CORN POLLINATION AFFECTED BY HEAT AND DROUGHT

High Temperature Versus Drought Stress

High-temperature damage to corn typically coincides with drought stress. It is difficult to separate the effects of drought and heat stress. However, high temperatures alone are not believed to severely stress corn pollination when there is adequate soil moisture.[1]

Effects of Heat on Pollen Shed

An individual tassel can shed pollen for a week with peak shed occurring on the second or third day.[2] Hot temperatures along with dry weather can hasten pollen shed. Each tassel produces millions of pollen grains providing adequate pollen in most conditions.[3] Pollen production may be reduced by continuous hot weather occurring a few days before and during pollination as photosynthesis may not be efficient and carbohydrate production can be reduced.[4]

Pollen shed from anthers is called dehiscence and occurs when there is a drop in humidity as temperatures begin to rise.[4] Typically, pollen shed begins in the early to mid-morning when temperatures are not as extreme and a second 'flush' of pollen shed sometimes occurs in the later afternoon with cooler temperatures. Humidity and temperature conditions can affect dehiscence, and a decrease in pollen shed has been reported when temperatures are greater than 86° F.[2]

New pollen continues to mature until all anthers have shed pollen from the tassel. Pollen grains have a thin outer membrane and remain viable for 18 to 24 hours in favorable conditions.[3] Viability is reduced to a couple of hours or less in extreme heat.[4] Temperatures of 100° F or greater cause extreme heat stress that can sometimes desiccate pollen before it can successfully fertilize an ovule or kernel.[2] High temperatures can also reduce viability before pollen grains are shed by anthers.[4]

Figure 1. Drought stressed plant during pollination showing rolled leaves.

Effects of Heat on Silking

Severe drought stress, as indicated by rolling leaves (Figure 1) and wilting of the corn plant, affects pollination primarily by its impact on silk elongation. Silks begin elongating from the ovules, or potential kernels, of the ear shoot about seven days before silks are visible outside the husk tips.[3] The silks from the butt of the ear elongate first, followed by those in the center and then the tip. Water stress around flowering and pollination delays silking, reduces silk elongation, and inhibits embryo development after pollination. Moisture combined with heat stress interferes with the synchronization of silk emergence and pollen shed.

CORN POLLINATION AFFECTED BY HEAT AND DROUGHT

Drought stress may desiccate silks leaving them unreceptive to pollen and the chance to fertilize the ovule. The tip silks are typically the last to emerge from the husk leaves, and if ears are longer than usual, the final silks from the tip of the ear may emerge after pollen shed.[3] If severe drought stress continues into early kernel development, abortion of fertilized ovules can also result in an incomplete kernel set (Figure 2). Aborted kernels are shrunken, mostly white and differ from unfertilized ovules in that development had already started.

There are two common techniques to assess the success or failure of pollination.[5] One popular method is the "shake test." Carefully unwrap the ear husk leaves and gently shake the ear. The silks from fertilized ovules will drop off. The proportion of silks dropping off the ear indicates the proportion of future kernels on an ear (Figure 3). Randomly sample several ears in a field to estimate the success of pollination.

The second technique is to wait until 10 days after fertilization of the ovules. Healthy developing kernels should appear as watery blisters during the R2 development stage.

Figure 2. Poor kernel set resulting from high heat and drought.

Figure 3. To check for embryo fertilization, remove husks and shake the ear. Silks that fall away indicate successful embryo fertilization. Embryos with attached silks indicate fertilization is yet to occur.

CORN POLLINATION AFFECTED BY HEAT AND DROUGHT

Summary

Kernel set can be irregular on ears when pollen shed and silk elongation are not synchronized. This is more common when moisture stress accompanies heat stress. Pollination can be successful during stretches of high temperatures if adequate moisture is supplied to the plant. When pollination is poor but some kernels are developing, the plant can continue to gain dry matter, and it is still possible to harvest the corn crop. In some areas, poorly pollinated fields can be harvested for silage use. During extreme situations of no pollination, the best quality forage will be found as close to flowering as possible.

Sources:

[1] Corn pollination: affect of high temperature and stress. Iowa State University. https://crops.extension.iastate.edu/.

[2] Nielsen, R.L. 2020. Tassel emergence and pollen shed. Corny News Network. Purdue University Extension. https://www.agry.purdue.edu/ext/corn/news/timeless/Tassels.html.

[3] Nielsen, R.L. 2020. Silk Development and emergence in corn. Corny News Network. Purdue University Extension. https://www.agry.purdue.edu/ext/corn/news/timeless/Silks.html.

[4] Hoegemeyer, T. 2011. How extended high heat disrupts corn pollination. University of Nebraska—Lincoln. https://cropwatch.unl.edu.

[5] Lauer, J. 2006. Concerns about drought as corn pollination begins. Agronomy Advice. University of Wisconsin Agronomy Department. http://corn.agronomy.wisc.edu/AA/A042.aspx.

Web sources verified 07/06/2021.