Potential of Silicon Amendment for Improved Wheat Production

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OBJECTIVES

To evaluate silicon (Si) effect on winter wheat growth and development, grain yield and grain quality.

INTRODUCTION

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. 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.

SILICON TREATMENTS

Proposed benefits:

- ✓ 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,
- ✓ improved tolerance to drought and disease, and pest pressure,,
- ✓ improved plant stand and straw strength.

MATERIALS AND METHODS

This study was established in the fall of 2016, at the University of Idaho Parma Research & Extension Center to evaluate silicon (Si) effect on wheat growth and development, grain yield and grain quality. Winter wheat (var. Stephens) was planted at 155 kg ha^{-1} 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 – at planting (Figure 1) and Feekes 5 (Figure 2) - and three application rates - 560, 280, and 140 kg Si ha^{-1} - 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 total Si content. At maturity, the effect of Si application rate and time on wheat grain yield, test weight, protein, and Si content were evaluated. The effect of silicon application rate and time on winter wheat grain yield and quality was analyzed with SAS 9.4, using Duncan's Multiple Range Test, at 90% confidence level.

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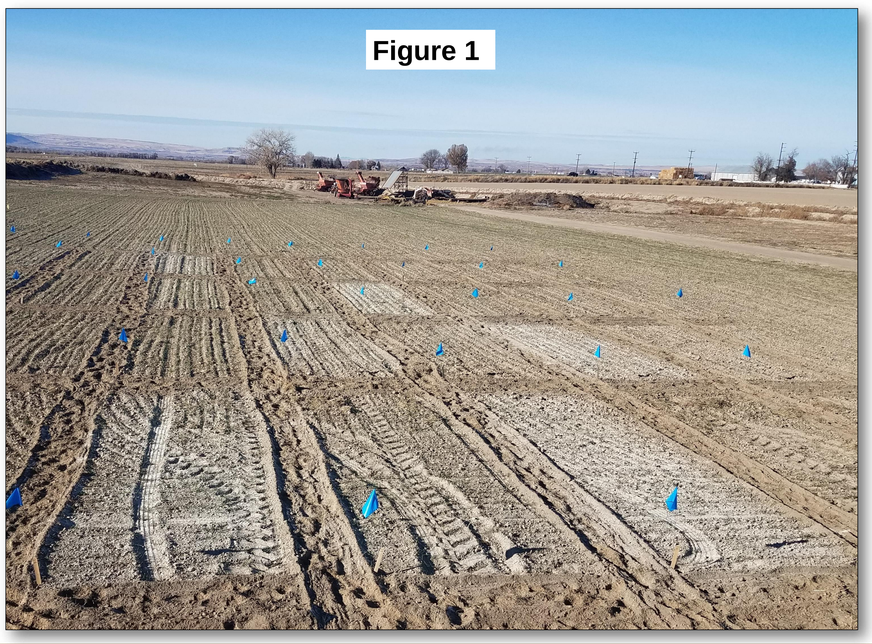

PRELIMINARY RESULTS

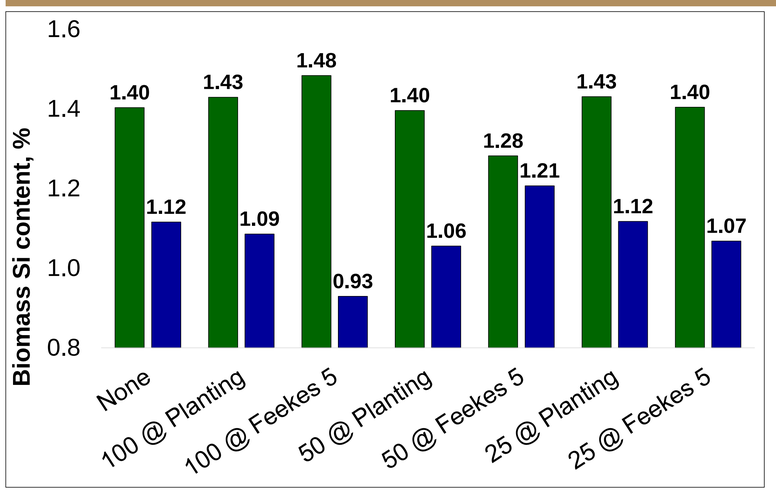

Figure 3. Winter wheat biomass Si content at tillering (2 weeks after Feekes 5 application) (green) and at harvest (blue), as affected by plant available Si application rate and time, Parma, ID, 2017.

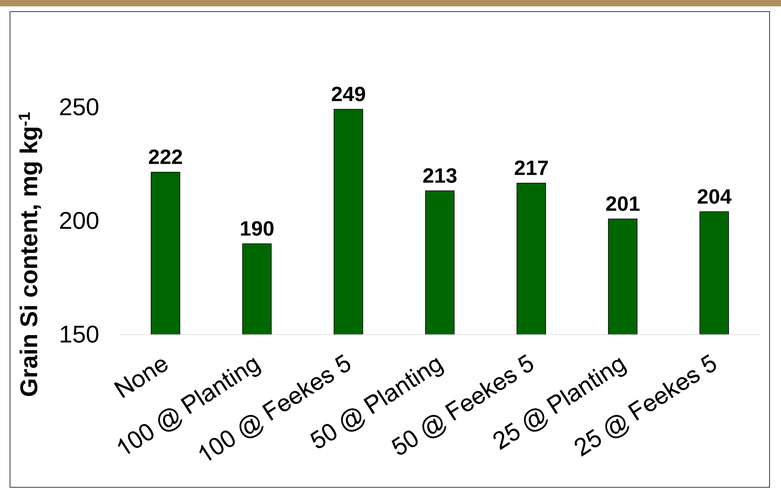

Figure 4. Winter wheat grain Si content at maturity, as affected by plant available Si application rate and time, Parma, ID, 2017.

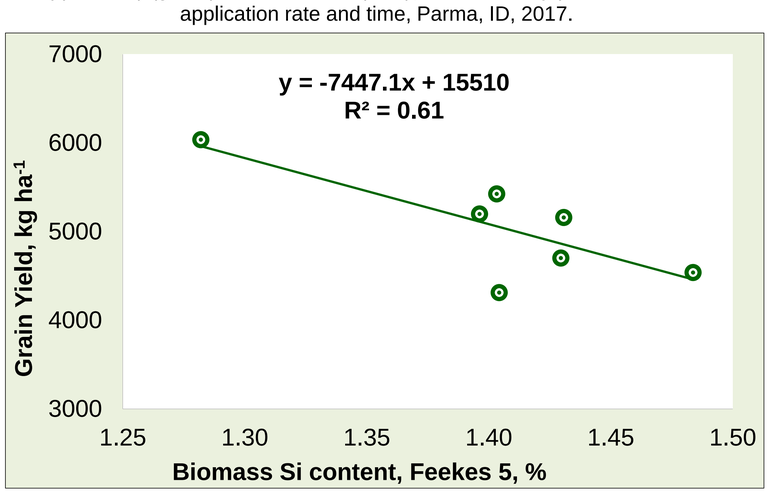

Figure 5. Relationship between winter wheat biomass Si content at tillering and grain yield, Parma, ID, 2017.

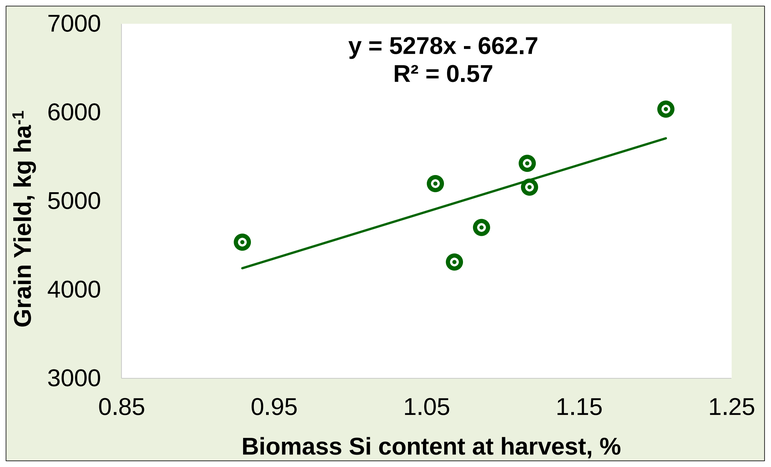

Figure 6. Relationship between winter wheat biomass Si content at harvest and grain yield, Parma, ID, 2017.

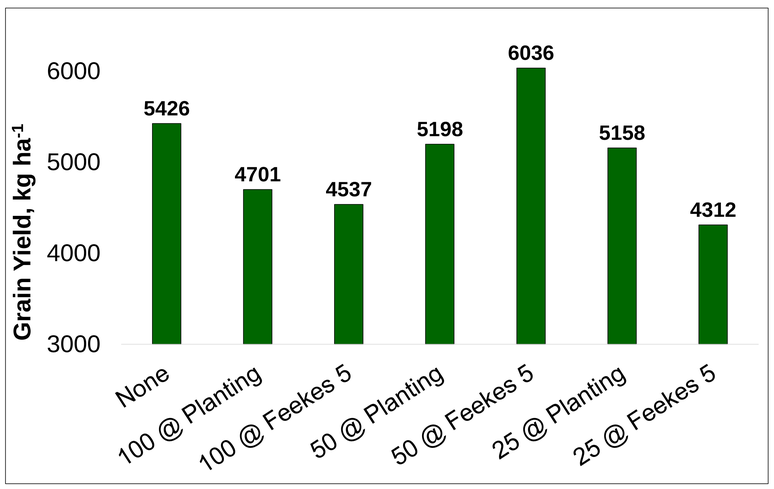

Figure 7. Winter wheat grain yield, as affected by rate and time of application of plant available Si, Parma, ID, 2017.

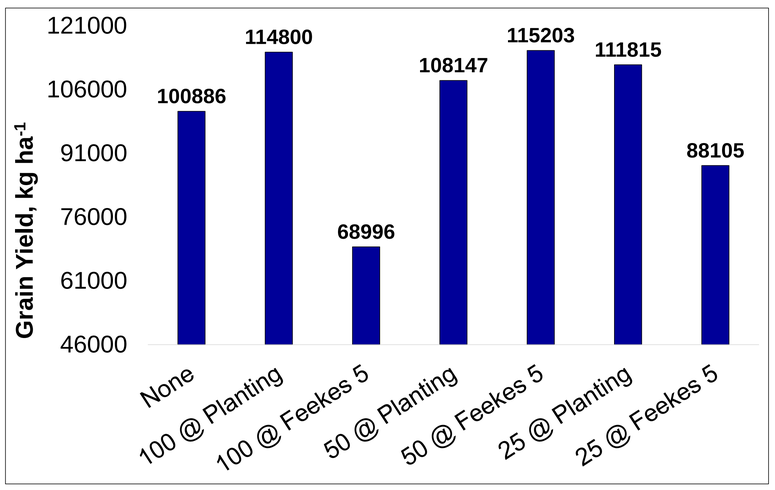

Figure 8. Winter wheat grain yield, as affected by rate and time of application of plant available Si, Parma, ID, 2016.

DISCUSSION

- ✓ Si content of winter wheat biomass has declined from Feekes 5 to harvest (Figure 3) due to translocation of Si into the grain (Figure 4). Strong linear relationship between biomass Si content at tillering (Figure 5) and at harvest (Figure 6) with winter wheat grain yield were noted. For mid-season biomass – lower Si content was associated with higher grain yields. Opposite was true for at-harvest biomass: the higher biomass Si content – the higher grain yield was achieved.
- ✓ Application of 100% Si at Feekes 5, had the lowest biomass Si content at harvest, the highest Si content in the grain, and the one of the lowest grain yields registered for this study in 2017 (Figure 7). Similar trend was noted in 2016 (Figure 8), where two lowers-yielding treatments were 100 @ Feekes 5 and 25% @ Feekes 5. On the other hand, in both growing seasons, the highest yield was observed for plots that received 50% at Feekes 5. Overall, grain yields were much lower in 2017 due to harsh weather conditions during the winter months. Interestingly, in 2017, only 50% @ Feekes 5 resulted in a yield higher than the non-Si treatment, whereas in 2016, most plots receiving Si has yielded more compared to the non-Si plots.
- ✓ Although in both years 50% rate of Si applied at tillering has resulted in the best grain yields, the study's inconsistent results underline the necessity to continue research work on potential Si application in cereals
- ✓ Follow-up greenhouse study will be conducted in winter 2017.

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