FOLIAR FERTILIZATION OF SOYBEANS

During the growing season, nutrient deficiencies in soybean are sometimes observed. Thus, the question that is often asked is "Can an in-season nutrient deficiency be remedied by the foliar application of the deficient nutrient"? The obvious next question is "Will a foliar application of the deficient nutrient increase yield, or rather will it increase yield enough to pay for the application"?

Information that appeared in the article "Research lacking to back claims for foliar-applied fertilizers" in the June 22, 2016 issue of Delta Farm Press should be considered. Key points from that article that was authored by a group of Univ. of Arkansas scientists/specialists follow.

- Producers who are considering the application of foliar-applied fertilizers should ask these questions. 1) What is the frequency of crop response? 2) What is the expected average yield increase, and will this increase cover or exceed the expense for the applied product? The answers to these questions should be based on valid, verifiable research.
- Recommendations to producers for foliar application of nutrients are usually based on tissue analysis. The tissue values that are used to define nutrient sufficiency or deficiency may have the following shortcomings. 1) They are not always based on research. 2) There is inadequate published information that defines the relationship between crop yield increase and the tissue values for many nutrients. 3) There is inadequate information to define the exact nutrient concentration that is needed to verify a yield response to foliar feeding. 4) Many of the accepted critical nutrient concentrations are specific to a particular plant part and growth stage–thus correct sampling is important. 5) There is not usually a single tissue nutrient concentration that can be used to define nutrient sufficiency or deficiency for the duration of the growing season. (Click here for a White Paper on this website titled "Soybean Seed/Tissue Analysis to Determine Plant Nutrient Status" that provides details about how correct analyses of soybean plant tissue can be a tool to detect/confirm nutrient deficiency in plants during the growing season and in seed following harvest.)
- The authors' statement "While we would encourage tissue analysis at the appropriate critical growth stage, mid- to late-season foliar-feeding based on tissue analysis results we believe are largely unwarranted" is arguably the best summation of whether or not foliar fertilization should be considered.

Results from a 2019-2020 multi-state project (46 sites in 16 states that included Arkansas, Louisiana, and Mississippi) are reported in an article titled "Foliar fertilizers rarely increase yield in United States soybean", and confirm the above assessment of foliar fertilization of soybeans by Univ. of Arkansas personnel. The research reported in the above-linked article was funded by the soy checkoff as part of USB's Science for Success program. Pertinent details of and results from that project follow.

- Six products that each contained some of the nutrients required by soybean were applied at growth stage R3 as prophylactic treatments at labeled rates (see Referenced Items for labels of applied products). All of the applied products were nationally marketed to U.S. soybean producers.
- None of the tested products increased soybean seed yield.
- Application of the tested foliar fertilizers did not change seed composition. Thus, foliar fertilizers applied at recommended rates should not be expected to increase protein or oil content of the seed.
- In this study, application of prophylactic foliar fertilizers to soybean decreased profitability.
- Yields at the study sites ranged from 27 to 83 bu/acre, and the above results were obtained regardless of yield environment.
- **The take-home message from this broad-based research is: producers looking to increase soybean yield or farm profitability are unlikely to see any benefit from applying foliar fertilizers in the absence of visual nutrient deficiency symptoms**.

A few studies have shown small yield increases resulting from the application of some foliar fertilizers to soybeans. However, the yield increases were either not economical or their profitability was not determined. Thus, application of a foliar-applied fertilizer product should be considered only to correct a confirmed in-season nutrient deficiency in soybeans. Even then, the certainty of a yield increase that will be profitable at the current commodity price is not guaranteed.

The above narrative presents a compelling case for not using foliar fertilization to increase soybean yield across a wide range of environments. Even though nutrient deficiencies may sometimes occur during the growing season, the best remedy is to apply the correct amount of fertilizer based on soil test results before planting the next crop so that the deficient nutrient becomes available for uptake by the plant's

root system during the following growing season. Application of deficient nutrients on the plant's foliage during the growing season will not likely result in sufficient uptake of those nutrients in an amount that will provide a profitable response.

Additional points to consider when deciding whether or not to apply foliar fertilizers to soybeans follow.

- Roots/root hairs are specialized for uptake of water and nutrients from the soil. Thus, they provide the best route for getting a deficient nutrient into the plant.
- Leaves are designed to collect sunlight, conduct photosynthesis, transport photosynthetic products to other parts of the plant, and transpire water vapor to cool the plant. Leaf surfaces are not conducive to absorption of fertilizer nutrients.
- Because very small amounts of nutrients can enter plant leaves, the macronutrients N, P, and K should not be considered for foliar application.
- Micronutrients (click here for White Paper on this website) applied as a foliar fertilizer may provide benefit to the current crop, but only if deficiency symptoms are confirmed. Again, these deficiencies are best remedied by application of the appropriate fertilizer(s) to the soil prior to the next growing season.
- To ensure maximum benefit from a foliar fertilizer application, make the application when there is maximum interception of the product by the plant foliage–i.e., if more soil than foliage is exposed to the spray at the time of application, then the foliar application will not accomplish its intended purpose because not enough of the fertilizer will be intercepted by foliage of the targeted plant.
- In order to maximize nutrient penetration from a foliar application, all leaves of the target plants should be thoroughly wetted.
- There is no substitute for a strong soil fertility program that is based on soil test results to support the maximum yield potential of soybeans.
- If foliar fertilization is conducted, ensure that the practice is economical vs. applying the deficient nutrient to the soil prior to planting next year's crop.

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