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Effect of organic and inorganic fertilizers on yield, quality and economics of garlic (*Allium sativum* L.)

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Abstract

The experiment was carried out at College of Horticulture & Forestry, Neri, Hamirpur (HP) during rabi season, 2021 to investigate the effect of integrated nutrient management on growth and yield in garlic and the experiment was laid out in the randomized complete block design with eighteen treatments. The results of the study revealed that minimum days to marketable maturity, maximum plant height, number of leaves per plant, average bulb weight, bulb length, bulb breadth, average clove weight, number of cloves per bulb, bulb yield per plot, neck thickness, total soluble solids and dry matter content were observed by application of T₁₂ (75% NPK + 40 kg S/ha + Azotobacter + PSB + FYM). Highest Benefit Cost ratio was also recorded in treatment T₁₂. The combined application of inorganic fertilizers along with biofertilizers and organic manures helps in improving the growth, yield and quality parameters of garlic.

Keywords: Garlic, biofertilizers, manures, yield, quality

Introduction

Garlic (*Allium sativum* L.) belongs to family Alliaceae and having chromosome number 2n=16. Garlic is the second most widely cultivated bulb crop after onion (Meena *et al.*, 2019) [21]. It originated in Central Asia and spread to other parts of the world (Bhandari *et al.*, 2012) [4]. It is the most nutritious crop among the bulbous crops. It is used as spices and condiments with high nutritive and medicinal value. It contains high amount of carbohydrates (29%), proteins (6.3%), minerals (0.3%) and essential oils (0.1- 0.4%) and contains appreciable quantities of fat, vitamins C and sulphur (Memane *et al.*, 2008) [22]. Garlic has some antifungal, antimicrobial, insecticidal and other medicinal properties (Singh and Singh., 2017) [29]. It is described as a hot stimulant, carminative and antirheumatic and its oil is a powerful antiseptic mainly due to the presence of allicin an important organosulfur compound (Das *et al.*, 2020) [8]. It is used as a vermifuge for expelling round worms and has been recommended for cure of several ailments viz., wounds, ulcers, pneumonia, bronchitis and gastro- intestinal disorders (Hazra *et al.*, 2011). [16]

Modern agriculture mainly depends upon inorganic fertilizers to fulfill nutrient demand of the crops. Low productivity of garlic in India is due to the lack of awareness among the farming community about improved practices like integrated nutrient management, high yielding varieties and proper plant protection measures (Kumar *et al.*, 2019) [18]. Organic manure is an eco-friendly, economically viable and ecologically sound that also played a significant role in improving physical, chemical and biological properties of soil (Acharya and Kumar., 2018) [1]. Organic manures have a significant role to play in the growth and development of garlic and it improves soil structure and water holding capacity. It acts as an excellent substrate for soil microbes and increases the proportion of carbon and nitrogen, directly stimulating the population and activity of microorganisms (Kumar *et al.*, 2019) [18]. Biofertilizers are known to play an important role in increasing availability of nitrogen and phosphorus besides improving biological fixation of atmospheric nitrogen and produce hormones and anti-metabolites (Bhat *et al.*, 2013) [5]. Biofertilizers are harmless, eco-friendly and low cost agro-input supplementary to chemical fertilizers. It increases the soil fertility, improve soil structure, porosity and water holding capacity and also enhance seed germination (Kumar and Singh., 2020) [19]. Azotobacter and Phosphate Solubilizing Bacteria play a vital role in sustaining both soil health and crop

production on a long-term basis, ensuring the availability of major nutrients. Azotobacter is a free living non-symbiotic nitrogen fixing bacteria and it produces auxins, gibberellins, cytokinin and some antibiotic metabolites role for benefit of the plant growth, yield and quality. Phosphate Solubilizing Bacteria solubilizes phosphorus to increase soil fertility and biological activities (Bhushan *et al.*, 2020) [6]. Therefore, to maintain the soil fertility and supply of plant nutrients in balanced proportion for optimum growth and yield of crop integrated approach is to be practiced through the combined use of inorganic, organic and bio-fertilizers of plant nutrients (Gamit *et al.*, 2019) [13].

Materials and Methods

The experiment has been conducted at Experimental Farm of College of Horticulture and Forestry, Neri, Hamirpur is situated in the Sub montane low hills zone (Zone-I) of Himachal Pradesh. Geographically, it is located at an altitude of 650m above mean sea level between 31°41'47.6"N & 72°28'6.3"E. Experiment was laid out in Randomized Complete Block Design with eighteen treatments and three replications at a spacing of 20 X 10 cm in a plot size of 1X 1m accommodating 50 plants in each plot. The experiment comprised of eighteen treatments viz., T₀: Control (No amendment), T₁: Cowurine + Jeevamrit + FYM (250 q/ha), T₂: Beejamrit + Jeevamrit + FYM (250 q/ha), T₃: Azotobacter + PSB + FYM (250 q/ha), T₄: 75% Recommended dose of NPK + Azotobacter + FYM, T₅: 75% Recommended dose of NPK + PSB + FYM, T₆: 75% Recommended dose of NPK + Azotobacter + PSB + FYM, T₇: 50% Recommended dose of NPK + Azotobacter + FYM, T₈: 50% Recommended dose of NPK + PSB + FYM, T₉: 50% Recommended dose of NPK + Azotobacter + PSB + FYM, T₁₀: 75% Recommended dose of NPK + 40 kg S/ha + Azotobacter + FYM, T₁₁: 75% Recommended dose of NPK + 40 kg Sulphur/ha + PSB + FYM, T₁₂: 75% Recommended dose of NPK + 40 kg S/ha + Azotobacter + PSB + FYM, T₁₃: 50% Recommended dose of NPK + 40 kg S/ha + Azotobacter + FYM, T₁₄: 50% Recommended dose of NPK + 40 kg S/ha + PSB + FYM, T₁₅: 50% Recommended dose of NPK + 40 kg S/ha + Azotobacter + PSB + FYM, T₁₆: 100% Recommended dose of NPK + 40 kg S/ha + FYM, T₁₇: 100% Recommended dose of NPK (125:75:60 kg/ha) + FYM.

Sowing was done on 19th October 2021. Seeds were sown in the lines at a spacing of 20 X 10 cm. The soil structure of experimental farm is to loam to clay loam with pH ranging from 6.8 to 7.0. The experimental field was thoroughly ploughed 2 times with the help of tractor followed by planking. All the stubble and weeds were removed. Agrifound Parvati variety developed by National Horticulture Research and Development Foundation, Nasik, Maharashtra was used for the present study. This variety is long day type and bulbs are bigger in size (5 – 6.5 cm diameter) and creamy white colour with pinkish tinge. It reaches maturity in 220-240 days. Calculated amount of inorganic fertilizers Nitrogen, Phosphorous, Potassium and Sulphur (125:75:60:40 kg/ha) were applied in the form of urea (203.8 kg/ha), Single Super Phosphate (356.25 kg/ha), Murate of Potash (75 kg/ha) and Bentonite Sulphur (44.45 kg/ha) in respective treatments before sowing of seed. One-third dose of N along with the full doses of P and K were applied as basal dose. Remaining one-third dose of N applied after a month of planting and one-third dose applied after 50 days of planting. Organic manures such as FYM (250 q/ha) were applied during field preparation in the respective treatments. Cloves were treated with cowurine and beejamrit as per treatments and

planted. Biofertilizers viz., Azotobacter and Phosphate Solubilizing Bacteria were applied after 15 days of sowing. No fertilizer was applied in the control plot. Cloves were soaked in the solution of 10% cow urine and 10% solution of beejamrit, sole application for one hour before sowing as per treatments. Azotobacter @ 200 g/ha, Phosphate Solubilizing Bacteria @ 200 g/ha and mixture of Azotobacter+ Phosphate Solubilizing Bacteria @ 200 g/ha were applied along with FYM as per the treatment combination. These biofertilizers were mixed thoroughly with FYM and kept for overnight and applied next day as per the different treatment combinations. Five randomly selected plants in each replication and treatment were considered to record the observations for days to marketable maturity, plant height (cm), number of leaves per plant, average bulb weight (g), bulb length (cm), bulb breadth (cm), average clove weight (g), number of cloves per bulb, bulb yield per plot (kg), neck thickness (cm), total soluble solids (^oB) and dry matter content (%). Mean values of data were subjected to analysis of variance as described by Gomez and Gomez (1984) for Randomized Complete Block Design.

Preparation of Jeevamrit and Beejamrit

Jeevamrit

Jeevamrit is a mixture of cow dung, cow urine from a local breed, jaggery, pulse floor and fertile soil in a plastic container. The soil should be either virgin or forest soil or from own organic farm where crop/vegetation health is best. For preparation of jeevamrit, required quantities of ingredients were thoroughly mixed in water and allowed to ferment for 7 days. Ingredients were stirred for at least ten minutes once in morning and once in evening in clockwise direction with wooden stick. Jeevamrit @ 10% drenching was given at fortnight interval in the respective treatments. Table 1 shows the standardized technique for preparation of jeevamrit (Sreenivasa *et al.*, 2010) [30].

Beejamrit

Palekar (2007) [24] suggested the standardized technique of preparing beejamrit. This is a mixture of cow dung, cow urine, lime and fertile soil. For preparation of beejamrit take 5 kg fresh cow dung in cloth & tie it with rope. Arrange to dip this cow dung in the bucket containing 20 litres of water up to 12 hours. In other container, add 50 gm of lime in one liter of water, let it stable for night. Next morning, squeeze the bundle of cow dung in same water thrice continuously, so that all essence of cow dung will get accumulated in it. Add handful of soil from the field's edge into this mixture and mix thoroughly. Lastly add 5 litres of cow urine & lime solution and stir well. Beejamrit is ready to use according to treatment plan.

Results and Discussion

Days to marketable maturity

When the plant tops start to fall and dry out, the garlic crop is ready to be harvested. A weakening of the main stem above the bulb and a yellowing of 75% of the leaves are signs of maturity (Deckerson, 1999) [9]. Minimum days to marketable maturity 204.33 days were recorded in treatment T₁₂ (75% Recommended dose of NPK + 40 kg S/ha + Azotobacter + PSB + FYM). Maximum days to marketable maturity 210.66 days were recorded in treatment T₀ (Control) [Table 2]. The early maturity of bulb might be due to the hormones and organic acid secreted by organic manures during decomposition which might have lead to early maturity as reported by (Sachin *et al.*, 2017) [28].

Plant height (cm)

Plant height is an important parameter for growth and yield of crop. Data recorded for plant height revealed that maximum plant height (92.00 cm) was recorded in treatment T₁₂ (75% Recommended dose of NPK + 40 kg S/ha + Azotobacter + PSB + FYM) [Table 2]. While, minimum plant height (71.66 cm) was recorded in treatment T₀ (Control). This might be due to enhanced availability of nutrients and production of some growth promoting substances that might have caused cell elongation and multiplication. Further, nitrogen might have increased the chlorophyll content of leaves and resulted in increased synthesis of carbohydrates, which in turn has influenced cell elongation and multiplication (Eragegowda *et al.*, 2018) [11]. Phosphate solubilizing microorganism solubilizes the unavailable bound phosphate of the soil and makes them available to plants which increase overall plant growth (Gamit *et al.*, 2019) [13]. These findings are in line with findings of Kumar *et al.*, (2019) [17], who reported that the plant height was significantly increased with combined application of organic and inorganic fertilizers and maintain long term soil fertility and sustain high level of productivity due to increased availability of nutrients to the plant initially through organic and inorganic fertilizers in the cropping season.

Number of leaves per plant

Data pertaining to number of leaves per plant is presented in Table 2. Maximum number of leaves per plant (18.41) were recorded in treatment T₁₂ (75% Recommended dose of NPK + 40 kg S/ha + Azotobacter + PSB + FYM). Whereas, minimum number of leaves per plant (10.83) were recorded by treatment T₀ (Control). This might be attributed to the effective functioning of bio-fertilizers, in terms of nitrogen fixation, phosphate solubilization and mobilization and synthesis of plant growth promoting substances, as well as increased nutrient availability at the proper time (Eragegowda *et al.*, 2018) [11]. Integrated nutrition management may have promoted vegetative development, which in turn increased the number of leaves and increased photosynthetic activity (Dhaker *et al.*, 2017) [10]. The solubilization effect of plant nutrients caused by the addition of farm yard manure as well as the chelating effect of metal ions, can be attributed to increase uptake of NPK by the plant. An increase in growth attributes may be due to sulphur increasing the root system of the plants which might have increased uptake of nutrients and were used in photosynthesis (Farooqui *et al.*, 2009) [12].

Average bulb weight (g)

Average bulb weight is one of the most important yield attributing traits. Data pertaining to average bulb weight is presented in Table 2. Maximum average bulb weight (60.59 g) was recorded by treatment T₁₂ (75% Recommended dose of NPK + 40 kg S/ha + Azotobacter + PSB + FYM). Whereas minimum average bulb weight (23.71 g) was recorded by treatment T₀ (Control). This might be due to the gradual and steady release of nutrient during the growth period as well as enhanced biological activity and proper nutrition to the crop (Nainwal *et al.*, 2015) [23]. Moreover, FYM has contains essential micronutrient other than NPK fertilizers required for healthy plant growth (Gupta *et al.*, 2020) [15]. Sulphur plays an important role in the synthesis of sulphur-containing amino acids in plant cells, especially in the early stages of plant growth and it is the fourth most important nutrient for plants after nitrogen, phosphorus, and potassium (Tripathy *et al.*, 2016) [31]. Bio-fertilizers are known to synthesize the growth promoting substances besides increasing

the availability of atmospheric nitrogen and soil phosphorus which might have led to increased uptake of nutrients and buildup of sufficient photosynthates enabling the increase in size of bulbs, resulting in increased average bulb weight (Gamit *et al.*, 2019) [13].

Bulb length (cm)

The data recorded for bulb length is submitted in Table 2. Maximum bulb length (3.81 cm) was recorded in treatment T₁₂ (75% Recommended dose of NPK + 40 kg S/ha + Azotobacter + PSB + FYM). Minimum bulb length (2.36 cm) was recorded by treatment T₀ (Control). Overall mean for bulb length was 3.22 cm. Increase in bulb length was registered in treatment 75% Recommended dose of NPK + 40 kg S/ha + Azotobacter + PSB + FYM might be due to enhanced availability of nutrients and production of promoting substances by balanced fertilization of nutrient sources that might have caused cell elongation and cell multiplication (Priyanshu *et al.*, 2020) [26]. Application of biofertilizers has increased the nitrogen level which might have mobilized the nutrients to available form to the crop and resulted into the better size of garlic bulbs (Apturkar *et al.*, 2014) [2]. Higher value of yield attributes with the combined use of inorganic, organic and biofertilizers may be due to continuous mineralization and availability of nutrients as needed during later stages of crop growth.

Bulb breadth (cm)

Data for bulb breadth has been presented in Table 2. Maximum bulb breadth (4.69 cm) was recorded in treatment T₁₂ (75% Recommended dose of NPK + 40 kg S/ha + Azotobacter + PSB + FYM). Minimum bulb breadth (2.46 cm) was recorded by treatment T₀ (Control). This could be due supply of nutrients at optimum level leading to accumulation of carbohydrates in ultimate produce by proper photosynthesis in leaves (Priyanshu *et al.*, 2020) [26]. Application of organic manures which provide major and micro nutrients resulted in increased the photosynthetic activity, chlorophyll formation, nitrogen metabolism and auxin contents in the plants ultimately improved the diameter of bulb (Dhaker *et al.*, 2017) [10]. Bhandari *et al.*, 2012 [4] reported that healthy top growth might be responsible for higher rate of photosynthesis and accumulated carbohydrates which resulted in increased size of bulbs as indicated by bulb diameter.

Average clove weight (g)

Average clove weight is an important yield attributing trait. The data recorded for average clove weight is submitted in Table 3. Maximum average clove weight (5.07 g) was recorded in treatment T₁₂ (75% Recommended dose of NPK + 40 kg S/ha + Azotobacter + PSB + FYM). Whereas, minimum average clove weight (1.48 g) was recorded by treatment T₀ (Control). Due to higher accumulation of carbohydrates as stored food and Sulphur is also responsible for gaining weight of cloves (Priyanshu *et al.*, 2020) [26]. Data pertaining to number of cloves per bulb is presented in Table 2.

Number of cloves per bulb

Maximum number of cloves per bulb (13.63) were recorded in treatment T₁₂ (75% Recommended dose of NPK + 40 kg S/ha + Azotobacter + PSB + FYM) [Table3]. Whereas, minimum number of cloves per bulb (8.60) were recorded by treatment T₀ (Control). Assefa *et al.*, (2015) [3] reported that number of cloves per bulb were significantly increased with the application of inorganic fertilizer along with FYM and Biofertilizers. The

formation of maximum number of cloves might be due to gradual and steady release of nutrient during the growth period as well as proper nutrition to the crop (Rai and Negi, 2021) ^[27].

Bulb yield (kg/plot)

The visualization of data in Table 3, indicated that treatment T₁₂ (75% Recommended dose of NPK + 40 kg S/ha + Azotobacter + PSB + FYM) recorded maximum bulb yield per plot (2.69kg). Minimum bulb yield (1.07 kg/plot) was recorded in treatment T₀ (Control). This might be due to the application of nutrients in integrated manner viz., organic, inorganic and biofertilizers combinations. Inorganic, organic manure like FYM and abundant quantity of Azotobacter and PSB improved physical and chemical properties of soil by better mineralization of organic manures and adding nitrogen in soil through Azotobacter making more availability of nutrients to the plants (Priyanshu *et al.*, 2020) ^[26]. These results are in line with the findings of Singh and Singh, (2017) who reported that use of Azotobacter and PSB not only makes available the atmospheric nitrogen and soil phosphorus to plants but also enhances the plant growth and bulb yield through release of hormones and nutrients. Increased yield may be due to role of Sulphur which increased chlorophyll content, photosynthesis activity and protein content in crop plants (Patidar *et al.*, 2017) ^[25].

Neck thickness (cm)

Data for neck thickness has been presented in Table 3. Maximum neck thickness (0.53 cm) was recorded in treatment T₁₂ (75% Recommended dose of NPK + 40 kg S/ha + Azotobacter + PSB + FYM). Whereas, minimum neck thickness (0.23 cm) was recorded in treatment T₀ (Control). This could be due availability of sufficient nutrients through the organic manures, inorganic and biofertilizers may be enhanced the meristematic activities and functioning of the protoplasm, which help to improved neck thickness (Apturkar *et al.*, 2014) ^[2]. Total Soluble Solids are the measure of the total amount of solids dissolved in a substance.

Total Soluble Solids (°B)

Data for total soluble solid is presented in Table 3. Highest Total Soluble Solids (36.56 °B) were recorded by the treatment T₁₂ (75% Recommended dose of NPK + 40 kg S/ha + Azotobacter + PSB + FYM). Whereas, the lowest total soluble solids (30.00 °B) were recorded by the treatment T₀ (Control). This might be due to the organic manures and biofertilizers viz., Azotobacter and Phosphate Solubilizing Bacteria which can provide adequate macro and micro plant nutrients which play important role in quality improvement through desirable enzymatic changes during crop growth (Meena *et al.*, 2016) ^[20]. The supply of sufficient quantities of N, P and K from the soil under synergistic effect of Azotobacter and PSB and nitrogen is an integral part of TSS and phosphorus is a structural component of some co-enzymes involved in the production of TSS and improved amino acid absorption, which helped to maintain a higher TSS level in the bulb (Gamit *et al.*, 2019) ^[13]. Priyanshu *et al.* (2020) ^[26] reported that the quality parameters improved with using 75% RDF with combination of Sulphur, FYM, PSB and Azotobacter.

Dry matter content (%)

The dry matter of bulb consists of all its constituents excluding water. The dry matter of bulb includes carbohydrates, fats, proteins, vitamins, minerals and antioxidants. Data for dry matter content is presented in Table 3. Highest dry matter

content (53.38%) was recorded in treatment T₁₂ (75% Recommended dose of NPK + 40 kg S/ha + Azotobacter + PSB + FYM). Whereas, lowest dry matter content (31.69%) was observed in treatment T₀ (Control). This might be due to adequate nutrient availability in the feeding zone which ultimately increased the uptake of nutrients, photosynthetic rate, and greater growth of plant by enhancing the quality of bulb (Choudhary *et al.*, 2015) ^[7]. Sulphur application leads to synthesis of sulphur containing amino acids i.e. cysteine and methionine which are needed for synthesis of protein and improvement in quality of garlic (Patidar *et al.*, 2017) ^[25].

Economics of garlic cultivation

Perusal of data given in Table 4, indicated that maximum gross income (₹ 13,71,900 /ha) was recorded in treatment T₁₂ (75% Recommended dose of NPK + 40 kg S/ha + Azotobacter + PSB + FYM) and minimum (₹ 5,45,700 /ha) was observed in treatment T₀ (Control). Maximum total cost of cultivation (₹ 3,49,967.40 /ha) was recorded in treatment T₁₆ (100% Recommended dose of NPK + 40 kg S/ha + FYM) and minimum (₹ 2,95,280 /ha) was observed in treatment T₀ (Control). Net income (₹ 10,23,204.48 /ha) was recorded maximum in treatment T₁₂ and minimum net income (₹ 2,50,420 /ha) was observed in treatment T₀. Highest benefit: cost ratio (2.93) was recorded in treatment T₁₂ and minimum (0.78) was observed in treatment T₂ (Beejamrit + Jeevamrit + FYM).

Table 1: Ingredients used for preparation of Jeevamrit

Ingredient	Quantity
Cowdung	10 kg
Cowurine	10 L
Jaggery	2 kg
PulseFlour	2 kg
FertileSoil	1 kg
Water	200 L

Table 2: Effect of nutrient management on growth and yield attributes in garlic

Treatment code	Days to marketable maturity	Plant height (cm)	No. of leaves /plant	Average bulb weight (g)	Bulb length (cm)	Bulb breadth (cm)
T ₀	210.66	71.66	10.83	23.71	2.36	2.46
T ₁	207.00	77.89	11.58	34.66	2.95	3.51
T ₂	210.00	75.98	14.16	29.48	2.89	3.22
T ₃	208.66	77.38	14.83	37.77	3.02	3.39
T ₄	206.33	81.83	13.41	41.18	3.25	4.09
T ₅	206.00	84.48	14.66	40.53	3.10	3.43
T ₆	204.66	87.16	16.75	51.29	3.41	3.48
T ₇	205.66	84.75	14.08	38.33	3.19	3.56
T ₈	208.00	81.62	14.16	36.47	3.27	3.82
T ₉	206.00	81.16	15.65	40.08	3.21	3.98
T ₁₀	207.00	84.83	14.91	40.21	3.33	3.89
T ₁₁	207.66	83.75	15.25	50.96	3.51	4.41
T ₁₂	204.33	92.00	18.25	60.59	3.81	4.69
T ₁₃	206.33	83.83	16.58	44.38	3.46	4.17
T ₁₄	207.33	84.41	14.25	44.45	3.30	4.06
T ₁₅	205.00	88.83	17.16	53.68	3.47	4.45
T ₁₆	207.00	80.58	16.08	37.52	3.16	3.83
T ₁₇	207.33	77.58	15.83	35.41	3.10	3.33
Mean	206.94	82.20	14.91	41.18	3.22	3.75
CD _(0.05)	1.63	5.62	1.06	11.25	0.46	0.76
SE(m)	0.56	1.95	0.36	3.89	0.16	0.26
C.V.	0.46	4.10	4.28	16.39	8.70	12.22

Table 3: Effect of nutrient management on yield and quality parameters in garlic

Treatment code	Average clove weight (g)	No. of cloves per bulb	Bulb yield per plot (kg)	Neck thickness (cm)	TSS (°B)	Dry matter content (%)
T ₀	1.48	8.60	1.07	0.23	30.00	31.69
T ₁	2.16	10.66	1.60	0.34	31.83	36.19
T ₂	2.17	10.20	1.32	0.37	32.66	35.25
T ₃	2.96	10.50	1.62	0.37	33.00	39.95
T ₄	3.10	11.66	1.70	0.38	33.33	48.13
T ₅	3.12	11.00	1.72	0.38	33.50	44.32
T ₆	3.94	11.36	2.44	0.46	34.33	45.74
T ₇	3.01	11.06	1.79	0.39	33.33	47.16
T ₈	3.09	11.70	1.72	0.39	34.00	40.09
T ₉	3.18	12.40	2.06	0.38	33.66	46.40
T ₁₀	3.17	12.20	2.43	0.40	33.00	44.56
T ₁₁	4.91	12.86	2.03	0.45	34.00	40.69
T ₁₂	5.07	13.63	2.69	0.58	36.56	53.28
T ₁₃	3.43	12.06	1.85	0.43	33.40	45.34
T ₁₄	3.23	12.00	1.98	0.38	33.33	41.56
T ₁₅	4.83	12.80	2.63	0.48	33.00	40.56
T ₁₆	3.50	11.36	1.99	0.39	33.33	40.96
T ₁₇	3.26	11.70	1.79	0.41	32.83	38.05
Mean	3.31	11.54	1.91	0.40	33.28	42.21
CD _(0.05)	1.43	1.07	0.05	0.13	2.50	3.38
SE(m)	0.49	0.37	0.02	0.04	0.86	1.17
C.V.	26.03	5.56	1.81	19.87	4.52	4.80

Table 4: Effect of nutrient management on economics of garlic cultivation

Treatment code	Total bulb yield (q/ha)	Total cost of cultivation (₹/ha)	Gross income (₹/ha)	Net Income (₹/ha)	B:C ratio
T ₀	90.95	2,95,280	5,45,700	2,50,420	0.84
T ₁	136	3,77,080	8,16,000	4,38,920	1.16
T ₂	112.20	3,77,085	6,73,200	2,96,115	0.78
T ₃	137.37	3,41,180	8,24,220	4,83,040	1.41
T ₄	144.50	3,47,295.52	8,67,000	5,19,704.48	1.49
T ₅	146.20	3,47,195.52	8,77,200	5,30,004.48	1.52
T ₆	207.40	3,47,695.52	12,44,400	8,96,704.48	2.57
T ₇	152.15	3,45,123.64	9,12,900	5,67,776.36	1.64
T ₈	146.20	3,45,023.64	8,77,200	5,32,176.36	1.54
T ₉	175.10	3,45,523.64	10,50,600	7,05,076.36	2.04
T ₁₀	206.55	3,48,295.52	12,39,300	8,91,004.48	2.55
T ₁₁	172.55	3,48,195.52	10,35,300	6,87,104.48	1.97
T ₁₂	228.65	3,48,695.52	13,71,900	10,23,204.48	2.93
T ₁₃	157.25	3,46,123.64	9,43,500	5,97,376.36	1.72
T ₁₄	168.30	3,46,023.64	10,09,800	6,63,776.36	1.91
T ₁₅	223.55	3,46,523.64	13,41,300	9,94,776.36	2.87
T ₁₆	169.15	3,49,967.40	10,14,900	6,64,932.60	1.89
T ₁₇	152.15	3,48,967.40	9,12,900	5,63,932.60	1.61

Conclusion

From the present studies, it can be concluded that the treatment T₁₂ was found superior for parameters viz., plant height (cm), number of leaves per plant, average bulb weight (g), bulb length (cm), bulb breadth (cm), average clove weight (g), number of cloves per bulb, bulb yield per plot (kg) and neck thickness (cm), soil nutrient status i.e. pH, EC (dSm-1), organic carbon (%), available nitrogen (kg/ha), phosphorus (kg/ha), potassium (kg/ha) and sulphur (kg/ha) and quality parameters like TSS (°B), dry matter content (%). Maximum gross income (₹13,71,900/ha), net income (₹ 10,23,204.48/ha) and benefit: cost ratio (2.93) were recorded by treatment. Hence, it can be concluded that integration of inorganic fertilizers with biofertilizers and organic manures helps in improving the growth, yield, quality characters and improve soil nutrient status.

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Competing Interests

It is declared there are no competing interests among authors.

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