Plant Archives Vol. 26, Supplement 1, 2026 pp. 1620-1623 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.supplement-1.217

INFLUENCE OF FOLIAR APPLICATION OF MACRO- AND MICRONUTRIENTS ON GROWTH, YIELD AND QUALITY OF ONION (*ALLIUM CEPA* L.) CV. "AGRIFOUND LIGHT RED"

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(Date of Receiving : 25-09-2025; Date of Acceptance : 05-12-2025)

ABSTRACT

A field experiment, entitled "Influence of foliar application of macro and micronutrients on growth, yield and quality of onion (*Allium cepa* L.) cv. Agrifound Light Red," was conducted during the Rabi season of 2020–21 at the Horticulture Research Farm-1, BBAU, Lucknow, (UP). To evaluate the effect of foliar-applied secondary macro (Zn) and micronutrients (S & B) on onion growth and development attributes. The experiment was laid out in a Randomized Block Design (RBD) with ten treatments and three replications, including graded foliar applications of Sulphur, zinc sulfate ($ZnSO_4$), and borax. Results indicated significant variations in growth and yield parameters among treatments. Treatment T_3 (Sulphur @ 0.5%) exhibited the highest plant height (62.48 cm), number of leaves per plant (7.78), bulb diameter (7.21 cm. Additionally, T_3 recorded the maximum fresh bulb weight (97.99 g) and dry bulb weight (21.75 g). Treatment T_6 ($ZnSO_4$ @ 0.5%) showed the highest specific gravity (1.33), indicating superior bulb density. The control treatment (T_0) consistently performed poorly across all parameters. The enhanced performance of sulphur at 0.5% can be attributed to its crucial role in enzymatic and photosynthetic activities, promoting vegetative growth and bulb development. These findings underscore the importance of optimized nutrient management in improving onion productivity and quality under field conditions.

Keywords: *Allium cepa*, foliar spray, sulphur, zinc sulphate, borax, bulb yield, onion quality, specific gravity.

Introduction

Onion (*Allium cepa* L.) is one of the most commercially important vegetable crops cultivated worldwide renowned as the "Queen of the Kitchen" due to its indispensable role in global cuisine. Belonging to the family Alliaceae, it is a biennial herb with chromosome number 2n = 2x = 16. However, it is mostly cultivated as an annual for its bulb. This monocotyledonous plant can be propagated through seeds, bulbs, or small bulbils (Foroutan M. 1999). Onions are one of the most ancient food sources on the planet and are one of the most important vegetable crops cultivated worldwide since the beginning of civilization (Mehta, 2017). India is the second-largest producer of onions after China, with Maharashtra, Karnataka, and Madhya Pradesh being the leading onion-producing states (NHB, 2019-20). Onions are typically cultivated in well-drained, loamy soils with a pH range of 6.2–6.8 (Raemaekers, 2001). They are photoperiod-sensitive and exhibit shallow root systems, requiring optimal nutrient management and irrigation for satisfactory yields (Pierce, 1987 & Rabinowitch, 1990). Onion bulbs are rich in carbohydrates, ascorbic acid and bioactive compounds such as quercetin, which exhibit antioxidant properties and play a role in reducing cardiovascular and cancer

risks (Singh *et al.,* 2001). However, Indian soils are often deficient in key micronutrients such as Zn, B, and S, which are essential for enzymatic activity, chlorophyll synthesis and structural development (Kanwar and Randhawa, 1967). Foliar application of selected micronutrients significantly decreases disease incidence, improving overall crop health and yield (Rahman *et al*., 2022). Deficiencies lead to poor bulb development, reduced quality, and diminished yield. Among nutrient delivery methods, foliar application offers a fast and efficient mechanism for nutrient absorption, especially in soils with adverse pH or structure (Latha & Nadanassababady, 2003 and Jeyathilake *et al*., 2006). Macro and micronutrient application, particularly of zinc, boron and sulphur, has been proven to significantly improve vegetative growth, bulb yield and quality parameters such as TSS, dry matter content and vitamin C concentration in onion (Manna *et al*., 2013 & Acharya *et al*., 2015 and Chowdhury (2017). Yet, limited research exists on the efficacy of foliar application of these nutrients under Uttar Pradesh agro-climatic conditions. Therefore, the present investigation was carried out to evaluate the impact of foliar application of boron, zinc and sulphur on growth, yield and quality traits of onion (*Allium cepa* L.) cv. Agrifound Light Red under Lucknow conditions.

Materials and Methods

The present field investigation was conducted during the Rabi season of 2020–21 at Horticultural Research Farm-1, Babasaheb Bhimrao Ambedkar University, Lucknow, Uttar Pradesh, India. The experimental site lies at 26°52′ N latitude and 80°57′ E longitude, with an elevation of 123 meters above mean sea level, falling under a humid subtropical agro-climatic zone. The experiment was laid out in a Randomized Block Design (RBD) with ten treatments and three replications, evaluating foliar applications of macro- and micronutrients, including boron (0.2%), zinc sulphate (0.5%), and elemental sulphur (0.2%), applied individually and in combinations. Each plot measured 2.0 m × 1.5 m, with a planting geometry of 15 cm × 10 cm (row × plant). The soil of the experimental field was sandy clay loam, slightly alkaline (pH 7.5–8.5), and low in organic carbon and available micronutrients. Soil physico-chemical properties were analyzed pre-sowing using standard methods as outlined by Jackson (1973). Onion seedlings (cv. Agrifound Light Red) were raised on nursery beds and transplanted at 45–50 days of age, when plants had 3-4 true leaves and were 10-15 cm tall. Foliar sprays commenced 30 days after transplanting, were repeated at 15-day intervals, and were conducted in the early morning using a hand sprayer to minimize phytotoxicity. Observations were recorded on key growth parameters (plant height, number of leaves per plant), yield parameters (bulb diameter, fresh and dry weight), and quality parameters (number of scales per bulb and specific gravity). Data were statistically analyzed using ANOVA following the procedure of Panse and Sukhatme (1985) with significance tested at 5% Critical Difference (CD).

Results and Discussion

Growth Parameters

For plant height (cm) at 90 DAT, the significantly highest plant height (60.31 cm) was recorded under treatment T_3 (Sulphur @ 0.5%), followed by T_6 ($ZnSO_4$ @ 0.5%) with 59.14 cm and T_9 (Borax @ 0.5%) at 58.12 cm. The lowest plant height (56.36 cm) was noted in control T_0 (water spray). This increase might be attributed to sulphur's role in enhancing chlorophyll synthesis and cell elongation. Number of leaves/plants. The maximum number of leaves per plant (7.78) was observed in T_3, followed by T_6 (7.09) and T_9 (6.67), while the minimum (5.83) was recorded in T0. The improvement in foliage may be linked to enhanced nutrient uptake and cell division under sulphur treatment.

Bulb Parameters

Diameter of bulb neck (mm). At 90 DAT the treatment T_3 showed the highest bulb neck diameter (1.67 mm), significantly superior to T_6 (1.51 mm) and T_9 (1.33 mm). The lowest diameter (0.86 mm) was found in T_0. Enhanced neck thickness under sulphur application may relate to better photosynthate allocation. Bulb diameter (cm): The treatment T_3 recorded the significantly highest bulb diameter (7.21 cm), followed by T_6 (6.72 cm) and T_9 (6.33 cm). The minimum value (3.50 cm) was observed in T_0. Sulphur may have enhanced cell expansion, resulting in larger bulbs. Fresh weight of bulb (g) the maximum fresh bulb weight (97.99 g) was recorded under T_3, followed by T_6 (96.39 g) and T_9 (93.37 g). T_0 recorded the lowest (77.25 g). The higher fresh weight can be ascribed to improved carbohydrate synthesis and translocation under sulphur application. Dry weight of bulb (g) significantly highest dry weight (21.75 g) was noted in T_3, while T_6 (21.18 g) and T_9 (20.55 g) followed. The control T_0 had the lowest value (15.23 g). This increase may be due to better conversion of assimilates into storage organs under sulphur-rich conditions. The maximum number of scales (9.41) was recorded in T_3, followed by T_6 (8.71) and T_9 (8.38). The lowest was in T_0 (5.43). Nutrient-rich foliar sprays likely enhanced meristematic activity, leading to more

scale formation. Specific gravity was significantly influenced by treatments. T_6 ($ZnSO_4$ @ 0.5%) recorded the highest specific gravity (1.33 cc), followed by T_9 (1.24 cc) and T_3 (1.01 cc). The lowest value was observed in T_0 (0.95 cc).

Table 1: Effect of Foliar Application on Growth and Bulb Parameters of Onion cv. Agrifound Light Red at 90 DAT

Treatments	Plant Height (cm)	Leaves/Plant	Bulb Diameter (cm)	Fresh Wt (g)	Dry Wt (g)	Scales/ Bulb	Specific Gravity (cc)
T_0 (Control)	56.36	5.83	5.11	74.57	14.64	5.43	0.95
T_1 Sulphur @ 0.1%	58.91	6.40	5.64	83.18	17.32	6.40	1.05
T_2 Sulphur @ 0.25%	61.02	7.21	6.39	91.16	19.29	7.53	1.09
T_3 Sulphur @ 0.5%	64.15	7.78	7.21	97.99	21.75	9.41	1.01
T_4 Zinc Sulphate @ 0.1%	59.00	6.35	5.64	83.18	17.32	6.35	1.13
T_5 Zinc Sulphate @ 0.25%	60.12	7.06	6.39	91.16	19.29	7.06	1.18
T_6 Zinc Sulphate @ 0.5%	61.34	7.09	6.72	96.39	21.18	8.71	1.33
T_7 Borax @ 0.1%	57.89	6.07	5.66	82.45	17.60	6.07	1.09
T_8 Borax @ 0.25%	59.88	7.67	5.91	87.53	19.70	7.67	1.12
T_9 Borax @ 0.5%	60.46	6.67	6.33	93.37	20.55	8.38	1.24
CD (P=0.05)	0.82	0.31	0.25	2.27	0.28	0.24	0.08
SEm±	0.27	0.10	0.08	0.76	0.09	0.08	0.02

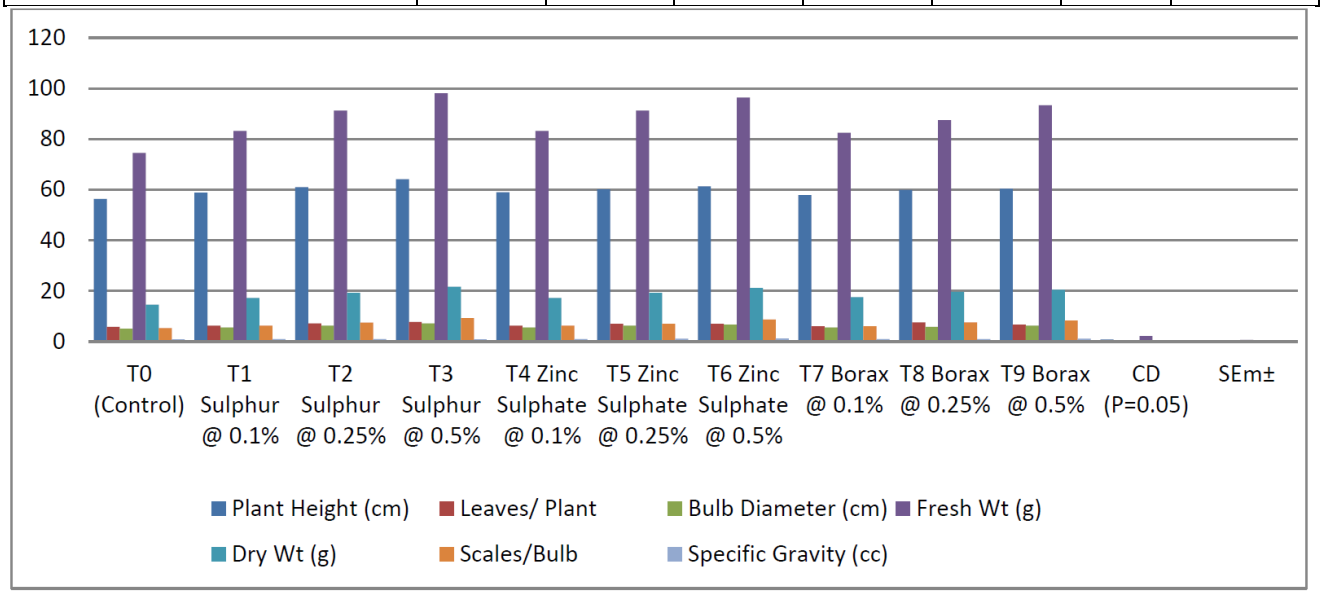

Fig. 1: Explanation of Growth parameters

Conclusion

The study demonstrated that foliar application of balanced macro- and micronutrients markedly improved the growth, yield, and quality of onion cv. Agrifound Light Red. Treatment combinations containing boron and zinc produced the highest plant height, leaf number, and bulb diameter. Moreover, targeted foliar application of key micronutrients effectively minimized tip-burn incidence in garlic, thereby strengthening plant health and enhancing overall productivity. Fresh and dry weights of bulbs increased notably under sulphur-enriched treatments, while specific gravity and the number of scales per bulb also improved significantly. Overall, the integrated foliar application of boron (0.2%), zinc sulphate (0.5%), and elemental sulphur (0.2%) proved to be the most effective in enhancing vegetative vigor and bulb quality traits. These findings suggest a viable nutrient management strategy for boosting onion productivity in similar agro-climatic zones.

Acknowledgements

The authors are thankful to the Head, Department of Horticulture, School of Agricultural Sciences and Technology, Babasaheb Bhimrao Ambedkar University (A Central University), Lucknow, Uttar

Pradesh, for providing the facilities for the conduct of our research.

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