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Changes in main nutrient concentrations of wheat (*Triticum aestivum* L.) and sorghum (*Sorghum bicolor* (L.) Moench) as affected by different fertilizer sources

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Abstract

Sorghum and wheat often find themselves in the spotlight, both grains have gained popularity in recent years due to their versatility and nutritional benefits. To evaluate the effect of Biological fertilizer and Chemical fertilizer on the growth of Wheat and Sorghum, a factorial experiment was conducted based on Randomized Complete Block Design (RCBD) with three replications at Urmia University (37.53 N and 45.08 E, altitude 1320 m, West Azarbayjan Province, Urmia, Iran) in 2021. Treatments were Wheat and Sorghum and Biological fertilizer included the mycorrhizal inocula, nitrogen (Azeto Barvar. 1), phosphorus (Phosphate Barvar2) and potassium (Barvar 2 Biofertilizer) and The chemical fertilizers were NPK (nitrogen, phosphorus, potassium). The highest leaf phosphorus percentage (0.203 %) observed in biological fertilizer treatment in sorghum, while the leaves of sorghum that were used biological fertilizer had low amount of potassium (0.51 %). The wheat crop had the lowest protein for biological (5.45 %) and chemical (5.85 %) fertilizers. In sorghum, the highest protein (9.48 %) belonged to the chemical fertilizer. Leaf protein and phosphorus in sorghum were more than wheat. The leaf potassium was the higher by biological fertilizer, but it was greater in wheat by chemical fertilizer.

Introduction

Wheat (*Triticum aestivum* L.; Poaceae family), is the second main grain crops in the world. It is the important staple food of the world which meets most of the protein requirement of the people. Sorghum (*Sorghum bicolor* (L.) Moench.), is a cereal crop ranked the world's fifth most important cereal grain after wheat, maize, rice and barley (Safdar *et al.,* 2023). The biological fertilizers cause to the rise in plant growth, photosynthetic activity, uptake of essential minerals such as P and N (Kaur *et al.,* 2023). Arbuscular Mycorrhizal (AM) symbiosis is integral to sustainable agriculture and enhances plant resilience to abiotic and biotic stressors (Ahmed *et al.,* 2025). The objective of this study was to evaluate the effect of fertilizers on the leaf phosphorus, potassium, and protein percentages of Wheat and Sorghum.

Materials and methods

To evaluate the effect of Biological fertilizer and Chemical fertilizer on the growth of Wheat and Sorghum, a factorial experiment was conducted based on Randomized Complete Block Design (RCBD) with three replications at Urmia University (37.53 N and 45.08 E, altitude 1320 m, West Azarbayjan Province, Urmia, Iran) in 2021. Treatments were Wheat and Sorghum and Biological fertilizer included the mycorrhizal inocula, nitrogen (Azeto Barvar. 1), phosphorus (Phosphate Barvar2) and potassium (Barvar 2 Biofertilizer) and the chemical fertilizers were NPK (nitrogen, phosphorus, potassium). The 5 plants of per plot were harvested and their leaves were dried to determine leaf phosphorus, potassium, and protein percentages. Analysis of variance (ANOVA) on data was performed using the general linear model (GLM) procedure in the SAS 9.1 software. The Duncan's Multiple Range Test was applied to compare treatment means.

Results and discussion

Table 1. Analysis of variance (mean of squares) of the effect of fertilizer and type of crop (Wheat and Sorghum) on the leaf phosphorus, leaf potassium and leaf protein.

Source of variation	df	Leaf Phosphorus	Leaf Potassium	Leaf Protein
Block	2	0.00022^{ns}	0.006603^{ns}	0.248242^{ns}
Crop	1	0.01613^{**}	0.001680^{ns}	36.921700^{**}
Fertilizer	1	0.002883^{**}	0.013068^{ns}	0.802384^{**}
Crop×Fertilizer	1	0.000972^{*}	0.555560^{**}	0.040716^{ns}
Error	6	0.000115	0.003328	0.056975
Coefficient of Variation (%)		7.5	8.4387	3.2222

ns: not significant, * and **: significant at 5% and 1% probability level.

Table 2. Means comparison of leaf phosphorus, leaf potassium and leaf protein in Wheat and Sorghum treated by biological and chemical fertilizers.

Crop	Leaf Phosphorus%	Leaf Potassium%	Leaf Protein%
Wheat	0.105500^{b}	0.67183^{a}	5.6537^{b}
Sorghum	0.178833^{a}	0.69550^{a}	9.1618^{a}
Fertilizer	**Leaf Phosphorus%**	**Leaf Potassium%**	**Leaf Protein%**
Biological fertilizer	0.157667^{a}	0.71667^{a}	7.1492^{b}
Chemical fertilizer	0.126667^{b}	0.65067^{a}	7.6663^{a}

The dissimilar letters in each column show significant differences at $P \leq 0.05$.

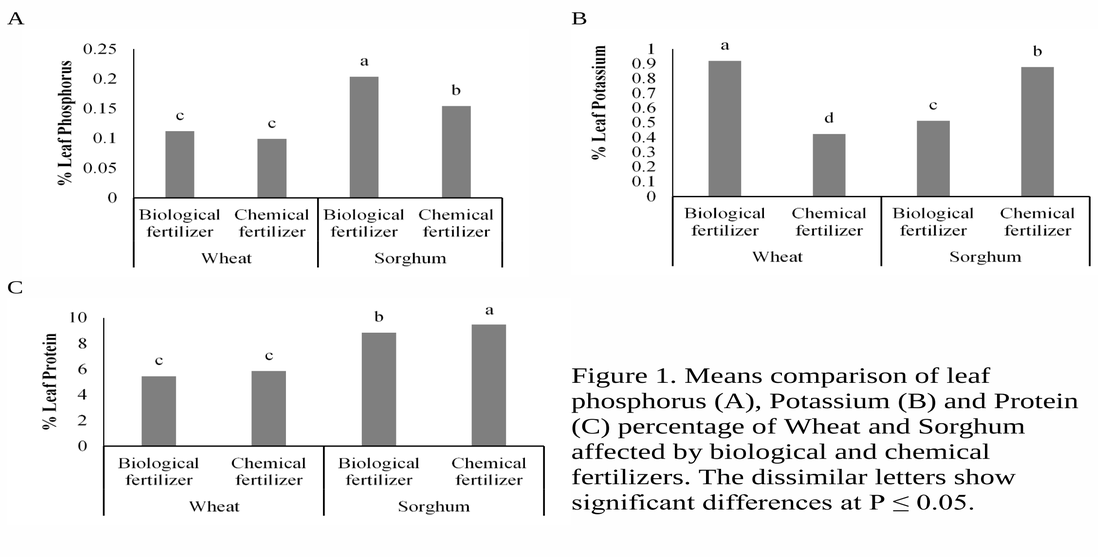

Figure 1. Means comparison of leaf phosphorus (A), Potassium (B) and Protein (C) percentage of Wheat and Sorghum affected by biological and chemical fertilizers. The dissimilar letters show significant differences at $P \leq 0.05$.

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