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Correcting Iron Deficiencies in Soybean with Foliar Iron Fertilizer

Kevin Bronson, Calvin Trostle, Wayne Keeling, and J.D. Booker

Texas A&M University Texas Agricultural Experiment Station, Lubbock, TX,

Texas A&M University Texas Agricultural Extension Service, Lubbock, TX.

Soybean is a occasional catch crop following failed cotton in the Texas High Plains. However, the widespread occurrence of high pH soils in our region is conducive to "lime-induced chlorosis" or iron (Fe) deficiency in soybean. High pH (pH 7.7-8.3) soils in the High Plains include Portales, Mankser, Pep, and Estacado, and these often occur on shoulder slopes above playa lakes. At high pH, soil Fe is very insoluble and the bicarbonate ions in soil, for unclear reasons, restrict Fe availability in soil and plant tissue, resulting in yellow (chlorotic) interveinal areas of the leaf (Marschner, 1986). The leaf veins themselves remain fairly dark green in typical Fe deficiency symptoms (Fig. 1). Soybean is widely known to be much more sensitive to Fe deficiency than cotton (Marschner, 1986). Sorghum and peanut (TAEX, 1996) are other important High Plains crops which are sensitive to Fe deficiencies, but in this bulletin we will focus on soybean. We observed Fe deficiency a few weeks after emergence in soybean planted 22 June, 2001 on 60 acres, i.e. one half of a center pivot field, near Ropesville, TX. The interveinal areas of leaves were a pale yellow green and the plants were stunted. However, these Fe deficiency symptoms were only observed in the southwestern one-third of the soybean

Fig. 1. Chlorotic, Fe deficient soybean

area, where we know that the soil type is the calcareous Portales soil (high pH, grayish soil color, abundant calcium carbonate nodules on soil surface). The rest of the soybean field, which had healthy, dark green plants was in the Amarillo soil (non-calcareous, reddish soil color) (Fig. 2).

Table 1 shows several soil and plant nutrient indicators. As mentioned, soil Ca is much greater in the Portales soil than in the Amarillo soil. Soil Fe was at the critical level of 4.2 ppm (TAEX, 1987) in the Amarillo soil, but much below this in the Portales. Interestingly, total leaf Fe determined by wet acid digestion and atomic absorption spectrophotometry, was similar between the chlorotic and green soybean leaves. Acid (HCl) soluble Fe, however, does reflect the visual deficiency symptoms, and this may therefore be the best leaf Fe status measurement that is commonly available in regional

Fig. 2. Green, non-Fe deficient soybean

Table 1. Soil and Plant indicators of iron deficiency for chlorotic and green soybean, Ropesville, Texas, 2001

	Soil type	Soil Ca (ppm)	Soil Fe (DTPA-extractable ppm)	Total leaf Fe (ppm)	Acid-soluble leaf Fe (ppm)	Leaf N (%)
Green soybean	Amarillo	**1823**	4.2	420	**146**	5.2
Chlorotic soybean	Portales	**4561**	3.1	460	**104**	5.1

soil and plant testing laboratories. The last column in Table 1 indicates that the chlorotic plants were not nitrogen (N) deficient.

Next, we applied 2.5 ga/ac of a locally available 5 % liquid Fe product (1.1 lb Fe/ac) by back-pack sprayer on one acre of the Fe deficient soybean area. In about one week the plants in this LEPA-irrigated (drag hoses not spray-irrigated) field responded with a very noticeable greening (Fig. 3). The producer then proceeded to spray the rest of the chlorotic area in the high pH Portales soil. "Site-specific" spraying of foliar Fe was easily done in this case as the Portales soil is in one easily identifiable part of the 60 –ac field. The product we used contained mostly ferrous sulfate form of Fe, which is less expensive than chelated Fe forms and apparently of similar efficacy when applied foliarly. It is not economical to soil-apply chelated Fe fertilizer to large row-cropped fields, as higher rates of this product would be required to build up soil Fe. Ferrous sulfate Fe fertilizers should not be applied to soil as the ferrous ($Fe+^{2}$) quickly oxidizes to ferric (Fe^{+3}), which is insoluble and unavailable to plants. Selecting available Fe chlorosis tolerant varieties of soybean (or sorghum) should be the first line of defense on high pH, low soil Fe soils.

For more information on correcting iron deficiencies go to:
http://soil-testing.tamu.edu/publications/787896-l5155.pdf

References

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Fig. 3. Effect of 2.5 ga/ac foliar spray of 5% liquid Fe fertilizer in Fe-deficient soybean area (row on left is un-treated).