PLANT AVAILABLE SILICON APPLICATION IN WINTER WHEAT

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ABSTRACT

Many studies throughout the world has shown that various crops have positively responded to silicon (Si) application in terms of plant health, nutrient uptake, yield, and quality. The study' objective was to evaluate the effect of Si application rate and time on winter wheat growth and development, grain yield and grain quality. Results suggest that application of plant available silicon at 50% rate at either emergence or Feekes 5 appears to be more advantageous in terms of winter wheat grain yield production. Results indicate that for lower-yielding field with lower organic matter, application of Si at emergence increased grain yields. In a higher-yielding field with higher organic matter, application of Si at emergence was not as important, but mid-season application at Feekes 5 made a substantially greater difference in improving grain yields.

INTRODUCTION

Many studies throughout the world has shown that various crops have positively responded to silica (Si) application in terms of plant health, nutrient uptake, yield and quality (Tubana et al., 2016). Some of the noted silica-related benefits include: i) improved plant nutrient uptake and utilization, increased nitrogen and phosphorus use efficiency, thus, lower rates of nitrogen (N), phosphorus (P), and potassium (K), in combination with Si, may result in higher yields and better quality, ii) improved tolerance to drought and disease, and pest pressure, iii) improved plant stand and straw strength. Although not considered an essential element for plant growth, Si has been recently recognized as a "beneficial substance" or "quasi-essential", due to its important role in plant nutrition, especially notable under stress.

MATERIALS AND METHODS

This study was established in the fall of 2015, at two locations at University of Idaho (UI) Parma Research & Extension Center to evaluate silica (Si) effect on wheat growth and development, grain yield and grain quality. Winter wheat (var. Stephens) was planted at 140 lb/ac seeding rate. Following preplant soil test, all plots were treated at seeding with N, P, and K to achieve UI recommended levels for wheat. Research plots were treated with Si (0-0-5) by Montana Grow Inc. (Bonner, MT). Wheat was irrigated using sprinkler irrigation system throughout the season. Two application times - emergence and Feekes 5 - and three application rates - 500, 250, and 125 lb Si per ac - corresponding to 100, 50, and 25% of manufacturer-recommended rates. Following Si application, plant height was measured in each plot. Whole plant above ground biomass samples were collected immediately prior to and two weeks after Si application. Biomass samples were analyzed for N, P, K, and Si content. At maturity, the effect of Si application rate and time on wheat grain yield, test weight, protein, and Si content were evaluated.

RESULTS AND DISCUSSION

Winter wheat visual assessment mid-season showed that silicon application at 100% rate at Feekes 5 resulted in notably taller, greener, healthier looking plants compared to no silicon applied. Plants receiving no silicon had fewer, smaller, shorter spikes, compared to those receiving silicon at Feekes 5. The visual appearance mid-season matched the grain yield potential expectations, especially for the higher-yielding Field M2. Winter wheat grain yield was higher at Field M2 compared to Field E1 (**Figure 1A**), possibly due to substantially higher organic matter content: 1.23% for Field E1, and 3.00% for Field M2. Grain protein content was slightly higher at Field E1, but comparable to Field M2 protein values (data not shown). The differences in grain yield were not statistically significant. At Field M2 (higher yielding), wheat responded more to silicon application compared to Field E1 (**Figure 1A**). At Field M2, 50% application (at both emergence and Feekes 5) resulted in notably higher grain yields compared to other rates. At Field E1, silicon applied at emergence was more beneficial, compared to Feekes 5 application. When averaged over two fields (**Figures 1B**, **2A**, and **2B**), application of plant available silicon at 50% rate at either emergence or Feekes 5 appears to be more advantageous in terms of winter wheat grain yield production. It appears that for lower-yielding environment with lower organic matter (Field E1), application of silicon at emergence increased grain yields, whereas in a higher-yielding field with higher organic matter (Field M2), application at emergence was not as important, but mid-season application at Feekes 5 made a substantially greater difference in improving grain yields. The study will be repeated in 2016-17 growing season.

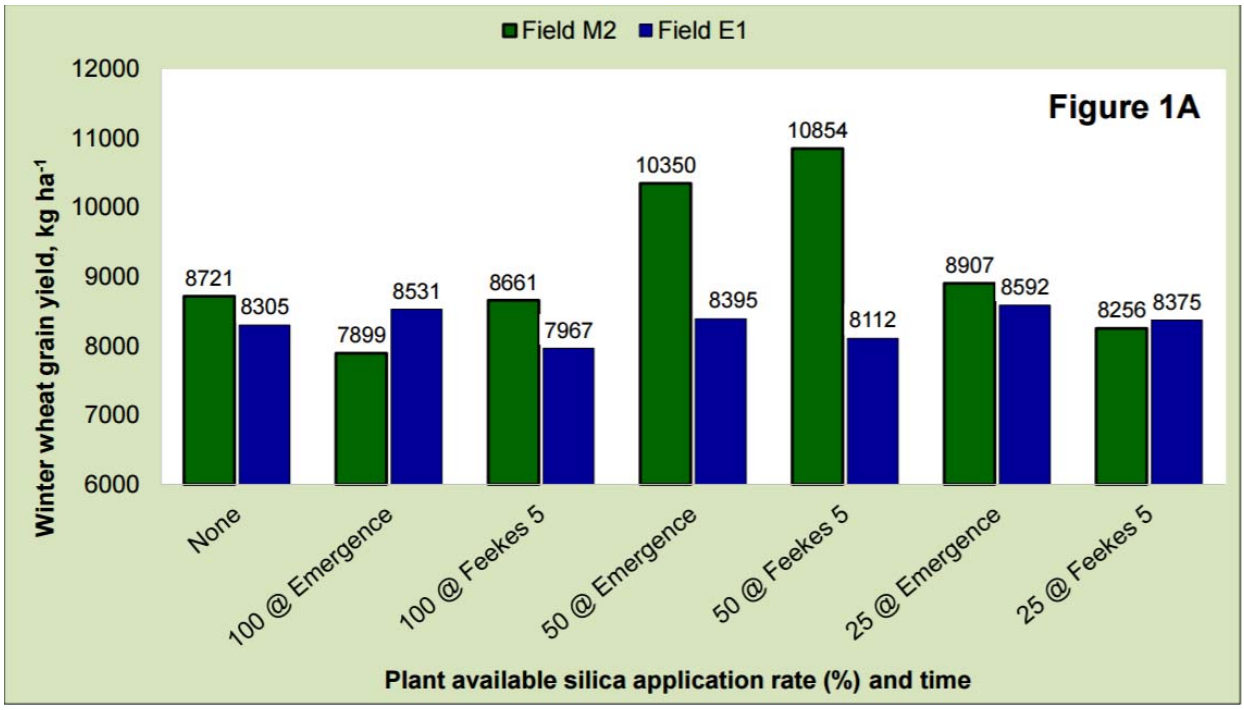

Figure 1A. Effect of plant available silicon application rate and time on winter wheat grain yield by-field, Parma, ID, 2015-16.

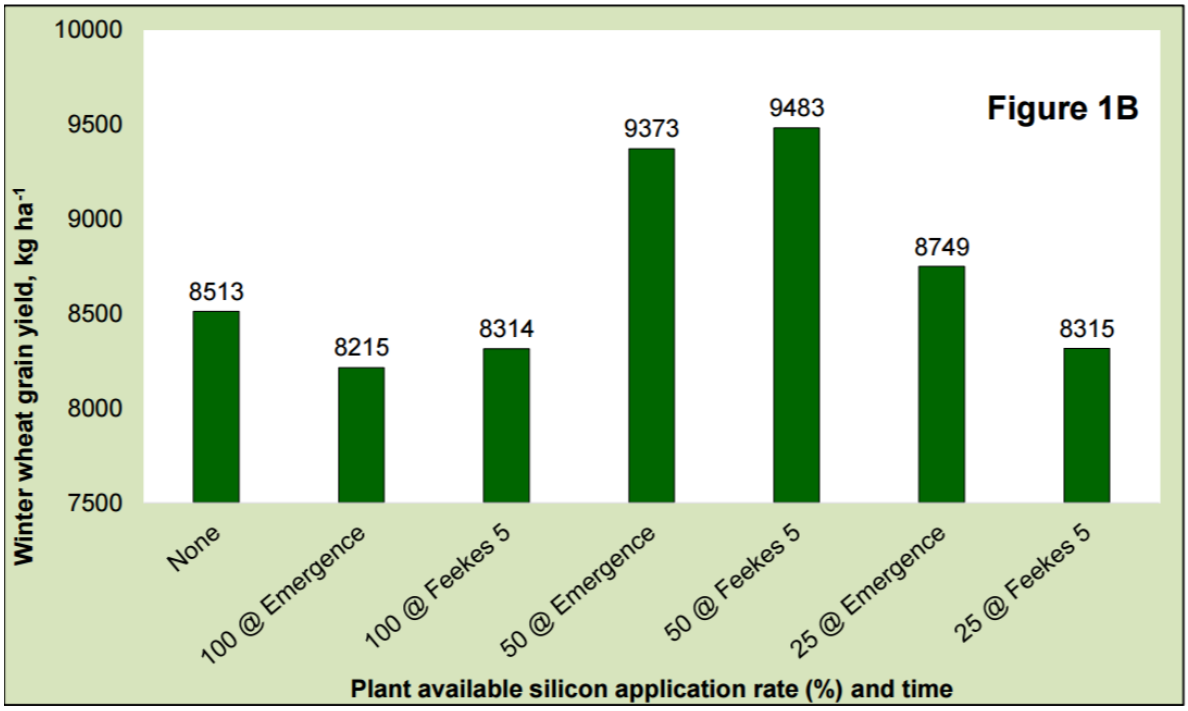

Figure 1B. Effect of plant available silicon application rate and time on winter wheat grain yield averaged across two fields, Parma, ID, 2015-16.

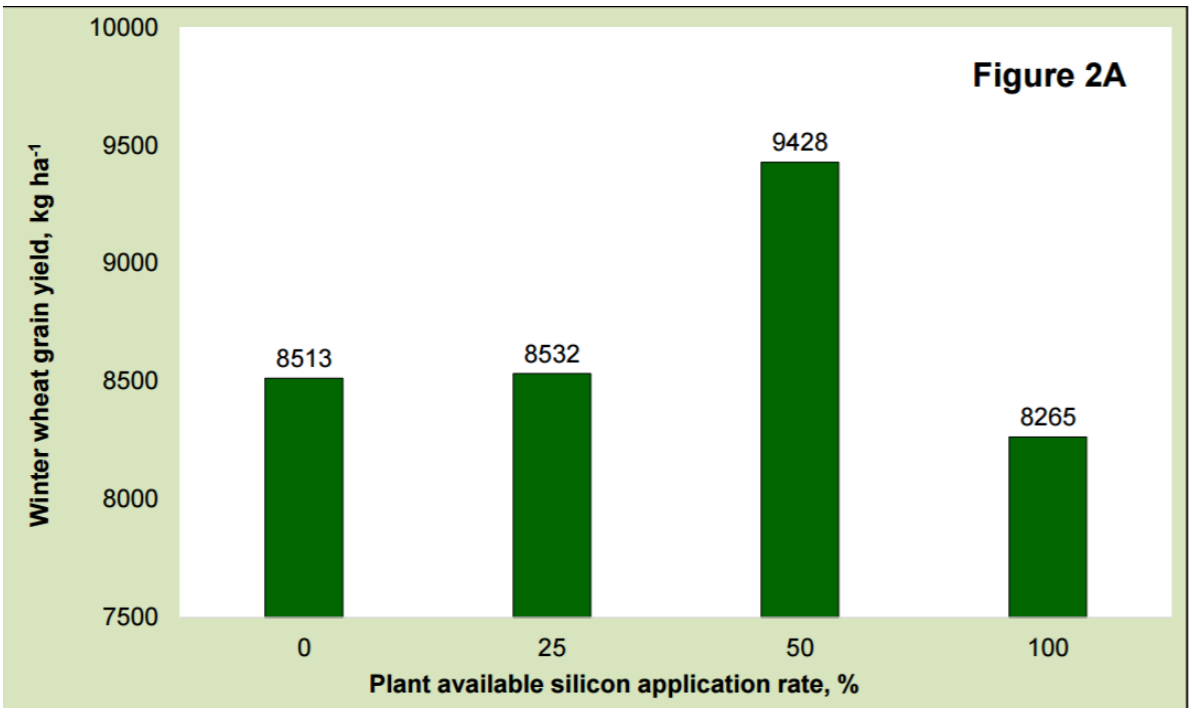

Figure 2A. Effect of plant available silicon application rate on winter wheat grain yield, averaged for 2 fields, Parma, ID, 2015-16.

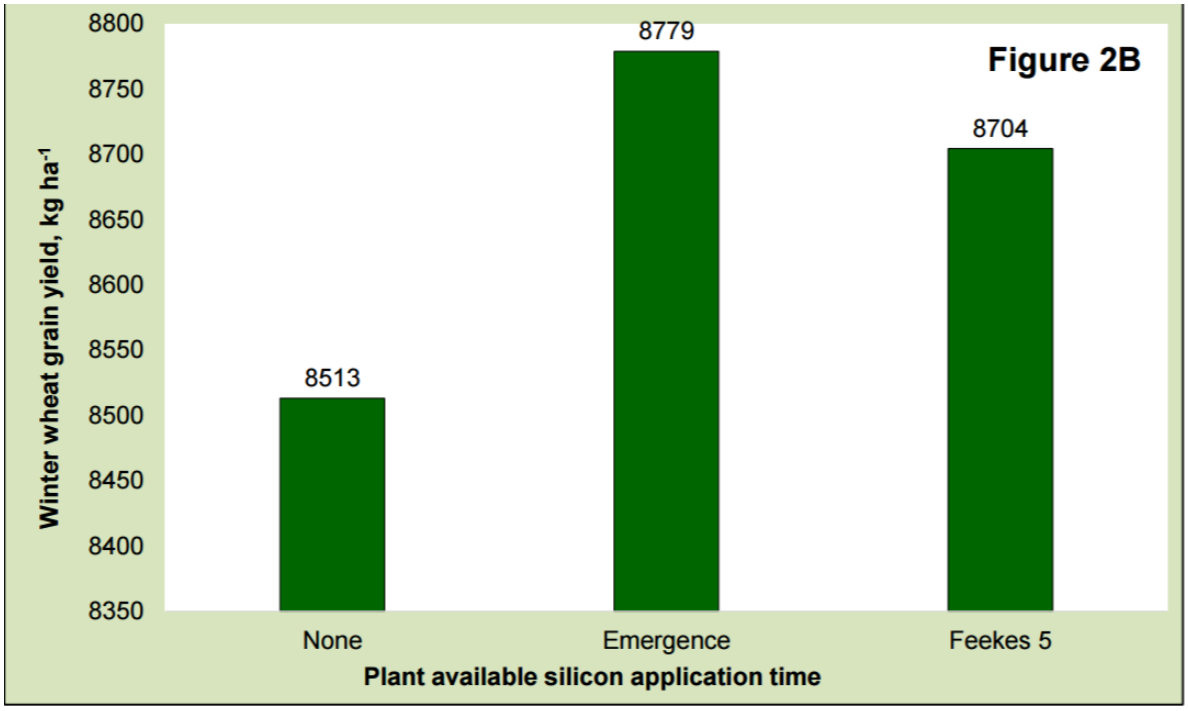

Figure 2B. Effect of plant available silicon application time on winter wheat grain yield, averaged for 2 fields, Parma, ID, 2015-16.

SUMMARY

This initial study suggested that application of plant-available Si seems to have potential for improving winter wheat production in Idaho. To make more concrete conclusions, the study will be repeated in 2016-17 growing season. In addition, a greenhouse study was initiated in winter 2017 to further investigate the effect of Si on wheat plant growth and grain production.

REFERENCES

Tubana, Brenda S., Babu, Tapasya, and Datnoff, Lawrence E. 2016. A Review of Silicon in Soils and Plants and Its Role in US Agriculture: History and Future Perspectives. Soil Science, 181(9-10): 393-411.