Copper Deficiency of Wheat

The occurrence of copper (Cu) deficiency of wheat in South Carolina is typically infrequent, but is known to occur on organic soils and on poorly-drained minerals soils. In most years there are no recognized occurrences of Cu deficiency in the state, but in years of high winter rainfall Cu deficiency symptoms are common.

Fig. 1. Copper deficient wheat is pale green. (J. W. Chapin)

Factors Affecting Copper Availability

Copper availability is reduced by complexation with organic matter. Most occurrences of Cu deficiency occur in organic soils and poorly-drained mineral soils which have fairly high organic matter contents. The high moisture content and low aeration of poorly-drained mineral soils also reduces Cu availability directly and indirectly by limiting growth of the wheat root system. A reduction in rooting due to soil compaction may also induce Cu deficiency in low Cu soils. High soil pH, phosphorus and zinc also increase the occurrence of Cu deficiency.

During wet years most Cu deficiency is observed in bottoms and extremely wet areas of poorly-drained mineral soils with elevated organic matter contents. For example, a field in Florence County showing extensive Cu deficiency had an organic matter content of 20% (determined by the loss on ignition method) and stayed wet most of the spring. Soil pH (5.5), phosphorus (60-100 lb per acre) and zinc (2 lb per acre) in this instance probably did not contribute to the deficiency because they were not high. Soil test Cu levels were extremely low, < 0.3 lb per acre.

Copper Deficiency Symptoms

Copper deficiency interferes with movement of calcium from the root system to the stems and leaves of the wheat plant. Therefore, Cu deficiency symptoms are quite similar to those occurring with calcium deficiency.

Copper deficient wheat is typically pale green (Fig 1). Marginal leaf yellowing and bleached tips progress to dry, twisted leaf tips (Fig. 2). Leaves may also curl or "pigtail" (Fig. 3) and the head may be incompletely emerged from the boot. Grain will often be shriveled and yield reduced substantially.

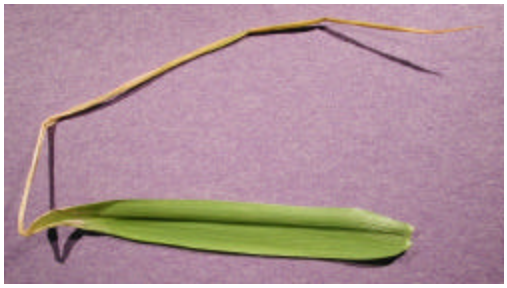

Fig. 2. Dry, twisted leaf tip of copper deficient wheat, note pale green color. (J. W. Chapin)

Tissue Levels of Copper

Tissue testing is the best way to assess Cu availability because soil testing for Cu deficiency is not particularly accurate, particularly on high organic matter soils. Normal sufficiency levels of leaf Cu are between 4.5 and 15 ppm. In the example cited above, flag leaf Cu was 4 ppm. Low leaf calcium reflected the effects of Cu deficiency on restricted calcium transport to the above-ground plant parts. The calcium level in the leaf tissue showing the severest Cu deficiency symptoms was only 0.15%, which is considered deficient.

Fig. 3. "Pigtail" symptom of copper deficiency. The lesions are from leaf blotch, a fungal disease not related to Cu deficiency. (J. W. Chapin)

Corrective Measures for Copper Deficiency

Foliar applications of Cu as copper sulfate at 0.25 to 0.5 lb Cu per acre (1 to 2 lb copper sulfate per acre) are recommended when Cu deficiency symptoms first appear. Soil applications of 5 lb Cu per acre (20 lb copper sulfate per acre) are recommended for fields where Cu deficiency has been confirmed with tissue testing the previous season. This level of Cu should give residual effects for 3 to 5 years after application. Routine applications of Cu are not warranted because the occurrence of Cu deficiency is relatively infrequent and limited in extent and excessive soil Cu levels may result in toxicity.

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