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Effect of Boron, Zinc and Iron on Economics of *Kharif* Onion (*Allium cepa* L.)

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Abstract

The experiment was carried out during July–September, 2016 at Tirhut College of Agriculture, Dholi kothi farm, Dholi (Muzaffarpur), a campus of Dr. Rajendra Prasad Central Agricultural University, Pusa (Samastipur), Bihar (848 125), India to study the effect of micronutrient application on economics of onion (*Allium cepa* L.). Onion is one of the most important bulb crops globally and a major commercial crop cultivated across the country, valued both as a spice and a vegetable. Micronutrients play a vital role in fertilization programs aimed at achieving higher and more sustainable bulb yields. Therefore, the present experiment was conducted to study the effect of zinc, iron, and boron on the economics of onion. The experiment was laid out in RBD with ten treatments with three replications. The treatments includes T_1 (NPKS), T_2 (NPKS+soil application of $ZnSO_4$ @ 25 ha^{-1}), T_3 (NPKS+soil application of $ZnSO_4$ @ 50 kg ha^{-1}), T_4 (NPKS+foliar application of ZnSO4 @ 0.5% at 30 and 45 DAT), T_5 (NPKS+soil application of Borax @ 10 kg ha^{-1}), T_6 (NPKS+soil application of Borax @ 15 kg ha^{-1}), T_7 (NPKS+foliar application of Borax @ 0.25% at 30 and 45 DAT), T_8 (NPKS+soil application of $FeSO_4$ @ 25 kg ha^{-1}), T_9 (NPKS+soil application of $FeSO_4$ @ 50 kg ha^{-1}), T_{10} (NPKS+foliar application of $FeSO_4$ @ 1% at 30 and 45 DAT) replicated thrice in a RBD. The highest gross return (₹ 3,93,776 ha^{-1}) and net income (₹ 3,06,524.05 ha^{-1}) was calculated in treatment T_3 (NPKS+soil application of $ZnSO_4$ @ 50 kg ha^{-1}) and B:C ratio (3.53) was calculated in treatment T_2 (NPKS+soil application of $ZnSO_4$ @ 25 kg ha^{-1}).

Keywords: Borax, economics, iron, NPKS, onion, zinc

1. Introduction

Vegetables, encompassing both annual and perennial varieties, include a range of edible components such as roots, stalks, flowers, fruits, and leaves, which can be enjoyed either raw or cooked, in whole or in part. They are essential for human nutrition, offering bioactive nutrients like dietary fibre, vitamins, minerals, and non-nutritive phytochemicals, including phenolic compounds, flavonoids, and bioactive peptides. These nutrients collectively contribute to reducing the risk of chronic diseases, including cardiovascular conditions, diabetes, certain cancers, and obesity. A high intake of vegetables in diets significantly enhances health benefits due to their abundant fibre, vitamins, minerals, flavonoids, phytoestrogens, sulfur compounds, and bioactive peptides (Mandal et al., 2018).

Botanically referred to as *Allium cepa* (L.), onions belong to the Amaryllidaceae family, which includes close relatives such as garlic, scallions, leeks, and chives (Khatemenla et al., 2017; Anonymous, 2010). They are rich in sulfur-containing compounds that contribute to their distinctive pungent aroma. The onion bulb is an excellent source of minerals, particularly phosphorus and calcium, and also provides protein and vitamin C. Additionally, onions contain quercetin, a flavonoid that aids in neutralizing free radicals in the body, inhibits the oxidation of low-density lipoprotein protects and regenerates vitamin E, and mitigates the harmful effects of chelating metal ions. Domestication of onion is believed to have occurred in West or Central Asia, with various claims linking it to regions such as Iran and Western Pakistan (Durgude et al., 2013; Cumo, 2015). Onion ranks as the fourth most significant vegetable crop in terms of economic value on a global scale (Torquato-Tavares et al., 2017). However, despite this impressive output, the nation encounters obstacles in enhancing onion productivity, as evidenced by a yield of 16.32 t ha^{-1}, which falls short of the global average of 18.53 t ha^{-1}. Today, onions are utilized in numerous forms, including fresh, frozen, canned, caramelized, pickled, and powdered. One of the primary factors contributing to low productivity in onion cultivation is unbalanced nutrition. The excessive and unregulated application of fertilizers poses a threat not only to agricultural sustainability but also to environmental health (Jaiswal et al., 2022). A significant challenge facing contemporary geochemistry is the insufficient availability of micronutrient forms in the soil for wheat and other cereal crops, which affects crop yields (Erenstein et al., 2022). The application of micronutrient fertilizers can lead to significant improvements in yield characteristics and protein content, enhancing nutrient availability and influencing the physiological aspects of crops, as evidenced by increased yields. A prolonged dependence on NPK fertilizers has led to soil degradation and nutritional imbalances (Shukla et al., 2015; Fakharzadeh et al., 2020; Gureev, 2021). When micronutrient fertilizers are applied in a balanced manner alongside macronutrients, they can enhance crop yields and optimize the effectiveness of NPK. A deficiency in any single essential micronutrient (such as B, Cu, Fe, Mn, Mo, Ni, Zn, or Cl) can hinder plant growth and development, resulting in a notable decrease in crop yields. Furthermore, micronutrient deficiency in food is a leading cause of mortality worldwide, contributing to diet-related health issues that can be mitigated through sustainable nutrient supply and efforts to combat malnutrition (Sidhu et al., 2020 Venkatesh et al., 2021; Erenstein et al., 2022). Enhanced agricultural techniques that focus on nutritional balance and optimal crop geometry can lead to increased productivity and improved bulb quality. Evidence suggests that the application of NPK, sulfur and other micronutrients contributes to achieving higher yields of superior quality bulbs; however, an unbalanced application of these nutrients can have detrimental effects (Bhardwaj and Parashar, 2023; Dogra et al., 2019).

2. Materials and Methods

The experiment was carried out during (*kharif*) July to October month of 2016–2017 at Tirhut College of Agriculture Dholi kothi farm, Dholi (Muzaffarpur), a campus of Dr. Rajendra Prasad Central Agricultural University, Pusa (Samastipur), Bihar (848125), India. Its geographical location is 25.98° N and 85.60° E at an altitude of 52.18 m above msl. The experiment was laid out in a RBD (Randomized Block Design) with ten treatments and three replications. The crop was planted in a plot (size 3×2 m^2) at a spacing of 15×10 cm^2. Before fertilizer application, random soil samples were taken from the experimental field and were analysed.

The experimental field soil was sandy loam with alkaline pH 8.40, low in soil organic carbon (0.46%), electrical conductivity (0.36 ds m^{-1}), available nitrogen (226 kg ha^{-1}), available phosphorus (16.0.9 kg ha^{-1}), potash (115.60 kg ha^{-1}), available boron (0.26 ppm) and zinc (0.84 ppm) and iron (9.06 ppm). The soil was deficient in available boron. Hence, the soil application and foliar application of micronutrient at 30 and 45 DAT as zinc sulphate for zinc, borax for boron and ferrous sulphate for iron was used as experimental material.

The treatments includes T_1 (NPKS), T_2 (NPKS+soil application of $ZnSO_4$ @ 25 kg ha^{-1}), T_3 (NPKS+soil application of $ZnSO_4$ @ 50 kg ha^{-1}), T_4 (NPKS+foliar application of $ZnSO_4$ @0.5% at 30 and 45 DAT), T_5 (NPKS+soil application of Borax @ 10 kg ha^{-1}), T_6 (NPKS+soil application of Borax @ 15 kg ha^{-1}), T_7 (NPKS+foliar application of Borax @ 0.25% at 30 and 45 DAT), T_8 (NPKS+soil application of $FeSO_4$ @ 25 kg ha^{-1}), T_9 (NPKS+soilapplication of $FeSO_4$ @ 50 kg ha^{-1}), T_{10} (NPKS+foliar application of $FeSO_4$ @ 1% at 30 and 45 DAT) replicated thrice in a RBD. The crop was grown as per recommended package of practices. The crop was harvested on the physiological maturity. The following economics were worked out based on the prevailing prices of output and cost of various inputs used during the period of experimentation as per usual method.

a. Cost of cultivation (₹ ha^{-1})

b. Gross return (₹ ha^{-1})

c. Net income (₹ ha^{-1})

d. Benefit: Cost ratio

The cost of cultivation was worked out by taking into consideration all the expenses incurred. Gross return was worked out by multiplying ha^{-1} bulb yield obtained under various treatments with the prevailing market selling rate i.e. Rs. 1600 q^{-1}. Net return was calculated by deducting the cost of cultivation from the gross return of the individual treatment. Benefit cost ratio was calculated by dividing net income by the Cost of cultivation of individual treatment.

Benefit cost ratio=(Net return (₹ ha^{-1})/Cost of cultivation (₹ ha^{-1})

3. Results and Discussion

The cost of cultivation of onion varied from ₹ 81,751.95 to ₹ 87,751.95 ha^{-1} shows in table 1, 2 and 3, gross return ₹ 2,74,656 to ₹ 3,93,776 ha^{-1} and net profit from ₹ 2,98,602.05

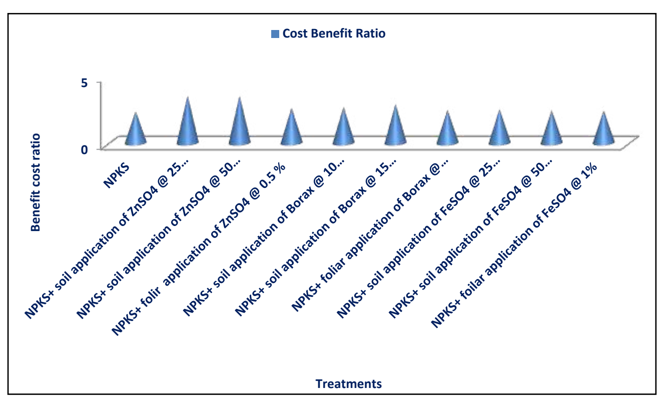

Figure 1: B:C Ratio of different Treatment in onion

Table 1: Economics of Onion crop

Treatment	Yield (q ha^{-1})	Gross return (₹ ha^{-1})	Common cost of cultivation (₹ ha^{-1})	Variable cost of cultivation (₹ ha^{-1})	Total cost of cultivation (₹ ha^{-1})	Net income (₹ ha^{-1})	Benefit cost ratio
T_1	171.66	2,74,656	81,751.95	-	81,751.95	1,92,904.05	2.36:1
T_2	239.44	3,83,104	81,751.95	2750	84,501.95	2,98,602.05	3.53:1
T_3	246.11	3,93,776	81,751.95	5500	87,251.95	3,06,524.05	3.51:1
T_4	188.33	3,01,328	81,751.95	1682	83,433.95	2,17,894.05	2.61:1
T_5	189.44	3,03,104	81,751.95	600	82,351.95	2,20,752.05	2.68:1
T_6	201.11	3,21,776	81,751.95	900	82,651.95	2,39,124.05	2.89:1
T_7	179.99	2,87,984	81,751.95	1362	83,113.95	2,04,124.05	2.46:1
T_8	186.11	2,97,776	81,751.95	3000	84,751.95	2,13,024.05	2.51:1
T_9	188.33	3,01,328	81,751.95	6000	87,751.95	2,13,576.05	2.43:1
T_{10}	178.33	2,85,328	81,751.95	1482	83,233.95	2,02,094.05	2.42:1
SEm±	1.54						
CD (p=0.05)	4.60						

Table 2: Common cost of cultivation of *kharif* onion (₹ ha^{-1})

Sl. No.	Particulars	Quantity	Rate	Total amount
1.	Cost of seed	8 kg ha^{-1}	900 kg^{-1}	7200/-
2.	Nursery bed preparation	10 labour	207 day^{-1} labour^{-1}	2070/-
3.	Plant protection and spraying	-	-	240/-
4.	Manures and fertilizers	-	-	720/-
5.	Application cost	5 labour	207 day^{-1} labour^{-1}	1,035/-
6.	Ploughing and planking	3 cross	1100 cross^{-1}	3300/-
7.	Plotting and bunding	10 labour	207 day^{-1} labour^{-1}	2070/-
8.	Uprooting seedlings and transplanting	30 labour	207day^{-1} labour^{-1}	6,210/-
9.	Fertilizer and manures	-	-	22,022/-
10.	Application cost	5 labour	207 day^{-1} labour^{-1}	1.035/-
11.	Three interculture @ 15 labour	45 labour	207 day^{-1} labour^{-1}	9,315/-
12.	Irrigation	5 irrigation	600 ha^{-1}	3000/-
13.	4 labour for each irrigation	20 labour	207 day^{-1} labour^{-1}	4,140/-
14.	Dimethoate (30 EC)	800 ml	320 liter^{-1}	256/-
15.	Application of Dimethoate cost	12 labour	207 day^{-1} labour^{-1}	2484/-
16.	Uprooting of bulbs, cutting of necks	25 labour	207 day^{-1} labour^{-1}	5,175/-
17.	Curing and transportation	15 labour	207 day^{-1} labour^{-1}	3,105/-
18.	Land rent	6 months	1000 year^{-1}	500/-
19.	Supervisory cost	4 months	1000 month^{-1}	4000/-
	Sub total			77,859/-
20.	Interest on working capital @ 10%	6 months		38,92.95/-
			Total	81,751.95/-

Table 3: Variable cost of cultivation of Kharif onion (₹ ha^{-1})

Sl. No.	Particulars	Quantity	Rate	Total amount (₹)
1.	NPKS	-	-	1,88,802
2.	Soil application of $ZnSO_4$	25 kg ha^{-1}	₹ 110 kg^{-1}	2750/
3.	Soil application of $ZnSO_4$	50 kg ha^{-1}	₹ 110 kg^{-1}	5550/
4.	Foliar application of $ZnSO_4$	4 kg ha^{-1}	₹ 110 kg^{-1}	1682/
5.	Soil application of Borax	10 kg ha^{-1}	₹ 60 kg^{-1}	600/
6.	Soil application of Borax	15 kg ha^{-1}	₹ 60 kg^{-1}	900/
7.	Foliar application of Borax	2 kg ha^{-1}	₹ 60 kg^{-1}	1362/
8.	Soil application of $FeSO_4$	25 kg ha^{-1}	₹ 120 kg^{-1}	3000/
9.	Soil application of $FeSO_4$	50 kg ha^{-1}	₹ 120 kg^{-1}	6000/
10.	Foliar application of $FeSO_4$	8 kg ha^{-1}	₹ 120 kg^{-1}	1482/

to ₹ 3,06,524.05 ha^{-1}. The highest gross return (₹ 3,93,776 ha^{-1}) and net income (₹ 3,06,524.05 ha^{-1}) was accrued with the treatment NPKS+Soil application of $ZnSo_4$ @ 50 kg ha^{-1} (T_3), which was followed by $ZnSO_4$ @ 25 kg ha^{-1}. The maximum net profit $rupee^{-1}$ investment and B:C ratio was turned out to be 3.53:1 with NPKS+soil application of $ZnSO_4$@ 25 kg ha^{-1} which was followed by treatment NPKS+soil application of $ZnSO_4$ @ 50 kg ha^{-1} (T_3) 3.51:1 shows table 1 and Figure 1. Thus, on the basis of results obtained and in the light of facts discussed in the foregoing pages related to yield and quality parameter, it may be inferred that the NPKS+soil application of $ZnSO_4$ @ 50 kg ha^{-1} produced better keeping and other quality and the maximum yield of 246.11 q ha^{-1} and fetched net profit of ₹ 3,06,524.05 ha^{-1} which may be considered as best treatment for commercial onion production with benefit-cost ratio of 3.51:1. The lowest gross returns (₹ 2,74,656 ha^{-1}), net income (₹ 1,92,904.05 ha^{-1}) and B:C ratio (2.36) of onion were recorded in (T_1) control shows in table 1. Thus, the net income obtained from the applied micronutrients was in accordance with the onion yield received ha^{-1} from such treatments and their sale value in the market.

4. Conclusion

On the basis of this study it was concluded that the highest gross return, net income was calculated in NPKS+soil application of $ZnSO_4$ @ 50 kg ha^{-1} but highest BC ratio was calculated in NPKS+soil application of $ZnSO_4$ @ 25 kg ha^{-1}.

5. References

Anonymous, 2010. Block, E. Garlic and Other Alliums: The Lore and the Science. Royal Society of Chemistry. ISBN978-0-85404-190-9. https://www.rsc.org/images/garliccontentsandsubjectindex_tcm18-164358.pdf.

Bhardwaj, R.L., Parashar, A., 2023. Maximizing productivity in onion bulb cultivation through crop geometry and NPKS nutrient management. The Journal of Applied Horticulture 25(3), 308–312. 10.37855/jah.2023.v25i03.55.

Cumo, C.E., 2015. Onion. In: Foods that Changed History: How Foods Shaped Civilization from the Ancient World to the Present. ABC-CLIO LLC (American Bibliographic Center, CLIO Press), 248–50.

Dogra, R., Thakur, A.K., Sharma, U., 2019. Studies on agronomic bio-fortification with micronutrients in onion (*Allium cepa* L.) seed crop. International Journal of Economic Plants 6(3):136-139

Durgude, A.G., Palwe, C.R., Sawale, D.D., Kadam, S.R., 2013. Response of onion to soil and foliar application of iron on entisols. The Asian Journal of Horticulture 8(2), 754–757.

Erenstein, O., Jaleta, M., Mottaleb, K.A., Sonder, K., Donovan, J., Braun, H.J., 2022. Global trends in wheat production, consumption and trade. In: Reynolds, M.P., Braun, H.J. (Eds.), Wheat Improvement. Springer, Cham. 10, 2452.

Fakharzadeh, S., Hafizi, M., Baghaei, M.A., Etesami, M., Khayamzadeh, M., Kalanaky, S., Akbari, M.E., Nazaran, M.H., 2020. Using nanochelating technology for biofortification and yield increase in rice. Scientific Reports 10, 4351.

Gureev, I., 2021. The use of micronutrient fertilizers in the cultivation of winter wheat. In: BIO Web of Conferences. EDP Sciences, Les Ulis, France 32, 02003.

Jaiswal, D.K., Gawande, S.J., Soumia, P.S., Krishna, R., Vaishnav, A., Ade, A.B., 2022. Biocontrol strategies: an eco-smart tool for integrated pest and diseases management. BMC Microbiology 22, 324.

Khatemenla, Singh, V.B., Maiti, C.S., Sangma, T.A., Kanaujia, S.P., Singh, P.K., 2017. Effect of zinc and boron on growth, yield and quality of onion (*Allium cepa* L.) cv. Agrifound Dark Red. Progressive Horticulture 49(2), 139–145.

Mandal, D., Shukla, A.C., Siddiqui, M.W., 2018. Sustainable horticulture, Volume 1: Diversity, production, and crop improvement (1st ed.). Apple Academic Press. https://doi.org/10.1201/b22429

Shukla, L., Bose, U.S., Ahirwar, M.K., 2015. Effect of foliar feeding of micronutrients on growth, yield and income from rabi onion var. Agri found Light Red. Annals of Plant and Soil Research 17(3), 307–310.

Sidhu, M.K., Raturi, H.C., Singh, S.K., Bora, L., Shukla, Y., 2020. Effect of foliar application of boron, iron and zinc on growth, yield and economics of cucumber grown under naturally ventilated polyhouse condition. Vegetable

Science 47(01), 110–115. https://doi.org/10.61180/vegsci.2020.v47.i1.19.

Torquato-Tavares, A., Pascual-Reyes, I.D., Barros-Milhomens, K.K., Alves-Ferreira, T., Rodrigues-do-Nascimento, I., 2017. Planting dates of *Allium cepa* L. hybrids in Gurupi, Tocantins, Brazil. RevistaChapingo Serie Horticultura 23, 123–133.

Venkatesh, U., Sharma, A., Ananthan, V.A., Subbiah, P., Durga, R., 2021. Micronutrient's deficiency in India: A systematic review and meta-analysis. Journal of Nutritional Science 10, e110.