollination window. Tassels should be checked early to mid-morning to determine if pollen shed is still occurring. When tassels are no longer shedding pollen, there is no need to protect silks.

Sources:

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