Lessons From Late-Season Stress In Corn

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The condition of the corn crop continues to deteriorate as soils have continued to dry out. As of August 21, only about a third of the topsoil in Illinois was rated as having adequate moisture. There was some rain (even in Champaign-Urbana) this week, but much of the corn crop would have benefited a good deal more from rain a month ago than it will from rain now.

Whether rain now will benefit corn relates most closely to the amount of green leaf area still left on the plants. This varies considerably among and within fields. Growing degree-day accumulations since May 1 are some 150 to 200 GD ahead of normal, and corn planted in central Illinois in early April has accumulated about 2,700 GDD, enough to mature some hybrids. So some fields have lost their leaf area naturally. Kernels in this case should be of normal size.

More commonly this year, plants in fields and parts of fields have lost much, or even all, of their leaf area as a result of stress. Most of the stress is a lack of water, with contributions in many cases from lack of nitrogen related to inadequate water uptake. Nitrogen loss, or movement of N to beneath the root uptake zone, has also contributed in some cases. As the loss of leaf area moves up the plant past the ear leaf, the ability of the plant to intercept sunlight and so to photosynthesize diminishes quickly.

The other factor that affects the crop's ability to continue filling kernels is the state of the kernels themselves and of the ear on which the kernels reside. The reduction in sugar supply caused by leaf damage or loss eventually causes kernels to lose their ability to take in more sugars, so it's possible that some kernels that are still small won't be able to fill any more even if the leaf area revives some late in the season.

Kernels that stop filling prematurely are typically small, with some starch in the crown but liquid at the base of kernels. This liquid eventually dries, and with little starch deposited late, kernels will be shrunken at the base. Such kernels often are light in weight, they tend not to fit together very well, and their starch density may be lower than normal; all of this means low test weights. Protein levels may be higher than normal due to lower starch deposition. The kernels may also have some sugars still present that darken during high-temperature drying. Dockage can be substantial, and in some cases animal feed may be the best use for such grain.

Another factor from which we might take a lesson this year is the very high variability to be found, both among and within fields. It is not unusual to find fields that might yield less than 100 bushels across the road from fields that will yield twice that. Causes for this phenomenon are not always obvious and will have many people scratching their heads long after the season. Let me enumerate some possible reasons.

Corn following corn is taking a beating in many areas compared to corn following soybean. Some of the reasons I gave last year for this phenomenon also apply now: corn planted following corn had less favorable conditions than corn planted following soybeans; N loss took place under wet conditions in the spring, and N availability was less in corn following corn; and stress (lack of good roots in 2010, lack of rain in 2011) affected corn following corn earlier, and to a larger extent, than corn following soybean.

Symptoms of water stress, often associated with symptoms of N deficiency, showed up much earlier in some fields than in others, sometimes without a clear reason. While there was loss of N, especially of fall-applied N or N applied more than a month before planting, I think that much of the water/N stress had to be linked to how well the crop was tapped into the water in the soil. But many have observed stress in fields where it wasn't expected.

Soil was compacted after last year's tillage by operations under wet conditions this spring. Such compaction may have contributed to early stress this year, but it may not have been a major cause. One diagnostic of the effects of compaction is to see if there is a pattern in the field, such as wheel tracks with reduced crop growth, at an angle following the tillage pattern. Many fields don't really show this. In fact, given that roots have sometimes been known to be favored by better soil–water–root connections in firmer soil, it's not impossible that compacted areas might show less stress than less-compacted areas.

One of the more unusual things I've heard about this year is a pattern of uneven growth down the row. Most things like tillage effects or N application problems appear in strips as we move across the field, but in at least two cases I've seen aerial photos showing a ripple pattern of growth down the row. The pattern is not straight across the field, as it would be if tillage or spraying were done across the rows, but rather it seems to be in strips that might be the width of tillage equipment. The only explanation we could come up with is some sort of "bounce" of the tillage implement that would cause uneven soil conditions down the row. One photo showed less of this along the edge of the field, which might reflect slower tillage or repeated tillage there.

In a general sense, years like this, when lack and unevenness of rainfall define the season, we can expect more variability among and within fields. That's because even small differences in soil conditions can cause a little more or a little less water to be available and make a big difference in how much growth and yield result. We always say that our soils in Illinois are "forgiving: – that they are good enough to let us do things like compaction and still get good yields. But in years like this, the amount of reprieve we can get from good soil may simply not be enough. Δ

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