CAN FOLIAR FERTILIZATION IMPROVE CROP YIELD?

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Can foliar fertilization improve crop yield where no signs of nutrient deficiency can be seen? This is an oft asked question which unfortunately does not have a black and white answer. The objective of this paper is to briefly highlight what is known about leaf functions and provide an overview of the performance of foliar fertilizers.

Supplying nutrients to plants is a primary function of roots and not leaves. Though not a primary function, nutrients may enter a plant through leaves. Nutrient uptake by leaves is much less than roots, but like roots, many factors impact the uptake of nutrients from leaves. Marschner (1994) provides a list of concerns related to foliar application of nutrients: (1) Low nutrient penetration rates, particularly in plants with thick cuticles; (2) Runoff from hydrophobic leaf surfaces; (3) Washing off by rain; (4) Rapid drying of spray solutions; (5) Limited rates of translocation of some nutrients; (6) Limited amounts of macronutrients that can be supplied by one foliar application; and (7) Leaf damage. Marschner (1994) also provides some guidance on where foliar nutrient applications may be beneficial. They include: (1) Soils where nutrient availability is low. This is particularly true for micronutrients on soils with a high pH and high organic matter content. (2) Conditions where dry topsoil limit nutrient availability. (3) At the onset of reproduction when root activity decreases and nutrient uptake is reduced.

Of most interest recently is foliar application of nutrients at the reproductive growth stages. In 1976, Garcia and Hanway sparked this question when they reported significant soybean yield increases that ranged from 1.2 to 8.0 bu/acre when N-P-K-S fertilizer was applied two times at R4 and R5, R5 and R6, or R6 and R6.5. Subsequent research results have been disappointing compared to Garcia and Hanway's work. Gray and Akin (1984) report on a study conducted in 28 states and found that on average soybean yield decreased 5.2% with the foliar application of nutrients. Parker and Boswell (1980) reported a 10.9 and 17.6% soybean yield decrease with application of foliar fertilizers. In corn, foliar applications of N-P-K-S after silking were reported to temporarily reduce photosynthesis and subsequently yield was reduced by 6.4% (Harder et al., 1982).

In more recent work in Minnesota, Rehm (2003) reported that one to three applications of N-P-K-S applied after silking resulted in corn yield increases and decreases on the order of -5.8 to +4.7 bu/acre. In Iowa, Sawyer and Barker (1999) found that foliar application of urea and mono-potassium phosphate at V6-V8, V12-V14, or 50% VT had minimal impact on corn grain yield.

With regard to soybeans, Rehm et al. (1997) showed no yield benefit when soybeans were sprayed with repeated applications of N-P-K-S at pod filling. DiFonzo and Laboski (unpublished data, 2004) found that application of N-P-K + micros at R3 and R5

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resulted in yield decreases and increases that ranged from -3.3 to +0.8 bu/acre. At the current price of soybeans ($5.50/bu) and the fertilizer used, a minimum yield increase of 3.1 bu/acre would have been required for this practice to be economical. Additionally, locations where the greatest yield decreases from foliar fertilization occurred coincided with the most evenly distributed rainfall throughout the growing season.

While it is possible for foliar fertilization to increase yields, it appears that the conditions under which a yield increase is assured are unknown. The variability in positive and negative yield responses and the lack of economical yield responses are such that widespread practice of foliar fertilization to boost yields is not recommended.

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