Yellowing of lower corn leaves: Nitrogen deficiency or drought?

At the end of August, it is quite normal to see the characteristic yellowing of lower corn leaves. Nitrogen (N) deficiency appears on lower leaves as leaf yellowing and tissue die-off, which starts at the leaf tip and forms a V-shape pointing down the mid-rib of the leaf – called “firing” of the leaves.. Symptoms start on the lowest leaves and extend up the stalk with the severity of deficiency (Figure below). This contrasts with potassium (K) deficiency, which is firing of the leaf margins (edges) of lower leaves.

Figure 1. Nitrogen deficiency symptoms due to drought stress on left plant.

Normally the corn plant will have taken up 75% of the total crop N by mid August, and stored much in the lower stalk and leaves. As cob development proceeds, N is translocated from recent root uptake via transpiration, with any shortfall being made up for by drawing down stored reserves.

When drought occurs, the flow of soil nitrate via mass flow and transpiration slows or stops. Crop development may continue, and the plant will start actively remobilizing N from these lower leaves. So even though there may be N in the soil, without water uptake, the crop will show N deficiency. So leaf yellowing is N deficiency triggered by drought.

Now having dark green leaves through to maturity is generally a sign of over-application of N. But this is not always advantageous since these bottom leaves may still transpire water and use nutrient resources yet conduct little photosynthesis due to shading by the upper canopy. So lower leaf yellowing or even falling off as the crop matures can actually be beneficial because nitrogen stored in those lower leaves moves to the grain. On the other hand, if the leaves are yellowing all the way to the ear or the whole plant is getting yellow that would be an indication of insufficient nitrogen.

Now South Dakota State University agronomists developed a simple thumbrule to assess N sufficiency in the corn crop by observing the severity of lower leaf yellowing in corn. If the 4th leaf below the primary ear leaf remained green (without visual yellowing from N deficiency), yield was generally not limited for lack of N.

Another indication of N sufficiency is the late season stalk nitrate-test. This is a test to gauge the success of nitrogen fertilization in corn. Nitrogen taken up by the corn plant tends to accumulate as the nitrate form in the lower stalk and leaves. During grain-fill, plants running low in N, mobilize more of this N out of the stalk. Conversely if the plant has ample N, it draws sparingly on this N, and if nitrogen is available in surplus amounts, then nitrate levels can be quite high in the lower stalk. This amount of nitrate-N remaining in the stalk at maturity can be compared to benchmark values to indicate whether the crop was inadequately, excessively or appropriately fertilized with nitrogen. Many of the soil test labs currently offer this test. An 8" section of the corn stalk is cut from the 6-14" height above the soil. Our Manitoba testing of this technique has found it to be useful as long as one samples within a couple weeks after reaching maturity (kernel black layer). If sampling is delayed too long after harvest and rainfall continues, it is possible that nitrate may leach from the stalk, producing low stalk levels.

And the postseason soil nitrate test taken at 0-24" may be indicative of whether sufficient N had been supplied for full yield potential. Preliminary analyses of recent University of Manitoba research suggests that a post-harvest nitrate-N test of less than 20 lbs N/acre to 24 inch soil depth indicates that the previous corn crop was probably deficient in N, a value of 20-50 lbs N/ac probably indicates that the previous corn crop was not excessively fertilized, and values greater than 50 lbs N/acre probably indicate that there was excess N available for the crop.

So a number of observations and tools are available to help the grower or agronomist assess the N status of the corn crop. But beware that such assessments of N sufficiency can also be confounded by drought conditions.