Sulfur fertilization can boost grain and hay protein levels in some areas

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Winter wheat may respond to sulfur fertilization, especially when applied with adequate nitrogen, a Montana State University study suggests.

Additions of soluble sulfur fertilizer significantly increased winter wheat grain protein content in two out of four years and increased grain yield in one of four years. Optimum responses to sulfur were measured at about 10 to 15 pounds of sulfur per acre. The study was conducted in the Knees area of the Golden Triangle, about 25 miles east of Brady by MSU professors Grant Jackson of the Western Triangle Agricultural Research Center and Rick Engel of MSU's Department of Land Resources and Environmental Sciences.

"Winter wheat can respond to sulfur additions in a manner similar to nitrogen," said Clain Jones, MSU Extension soil fertility specialist at MSU. "Nitrogen is the nutrient most often limiting wheat yields in Montana, yet when nitrogen levels are adequate, sulfur can sometimes increase protein and sometimes yield." Sulfur, like nitrogen, is a building block for protein, Jones said. Applying one without the other can result in less than optimum grain protein.

"Since winter wheat is increasingly being purchased for multiple flour products, grain protein content and flour quality are becoming more important when marketing the wheat," Jackson said. "Therefore, farmers growing winter wheat benefit from the addition of nitrogen and possibly sulfur fertilizers through increased grain yields and protein content."

In this study, grain protein levels were high for winter wheat, ranging from about 12 to 18 percent. The highest levels of grain protein were achieved with the highest nitrogen and sulfur fertilizer rates. These findings are consistent with an earlier study in 2001 at Belt, Geyser, Moore and Moccasin, by David Wichman of the Central Agricultural Research Center. In those studies, sulfur applications increased alfalfa-hay protein content at three of the four sites, yet increased yield only at Moccasin.

In dry conditions, sulfur additions may be beneficial even when sulfur soil tests indicate high levels of sulfur in the soil.

"This is likely due to less gypsum weathering and decomposition of organic matter in dry conditions," Jackson said. Conversely, there's often no yield or protein response even when the soil test is low, often due to high levels of sulfur at depth. The highest likelihood of a sulfur response occurs on coarse, shallow soils as these soils generally do not contain much gypsum and have trouble retaining the sulfur that is present.

Sulfur deficiencies in Montana, as well as other regions of the Northern Great Plains have been on the rise. Historically, very little sulfur fertilizer has been applied to Montana soils and through many years of cropping, soil sulfur reserves have become depleted in some areas. Higher yielding crops have also removed sulfur from the soil and accelerated the loss of soil sulfur reserves.

Despite the finding that sulfur has increased winter wheat grain protein in this one study, the overall results on sulfur have been mixed. In the Golden Triangle, sulfur fertilizer applications for the past couple of years have either decreased or had no effect on grain protein levels and had little effect on grain yield.

"Results from sulfur applications have been mixed, so apply sulfur with caution," said Jackson.

The most common sulfur fertilizers are ammonium sulfate (21-0-0-24), ammonium phosphate sulfate (16-20-0-14), ammonium thiosulfate (12-0-0-14), gypsum (0-0-0-19), epsom salt (0-0-0-13), elemental sulfur (0-0-0-100), and granular sulfur (0-0-0-90). Elemental and granular sulfur are not readily available and may not cause a yield response for one to three years. In this study, ammonium thiosulfate was used, and in the alfalfa-grass study, granular sulfur was used.

"Because sulfur soil tests do not always reflect how a crop will respond to sulfur fertilizer applications, the best way to determine if sulfur applications will result in positive responses is to test your field for increases in grain protein and/or yield by applying soluble sulfur fertilizer in strips," Jones said.

"Growers should still plan on applying about 2.5 pounds of nitrogen (soil test nitrate nitrogen plus fertilizer nitrogen) per bushel depending on protein requirements," said Jackson. Winter wheat grain protein typically increases 1 percent with approximately 22 pounds per acre of additional nitrogen under low to moderate rainfall and 33 pounds per acre of additional nitrogen under high rainfall conditions.

Engel said, "A winter wheat grain protein greater than 12.5 percent is generally associated with adequate nitrogen nutrition and a grain protein less than 12.5 percent is associated with nitrogen deficiency."

Wheat requires relatively small amounts of sulfur and may be better suited than some crops in sulfur deficient soils.

A summary of the winter wheat study may be found at http://landresources.montana.edu/fertilizerfacts (# 41). Contact your local MSU Extension agent or crop adviser for help with your sulfur and nitrogen fertilizer decisions, or for additional information on soil testing, fertilizer calculations, and placement, see Nutrient Management Modules 1, 3, 6 and 11 on the Web at http://landresources.montana.edu/nm.