The process of estimating yield potential in corn fields prior to grain harvest includes an assessment of the success of "kernel set" on the ears. Poor tip fill on ears, resulting from a combination of pollination failure and kernel abortion, is not uncommon in fields where severe crop stress has occurred during pollination or in the early weeks following pollination.

The absence of kernels on the tips of ears as a result of stress "makes sense" from the standpoint that most agronomists will tell you that the tip silks are the last to emerge from the husk during pollination and, thus, are usually the last to receive pollen if pollen is still available. If pollen is no longer available, then the tip ovules are never fertilized (in a sexual context) and no kernels develop.

If pollen is available and the tip ovules are fertilized, then the resulting tip kernels are younger relative to the others on the cob and so are more vulnerable to abortion if severe photosynthetic stress occurs early in the grain fill process that greatly limits the availability of photosynthate to the developing kernels. The causes of severe photosynthetic stress are varied and include drought stress, heat stress, severe defoliation (e.g., hail damage), and nutrient deficiencies (e.g., nitrogen).

A less common pattern of poor kernel set is one that is often described as the "zipper" pattern wherein 1 or more entire rows of kernels along one side of a cob are absent due to some combination of pollination failure and kernel abortion. A subsequent symptom that often develops on such "zipper ears" is a noticeable curvature of the cob, sometimes to the extent that folks describe it as a "banana ear". These curved ears are a consequence of the absence of kernels on one side...
of the cob coupled with the continued development of kernels on the other side that “force” the cob to bend or curve.

While most recognize that the absence of kernels down one side of the ear is the result of severe photosynthetic stress, it is less obvious why the pollination failure or kernel abortion occurred along that side of the ear rather than being localized at the tip of the ear. Silk development typically begins with the basal ovules at the butt of the ear and progresses up the ear which means that the first silks to emerge and be fertilized are primarily from the basal half of the ear. This acropetal progression of silk elongation is thought to occur uniformly from base to tip such that silk emergence occurs uniformly around the circumference of the ear at any particular position on the ear. If this is true, then what is the cause of the "zipper" pattern of poor kernel set?

**Silks "Shading" Other Silks?**

I can offer one opinion based on observations I have made in fields where the "zipper" pattern occurs. Most of the time when I have discovered "zipper" ears, the side of the ear with the kernel set problem is the same side over which the silks draped during the pollen shed period.

This leads me to speculate that perhaps the draping of the silks resulted in the underlying silks being "shaded" from initial contact with pollen, resulting in those silks a) never coming into contact with pollen (ovules not fertilized) or b) those silks being pollinated later than the rest (delayed kernel development, more vulnerable to abortion under stress). If the latter delayed exposure to pollen and subsequent delayed kernel set occurs, then those younger kernels would be more vulnerable to severe stress in the first week or so after pollination. This possible contributing factor intrigues me because "zipper" ears are not restricted to fields with severe drought / heat stress. They often are also found in fields that exhibit severe nitrogen deficiency stress.

**Differential Heating Around Circumference of Ears?**

Another possible contributing factor was recently suggested to me by a colleague within Pioneer Hi-Bred Int'l who indicated that drought researchers at Pioneer have reportedly documented that cob / ovule / kernel temperature can vary around the circumference of a developing ear of corn, with upper side of the ear potentially warmer than lower side of the ear. If true, I presume such a difference would be caused by more exposure to sunlight on the upper side during the day. That observation reminded me of a research article published in 2001 that looked at the effects of differential heating on silk timing and kernel survival in corn (Cárcovera and Otegui, 2001).

In that research, the authors applied electrical heating strips at the tips or along one side of ears for a 14-day interval from about 2 days before silk emergence to about 12 days after silk emergence. The heating strips were designed in such a way as to raise the temperature of the affected area of the ear by about 9 degrees F with respect to the ambient air temperature.

Neither of the heating treatments affected silk emergence timing or number of emerged silks, probably because the heating treatments were imposed after silk elongation had already begun within the husks. Heating the tips of ears had no effect on final kernel numbers.

However, heating of one side of the ears resulted in significant kernel abortion on the opposite,
non-heated side of the ears. The authors speculated that the heating treatment may have enhanced the metabolic activity and increased the partitioning of the photosynthetic assimilate to the developing kernels on the heated side of the ear, at the expense of the lesser photosynthetic assimilate made available to the developing kernels on the non-heated side of the ear.

The results of this research, coupled with the observations from Pioneer researchers that the upper sides of ears are often warmer than lower sides, would certainly offer a possible explanation of the "zipper" pattern of kernel abortion in years where the crop experiences not only excessive heat but also drought stress during or shortly after pollination. In addition to delayed metabolic rates and restricted photosynthetic assimilates, the development rate of the cooler kernels would be slower and, thus, the kernels somewhat "younger" and more vulnerable to the effects of severe stress.

As I have looked more closely at "zippered" ears in recent days, though, the "zipper" pattern does not always occur on the lower (and possibly cooler) sides of the ear. However, the concept of differential heating of ears around their circumference certainly seems plausible as a factor contributing to the "zipper" pattern of kernel abortion.

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