

IS FOLIAR FERTILIZATION USEFUL TO SUPPLEMENT PRE-PLANT FERTILIZATION?

Antonio P. Mallarino, Professor, Department of Agronomy, Iowa State University

It's that time of the season when many producers wonder if foliar fertilization could help improve soybean growth and grain yield, and some also wonder about corn. They wonder if pre-plant fertilization was adequate; if late planting dates, replanting, and cold or excessively wet conditions limited early nutrient uptake; or if assumed adequate soil nutrient levels may limit yield when growing conditions are excellent. Foliar fertilization should be viewed as a compliment of pre-plant fertilization or a "rescue" treatment. Only a very small fraction of the needed amount of nutrients can be applied to the foliage because high nutrient concentrations in the leaf surface have toxic or salt-induced damaging effects, and repeated applications would be too costly.

Information from research

Hundreds of field trials conducted across the Midwest before the 1990s focused on foliar fertilization for soybean and a few for corn, mainly during the reproductive growth stages (R1 or more advanced). Fertilizers included nitrogen (N), phosphorus (P), potassium (K), and sulfur (S), although several trials included micronutrients. Researchers thought that foliar applied nutrients at these stages would delay leaf senescence and minimize "seed starvation" when nutrient uptake from soil or N₂ gas fixation by nodulated soybean was limited. A few Iowa trials in the middle 1970s suggested that spraying an N-P-K-S mixture at the R5 or R6 growth stages could increase yield by 7 to 8 bu/acre. However, several subsequent trials in Iowa and other Midwestern states until the early 2000s showed inconsistent results, with an equal frequency of yield increases and decreases.

The most recent ISU research with foliar fertilization of soybean at the R2 to R3 growth stages was in 2005 and 2006. The results were summarized before (see <http://www.extension.iastate.edu/CropNews/2010/0629mallarino.htm>). Treatments included foliar fertilization (3 gal/acre of 3-18-18 sprayed at either the V5 or R2/R3 growth stages or at both stages, and 3.3 gal/acre of 28% UAN at the R2/R3 stage), fungicide applied alone at the R2/R3 stage (Headline®), and tank mixes of the fungicide with 3-18-18 or UAN. On average, the fungicide increased yield by 2.9 bu/acre and delayed leaf senescence, although disease control was observed only for Brown Spot in three fields. Spraying 3-18-18 fertilizer on average did not affect yield, but spraying with UAN decreased yield. The UAN application caused moderate leaf burning and the 3-18-18 application caused no burning.

A great deal of research in Iowa since the middle 1990s focused on spraying nutrients to soybean at early growth stages. About 100 trials were conducted, with treatments being foliar fertilizers sprayed with or without a tank mix with glyphosate herbicide at the V5 to V7 growth stages. The commercial products tested (not all products were included

1

in all trials) included 8-0-8, 3-18-18, 10-10-10 (N-P₂O₅-K₂O) with the two N-P-K products with or without S and with or without the micronutrients boron (B), iron (Fe), and zinc (Zn). Product rates ranged from 2 to 6 gal/acre applied once or twice (spaced 8 to 10 days). Foliar fertilization increased yield in 15 to 30 percent of fields, and about 15 percent of fields on average. Detailed results were published before (see <http://www.extension.iastate.edu/CropNews/2008/0703Mallarino.htm>). The average response to the best treatment across all fields was 0.7 bu/acre. Yield with single or double applications did not differ consistently. Treatments differences were not consistent across fields, but yield increases tended to be higher for the 3 gal/acre rate of 3-18-18. Adding S or micronutrients did not produce higher yield, and the highest rate of 10-10-10 and 8-0-8 sometimes reduced yield (some leaf burn was observed).

Unfortunately, plant tissue testing is not a good index of P and K fertilizer needs for corn or soybean (see <http://www.extension.iastate.edu/CropNews/2010/0630mallarino.htm>). This is also the case for other nutrients, mainly due to a lack of recent calibration research in Iowa or neighboring states showing how nutrient levels in plant tissue relate to crop response to fertilization. ISU research continues addressing this issue for N, P, K, and S, however, and a new project is beginning, with focus on micronutrients.

So what can be recommended?

- Consider foliar fertilization carefully, and don't expect an economic yield increase in most fields. The probability of a yield response increases when pre-plant fertilization rates were lower than recommended, there are nutrient deficiency symptoms, or soil or climatic factors (other than drought) limit nutrient uptake in late spring or early summer.
- Plant tissue testing together with soil testing for areas within a field that show deficiency symptoms or poor growth compared with unaffected areas may be useful to make decisions about foliar fertilization. You must be aware of possibly misleading results, however, because several growth factors can increase or reduce the nutrient concentration in tissue.
- Although there are no clear rules, avoid high rates of N, K, or S because may cause leaf burn and a yield decrease. Also avoid spraying early or during the day when high temperature is forecast (below about 80 to 85 degrees should be safe mainly for low-salt products), and apply in the evening instead.