

Effect of Clove Weight and Soil Amendments on Yield and Quality of Garlic Bulbs

MANISH KUMAR*, SHIPRA GHARWAL, PALAK SHARMA AND CHERRY NALWA

Department of Seed Science and Technology, Dr Y.S. Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh-173 230, India

*drmanishuhf@rediffmail.com

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ABSTRACT: The experiment was conducted during Rabi season of 2017-18 at Khaltoo farm of Department of Seed Science and Technology, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, H.P. India and was laid out in Randomized Block Design (factorial) with three replications of each treatment combination. The observations were recorded on plant height, number of leaves per plant, bulb yield (kg/plot and q/ha), diameter of bulb, weight of clove, TSS etc. Analysis of variance showed significant differences among all treatment combinations for all the traits under study. Highest bulb yield per plot was obtained with the treatment combination S_3T_2 (clove weight of >5g and vermicompost @5 kg). Clove weight S_3 (>5g) and soil amendment T_2 (vermicompost @5 kg) independently also gave the best results for most of the growth and yield characters.

Keywords: Clove weight, Garlic bulbs, Soil amendments, Quality, Planting material, Yield.

Garlic (*Allium sativum* L.) is the most widely cultivated *Allium* species after onion belonging to the family Amaryllidaceae [1]. Garlic productivity in India is comparatively low as compared to the other regions of the world. So, in the recent years due attention has been given to improve the plant growth and yield with the application of various soil amendments as they modify plant characters which ultimately affect the yield and quality of garlic. Similarly, as the garlic is reproduced exclusively by vegetative means, the plant characters such as clove weight or clove size used as planting material also affects the bulb size, yield and quality of the produce significantly [2]. No doubt the use of the large sized cloves increases the yield significantly but it also enhances the cost of production by increasing the seed rate, whereas, small sized bulbs result into lower yield with lesser seed quantity. Keeping this in view, there is an urgent need to use optimum size garlic cloves as planting material and application of type and quantity of manures and soil amendments in order to have proper growth of plants and better yield.

MATERIALS AND METHODS

The study was conducted at experimental farm of the Department of Seed Science and Technology, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, HP during Rabi season of 2017-18. Climate of the

area was sub-temperate and sub-humid characterized by cold winters. The soil structure of the experimental farm was gravelly loam to gravelly clay loam with pH ranging from 6.8-7.0.

The present study was undertaken on the 'Agrifound Parvati' cultivar of garlic. The experiment was laid out on 29th October 2017 in Randomized Block Design (Factorial) with twenty-one treatment combinations (7×3) replicated thrice. The cloves were planted at a spacing of 15 x 15 cm in a plot having size of 1.0m², accommodating 36 plants per plot. The treatments comprised of twenty-one combinations of clove weight and soil amendments. Factor 1: Clove weight S_1 -1-3 g, S_2 -3.1-5 g & S_3 >5 g. Factor 2: Soil amendments T_1 -Vermicompost @2.5 kg/m², T_2 -Vermicompost @5 kg/m², T_3 -Cocopeat @2.5 kg/ m², T_4 -Cocopeat @5 kg/ m², T_5 -Leaf compost @2.5 kg/m², T_6 -Leaf compost @5 kg/m² and T_7 -Recommended doses of N, P, K.

The observations on various parameters were recorded and all the parameters were statistically analyzed [3]. The level of significance for different variables was tested at 5 % value of significance.

RESULTS AND DISCUSSION

The effect of different clove weight and soil amendments on the various plant and bulb characteristics of garlic is

depicted in Table 1 and 2. It is evident from the tables that the plant and bulb characteristics were significantly influenced by the different treatment combinations.

Number of days to sprouting

Minimum number of days to first sprouting was recorded in the treatment S_3T_2 (5.33 days) which was statistically at par with S_3T_4 (5.57 days), S_2T_2 (5.96 days) and S_1T_2 (6.33 days) whereas the maximum number of days to sprouting was taken in S_1T_5 (13 days). It may be due to the fact that with the increase in the rate of vermicompost application, the number of days taken by garlic sprouts to emerge above soil surface decreased [4]. Also, the effect of clove size was significant on the number of days required for the emergence of the plant above the soil surface. Earlier emergence of garlic plants from the large weight cloves than small weight ones could be attributed to availability of higher amounts of stored food [5].

Plant height 60 days after planting (cm)

The plant height 60 days after planting was higher in S_3T_2 (44.5 cm) which was statistically at par with S_2T_2 (44.13 cm) and were significantly higher than all the other

treatments. The lowest plant height 60 days after planting was recorded in S_1T_5 (27.73 cm). These results may be attributed to the fact that larger size cloves result in increased plant height because of more reserve food material present in them during initial stages of growth [6]. The plant height was also significantly increased by vermicompost which may be attributed to the fact that vermicompost contains a good range of essential micronutrient other than NPK fertilizers, required for healthy plant growth [7] and sufficient N from vermicompost which is one of the important building blocks of amino acids ($-NH_2$), where they link together and form proteins and make up metabolic processes required for plant growth.

Number of leaves per plant

The analysis of variance showed significant differences for number of leaves per plant as shown in Table 1. The data reveals that there were significant differences between treatments. The maximum number of leaves per plant was reported in S_3T_2 (13.16) which was statistically at par with S_2T_2 (12.00) and were significantly higher than all the other treatment combinations. The number of leaves per plant was minimum in S_1T_7 (7.97). It was found

Table 1. Effect of clove weight and soil amendments on the plant characteristics of garlic

Treatments	Days to first sprouting	Plant height (cm) 60 days after planting	Number of leaves per plant	Plant height (cm) at harvest	Yield per plot (kg/m ²)	Bulb yield (q/ha)
S_1T_1	8.67	33.90	10.00	54.83	1.84	184.00
S_1T_2	6.33	42.97	11.00	59.80	1.79	179.67
S_1T_3	10.67	41.17	8.17	57.03	1.73	173.33
S_1T_4	9.33	36.17	9.73	55.43	1.56	155.96
S_1T_5	13.00	27.73	9.20	58.10	1.41	140.90
S_1T_6	11.83	28.47	10.05	52.10	1.42	142.00
S_1T_7	11.17	30.00	7.97	53.47	1.29	129.50
S_2T_1	8.33	35.07	11.67	56.37	1.58	157.83
S_2T_2	5.96	44.13	12.00	61.67	1.85	185.17
S_2T_3	7.93	41.43	9.14	59.37	1.58	158.50
S_2T_4	7.33	37.50	9.36	57.47	1.64	164.00
S_2T_5	12.00	28.47	9.92	48.97	1.42	141.66
S_2T_6	11.00	30.27	8.24	51.80	1.42	142.00
S_2T_7	10.00	33.00	10.08	54.60	1.35	134.93
S_3T_1	7.33	36.13	10.82	56.20	1.62	162.33
S_3T_2	5.33	44.50	13.16	62.67	1.90	190.00
S_3T_3	8.00	41.67	9.75	59.03	1.72	172.33
S_3T_4	5.57	38.53	8.83	57.63	1.83	182.66
S_3T_5	12.33	28.30	10.17	59.53	1.47	147.33
S_3T_6	9.33	30.60	9.15	53.57	1.47	146.66
S_3T_7	8.17	33.50	9.65	53.83	1.45	145.16
CD _(0.05)	1.16	0.91	1.27	1.39	0.11	10.71

that large weight cloves produced more number of leaves per plant because of more reserve food material present in them during initial stages of growth [6]. It was also observed that the application of compost and manure significantly increased vegetative characters [9]. This is because vermicompost has been reported to contain several plant growth promoters, enzymes, beneficial bacteria and mycorrhizae [10].

Plant height at harvest (cm)

The data in Table 1 reveals that there were significant differences in plant height at harvest. The plant height at harvest was maximum in S_3T_2 (62.67 cm) which was statistically at par with S_2T_2 (61.67 cm) and significantly higher than all the other treatments whereas, the minimum plant height at harvest was reported in S_2T_5 (48.97 cm). Maximum plant height of garlic was noticed on the application of vermicompost whereas minimum plant height was noticed when vermicompost was not applied [4]. The increase in height due to the application of vermicompost could be attributed to the fact that vermicompost contains a good range of essential micronutrient other than NPK fertilizers required for healthy plant growth.

Yield per plot (kg)

The effect of the clove weight and soil amendments showed significant differences on yield per plot of garlic as depicted in Table 1. It was found that the treatment S_3T_2 (1.90 kg) resulted in highest yield per plot which was statistically at par with S_2T_2 (1.85 kg), S_1T_1 (1.84 kg) and S_3T_4 (1.83 kg) and significantly higher than all the other treatments. The lowest yield per plot was recorded in S_1T_7 (1.29 kg). This may be because vermicompost has promotive effect on bulb yield as it enhances the carbohydrate and nitrogen metabolism of pectic substances as well as improves the water metabolism and water relation in plants [11].

Bulb yield (q/ha)

The analysis of variance showed significant differences for bulb yield (q/ha) in garlic as shown in Table 1. The treatment S_3T_2 (190 q/ha) resulted in highest bulb yield and it was found statistically at par with S_2T_2 (185.17 q/ha), S_1T_1 (184.00 q/ha) and S_3T_4 (182.66 q/ha) and significantly higher than all the other treatments whereas S_1T_7 (129.50 q/ha) showed the lowest bulb yield. This may be attributed to the fact that vermicompost treatment increased scorodose accumulation, which was directly

related to harvest index, resulting in greater yield and better bulb quality [12].

Bulb fresh weight (g)

Maximum bulb fresh weight was obtained with the treatment S_3T_2 (52.76 g) which was statistically at par with S_2T_2 (51.42 g), S_1T_1 (51.10 g) and S_3T_4 (50.73 g) and significantly higher than all the other treatments. Whereas treatment S_1T_7 (35.96 g) recorded minimum bulb fresh weight as shown in Table 2. The higher fresh weight of bulb by planting larger sized cloves may be attributed to the fact that it helped in better development of root system enabling the proper absorption and utilization of water and nutrient which would results into better quality [13]. Also, the average weight of bulb increased significantly by increased vermicompost application due to increased supply of major plant nutrients that are required in larger quantities for growth and development of plants.

Bulb dry weight (g)

Analysis of variance showed significant differences for the effect of clove weight and soil amendments on bulb dry weight (g) as shown in Table 2. Maximum bulb dry weight was recorded with the treatment S_1T_3 (31.81 g) which was statistically at par with S_1T_1 (28.88 g) and significantly higher than all the other treatments, whereas treatment S_3T_3 (12.26 g) recorded minimum bulb dry weight as depicted in Table 2. These results may be because vermicompost increased the bulb dry weight due to accumulation of non-structural carbohydrates whose distribution patterns change, thus favoring the metabolism of fructan precursors and accumulation of scorodose [12].

Bulb diameter (cm)

Maximum bulb diameter was recorded with the treatment S_3T_7 (4.80 cm) which was statistically at par with S_3T_3 (4.73 cm), S_3T_5 (4.67 cm), S_3T_4 (4.65 cm), S_3T_1 (4.58 cm) and S_3T_6 (4.55 cm) and significantly higher than all the other treatments, whereas treatment S_1T_3 (2.85 cm) recorded minimum diameter of bulb.

Number of cloves per bulb

Analysis of variance showed significant differences for the effect of clove weight soil amendments on the number of cloves per bulb which is presented in Table 2. Maximum number of cloves per bulb was obtained with the treatment S_1T_2 (12.33) which was statistically at par with S_1T_6 (12.20), S_1T_3 (11.87), S_1T_5 (11.80) and S_1T_4 (11.53) and significantly higher than all the other treatments,

Table 2. Effect of clove weight and soil amendments on bulb characteristics of garlic

Treatments	Bulb fresh weight (g)	Bulb dry weight (g)	Bulb diameter (cm)	Number of cloves per bulb	Weight of cloves (g)	Moisture content (%) of bulb	Moisture content (%) of clove	TSS (°B)
S ₁ T ₁	51.10	28.88	3.51	11.07	4.62	43.48	29.63	29.16
S ₁ T ₂	49.89	22.14	3.65	12.33	4.07	55.90	30.42	25.50
S ₁ T ₃	48.13	31.81	2.85	11.87	4.08	33.96	78.03	23.66
S ₁ T ₄	43.31	15.45	3.58	11.53	3.76	64.31	56.56	26.66
S ₁ T ₅	39.13	13.44	3.50	11.80	3.32	65.64	49.83	25.93
S ₁ T ₆	39.43	17.50	2.97	12.20	3.24	55.62	65.02	17.66
S ₁ T ₇	35.96	18.61	4.04	11.33	3.19	48.20	45.36	25.33
S ₂ T ₁	43.83	17.24	3.93	9.80	4.52	60.65	33.08	25.83
S ₂ T ₂	51.42	23.94	3.55	11.40	4.48	53.54	21.38	31.16
S ₂ T ₃	44.02	18.20	3.81	11.00	4.00	58.64	47.32	29.20
S ₂ T ₄	45.54	15.04	3.63	10.40	4.38	66.94	75.59	29.10
S ₂ T ₅	39.34	14.45	3.85	9.67	4.08	63.28	42.22	26.86
S ₂ T ₆	39.43	14.54	3.95	9.60	4.11	63.10	43.20	30.20
S ₂ T ₇	37.47	16.23	4.14	10.73	3.49	56.70	35.49	26.86
S ₃ T ₁	45.08	15.44	4.58	9.07	5.76	65.73	19.83	32.00
S ₃ T ₂	52.76	17.01	4.35	9.40	4.98	67.52	23.44	30.66
S ₃ T ₃	47.86	12.26	4.73	8.40	5.61	74.39	47.68	31.16
S ₃ T ₄	50.73	20.45	4.65	9.20	5.54	59.67	28.34	28.40
S ₃ T ₅	40.91	12.57	4.67	9.13	4.48	69.23	33.33	31.33
S ₃ T ₆	40.73	14.20	4.55	9.20	4.44	65.09	55.50	29.66
S ₃ T ₇	40.31	13.93	4.80	9.27	4.35	65.44	48.30	29.10
CD _(0.05)	2.25	3.55	0.44	0.91	0.39	9.9	13.76	3.54

whereas treatment recorded minimum number of cloves per bulb S₃T₃ (8.40). It was found that a bulb with few cloves produces large individual seeds [14].

Weight of cloves (g)

Among the different clove weight, highest weight of cloves was recorded with treatment S₃T₁(5.76 g) which was statistically at par with S₃T₃ (5.61 g) and S₃T₄(5.54 g) and significantly superior to all the other treatments, whereas the lowest clove weight was recorded with treatment S₁T₇ (3.19 g) as shown in Table 2. This may be due to several growth promoters, enzymes, beneficial bacteria and mycorrhizae contained in vermicompost that led to high mean clove weight through facilitating improved leaf growth and photosynthetic activities thereby increasing portioning of assimilate to the storage organ.

Moisture content (%) of bulb

Highest moisture content (%) of bulb was noticed with treatment S₃T₃(74.39%)which was statistically at par with S₃T₅(69.23%), S₃T₂(67.52%), S₂T₄(66.94%), S₃T₁(65.73%), S₁T₅(65.64%), S₃T₇(65.44%) and S₃T₆(65.09%) and significantly higher than all the other

treatments, whereas minimum moisture content (%) of bulb was recorded with treatment S₁T₃ (33.96%) as shown in Table 2.

Moisture content (%) of clove

The moisture content (%) of clove was significantly influenced by different clove weight and soil amendments as shown in Table 2. The moisture content (%) of clove was maximum in treatment S₁T₃ (78.03%) which was statistically at par with S₂T₄(75.59%) and S₁T₆(65.02%) and significantly higher than all the other treatments. The moisture content (%) of clove was minimum in S₃T₁ (19.83%).

TSS (°B)

Among the different treatments, significantly higher TSS was noticed with S₃T₁which was 32°B which was statistically at par with S₃T₅(31.33°B), S₃T₃(31.16°B), S₂T₂(31.16°B), S₃T₂(30.66°B), S₂T₆(30.20°B), S₃T₆(29.66°B), S₂T₃ (29.20°B), S₁T₁(29.16°B), S₃T₇(29.10°B) and S₂T₄(29.10°B) and significantly higher than all the other treatments. Minimum TSS was recorded with S₁T₆ (17.66°B).This might be due to more accumulation of reserve substances in the bulbs.

CONCLUSION

From the present investigation it was concluded that the treatment S₃T₂ (clove of >5g and vermicompost @5 kg/m²) recorded highest number of leaves per plant, plant height at harvest, bulb yield (kg/plot and q/ha), fresh weight of bulbs and was significantly superior over all other treatments. Hence, this treatment can be recommended for higher productivity with good quality planning material production in garlic after validation for one year at farmer's field after determining the cost-benefit ratio. With regard to quality of bulbs the treatment S₃T₁ (clove of >5g and vermicompost @2.5 kg) recorded highest clove weight, bulb diameter and TSS and was significantly superior over other treatments for these traits. Hence, this treatment can be adopted for quality production of garlic bulbs.

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