THE IMPACT OF SI FERTILIZATION ON HEALTHY ATTRIBUTES AND YIELD OF GRAINS OF WHEAT PLANTS GROWN UNDER P DEFICIENCY

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Introduction

Phosphorus (P) deficiency is one of the major limiting factor of wheat production at worldwide (Balemi et. al. 2012). Although silicon (Si) is known to improve plant growth under low phosphorus (P) conditions (Hu et al. 2021), the impact of Si supply on nutritional quality of wheat grains at field conditions remains unclear. This study is aimed to investigate the impact of Si fertilization on healthy attributes and yield of grains of wheat plants grown under P deficiency.

Material and Methods

A field experiment on an Andisol was conducted by using two wheat cultivars with contrasting tolerance to P deficiency (cv. Púrpura, sensitive to P-deficiency; and cv. Fritz, tolerant to P-deficiency) during two growing seasons. Three P fertilization doses (0, 200, 400 mg P kg^{-1} soil) were applied in combination with three Si levels (0, 250, 500 mg Si kg^{-1} soil). At mature grain stage, Si and P concentration, total phenols, phenolics acids, radical scavenging activity and yield components were evaluated.

Results and Discussion

At both growing seasons, Si supply enhanced grain P concentration of cv. Púrpura grown in absence of P (Figure 1), whereas grain Si concentration increased in both cultivars along the gradient of P supply (Figure 2).

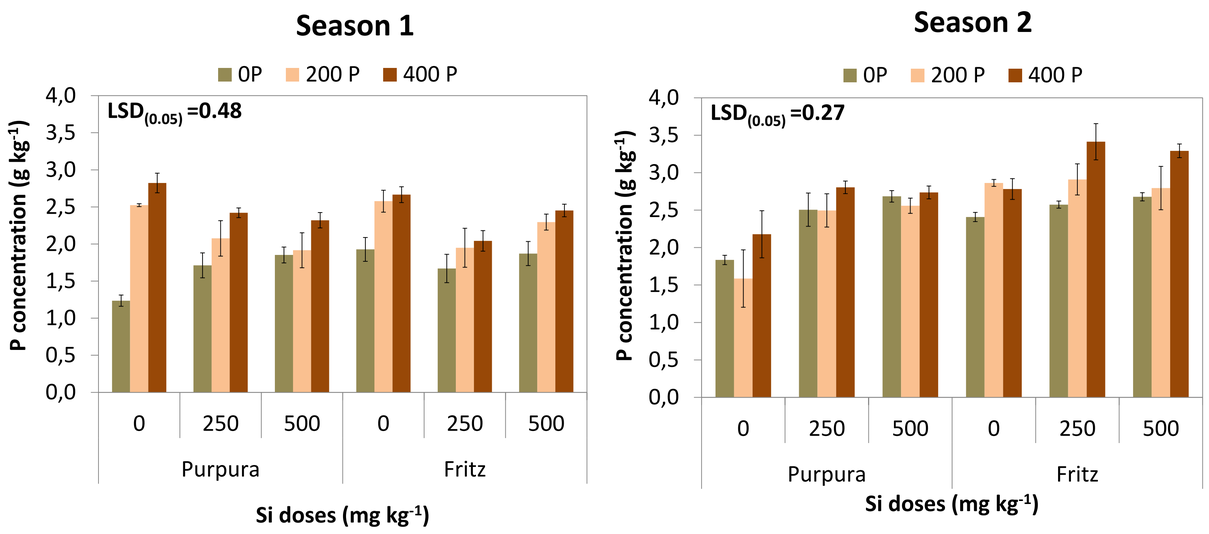


Figure 1. Phosphorus concentration in wheat cultivars Púrpura and Fritz grown with different P and Si fertilization at different growth stages (tillering, anthesis and mature grain) during two growing seasons. Data are means of three replicates ± SD.

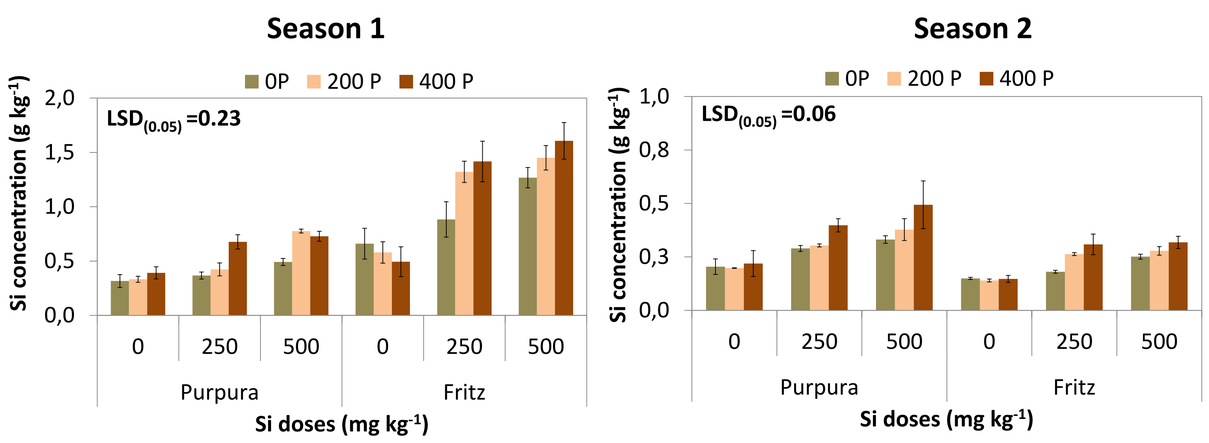
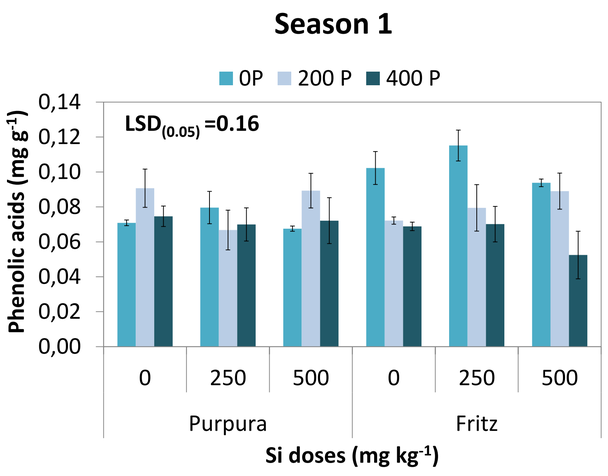


Figure 2. Silicon concentration in wheat cultivars Púrpura and Fritz grown with different P and Si fertilization at different growth stages (tillering, anthesis and mature grain) during two growing seasons. Data are means of three replicates ± SD.



A slight increment of phenolic acids induced by 250 mg kg^{-1} Si was also detected in grains of both wheat cultivars grown without P.

Figure 3. Phenolic acids concentration of in grains of wheat cultivars grown with different P and Si fertilization. Data are means of three replicates ± SD.

Conclusion

Silicon supply improved P concentration in wheat cv. Fritz and cv. Purpura. In addition, Si application stimulated total phenols production, phenolic acid and oxidative capacity of grains in both wheat cultivars grown without P. Silicon fertilization could be used as a strategy to improve crop production in soils with low P availability.

Interestingly, increasing Si doses augmented phenol concentration (Figure 4) and antioxidant capacity (Figure 5) in grains of cv. Púrpura grown without P at both growing seasons. In contrast, Si decreased grain phenol concentration of cv. Fritz under P deficiency (Figure 4).

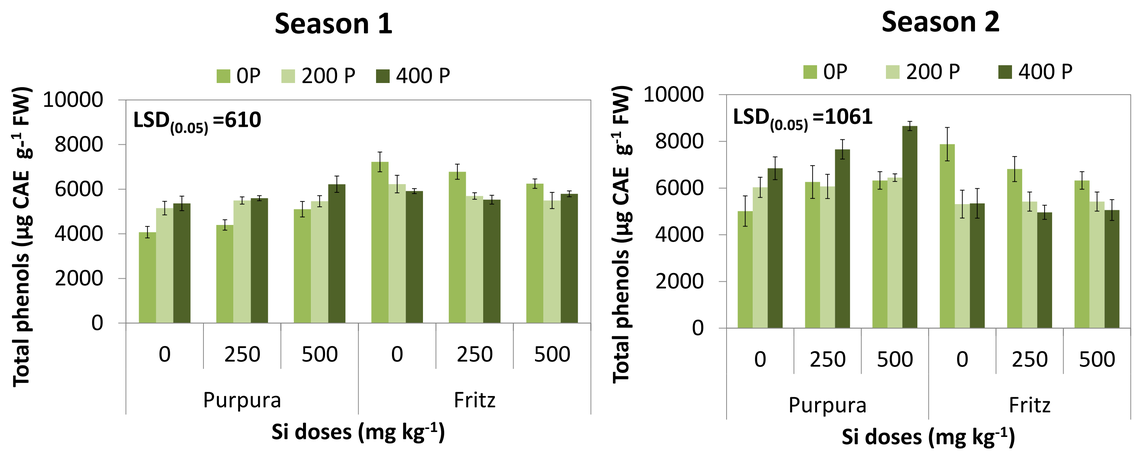


Figure 4. The impact of the different Si and P fertilization doses on grain yield of barley cultivars at mature grain state during two growing seasons. Data are means of three replicates ± SD.

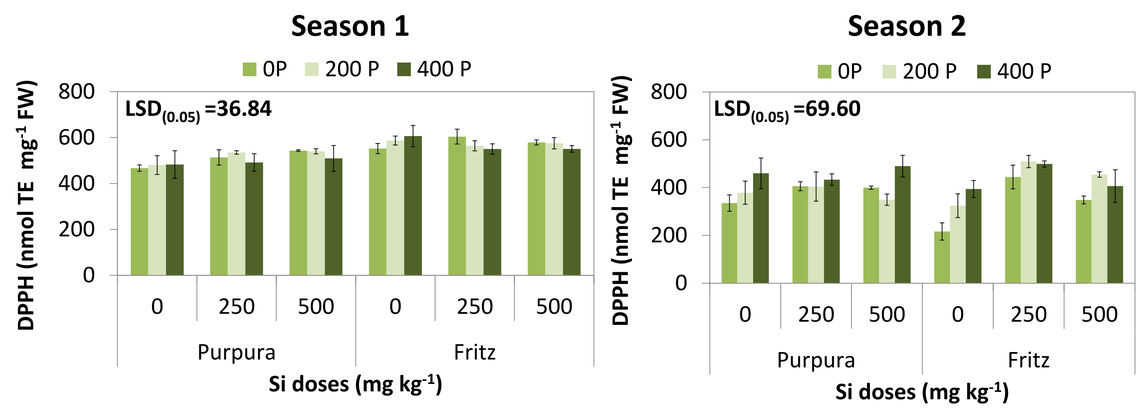


Figure 5 . The impact of the different Si and P fertilization doses on grain yield of barley cultivars at mature grain state during two growing seasons. Data are means of three replicates ± SD.

A positive effect of Si fertilization on grain yield of both wheat cultivars grown either without or with P fertilization at both growing seasons was also found (Figure 6).

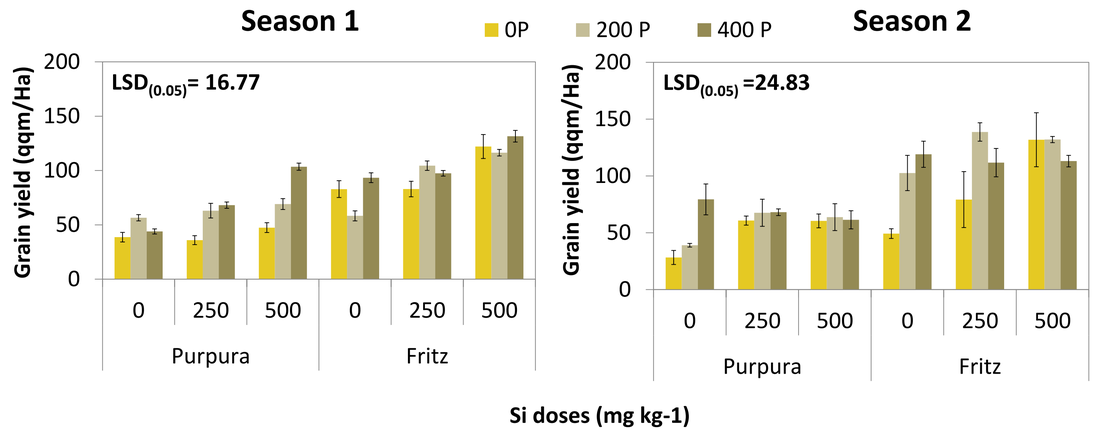


Figure 6. The impact of the different Si and P fertilization doses on grain yield of barley cultivars at mature grain state during two growing seasons. Data are means of three replicates ± SD.

References

Balemi, T., Negisho, K. (2012). Management of soil phosphorus and plant adaptation mechanisms to phosphorus stress for sustainable crop production: a review. J. Soil Sci. Plant Nutr. 12, 547-562.

Hu, AY., Xu, SN., Qin, DN., Li, W., Zhao, XQ. (2021). Role of Silicon in Mediating Phosphorus Imbalance in Plants. Plants, 10, 51.

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