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.

INRODUCTION

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 2015, at two locations at University of Idaho (UI) 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 - emergence and Feekes 5 - 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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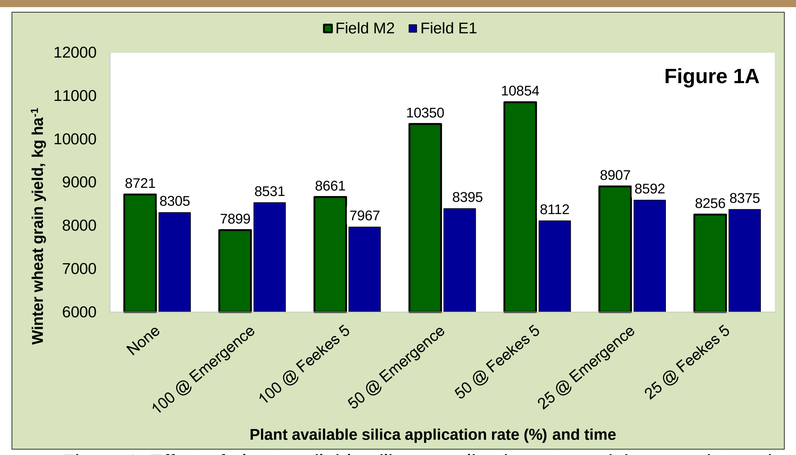
PRELIMINARY RESULTS



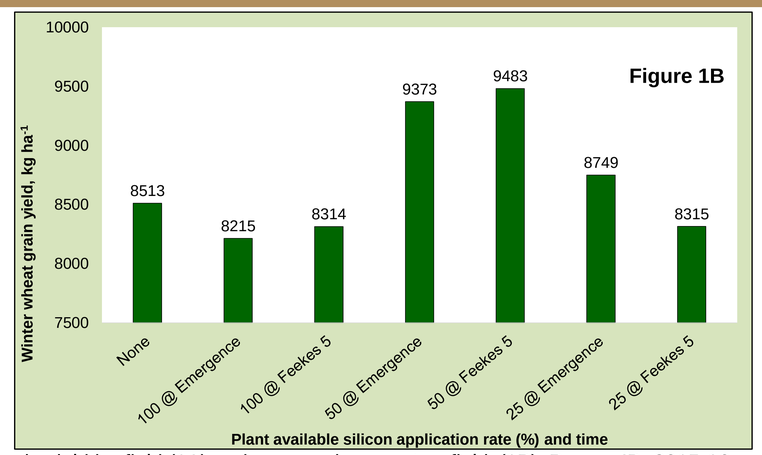
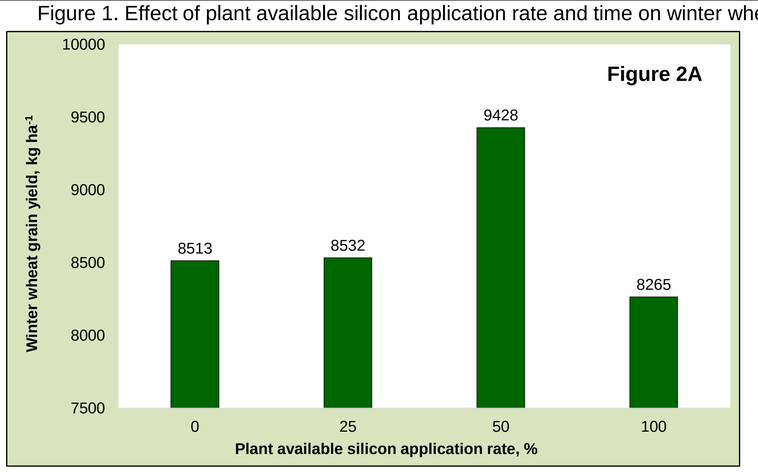


Figure 1. Effect of plant available silicon application rate and time on winter wheat grain yield by-field (1A) and averaged across two fields(1B), Parma, ID, 2015-16.



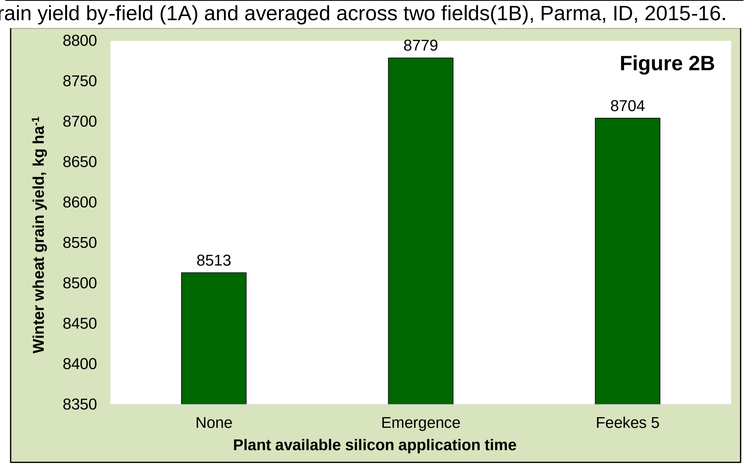


Figure 2. Effect of plant available silicon application rate (2A) and time (2B) on winter wheat grain yield, averaged for 2 fields, Parma, ID, 2015-16.

DISCUSSION

- ✓ Winter wheat visual assessment mid-season showed that silicon application at 100% rate at Feekes 5 (right) resulted in notably taller, greener, healthier looking plants compared to no silicon applied (left), Figure 3A. Plant stand from silicon applied at emergence was visually comparable to no silicon applied.
- ✓ Figure 3B shows winter wheat spikes from one randomly selected plant from no silicon applied (left) and silicon applied at 100% rate at Feekes 5 (right). 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.

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