

## Purdue University Department of Agronomy

### Corny News Network

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# Silk Development and Emergence in Corn

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- Corn produces individual male and female flowers on the same plant.
- The ear represents the female flower of the corn plant.
- Severe soil moisture deficits can delay silk emergence and disrupt the synchrony of pollen shed and silk availability, resulting in poor kernel set.

The corn plant produces individual male and female flowers (a flowering habit called monoecious for you corny trivia fans.) Interestingly, both flowers are initially bisexual (aka “perfect”), but during the course of development the female components (gynoecia) of the male flowers and the male components (stamens) of the female flowers abort, resulting in tassel (male) and ear (female) development.

The silks that emerge from the ear shoot are the functional stigmas of the female flowers of a corn plant. Each silk connects to an individual ovule (potential kernel). A given silk must be pollinated in order for the ovule to be fertilized and develop into a kernel. Up to 1000 ovules typically form per ear, even though we typically harvest only 400 to 600 actual kernels per ear.

Technically, growth stage R1 (Abendroth et al., 2011) for a given ear is defined when a single silk strand is visible from the tip of the husk. A field is defined as being at growth stage R1 when silks have emerged on at least 50 % of the plants. This whole field definition for growth stage R1 is synonymous with the term “mid-silk”.

## Silk Elongation and Emergence

Silks begin to elongate from the ovules 10 to 14 days prior to growth stage R1 or approximately at the V12 leaf stage. Silk elongation begins first from the basal ovules of the cob, then proceeds sequentially up the ear. Because of this acropetal sequence of silk elongation, silks from the basal (butt) portion of the ear typically emerge first from the husk, while the tip silks generally emerge last. Complete silk emergence from an ear generally occurs within four to eight days after the first silks emerge from the husk leaves.

As silks first emerge from the husk, they lengthen as much as 1.5 inches per day for the first day or two, but gradually slow over the next several days. Silk elongation occurs by expansion of existing

cells, so elongation rate slows as more and more cells reach maximum size. Elongation of an individual silk stops shortly after pollen is captured, germinates and then penetrates the silk.

If not pollinated, silk elongation stops about 10 days after silk emergence due to senescence of the silk tissue. Unusually long silks can be a diagnostic symptom that the ear was not successfully pollinated.

Silks remain receptive to pollen grain germination up to 10 days after silk emergence, but to an ever-decreasing degree. The majority of successful ovule fertilization occurs during the first 4 to 5 days after silk emergence (see photos that follow).

Natural senescence of silk tissue over time results in collapsed tissue that restricts continued growth of the pollen tube. Silk emergence usually occurs in close synchrony with pollen shed, so that duration of silk receptivity is normally not a concern. Failure of silks to emerge in the first place, however, does not bode well for successful pollination.

## Pollination and Fertilization

For those of you serious about semantics, let's review two definitions relevant to sex in the cornfield. Pollination is the act of transferring the pollen grains to the silks by wind or insects. Fertilization is the union of the male gametes from the pollen with the female gametes from the ovule. Technically, pollination is almost always successful (i.e., the pollen reaches the silks), but unsuccessful fertilization (i.e., pollen tube failure, silk failure, pollen death) will fail to result in a kernel.

Pollen grain germination occurs within minutes after a pollen grain lands on a receptive silk. A pollen tube, containing the male genetic material, develops and grows inside the silk, and fertilizes the ovule within 24 hours. Pollen grains can land and germinate anywhere along the length of an exposed receptive silk. Many pollen grains may germinate on a receptive silk, but typically only one will successfully fertilize the ovule.

## Silk Emergence Failure

**Severe Drought Stress.** The most common cause of incomplete silk emergence is severe drought stress. Silks have the greatest water content of any corn plant tissue and thus are most sensitive to moisture levels in the plant. Severe moisture deficits will slow silk elongation, causing a delay or failure of silks to emerge from the ear shoot. If the delay is long enough, pollen shed may be almost or completely finished before receptive silks are available; resulting in nearly blank or totally blank cobs. Severe drought stress accompanied by low relative humidity can also desiccate exposed silks and render them non-receptive to pollen germination.

The severity of drought stress required for significant silk emergence delay or desiccation can probably be characterized by severe leaf rolling that begins early in the morning and continues into the early evening hours. Such severe leaf rolling is often accompanied by a change in leaf color from "healthy" green to a grayish-tinged green that may eventually die and bleach to a straw color.

**Silk Clipping by Insects.** Although technically not described as silk emergence failure, severe silk clipping by insects such as corn rootworm beetle or Japanese beetle nonetheless can interfere with

the success of pollination by decreasing or eliminating viable or receptive exposed silk tissue. Fortunately, unless the beetle activity is nonstop for days, continued elongation of silks from the husk will expose undamaged and receptive silk tissue at the rate of about one inch or more per day.

**Silk "Balling"**. Occasionally, silks fail to emerge successfully because they fail to elongate in their usual straight "path" up the ear toward the end of the husk leaves. Instead, silk elongation becomes convoluted (twisted, coiled, scrambled) inside the husk leaves. This silk "balling" phenomenon is not well-understood and hybrids tend to vary in their vulnerability to this type of silk emergence failure. Two different pieces of circumstantial evidence are often associated with the problem. One is a physical restriction imposed on silk elongation caused by unusually "tight" or long husk leaves in certain hybrids. The other circumstance often correlated with silk "balling" is the occurrence of unusually cool nights during the time silk elongation is occurring, but prior to silk emergence. The physiological effect of such cool nights on silk elongation is not understood. It has been years since I last saw a field with a significant level of silk "balling" (Nielsen, 2000).

[Click on image to view larger version.](#)



Silk elongation on the lower half of a V12 ear shoot; 10 to 14 days before silk emergence..



Silk elongation on the lower 2/3 of a V14 ear, about 4 days after V12; 6 to 10 days before silk emergence.



Variable silk length along length of cob at first silk emergence; illustrating the acropetal development of silks..



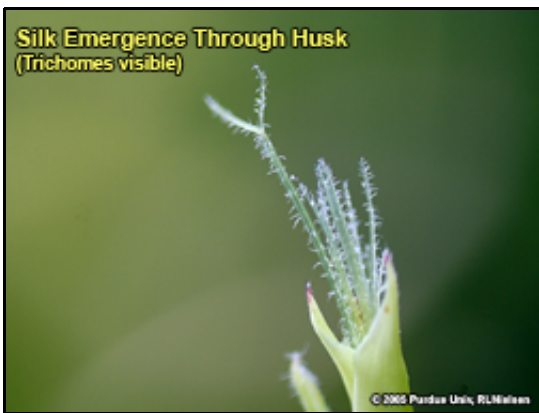
Silks recently clipped with a knife; note the discolored, non-receptive ends of the silks where the clipping occurred.



About 1.5 inches of silk elongation since being manually clipped about 15hrs previous.



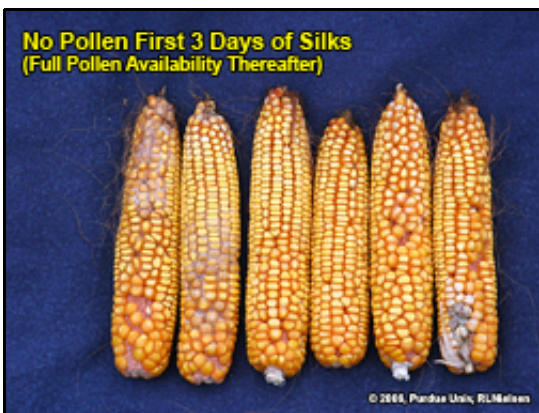
Western Corn Rootworm beetles (*Diabrotica* spp.) actively feeding on silks and pollen.



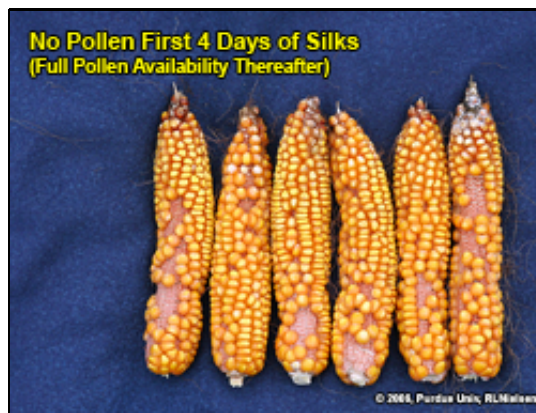
Trichomes visible on silks just emerging through husk leaves.



Pollen "captured" by silk trichomes on a popcorn hybrid with anthocyanin-pigmented silks.



Kernel set on ears where pollination was prevented for 3 days after first silk emergence, then allowed to proceed without interference.



Kernel set on ears where pollination was prevented for 4 days after first silk emergence, then allowed to proceed without interference.



## Related Reading

Abendroth, L.J., R.W Elmore, M.J. Boyer, and S.K. Marlay. 2011. Corn Growth and Development. Iowa State Univ. Extension Publication #PMR-1009. <https://store.extension.iastate.edu/Product/Corn-Growth-and-Development> [URL accessed July 2016].

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