Late-Season Potassium Deficiency Symptoms in Southern Soybeans

By Cliff Snyder and Lanny O. Ashlock

Symptoms of K deficiency in soybeans have characteristically occurred on lower leaves because K is redistributed from older plant parts to newer ones throughout the season. As the severity increases, the symptoms extend up the plants. Potassium deficiency has also been shown to occur in the young leaves at the top of high-yielding, fast maturing crops such as cotton and wheat. In recent years, symptoms of K shortage have also been observed in the middle and upper canopy of soybeans on soils testing low in K (below 100 lb/A Mehlich 3 K). This should not be too surprising since soybeans accumulate 60 to 80 percent of their K needs after flowering, and higher crop yields are placing an increased demand on the available soil K supply.

Soybeans are exhibiting changes in potassium (K) deficiency symptoms that result from heavy K demand later in the growing season.

Soybeans are often planted earlier now in the South, with the adoption of more reduced tillage systems and increased producer acceptance of the Early Soybean Production System (ESPS). The ESPS allows the grower to reduce the risk of damage from summer droughts during peak blooming and early seed development. Planting of early-maturing varieties in April results in an earlier maturity and harvest. Most of these newer early-maturing soybean varieties used in the South also have semi-determinate and/or indeterminate characteristics, which means that the plants will continue to make some vegetative growth after they begin to flower. Continued vegetative growth at the time of reproductive growth may affect the K redistribution in plants that are low in K. The end result can be K deficiency in the upper leaves of plants instead of the lower leaves. This situation can be intensified if there is limited seed development in the lower canopy and a heavy, rapid seed development occurs in the upper canopy. Periodic intervals of drought stress during rapid seed development can contribute to the late-season K deficiency.

SOYBEAN FIELD in eastern Arkansas with late-season K deficiency.

Upper-leaf K deficiency should not be confused with chloride (Cl) toxicity, which has very similar symptoms. Chloride toxicity appears as marginal leaf yellowing, often beginning at the leaf tips, turning

POTASSIUM-DEFICIENT leaves from the four uppermost nodes of a late season affected soybean plant. Leaf K was 0.45 percent; leaf Cl was 2,265 ppm.

COMPARE K-DEFICIENT leaves with these healthier leaves from four uppermost nodes of soybean plants in same field. Leaf K was 0.67 percent; leaf Cl was 2,007 ppm in the healthier plants.

rapidly to brown, dry leaves which prematurely drop. Leaf Cl levels of about 20,000 parts per million (ppm) are considered toxic to most varieties. Field documentation of Cl-toxicity in the Midsouth has shown that irrigation wells are the principal sources of Cl. The application of waters high in Cl, on soils with poor internal drainage, can allow Cl to build to levels that can be toxic to certain soybean varieties classified as Cl-includers. Chloride-excluding varieties usually have leaf Cl levels below 10,000 to 20,000 ppm and are less sensitive to Cl toxicity. Potassium deficiency is a much greater hazard than Cl toxicity on the vast majority of silt loam soils supporting soybeans, rice and wheat.

Potassium deficient plants may suffer these complications: 1) reduced photosynthesis, 2) reduced transpiration and reduced leaf cooling, which results in great susceptibility to drought stress; and 3) increased leaf sugar levels, which invite disease. Low K can lead to reduced yields and seed quality from pod and stem blight, caused by the fungus *Diaporthe sojae L.*, and purple seed stain caused by *Cercospora kikuchii L.*

Soil testing and plant analysis should be used to confirm K deficiency. Research has shown that K can be applied as late as early pod development (R3-R4) on a soil testing low in K and still increase yields as much as 7 to 9 bu/A with adequate rainfall or irrigation.

Prevent K deficiency by applying preplant and/or side-dressed K according to soil tests. If deficiency symptoms begin to develop, conduct diagnostic soil and leaf tests to identify the problem. Remember to consider factors such as soil acidity, compaction, nematodes, and root diseases. Once deficiency symptoms occur, some yield potential has already been lost.

Good growing conditions in the South in 1992 and 1994 resulted in record soybean yields on well-managed fields. High yields remove large quantities of K...a 60 bu/A yield removes more than 80 lb of K_2O. The harvested K must be replaced by fertilization to sustain future soil productivity and crop production. Potassium needs should be provided in balance with other required plant nutrients. BC

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