

Original Research Article

Discover the impact of sulfur and potassium on the nitrogen, phosphorus, sulfur, and potassium concentrations in onion bulbs

Abstract

A scientific research has been conducted using a RCBD technique with three replications, are focusing on two factors affecting onion growth. The purpose was to assess the impact of different sulfur levels $S_1 = 5$, $S_2=15$, $S_3=25$, and $S_4=35$ kg ha^{-1} and potassium levels $K_1=100$, $K_2=120$, $K_3=140$, and $K_4=160$ kg /ha on the nutrient content of N, P, K, and S in onion bulbs was done in Sher-e-Bangla Agricultural University in Dhaka, Bangladesh. The time duration is October 2020 to June 2021. Based on the observations, it has been found that the bulb showed the highest level of nitrogen when treated with sulfur (5 kg/ha) and potassium (100 kg/ha respectively). In contrast, the lowest nitrogen level has been observed when the bulb was treated with sulfur and potassium (35 & 140 kg/ha respectively). Furthermore, the bulb exhibited the highest concentrations of phosphorus (P), potassium (K), and sulfur (S) at a potassium 140 kg/ha and a sulfur 35 kg/ha . Conversely, the lowest values for these parameters were observed when the bulb was treated with the lowest amount of sulfur and potassium.

Key word: Onion, Nitrogen, Phosphorus, Potassium, Sulfur

Introduction

Onion (*Allium cepa* L.) is the kitchen queen among the spices. It has using versatility. It can be used raw or cooked. It is the main spice for many curries, pilaf, and biryani. It not only increases the taste of food, but also has lots of medicinal and nutritional values like iron, calcium, protein, vitamins, antioxidants, and the and the anti-cancer element quercetin [1,2]. For the above

reasons, it is on the farmers list from 5000 years ago. In FAO's list, it has a dominating place [3] According to FAOSTAT, 5.96 million acres were used to cultivate it [4]. The production was 185.365 kg/ha. Like other crops and species, for growing well, onions need different types of nutrients. Among the nutrients, potassium and sulfur are important. For many physiological activities, like photosynthesis, respiration, ion absorption and transferring, and protein synthesis, which are related to the growth, development, and yield, potassium and sulfur have a positive impact [5,3].

The main goal of this paper is to learn about the influences of sulfur and potassium on nitrogen, phosphorus, sulfur and potassium concentrations in onion bulb.

Materials and method

The experiment has two parts, field research and lab research. The SAU campus has been utilized for conducting research in natural settings, while the Agricultural Chemistry lab of SAU has been utilized for conducting research in controlled laboratory environments. The time duration is October 2020 to June 2021.

Plant Materials

BARI Piaz-6 is a onion variety, has been used as experimental planting material.

Treatments

The experiment has been set in RCBD technique, having two factors with three replications.

List 1 : The two factors are given below

A: Sulfur kg ha ⁻¹	B: Potassium kg ha ⁻¹
1. S ₁ = 5	K ₁ = 100
2. S ₂ = 15	K ₂ = 120
3. S ₃ = 25	K ₃ = 140
4. S ₄ = 35	K ₄ = 160

Total 16 treatment combination

Agricultural Practice

Agricultural practice has done following the common practicing rules for onion production. No special steps have done here.

Data collection

Extensive data has been meticulously collected to analyze the concentration levels of essential nutrients such as nitrogen (N), phosphorus (P), potassium (K), and sulfur (S) present in onion bulbs.

Statistical Analysis

For statistical analysis, the Microcomputer Statistical Package - C (MSTAT-C) has been used.

Result and Discussion

From the graph 1, Increasing Sulfur decreases the N content in the onion bulb. Unlike Nitrogen, P, K, and S have increased with the increase of sulfur (Graph 3,5,7). The highest content of Nitrogen (2.51%) has been found, when the sulfur has 5 kg /ha , meanwhile P (0.14%) , K (2.69%) and S (0.16%) have been found at 35 kg S/ha. The nitrogen content decreases as sulfur increases, while the levels of phosphorus, potassium, and sulfur increase with higher sulfur levels. At 35 kg of sulfur per hectare, nitrogen content(2.30%) is the lowest, and at 5 kg of sulfur per hectare, phosphorus(0.11%), potassium(2.50), and sulfur(0.11) are at their lowest levels (Graph 1,2,3,4).

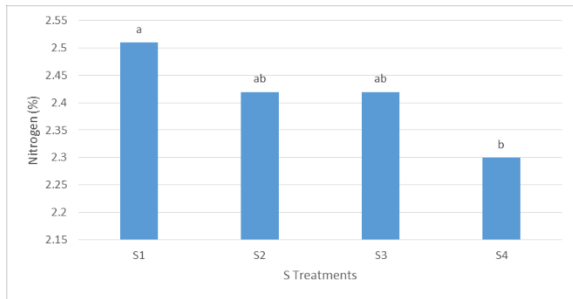


Fig 1 : Bar graph of Nitrogen % against S treatments

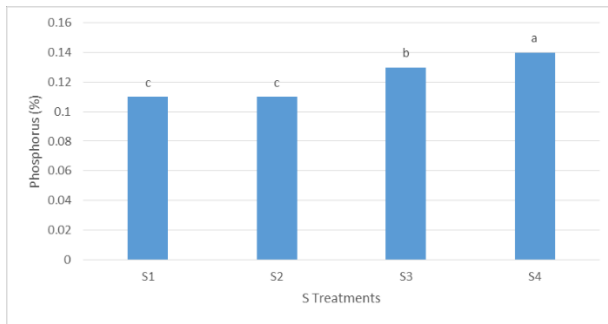


Fig 2 : Bar graph of Phosphorus % against S treatments

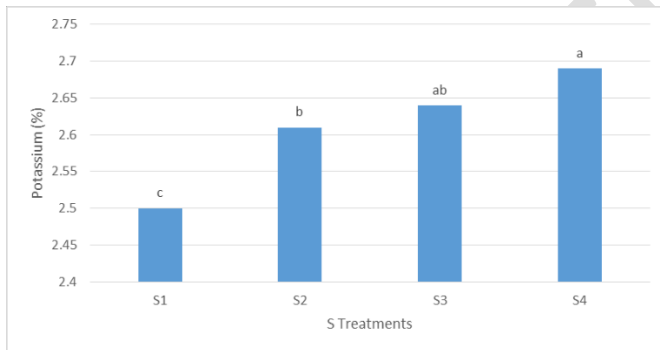


Fig 3: Bar graph of Potassium % against S treatments

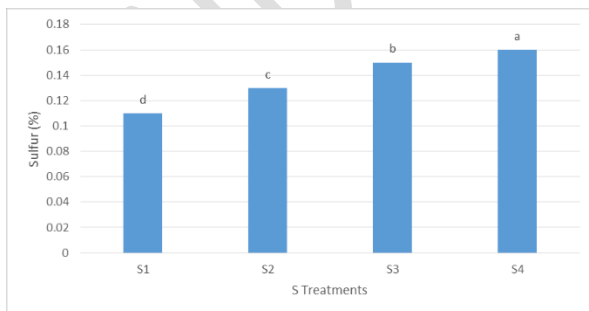


Fig 4: Bar graph of Sulfur % against S treatments

From the graph 5, Increasing Potassium decreases the N content in the onion bulb. With some fluctuation Phosphorus, Potassium, and Sulfur have increased with the increase of Potassium (Figure 6, 7, 8). The highest content of N (approx. 2.51%) has been found at a 100 kg K/ha dose, whereas P (0.15%) , K (3.30%) and S (0.15%) have been found at 140 kg k/ha. The nitrogen content decreases as potassium increases, while the levels of phosphorus, potassium, and sulfur increase with a certain higher levels of potassium. At 160 kg of potassium per hectare, nitrogen content(2.10%) is the lowest, and at 100 kg of potassium per hectare, phosphorus(0.10%), potassium(1.20), and sulfur(0.11) are at their lowest levels (Graph 1,2,3,4).

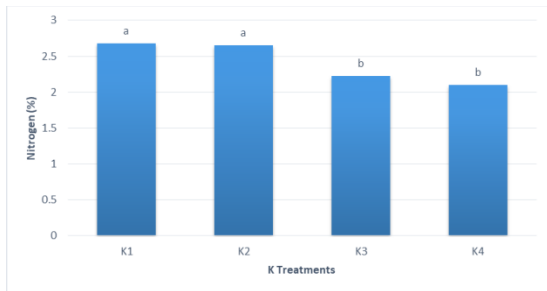


Fig 5 : Bar graph of Nitrogen % against K treatments

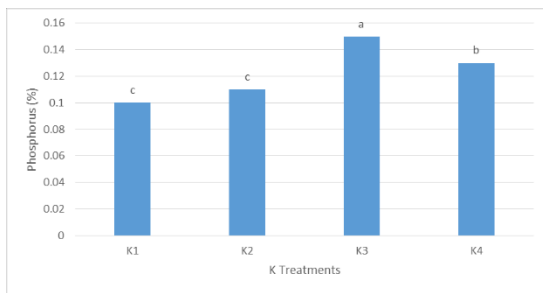


Fig 6: Bar graph of Phosphorus % against K treatments

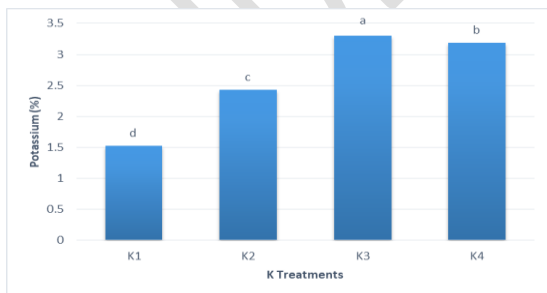


Fig 7: Bar graph of Potassium % against K treatments

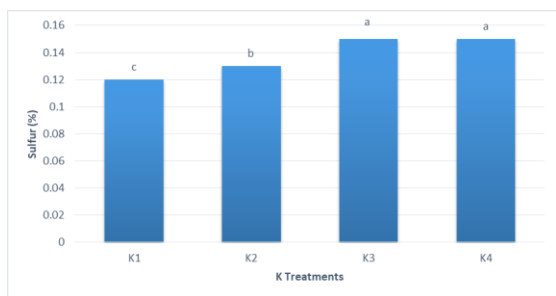


Fig 8 : Bar graph of Sulfur % against K treatments

In several studies, it has been observed that the degree of three elements - phosphorus, potassium, and sulfur - increase as the degree of sulfur and potassium raise, with the exception of nitrogen. Conversely, when sulfur and potassium levels decrease, so do the levels of these three nutrients, except for nitrogen. For instance, EL-Desuki, M., et al., Nagaich, K.N, et al., and Singh, S.P *et al* found that higher application doses of potassium and sulfur led to increased lifting of Phosphorus, Potassium, and Sulfur in onion bulbs compared to lesser doses [7,8,9]. The study by Singh, H., et al indicated that nitrogen, sulfur, and phosphorus content, as well as their uptake, were significantly affected by variations in sulfur levels [10]. Furthermore, Pradhan, M et al. noted that the type of sulfur - be it gypsum or elemental sulfur - did not impact the uptake of nitrogen, phosphorus, potassium, and sulfur [11]. Notably, nitrogen showed a negative correlation with sulfur and potassium in this experiment, but in a separate experiment, Verma and Harendra found that sulfur and potassium increased nitrogen levels along with the levels of P, K, and S [12]. Behairy, Awatef G., et al. echoed similar findings [13]. Additionally, the inclusion of these four nutrients led to changes in TSS (total soluble solids) and carbohydrate content.

Conclusion

The findings indicate that increasing levels of sulfur and potassium in onion cultivation lead to a decrease in nitrogen content, while simultaneously enhancing the levels of phosphorus, potassium, and sulfur. This relationship underscores the complex interplay between these nutrients, suggesting that optimal nutrient management is crucial for maximizing onion bulb quality.

Disclaimer

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

References

- 1.AL-Mohammad, M.H. and AL-Taey, D.K.A. (2019). Effect of tyrosine and sulfur on growth, yield and antioxidant compounds in arugula leaves and seeds. *Res. Crops.* 20(1): 116-120.
- 2.Ahmed, M.G., Azza, A.A. and Elghamy, H.E. (2013). Chemical nutritional and biochemical studies of Onion protein isolate. *J. Nat. Sci.* 11(2): 8- 13.
- 3.Mishu, M.H., Ahmed, F., Rafii, M.Y., Golam, F. and Latif MA. (2013). Effect of sulphur on growth, yield and yield attributes in onion (*Allium cepa* L.). *Australian J. Crop Sci.* 7(9):1416-1422.
- 4.FAOSTAT. 2022. <http://www.fao.org/faostat/en/#data/QC>
- 5.Bairwa, R.K., Narolia, R.K., Bhunia, S.R., Yadav, P.K., Sharma, A.K. and Dotaniya, C.K. (2020). Effect of Nitrogen, Potassium and Sulphur Fertilization on Nutrient.
- 7.EL-Desuki, M., Abdel-Mouty, M.M. and Ali, A.H. (2021). Response of onion plants to additional dose of potassium application. *J. Appl. Sci. Res.* 2(9): 592-597.
- 8.Nagaich, K.N., Trivedi, S.K., Rajesh-Lekhi and Lekhi, R. (1999). Effect of sulphur and potassium fertilization in onion (*Allium cepa* L.). *Hortic. J.*,12: 25-31.
- 9.Sing, S.P. and Verma, A.B. (2001). Response of onion (*Allium cepa* L.) to potassium application. *Indian J. of Agron.*, 46: 182-185.
- 10.Singh, H. and Singh, G. (2005). Effect of phosphorus and sulphur on yield, content and uptake of nutrient by garlic. *Ann. Agric. Res.* 26(1): 48-50.
- 11.Pradhan, M., Pattnaik, A. K., Tripathy, P., Mallikarjunarao, A. K., Sahoo, B. B. and Lenka, J. (2015). Influence of sulphur fertilization on nutrient uptake of onion. *J. Crop Weed.* 11: 134-138.
- 12.Verma, D. H. A. R. M. E. S. H., and H. A. R. E. N. D. R. A. Singh. (2012) "Response of varying levels of potassium and sulphur on yield and uptake of nutrients by onion." *Annals of Plant and Soil Research* 14.2: 143-146.

13. Behairy, Awatef G., et al. (2015) "Growth, yield and bulb quality of onion plants (*Allium cepa* L.) as affected by foliar and soil application of potassium." *Middle East Journal of Agriculture Research* 4.1: 60-66.

UNDER PEER REVIEW