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In This Issue

Effects Of Severe Stress During Grain Filling In Corn

(Bob Nielsen)

- Perfect conditions for ear size determination and pollination can be negated if severe stress occurs during the grain fill period.
- Yield loss during grain fill can occur from 1) stand loss, 2) incomplete kernel set, 3) decreased kernel weight, and 4) premature plant death.

Yield potential in corn is influenced at several stages of growth and development. Ear size potential (number of potential kernels) is determined quite early (Nielsen, 2023), from about leaf stage V6 to V15 (knee-high to about shoulder-high). The next influential period for the corn crop is pollination (Nielsen, 2025b). The period following successful pollination and finishing at kernel black layer is defined as the grain filling period in corn and represents the final important yield determination period. See Nielsen (2021a) for descriptions and images of grain fill stages in corn .

Perfect conditions for ear size determination and pollination can be negated if severe stress occurs during the grain fill period. Yield loss during grain fill can occur from 1) stand loss, 2) incomplete kernel set, 3) decreased kernel weight, and 4) premature plant death.

Stand Loss During Grain Fill

Significant reductions in plant population are not as likely after pollination compared to earlier in the season. Loss of plants after pollination can occur as a result of severe storms (wind, hail, flood, ponding), animal damage (raccoons, deer, cattle), errant ATVs or agronomists wandering the field. However, yield loss due to late season stand loss is usually greater than that which occurs earlier in the season because ear number per plant and potential kernel number per ear are already determined, i.e., there is no opportunity for surviving plants to compensate by increasing these yield components. With late season stand loss, surviving, adjacent plants respond to the lesser plant competition primarily by increasing kernel weight.

Incomplete Kernel Set in Corn

The term “kernel set” refers to the degree to which kernels have developed up and down the cob. Incomplete kernel set is not always apparent from “windshield” surveys of a corn field. Husks and cob will continue to lengthen even if kernel set is incomplete. A wonderfully long, robust-looking, healthy green ear of corn can completely mask even a 100 percent failure of pollination or severe kernel abortion.

TECHNICAL TRIVIA:
Pollination is the movement of pollen from the tassels to the silks.
Fertilization is the actual union of the male and female gametes once the pollen tube reaches the ovule.

One of the causes of incomplete kernel set is **unsuccessful fertilization of the ovules during pollination**. Unsuccessful fertilization results in ovules that never develop into kernels and, subsequently, ears with varying degrees and patterns of incomplete kernel set. Many factors can cause incomplete pollination and distinguishing between them can be very difficult. See my related article (Nielsen, 2025a) for more discussion about unsuccessful fertilization.

Another cause of incomplete kernel set is **abortion of fertilized ovules** early in the grain filling period. Aborted kernels will be shrunken, mostly white, often with the yellow embryo visible; compared to normal plump yellow kernels. Unfertilized ovules, on the other hand, will result in visibly blank areas on the cob.

Kernels are most susceptible to abortion during the first 2 weeks following pollination, particularly kernels near the tip of the ear. Tip kernels are generally last to be fertilized, less vigorous than the rest, and are most susceptible to abortion. Once kernels have reached the dough (R3) stage of development, further yield losses will occur mainly from reductions in kernel dry weight accumulation.

Kernel abortion can be caused by any stress that greatly limits photosynthetic rates and, thus, photosynthate availability during or shortly following pollination…

- Severe drought stress.
- Excessive heat stress.
- Severe nutrient deficiencies (especially nitrogen).
- Extensive loss of green leaf tissue by foliar diseases like gray leaf spot (*Cercospora zeae-maydis*), northern corn leaf blight (*Exserohilum turcicum*), or tar spot (*Phyllachora maydis*).
- Extensive loss of green leaf tissue from severe hail damage.
- Consecutive days of heavily overcast, cloudy conditions.

Decreased Kernel Weight

Severe photosynthetic stress during dough (R4) and dent (R5) stages of grain fill reduces kernel weight and can cause premature kernel black layer formation. Decreased kernel weight can result from severe drought and heat stress during grain fill; extensive European corn borer tunneling (especially in the ear shanks); loss of photosynthetic leaf area by nutrient deficiency, hail, insects, or disease during grain fill; and killing fall frosts prior to normal black layer development.

Once grain has reached physiological maturity (R6), severe stress will have no further physiological effect on final grain yield per se. However, severe stress prior to R6 can weaken stalk tissue and predispose the plants to the development of stalk rots (Nielsen, 2021b). Weakened or rotted stalks combined with post-maturity damaging wind storms can easily result in significant mechanical harvest losses and, thus, less grain in the bin.

Premature Plant Death

A killing fall frost prior to physiological maturity can cause premature leaf death or whole plant death. Premature death of leaves results in yield losses because the photosynthetic "factory" output is greatly reduced. The plant may remobilize stored carbohydrates from the leaves or stalk tissue to the developing ears, but yield potential will still be lost. Approximate yield losses due to premature death of leaves, but not stalks, range from 36, 31, and 7% when the leaf death occurs at R4 (dough), R5 (full dent), and half-milkline stages of kernel development, respectively (Afuakwa & Crookston, 1984).

Premature death of whole plants results in greater yield losses than if only leaves are killed. Death of all plant tissue prevents any further remobilization of stored carbohydrates to the developing ear. Whole plant death that occurs before normal black layer formation will cause *premature* black layer development, resulting in incomplete grain fill and lightweight, chaffy grain. Grain moisture will be greater than 35%, requiring substantial field drydown before harvest. Approximate yield losses due to premature whole plant death range from 50, 39, and 12% when the whole plant death occurs at R4 (dough), R5 (full dent), and half-milkline stages of kernel development, respectively (Afuakwa & Crookston, 1984).

A common misconception is that kernel black layer formation sometimes fails to occur following a frost or other late-season severe stress. Not true. FAKE NEWS! The kernel black layer always develops. Any severe stress that occurs during the grain fill period will cause premature kernel black layer formation and is related to the reduction in or termination of sucrose (photosynthate) availability to the developing kernels (Afuakwa et al., 1984).

Citations and Related Reading

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Drying Expected To Continue Over The Coming Weeks

(Austin Pearson)

Precipitation over the last 30 days has been very spotty, the usual narrative when dealing with summertime convection. Thunderstorms in northwestern Indiana provided relief from ongoing drought conditions in certain areas, with some locations receiving over 2 inches of rainfall above the 30-day (July 15-August 13) normal (Figure 1). Just south and east of this region, precipitation was up to 2 inches below normal for the same period. Additionally, central Indiana also shows increasing departures, with deficits reaching as much as 3 inches below normal in some places. Recently, many parts of Indiana have experienced less than 25 percent of their typical rainfall since July 31 (Figure 2), which is leading to drier conditions being reported. The bonus – I am back to mowing my yard every other week!

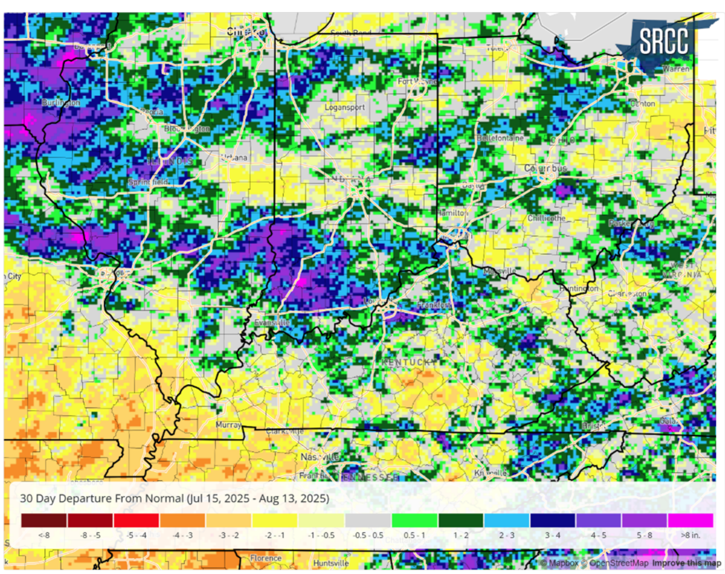

Figure 1: July 15 – August 13, 2025, accumulated precipitation departure from normal.

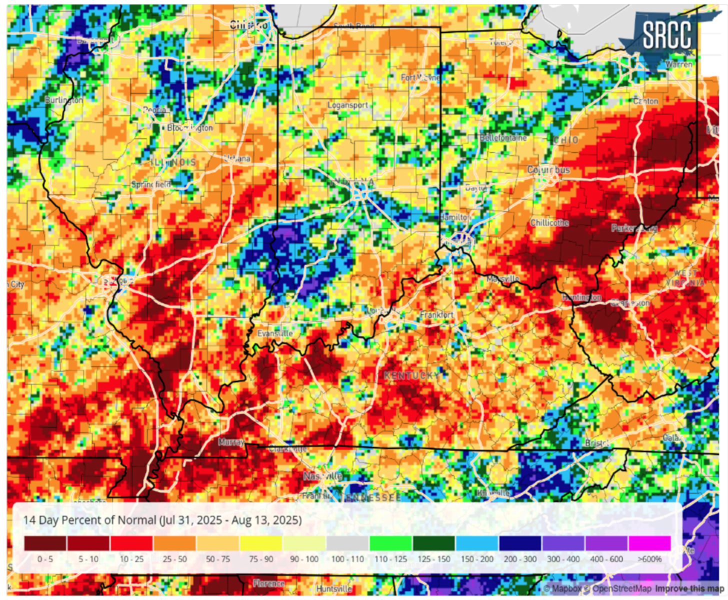

Figure 2: July 31 – August 13, 2025, accumulated precipitation departure from normal.

The US Drought Monitor observed some improvements in northwestern Indiana over recent weeks. Still, the persistent hot and dry conditions are beginning to shift areas in central and northern Indiana back toward drier conditions (Figure 3). The August 12 US Drought Monitor indicated that about 20 percent of the state was in either abnormally dry (D0) or moderate drought (D1) conditions, up just shy of 5 percent from last week. Areas of the state in D1 were up nearly 2 percent compared to the previous week.

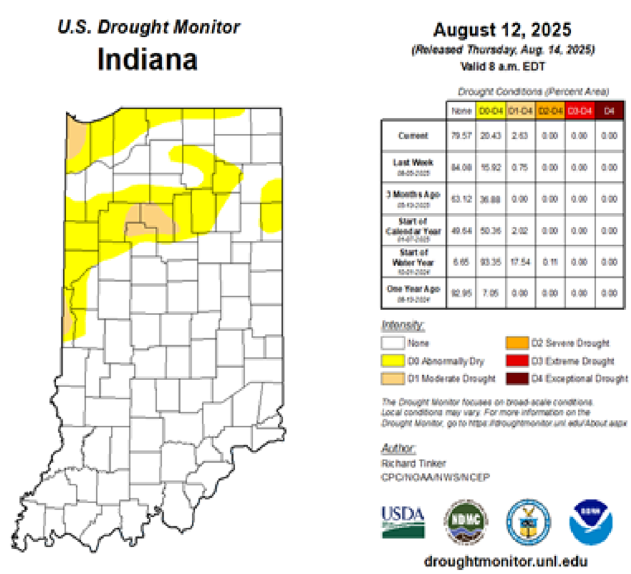

Figure 3: The August 12, 2025, US Drought Monitor Map.

How long will the dryness persist? The 7-day forecast for precipitation from August 14-21 suggests limited improvement, as most of the state expects less than 0.5 inches of rain (Figure 4). Some parts of northeast Indiana might receive up to an inch, however. Additionally, the Climate Prediction Center projects near-normal to below-normal rainfall across the entire state through the end of August, indicating that drying conditions could continue in the coming weeks. The good news is that temperatures will be close to normal or below average through the end of the month.

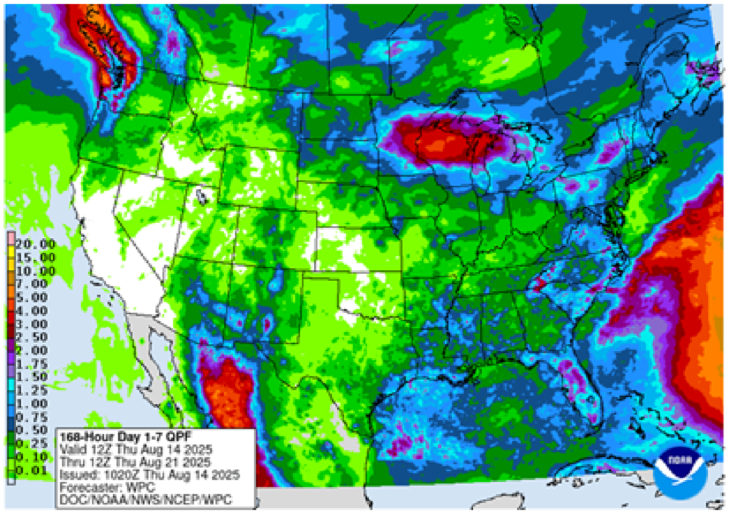

Figure 4: August 14-21, 2025, quantitative precipitation forecast.