

Influence of Organic and Inorganic nutrients on horticultural and biochemical traits of Garlic (*Allium sativum* L.)

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need to redefine the overall title carefully to ensure it reflect to the nature of the study (paper)

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Abstract

The present study was conducted at Vegetable Research Farm at Dr YSP UHF Nauni, Soland 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/m²(T₁₃). Observations from the recorded data also proved that 75% RDN + Zn @ 5kg/ha + S @ 40kg/ha + 5% Jeevamrit @ 1 l/m²(T₁₃) 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

INTRODUCTION

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Also, what is the research significant to conduct this study

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 (Diribaet *al.*, 2013). Garlic comes from the old English word "gar," which means "spear" and could imply "clove." Garlic has a far higher 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 (Memaneet *al.*, 2008). 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 (Selim, 2021). 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 (Montgomery, 2021). 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.

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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/m², T_8 : 75% RDN + Zn @ 7.5kg/ha + 5% Jeevamrit @ 1 l/m², 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/m², T_{12} : 75% RDN + S @ 50kg/ha + 5% Jeevamrit @ 1 l/m² and T_{13} : 75% RDN + Zn @ 5kg/ha + S @ 40kg/ha + 5% Jeevamrit @ 1 l/m². 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.

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Unclear and ambiguous and vague statement

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RESULTS AND DISCUSSION

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/m², 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 (T₁₃). 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. Assefaet *al.* (2015) 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 Anandet *al.* (2017), 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.

Farooquiet *al.* (2009) and Anandet *al.* (2017) 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 Rathodet *al.* (2020), who found that sulphur has a synergetic impact with other nutrients such as nitrogen in 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 Chanchanet *al.* (2013). The findings are similar to those of Patidaret *al.* (2017), 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 Babaleshwaret *al.* (2017) and Chattooet *al.* (2019) 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 Kurubettaet *al.* (2017). In terms of enhanced yield, Manjuthaet *al.* (2009) reported comparable results. Using jeevamrit as a foliar spray, on the other hand, boosted agricultural output and efficacy against several plant diseases, according to Chadhaet *al.* (2012).

Biochemical Attributes

The treatment T₁₃ (75 % RDN + Zn @ 5kg/ha + S @ 40kg/ha + 5 % Jeevamrit @ 1 l/m²) had the highest oleoresin content (1.55%), followed by T₁₀ (100 % RDN + S @ 50kg/ha). The use of sulphur increased the oleoresin content significantly. According to Jaggi (2004), these results are correct. According to Gorana (2015), 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/ m² resulted in the highest (1.60%) oleoresin concentration in garlic. T₁₀ (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 (2005). T₁₃ (75 % RDN + Zn @ 5kg/ha + S @ 40kg/ha + 5 % Jeevamrit @ 1 l/m²) had the highest dry matter content (46.12 %), which was statistically comparable to T₁₀ (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. Damseet *al.* (2014) and Anand *et al.* (2015) 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 Diribaet *al.* (2013).

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/m² 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/m² (OFT).

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

Treatment code/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

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

Treatment code/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

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REFERENCES:

Anand M, SankariAand Anita B. 2017. Influence of integrated nutrient management for

garlic under nilgiris condition. *Journal of Current Microbiology and Applied Sciences* **6**:3833-38.

Assefa A G, Mesgina S H, Abrha Y W. 2015. Effect of inorganic and organic fertilizers on the growth and yield of garlic crop (*Allium sativum* L.) in Northern Ethiopia. *Journal of agricultural Science*. **7**:80-86.

Babaleshwar S B, Koppad S R, Math K K and Dharmatti R. 2017. Influence of sulphur on growth and yield of garlic (*Allium sativum* L.). *Journal of Pharmacognosy and Phytochemistry* **6**: 450-52.

Banafar R N S and Gupta N K 2005. Influence of soil and foliar application of sulphur on growth, yield and quality on onion. Proc. National Seminar on Agro-technology, Quality, Processing and Export of Spices, March 20-21, 2005. J.N.K.V.V. Jabalpur. pp. 67.

Chadha S, Rameshwar, Ashlesha, Saini J P and Paul Y S. 2012. Vedic krishi: Sustainable livelihood option for small and marginal farmers. *Indian Journal of Traditional Knowledge* **11**:480-86.

Chanchan M, Hori J K and Ghanti S. 2013. Response of garlic to foliar application of some micronutrients. *Journal of Crop and Weed* **9**:138-41.

Chattoo M A, Magray M M, Malik A A, Shah M D and Chisti J A. 2019. Effect of sources and levels of sulphur on growth, yield and quality of onion. *International Journal of Current Microbiology and Applied Sciences* **8**:1462-70.

Damse D N, Bhalekar M N and Pawar P K. 2014. Effect of integrated nutrient management on growth and yield of garlic. *The Bioscan* **9**:1557-60.

Diriba S, Nigussie D, Kebede W, Getachew T and Sharma J J. 2013. Growth and nutrients content and uptake of garlic (*Allium sativum* L.) as influenced by different types of fertilizer and soils. *African Journal of Agricultural Research* **8**:5387-90.

Farooqui M A, Naruka I S, Rathore S S, Singh P P and Shaktawat R P S. 2009. Effect of nitrogen and sulphur levels on growth and yield of garlic (*Allium sativum* L.). *Asian Journal of Food and Agro-Industry* **2**(Special Issue).

Gorana. 2015. Effect of zinc and boron on growth and yield of different cultivars of garlic (*Allium sativum* L.). PhD Thesis RVSKVV, Gwalior (MP).

JaggRC.2004.Effectof sulphur levels and sources on composition and yield of onion. *International Journal of Agriculture Sciences* **74**:219-20.

Kurubetta K D, Mesta R K, Allolli T B, Tatagar M H and Sweta K. 2017. Response of onion (*Allium cepa*) for graded levels of fertilizers and jeevamruta application. *Research Journal of Chemical and Environmental Sciences* **5**:19-21.

Manjutha G S, Upperi S N, Pujari B T, Yeledahalli and Kuligod V B. 2009. Effect of farm yard manure treated with jeevamrita on yield attributes, yield and economics of sunflower. *Karnataka Journal of Agriculture Sciences* **22**:198-99.

Montgomery David R, Bikle A.2021. Soil health and nutrient density: Beyond organic vs. conventional farming. *Frontiers in Sustainable Food Systems* **5**:DOI=10.3389/FSUFS.2021.699147.

Memane P G, Tomer R S, Kulkarni G U and Chovatia R S. 2008. Effect of clove weight and plant growth regulators on growth and yield of garlic (*Allium sativum* L.) cv. Gujrat Garlic 3. *The Asian Journal of Horticulture* **3**:82-86.

Patidar M, Shaktawat R P S and Naruka I S 2017. Effect of sulphur and vermicompost on growth, yield and quality of garlic (*Allium sativum* L.). *Journal of Krishi Vigyan* **5**:54-56.

Rathod P H, Katkar R N, Vrushali R, Bhende S M Ghawade S R Lakhe and Kharche V K. 2020. Effect of sulphur and zinc containing customized fertilizers on growth, yield and nutrient uptake of onion. *International Journal of Current Microbiology and Applied Science* **9**:2061-69.

Selim, M. M. (2021). Introduction to the Integrated Nutrient Management Strategies, and Contribution on Yield and Soil Properties. *Journal of Plant Sciences* **9**:139-50.

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