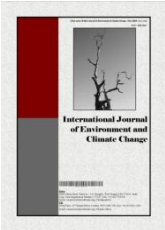

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Influence of Organic and Inorganic Nutrients on Horticultural and Biochemical Traits of Garlic (*Allium sativum* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present study was conducted at Vegetable Research Farm at Dr YSP UHF Nauni, Solan during the year 2019-20 and 2020-21. The experimentation was designed in RCBD along with three replications. The data was worked out for various growth, yield and biochemical attributes of garlic. The outcomes of the investigation presented that maximum plant height (88.49 cm), number of leaves per plant (10.35), bulb weight (64.81g), yield per hectare (199.46 q), was calculated for the treatment combination comprising of 75% RDN + Zn @ 5kg/ha + S @ 40kg/ha + 5% Jeevamrit @ 1 l/m^2(T_{13}). Observations from the recorded data also proved that 75% RDN + Zn @ 5kg/ha + S @ 40kg/ha + 5% Jeevamrit @ 1 l/m^2(T_{13}) recorded maximum oleoresin content(%)and dry matter content (%) i.e. 1.55 and 46.12. Hence, this combination can be further recommended to grower, so they can fetch more yield from the limited land holding.

Keywords: Garlic; growth; yield; oleoresin content; sulphur content.

1. INTRODUCTION

Garlic (*Allium sativum* L.) is a plant that originated in Central Asia and belongs to the Alliaceae family. It is utilised for both culinary and medicinal purposes [1]. Garlic comes from the old English word "gar", which means "spear" and could imply "clove." Garlic has a far higher

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nutritional value than other bulbous crops. It contains a significant amount of carbohydrates (29%), proteins (6.3%), minerals (0.3%), and essential oils (0.1-0.4%), as well as lipids, vitamin C, and sulphur [2]. The lack of information among farmers about better technology such as integrated fertilizer management, adoption of high yielding cultivars, and suitable plant protection measures is one of the key causes for India's low productivity [3]. Synthetic chemical fertilizers used alone can harm soil health and result in unsustainable yields, whereas combining inorganic fertilizers and organic amendments can reduce synthetic fertilizer use while improving soil health and nutrient availability, resulting in higher crop yields and better quality produce [4]. One of the most critical factors impacting plant growth and productivity is plant nutrition. Bulbous crops are heavy feeders, requiring proper amounts of nitrogen, phosphorous, potassium, and sulphur, among other nutrients, all of which can have a negative impact on bulb growth, production, and quality if they are deficient in the soil. The efficient and balanced use of organic and inorganic components can produce garlic with a high yield and good quality. As a result, the need of integrated nutrient delivery in sustaining productivity is highlighted in order to repair and preserve long-term soil health and productivity, which would otherwise decline owing to continuous and intensive cultivation without sufficient nutrient management. Only when the nutrient supply system combines both organic and synthetic fertilizers can a crop's full potential be realised. As a result, the current study was conducted to determine the impact of nutrient management on garlic output.

2. MATERIALS & METHODS

The experiment took place in the Dr. YS Parmar University of Horticulture and Forestry's Experimental Farm of Vegetable Science in Nauni, Solan during Rabi 2019-20. (H.P). With three replications and thirteen treatments, the experiment was set up in a completely randomised block design. The treatments were T_1 : Absolute control, T_2 : 100% RDN 125:75:60 kg per hectare of NPK, T_3 : 90% RDN + 10% RDN through Vermicompost, T_4 : 80% RDN+ 20% RDN through Vermicompost, T_5 : 100% RDN + Zn @ 5kg/ha, T_6 : 100% RDN + Zn @ 7.5kg/ha, T_7 : 75% RDN + Zn @ 5kg/ha + 5% Jeevamrit @ 1 l/m^2, T_8: 75% RDN + Zn @ 7.5kg/ha + 5% Jeevamrit @ 1 l/m^2, T_9 : 100% RDN + S @ 40kg/ha, T_{10} : 100% RDN + S @ 50kg/ha,T_{11} : 75% RDN + S @ 40kg/ha + 5% Jeevamrit @ 1 l/m^2,T_{12} :75% RDN + S @ 50kg/ha + 5% Jeevamrit @ 1 l/m^2 and T_{13} : 75% RDN + Zn @ 5kg/ha + S @ 40kg/ha + 5% Jeevamrit @ 1 l/m^2.In a 2 × 2 m plot, 200 plants were planted at a spacing of 20 ×10 cm. On October 22, 2018, good quality garlic cloves were picked from the seed material and sowed. The long-day variety 'Kandaghat Selection' was employed in the study. The bulbs are creamish white in colour with a diameter of 3.5 to 5.5 cm with 13-16 yellowish white cloves, making them ideal for growing in India's northern mountainous locations. Between 150 and 250 q/ha is the average yield per hectare.

3. RESULTS AND DISCUSSION

3.1 Growth and Yield Related Attributes

In comparison to the control, the application of inorganic and organic fertilizers increased plant height, number of leaves per plant, bulb weight, and bulb production per hectare, among other characteristics. In the treatment 75 %RDN + Zn @ 5kg/ha + S @ 40kg/ha + 5 % Jeevamrit @ 1 l/m^2, the maximum plant height (88.49 cm), number of leaves per plant (10.35), bulb weight (64.81 g), and bulb yield per hectare (199.46 q) were recorded (T_{13}). The combined application of N, P, S and Zn in the current study resulted in a considerable variance in plant height at various combinations, including jeevamrit treatment. Assefa et al. [5] found that increasing the combinations of nutrient types N, P, S and Zn within the recommended amounts enhanced plant height gradually (2015). N:P:K:S (75:40:40:40: kg/ha) led in a considerable increase in plant height, according to Anand et al. [6], validating the stimulating impact of the NPKS combination. The use of NPKS aided the plant's metabolic and auxin processes, resulting in a increasing in plant height. Under integrated nutrition management treatments, the maximum number of leaves may be attributable to continuous release of nutrients throughout the crop growth period, resulting in increases in the number of leaves per plant.

Farooqui et al. [7] and Anand et al. [6] came to identical conclusions as this study. The use of balanced amounts of N, P, S and Zn fertilizers results in an increase in bulb weight, which has a good effect on onion bulb weight. The current findings are consistent with those of Rathod et al. [8], who found that sulphur has a synergetic impact with other nutrients such as nitrogen in

Table 1. Growth and yield attributes of garlic as influenced by organic and inorganic nutrient sources

Treatment details	Plant height (cm)	Number of leaves per plant	Bulb weight (g)	Bulb yield per hectare (q)
Absolute Control (T_1)	69.12	7.88	41.33	132.86
100% RDN (125:75:60 kg per hectare of NPK) (T_2)	74.62	8.36	43.06	158.33
90% RDN + 10% RDN through Vermicompost (T_3)	75.56	8.48	44.46	164.53
80% RDN+ 20% RDN through Vermicompost (T_4)	77.42	8.60	47.46	170.66
100% RDN + Zn @ 5kg/ha (T_5)	81.65	9.28	50.45	178.8
100% RDN + Zn @ 7.5kg/ha (T_6)	83.38	9.36	52.26	182.73
75% RDN + Zn @ 5kg/ha + 5% Jeevamrit @ 1 l/m^2 (T_7)	79.44	8.76	55.80	161.13
75% RDN + Zn @ 7.5kg/ha + 5% Jeevamrit @ 1 l/m^2 (T_8)	80.74	8.84	59.61	176.26
100% RDN + S @ 40kg/ha (T_9)	84.67	9.66	57.69	191.66
100% RDN + S @ 50kg/ha (T_{10})	85.73	9.81	59.86	194.53
75% RDN + S @ 40kg/ha + 5% Jeevamrit @ 1 l/m^2 (T_{11})	85.06	9.36	61.53	187.06
75% RDN + S @ 50kg/ha + 5% Jeevamrit @ 1 l/m^2 (T_{12})	85.15	9.44	61.66	188.06
75% RDN + Zn @ 5kg/ha + S @ 40kg/ha + 5% Jeevamrit @ 1l/m^2 (T_{13})	88.49	10.35	64.81	199.46
CD (0.05)	**0.78**	**0.14**	**0.76**	**6.09**

Table 2. Biochemical traits of garlic as influenced by organic and inorganic nutrient sources

Treatment details	Oleoresin content (%)	Sulphur content of bulb (%)	Dry matter content (%)
Absolute Control (T_1)	0.68	1.05	37.32
100% RDN (125:75:60 kg per hectare of NPK) (T_2)	1.02	1.14	39.94
90% RDN + 10% RDN through Vermicompost (T_3)	1.12	1.21	40.15
80% RDN+ 20% RDN through Vermicompost (T_4)	1.18	1.21	40.96
100% RDN + Zn @ 5kg/ha (T_5)	1.21	1.26	42.05
100% RDN + Zn @ 7.5kg/ha (T_6)	1.25	1.28	42.62
75% RDN + Zn @ 5kg/ha + 5% Jeevamrit @ 1 l/m^2 (T_7)	1.19	1.22	41.11
75% RDN + Zn @ 7.5kg/ha + 5% Jeevamrit @ 1 l/m^2 (T_8)	1.2	1.23	41.86
100% RDN + S @ 40kg/ha (T_9)	1.33	1.50	44.21
100% RDN + S @ 50kg/ha (T_{10})	1.42	1.59	45.52
75% RDN + S @ 40kg/ha + 5% Jeevamrit @ 1 l/m^2 (T_{11})	1.27	1.32	43.02
75% RDN + S @ 50kg/ha + 5% Jeevamrit @ 1 l/m^2 (T_{12})	1.29	1.39	43.88
75% RDN + Zn @ 5kg/ha + S @ 40kg/ha + 5% Jeevamrit @ 1l/m^2 (T_{13})	1.55	1.36	46.12
CD (0.05)	**0.05**	**0.04**	**1.49**

boosting bulb weight. The onion bulb's growth and development were aided by a well-balanced diet. The fact that micronutrients play a critical role in plant nutrition intake and usage, as well as regulating numerous physiological processes such as photosynthesis, protein, and chlorophyll

synthesis, may explain the increase in garlic output due to Zn treatment. All of this leads to an increase in yield, according to Chanchan et al. [9]. The findings are similar to those of Patidar et al. [10], who found that applying N, P, K, S, Zn, FYM and jeevamrit increased yield, probably due to the combined effect of the multiple amendments. The findings of Babaleshwar et al. [11] and Chattoo et al. [12] confirm these findings. The use of jeevamrit increased growth and yield contributing features greatly. Jeevamrit treatment has a considerable impact on yield characteristics such as bulb weight, bulb width, and clove number, according to Kurubetta et al. [13]. In terms of enhanced yield, Manjutha et al. [14] reported comparable results. Using jeevamrit as a foliar spray, on the other hand, boosted agricultural output and efficacy against several plant diseases, according to Chadha et al. [15].

3.2 Biochemical Attributes

The treatment T_{13} (75 % RDN + Zn @ 5kg/ha + S @ 40kg/ha + 5 % Jeevamrit @ 1 l/m^2) had the highest oleoresin content (1.55%), followed by T_{10} (100 % RDN + S @ 50kg/ha). The use of sulphur increased the oleoresin content significantly. According to Jaggi [16], these results are correct. According to Gorana [17], using micronutrients including zinc and boron, as well as using approved fertilizer levels, showed to be crucial in improving garlic quality. The current findings are consistent with Singh (2020), who found that using a 100% recommended dose of NPK + 50 kg S/ha + 5% Jeevamrit @ 1 l/ m^2 resulted in the highest (1.60%) oleoresin concentration in garlic. T_{10} (100 percent RDN + S @ 50kg/ha) had the highest sulphur level (1.59%). This is due to the fact that when S is administered, a substantial amount of organic bound S is generated, which contains amino acids like cysteine and methionine, which are required for protein synthesis and garlic quality improvement. The findings are in line with those of Banafar and Gupta [18]. T_{13} (75 % RDN + Zn @ 5kg/ha + S @ 40kg/ha + 5 % Jeevamrit @ 1 l/m^2) had the highest dry matter content (46.12 %), which was statistically comparable to T_{10} (100 % RDN + S @ 50kg/ha).This could be related to sulphur's role in enhancing amino acids, as well as the fact that nutrient uptake causes the bulb to accumulate more dry matter. Damse et al. [19] and Anand et al. [6] found similar results (2017). The application of nitrogen and phosphorus at 92 kg N ha^{-1} + 40 kg P ha^{-1}, as well as 30 and 60 kg S ha^{-1}, resulted in significantly greater bulb dry matter content in garlic, according to Diriba et al. [1].

4. CONCLUSION

The effects of organic and inorganic sources of nutrients on garlic growth, production, and quality were found to be significant in the current study. The application of 75 % RDN + Zn @ 5kg/ha + S @ 40kg/ha + 5 % Jeevamrit @ 1 l/m^2 produced the best results in terms of growth, yield, and quality. Following verification of findings on the farmer's field, farmers in Himachal Pradesh might be advised to apply 75 %RDN + Zn @ 5kg/ha + S @ 40kg/ha + 5 %Jeevamrit @ 1 l/m^2 (OFT).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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