Sulfur Effects on Two Varieties of Malting Barley Grain Yield and Quality

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Introduction

Sulfur deficiency in crops has become more widespread in the past 20 years, following reductions in land deposition of atmospheric SO_2 (sulfur dioxide) and lower sulfur (S) content as impurities in pesticides. While more extensive research has been conducted to examine the effect of S fertilization on other major crops like corn, wheat, and soybeans in North Dakota, barley has gained limited attention. Because grain protein is the most important quality component of malting barley, where <12% is preferred, and >13% is a serious grain quality defect, the amount of N fertilizer recommended to enhance yields can sometimes be less than adequate to optimize yields because higher amounts can increase grain protein above the desired quality levels. Some farmers anecdotally believe that high residual soil S can significantly enhance grain protein, and therefore lower grain quality. But it is also probable that S enhances grain yields which often may cause dilution, and therefore lower grain protein as has been seen in some wheat studies.

Objectives

1. Investigate yield and grain quality response to S of two commonly grown malting barley varieties (ND Genesis and Tradition) in North Dakota.
2. Determine if any sulfur effects on barley differ between soil N levels.

Methods

The trial was conducted at two sites: - the NDSU Carrington Research Extension Center and on a farmer's field near New Rockford. At CREC, flax was the previous crop, soil residual N was 39 lbs N, and SOM was 3.4%. At New Rockford, soybean was previous crop, soil N was 38 lbs, and SOM was 3.1%. Two varieties of malting barley - ND Genesis (two-row), and Tradition (six-row), were evaluated on their yield and grain quality response to four S rates at 0, 10, 20, 30 lbs S/ac applied as ammonium sulfate. These were applied in all combinations with N at 0, 30, and 60 lbs at CREC, and 30, 60, and 90 lbs/ac at New Rockford. An additional 0 lb N rate at 10 lbs S was included at the New Rockford site, to verify if yield would be improved by N at same rate of 10 lbs S. Treatments were replicated four times. Data collected and reported were grain yield, protein, plump and thin.

Results and discussion

At CREC, yields were significantly different between varieties. Tradition produced 59 bushels, 6 bushels more than ND Genesis. Meanwhile, there was an interaction effect of S and N on yield, which implies yield differences between N treatments depended on the level of S applied. When no N was applied (check), the crop yields were low, with the lowest registered for all S treated plots (Figure 1). Meanwhile, at 30 lbs N (where the crop also suffered from N deficiency), the lowest yield was at 30 lbs S, followed by no S. No evident trend of S effect was observed at 60 lbs N. These results seem to suggest that application of a high rate of S to an N-deficient barley crop could lower yields. Mean grain protein levels among fertilizer rate or variety treatments were <12.5%. Grain protein was significantly greater for Tradition (11.38%) than ND Genesis (10.44%). Protein was not affected by S. Differences were significant only between the check and 60 lbs N. Neither plump nor thin were affected by N or S rates.

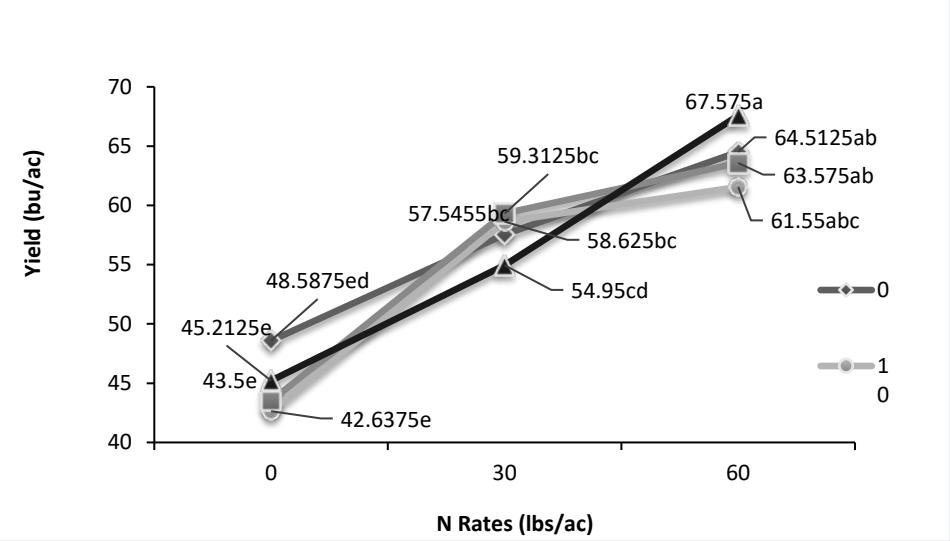

Figure 1. Interaction of grain yield of barley in response to sulfur at three N rates (CREC site).
([ab] Values followed by different letters are significantly different at P<0.05.)

At New Rockford, yield differences due to S response were observed between 0 lbs S and 20 lbs S (Figure 2). Yields were not different between varieties (86.5 bushels each), nor between N rates, except between the check (0 lbs N) versus 60 and 90 lbs N. Unlike at CREC, where flax (a non-legume) was the previous crop, N contribution due to soybean effect (contributing an N credit of about 40 lbs according to the N fertilizer recommendations in ND), and probably high N mineralization from soil organic matter contributed towards yields at 30 and at 60 lb N rates. Tradition produced significantly greater grain protein (13.2%) and plump (244.7%) compared to 11.28% protein and 241.6% for plump by ND Genesis.

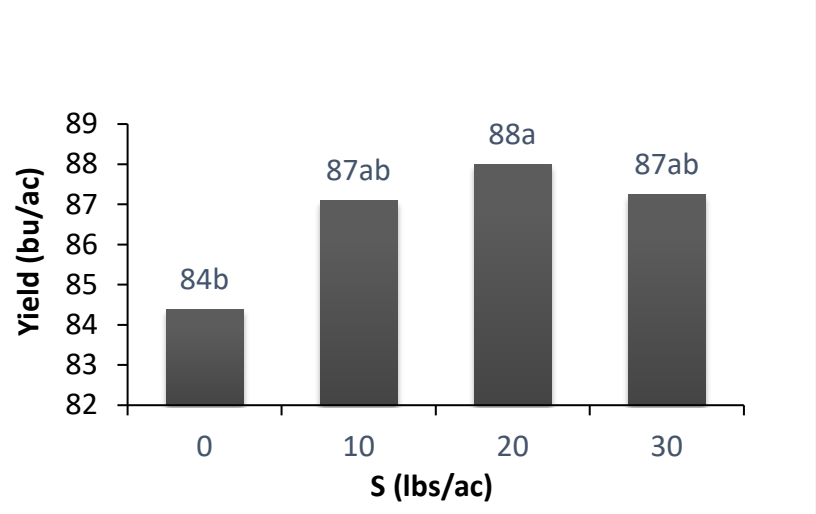

Figure 2. Yield of barley averaged across two varieties and N rates in response to sulfur (South of New Rockford).
([ab] Values followed by different letters are significantly different at P<0.05.)

Summary

Yields were improved by sulfur application at New Rockford. At Carrington, yields seemed to have been negatively affected by S when barley was severely deficient in N. Tradition had better yields at Carrington, and plump at New Rockford. The grain protein of Tradition was greater at both sites for ND Genesis, which could pose risk of poor quality grain for Tradition if N rates were higher. There was no evidence that the two varieties differed significantly in their response to S.