Pollination and Diminished Kernel Set in Corn

Key Points

- Early adverse environmental conditions and other stresses can influence the number of kernel rows that develop on a corn ear.

- Corn pollination is dependent on the health and viability of the reproductive structures on the plant.

- The number of pollen grains produced by a tassel can be several million.

- Less than 5 percent of the ovules of an ear are fertilized by pollen produced by the same plant.

Tassels and Ears Initiate

Corn pollination is dependent on the health and viability of the reproductive structures on the plant: the silk and ear (female) and tassel (male). Early in the life of a corn plant, about V5 growth stage, both structures are initiated. If a plant is dissected at V5, miniature ears can be found at many of the leaf nodes and a small tassel can also be found. Shortly after ear initiation, the number of kernel rows is determined; however, ear length is determined just before tasseling. Early adverse environmental conditions and other stresses can influence the number of kernel rows that are developed.

Each individual kernel is an ovule and will have a silk associated with it. The miniature tassel consists of the many spikelets that line each tassel branch. The spikelets contain 2 flowers or florets that contain the male reproductive structures or stamen. Three anthers that produce thousands of pollen grains are associated with the stamen of each floret. Multiplying the number of spikelets on a tassel by the pollen grains produced within each one, shows that the number of total pollen grains for each tassel can be several million. Even with all this pollen, less than 5% of the ovules on an individual ear are typically fertilized with pollen originating from the plant’s own tassel. Severe stress at V5 growth stage can potentially reduce tassel branching and spikelet formation.1

Pollination and Ovule Fertilization

Shortly after the tassel is fully emerged from the whorl (VT growth stage), pollen shed or anthesis begins. Tassel spikelets along the main tassel stem open first and release the pollen within. Spikelet opening continues up and down the main axis and throughout the branches for up to 2 weeks; however, 5 to 8 days is normal with a peak release around day 3.2

Pollen shed is heaviest in the early morning and can be delayed during rain or extremely high humidity. Generally, pollen shed and viability are minimally affected by average environmental conditions; however, extremely hot and dry conditions can reduce pollen viability and decrease the length of time pollen is shed.

About 2 days after pollen starts to drop, silks begin emerging from the ear husk. Silks originating from the base of the ear appear first, with those from the ear tip emerging last. All silks typically emerge within 2 to 3 days (Figure 1). Silk elongation can continue to some extent until one pollen grain of the many that lands on it initiates the growth of a pollen tube to the ovule or potential kernel. Silk viability is around 10 days but may be as long as 14 days.3 An abundance of long green silks is an indication that fertilization has not taken place.

Fertilization of the ovule occurs within 12 to 28 hours after the pollen tube initiates. Once the ovule is fertilized, the silk detaches from the ovule and begins to die and turn brown. Fertilization success can be determined by removing an ear and carefully pulling back the husks to view the potential kernels and silks. Shake the ear to observe the undetached silks. If the silk is attached, then the ovule is not fertilized.

Several situations can be the cause for unfertilized ovules including: 1) silks emerging after pollen has become non-viable, 2) delayed pollen shed because of extended rainy and cloudy conditions, 3) silks clipped by insects, and 4) other injuries to the silks such as hail. In rare occurrences, a condition called “silk balling” may occur.
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In this situation, silks become wadded up under the husk and as a result are unavailable for pollen grains. The condition likely develops when the husks are so tight around the developing ear that the silks are prevented from growing out normally.

**Diminished Kernel Set**

As mentioned earlier, several conditions can cause kernel set to be less than desirable. The reduction in kernels can occur early in the plant’s life, at pollination, or abort because of other conditions after fertilization.

The following factors can cause kernel reduction during and after pollination:

**Drought Stress.** Plants that undergo drought stress usually push the tassel out of the whorl. However, silks require moisture to grow and extend beyond the husk; therefore, plants under severe drought stress can have a reduction in kernel number because silks are not available (Figure 2).

Farmers with access to irrigation can apply water during this critical time to help reduce the effect of drought and silk retardation.

**Insect Feeding Injury.** Corn rootworm beetles and Japanese beetles find corn silks very tasty. When their population and silk feeding injuries are high, clipped silks may not be able to re-grow and become receptive before pollen becomes non-viable. Scouting can help identify potential insect problems. If thresholds are surpassed, appropriate insecticides may be applied to reduce their effect and help preserve or protect ovule fertilization.

**Pollen Desiccation.** It is unusual for pollen to desiccate or die prior to a successful fertilization of the silks. However, if the plant is exposed to severe heat stress, pollen can dry out and become non-viable.

**Extended Rainy or Cloudy Weather.** Photosynthesis process is interrupted during rainfall and significant cloud cover. Should this occur for an extended period during pollination, pollen may not be released when the silks are receptive. This could be evident at different areas on the ear, depending on when the stress occurred and which silks were available.

**Temperature Variances.** Temperature variances just before and during pollination may delay tassel emergence or cause silks to become non-receptive. For example, temperatures could be relatively warm just prior to tassel emergence and then become very cool when tasseling and silking start.

**Kernel Abortion.** Aborted kernels appear different than unfertilized ovules. Aborted kernels have a white to yellowish color because starch was beginning to develop in the kernel. Unfertilized ovules have no coloration or development. Aborted kernels can be caused by plant stresses occurring just after pollination has occurred. Heat, drought, saturated soils, extreme temperature variances, extended rainy and cloudy days, high night-time temperatures, and fertility deficiencies are among the stresses that can cause tip back or unfilled ear tips (Figure 3). In general, all of these stresses have an effect on photosynthesis and energy production process. When energy is reduced, the plant responds by reducing the number of kernels.

**Summary**

When reduced kernel set is found, regardless of the reason, there is nothing that can be done to change the situation for the current crop. However, scouting to determine the cause(s) may lead to management practices that can help reduce the potential for losing ovules in future crops.

Although temperature and drought conditions cannot be controlled, there are several factors farmers can modify to help reduce plant stress, improve pollination, and increase the number of kernels set. These include tillage, tilling, water management, fertility, plant population and spacing, seed product selection, insect control, and properly timed herbicide applications.

**Sources:**