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Sulfur fertilization of corn and winter wheat

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Quick Facts

- Sulfur is essential for plant growth and is available to plants from many sources. In eastern Colorado, the most important sources are the soil minerals, organic matter and irrigation water.
- No grain yield increases have been found from the addition of fertilizer S in research tests on center-pivot irrigated corn or dryland winter wheat.
- In these trials, it was found that irrigation waters and the soils contain more than adequate S to sustain maximum production.
- The soil test for S may not be a reliable indicator of potential crop response to S when used alone. Irrigation water S content, organic matter content and soil texture along with deep soil samples (2 ft.) improve this prediction considerably.
- Plant tissue N:S ratios must be interpreted with caution and should be used only as general indicators of the crop's nutritional status. If corn has a N:S ratio of 12 and wheat of 16 or less, they are probably adequately supplied with S.

Sulfur deficiency systems are often confused with nitrogen (N) deficiency systems; both have chlorotic or yellow-green leaves. The difference is that with sulfur (S) the symptoms are seen first on the youngest leaves whereas N deficiency is seen first on the older leaves along with "firing" on the leaf tip and margins. Sulfur deficiency symptoms usually are not widespread across a field but appear in small localized areas.

Plants can use S from several sources. The most important sources in eastern Colorado are the soil minerals and irrigation water. Crop residues, soil organic matter, rainfall and the atmosphere also contribute some S. Irrigated corn requires about 23 lbs S/A to produce 150 bu/A grain and dryland winter wheat producing 35 bu/A requires 8 lbs S/A. Most soils and irrigation water in the eastern plains presently supply ample amounts of S for these crops at present production levels. In situations where S supplies from these sources are inadequate, then S fertilizers should be used.

Has S fertilization of corn or dryland winter wheat increased yields in eastern Colorado? During several years of field research the authors have not found any significant yield increases from additional S. The fertile soils and the high S content of the irrigation water supplied enough S for corn or wheat production in these studies. In a two-year study in center-pivot irrigated corn fields near Holyoke, S was added through the sprinkler system as ammonium thiosulfate in the early or mid-season as part of a high fertility program. The addition of S was made under commercial operating conditions as well as under small plot research conditions. The results were the same in both types of tests; no statistically significant yield increase was observed.

The response of dryland wheat to S fertilization was studied at six locations in eastern colorado. Ammonium thiosulfate was applied at planting or in the early spring to Scout 66 in small plot tests. No yield increases were observed from the additional S at any site.

Determining the response of a crop to additional S from a soil test alone is not reliable. The irrigation water S content (for irrigated crops), organic matter content and texture must be considered along with the soil test for the most reliable evaluation of the soil S status. Presently, sulfur deficiencies are usually expected to be a potential problem only on sandy soils low in organic matter content. The finer textured soils with higher organic matter contents, greater than 1%, are normally well supplied with S.

N:S Ratios

Another tool used by some laboratories to determine the S status of a crop is the N:S ratio in the plant tissue. Since both N and S are involved in protein production, the full benefit from adding one is dependent on an ample supply of the other. The ratio of N:S in proteins is relatively constant. Critical values for the N:S ratio must be determined for each crop. The critical value is that value below (or above in the case of N:S ratios) which the plant is considered deficient. The N:S ratio may then be used with the critical concentrations of S and N as an indicator of the S nutrition of a crop. With adequate S, the N:S ratio is narrower than the determined critical N:S ratio. If S is inadequate, the N:S ratio will be wider than the N:S critical ratio. If the nutrient concentrations are within established sufficiency levels and the N:S ratio is within its critical ratio, a crop will probably not respond to additional S.

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Many researchers believe that the N:S ratio is very limited in predicting crop response to S fertilization. The ratio has been shown to vary widely without any particular trend when there are adequate supplies of S available. It also varies widely from year to year. Therefore, these ratios must be interpreted with caution and perhaps should only be used as a general indicator of S nutrition.

Critical N:S ratios also change with plant age and with different plant parts. Therefore, ratios must be determined on a specific plant part and at a specific time in order to correlate with established critical ratios. In corn near tasseling the ear leaf should be collected for analysis. In wheat, as the head emerges from the boot, the entire tiller should be collected for analysis. Corn plants at silking (or tasseling) should contain more than 0.1% S, more than 2.5% N and have a N:S ratio of 12 or less (i.e., 12 N:1 S). Wheat plants should contain more than 0.15% S, more than 1.75% N and have a N:S ratio of 16 or less when the head is emerging from the boot. These critical concentrations and ratios change slightly with different growth stages and, as explained previously, are to be used as general indicators.

Plant N:S ratios from samples collected during two growing seasons did not suggest a potential for a S response in corn and wheat. The N:S ratios found in eastern Colorado ranged between 10 and 12 for both wheat and corn. The N:S ratio and nutrient concentrations indicate that adequate S levels were present in the young corn plants (8 leaf stage) so no yield response was expected. After fertilizing, the S concentration in the plant increased which narrowed the ratio, but yield was not affected. The increased S uptake probably represents luxury consumption of S. This indicates more than adequate S was available to meet the nutritional needs of the crop without applying fertilizer S.

Sulfur deficiencies are sometimes observed in the early season when the weather has been cold and wet. The symptoms generally disappear as the season progresses when the soils warm up and irrigation begins. Reports from Kansas State University research indicate that this early deficiency is not expected to reduce yield.