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Effect of vermicompost and liquid bioenhancers on growth, yield and quality of okra (*Abelmoschus esculantus* L.)

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Abstract
The study was carried out at the vegetable farm, Department of Vegetable Science, College of Horticulture and Forestry, Jhalrapatan City, Jhalawar during *zaid* season from March, 2022 to June, 2022 to investigate the **"**Effect of vermicompost and liquid bioenhancers on growth, yield and quality of okra (*Abelmoschus esculantus* L.)". The experiment consisted of three level of vermicompost (0, 2.5 and 5 t/ha) and liquid bioenhancers (*Panchagavya* and *Jeevamrut* @ 0, 3, 6% including control) with total of 15 treatments. The experiment was laid out in a Factorial Randomized Block Design (FRBD) with three replications. Data were collected on different growth, yield and quality contributing characters of okra.

The individual application of V_2 (vermicompost @ 5 t/ha) significantly increased the plant height (51.88 cm and 67.59 cm), number of nodes (15.63 and 17.99), number of flower per plant (18.07 and 25.48) at 60 and 90 DAS, respectively, number of fruit per plant (20.12) and crude protein (2.27%), respectively, as compared to control.

With the foliar application of B_2 (*Panchagavya* 6%) significant increase in plant height (50.03 cm and 61.80 cm), number of nodes (13.85 and 15.58), number of flower per plant (17.38 and 24.91) at 60 and 90 DAS, respectively, number of fruit per plant (18.86) and crude protein (2.02%), as compared to control.

The combined application of V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%) recorded the maximum growth parameters *i.e*., plant height (52.92 cm and 70.08 cm), number of nodes (17.64 and 19.30), number of flower per plant (18.37 and 25.67) at 60 and 90 DAS, respectively, number of fruit per plant (20.50) and crude protein content (2.57%), as compared to control (V_0B_0).

Keywords: Foliar spray, growth, *jeevamrut*, liquid bioenchancers, okra, *panchagavya*, vermicompost

Introduction
Okra (*Abelmoschus esculentus* L.) usually known as *Bhindi* or lady's finger belongs to the Malvaceae family, widely cultivated for its tender, green fruits. Chromosome number of 2n = 130. It is supposed to originate from Ethopia. Okra is presently grown in many countries including, Turkey, Iran, Western Africa, Bangladesh, Afganisthan, Burma, Pakisthan, Malaysia, Japan, Branzil, Cyprus, Ethiopia, Ghana and United States of America. It is annual crop of vegetables in tropical and subtropical parts of the world. In India, it is one of the most important nutritious vegetable crops grown round the year. Okra is a fruit vegetable mostly consumed by almost all classes of people throughout the world. It is an often – cross pollinated vegetable with up to 20% cross pollination occurring through insect and other pollinators.

India is the second largest producing country in the world with 5.23 lac hectare areas with 64.16 lac MT productions (Anonymous, 2021-22) [2]. In Rajasthan, total area under vegetable crop production is 4.28 thousand ha with 19.73 thousand metric tonnes, respectively (Anonymous, 2021-22) [2].

Vermicompost is a stable organic fine granular matter, when applied to the soil, it loosens the soil and enhances the passage to the air inlet. The organic carbon in vermicompost slowly and gradually releases the nutrients into the system and helps the plant to absorb the nutrients. It also increases soil structural stability and reduces vulnerability of soil to calamities like erosion.

Organic growth promoters are the products that reduce the need for fertilizers and increase plant growth, resistance to water and abiotic stresses. In small concentrations, these substances are efficient, favouring the good performance of the plant's vital processes and allowing high yields and good quality products. *Panchagavya* consists of five components, namely cow dung, urine, milk, curd, and ghee. *Panchagavya* is also known to contain growth regulatory substances such as IAA, GA, and cytokinin. *Panchagavya* has played a significant role in providing resistance to pests and diseases, resulting in increased overall yields (Tharmaraj *et al*., 2011) [11]. *Jeevamrut* promotes immense biological activity in soil and provides the nutrients for the crop stand. Mixing cow urine, cow dung, pulse flour and jaggary (gur), it is prepared and allowed to ferment for a week.

Materials and Methods

Jhalawar district is located at $23^0$4' to $24^0$52' N-L attitude and $75^0$29' to $76^0$56' E-Longitude in South Eastern Rajasthan. Agro- climatically, the district falls in zone V, known as Humid South Eastern Plain. About 84.22% population of the district is rural whose main occupation in agriculture. The average rainfall in the region is 954.7 mm. Maximum temperature range in the summer is 43-48 ^{0}C and minimum 1.0-2.6 ^{0}C during winter. The soil of the experimental site is black soil of the clay loam type with proper drainage facilities.

The experiment was laid out in a randomized block design (RBD) with three replications and 13 treatments as per recommended dose of fertilizer (NPK @ 60:32:30 kg/ha) involving levels of vermicompost, *panchagavya* and *jeevamrut* soil application and foliar spray at different growth stages of the crop.

V_0B_0: Control, V_0B_1: Vermicompost @ 0 t/ha + *Panchagavya* @ 3%, V_0B_2: Vermicompost @ 0 t/ha + *Panchagavya* @ 6%, V_0B_3: Vermicompost @ 0 t/ha + *Jeevamrut* @ 3%, V_0B_4: Vermicompost @ 0 t/ha + *Jeevamrut* @ 6%, V_1B_0: Vermicompost @ 2.5 t/ha, V_1B_1: Vermicompost @ 2.5 t/ha + *Panchagavya* @ 3%, V_1B_2: Vermicompost @ 2.5 t/ha + *Panchagavya* @ 6%, V_1B_3: Vermicompost @ 2.5 t/ha + *Jeevamrut* @ 3%, V_1B_4: Vermicompost @ 2.5 t/ha + *Jeevamrut* @ 6%, V_2B_0: Vermicompost @ 5 t/ha, V_2B_1: Vermicompost @ 5 t/ha + *Panchagavya* @ 3%, V_2B_2: Vermicompost @ 5 t/ha + *Panchagavya* @ 6%, V_2B_3: Vermicompost @ 5 t/ha + *Jeevamrut* @ 3%, V_2B_4: Vermicompost @ 5 t/ha + *Jeevamrut* @ 6%.

The plant height was measured from the lower cotyledonary node to growing tip and average mean of five plants was taken and expressed in centimeters at 60 and 90 DAS. At final harvest, the total number of nodes on the main stem of each tagged plant was counted, and average of five plants was expressed as number of nodes on main stem. The total numbers of flowers in five randomly tagged plants were counted periodically until the final harvesting of fruits from each plot and average number of flowers per plant was calculated. The number of fresh fruit harvested from fine randomly selected plants was recorded at each harvesting and per plant average number of fruits was calculated.

Results

Plant height (cm) at 60 and 90 DAS

The data pertaining to plant height is depicted in Table (4.1 and 4.2) which showed that vermicompost and liquid bioenhancers alone and in combination had increased the plant height at 60 & 90 DAS over control. The maximum plant height was recorded in V_2 (Vermicompost @ 5 t/ha) with 51.88 cm and 67.59 cm over control (V_0) with 45.32 cm and 53.33 cm, respectively at 60 and 90 DAS. The increase plant height in treatment level V_2 (VC @ 5 t/ha) was 14.47 and 26.73% at 60 and 90 DAS, respectively, higher over control.

Further, among the liquid bioenhancers, maximum plant height was recorded in treatment B_2 (*Panchagavya* 6%) with 50.03 cm and minimum plant height with of 46.84 cm in treatment B_0 but it was found statistically at par with B_4 (*Jeevamrut* 6%) at 60 DAS and whereas at 90 DAS the maximum plant height of 61.80 cm in treatment B_2 (*Panchagavya* 6%) minimum plant height of 57.04 cm in control (B_0) but the treatment B_4 (*Jeevamrut* 6%) was found at par with B_2 (*Panchagavya* 6%). The increase plant height in treatment level B_2 (*Panchagavya* 6%) was 6.81 and 8.34% at 60 and 90 DAS, respectively, higher over control.

The combined effects of vermicompost and liquid bioenhancers reveals that maximum plant height (52.92 cm) was recorded in treatment of V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%) at 60 DAS but V_2B_4 (VC @ 5 t/ha + *Jeevamrut* 6%) and V_2B_1 (VC @ 5 t/ha + *Panchagavya* 3%) was found statistically at par with V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%). At 90 DAS, the maximum plant height (70.08 cm) was recorded in treatment of V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%) and minimum 51.03 cm in control (V_0B_0). The treatment V_2B_4 (VC @ 5 t/ha + *Jeevamrut* 6%) and V_2B_1 (VC @ 5 t/ha + *Panchagavya* 3%) was found statistically at par with V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%). The increase plant height in treatment level V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%) was 25.28 and 37.33% at 60 and 90 DAS, respectively, higher over control.

Number of nodes at 60 and 90 DAS

A keen observation data presented in Table (4.3 and 4.4) showed significant variations for number of nodes for vermicompost, liquid bioenhancers alone and in combined as compared to control on 60 and 90 DAS. The maximum number of nodes was recorded in treatment V_2 (VC @ 5 t/ha) with 15.63 and 17.99 and minimum in control (V_0) with 10.14 and 11.49 at 60 and 90 DAS. It was further noted that increased number of nodes per plant in treatment level V_2 (VC @ 5 t/ha) was 54.14 and 56.57% at 60 and 90 DAS, respectively, higher over control.

Further, the foliar spray of B_2 (*Panchagavya* 6%) showed maximum number of nodes *i.e*. 13.85 and 15.58 and was found statistically at par with B_2 (*Panchagavya* 6%). Whereas, minimum number of nodes *i. e*. 11.21 and 13.22 was recorded in control (B_0) at 60 and 90 DAS. The increase in the number of nodes per plant in treatment level B_2 (*Panchagavya* 6%) was 23.55 and 17.85% at 60 and 90 DAS, respectively, higher over control.

The combined effects of vermicompost and liquid bioenhancers recorded maximum number of nodes (17.64 and 19.30) in treatment of V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%) at 60 DAS and 90 DAS and minimum in control (V_0B_0) *i.e.* 9.22 and 10.77. The treatment V_2B_4 (VC @ 5 t/ha + *Jeevamrut* 6%) and V_2B_1 (VC @ 5 t/ha + *Panchagavya* 3%) was found statistically at par with V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%). It was further noted that increased number of nodes per plant in treatment level V_2

B_2 (VC @ 5 t/ha + *Panchagavya* 6%) was 91.32 and 79.20% at 60 and 90 DAS, respectively, higher over control.

Number of flowers per plant at 60 and 90 DAS

The number of flowers per plant exhibited highly significant variation Table (4.5 and 4.6) over control with application of vermicompost and liquid bioenhancers. The maximum number of flower was recorded in treatment V_2 (VC @ 5 t/ha) with 18.07 and 25.48 and minimum in treatment V_0 (control) with 16.17 and 23.96 at 60 and 90 DAS. It was further noted that increased number of flower per plant in treatment level V_2 (VC @ 5 t/ha) was 11.75 and 6.34% at 60 and 90 DAS, respectively, higher over control.

The foliar spray of liquid bioenhancers affected the number of flowers per plant over control. Maximum number of flower was recorded in B_2 (*Panchagavya* 6%) *i.e.* 17.38 and 24.91 at 60 and 90 DAS but it was found statistically at par with treatment B_4 (*Jeevamrut* 6%) whereas minimum number of flower per plant was recorded in B_0 (control) *i.e.* 16.80 and 24.42 at 60 and 90 DAS, respectively. The increase in the number of flowers per plant in treatment level B_2 (*Panchagavya* 6%) was 3.45 and 2.00% at 60 and 90 DAS, respectively, higher over control.

Further, application vermicompost and liquid bioenhancers spray also showed significantly affect with that maximum number of flowers per plant with 18.37 and 25.67 in treatment of V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%) and minimum in treatment of control (V_0B_0) with at 60 and 90 DAS. However, V_2B_4 (VC @ 5 t/ha + *Jeevamrut* 6%) was found at par with V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%). The increase in the number of flowers per plant in treatment level V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%) was 20.45 and 8.98% at 60 and 90 DAS, respectively, higher over control.

Number of fruits per plant

A perusal of data Table (4.7) showed that number of fruits per plant was significantly affected with application of vermicompost and liquid bioenhancers over control. Maximum number of fruits per plant was observed in V_2 (VC @ 5 t/ha) with 20.12 and minimum number of fruits per plant in control (V_0) with 16.88. It was further noted that number of fruits per plant in treatment V_2 (VC @ 5 t/ha) was 19.19% higher over control.

Similarly, application of bioenhancers also increase the number of fruits per plant significantly over control. Maximum number of fruits per plant was recorded in B_2 (*Panchagavya* 6%) with 18.86, but it was found statistically at par with B_4 (*Jeevamrut* 6%) and B_1 (*Panchagavya* 3%), whereas minimum number of fruits per plant was found in control (B_0) with 17.91. It was further noted that number of fruits per plant in treatment B_2 (*Panchagavya* 6%) was 5.30% higher over control.

Further, combined effect of vermicompost and liquid bioenhancers also had significant effect on number of fruits per plant over control. Maximum number of fruits per plant was recorded in V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%) with 20.50 while minimum was recorded in control (V_0B_0) with 16.70. However, it was found statistically at par with treatment V_2B_4 (VC @ 5 t/ha + *Jeevamrut* 6%) and V_2B_1 (VC @ 5 t/ha + *Panchagavya* 3%), respectively. It was further noted that number of fruits per plant in treatment V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%) was 22.75% higher over control.

Crude protein (%)

The data with regards to effect of vermicompost and liquid bioenhancers on crude protein is given in Table (4.8) that crude protein exhibited significant of higher values as compared to control with application of vermicompost and liquid bioenhancers. The crude protein content was recorded higher in V_2 (VC @ 5 t/ha) with 2.27%, whereas lower crude protein content was found in control (V_0) with 1.56%. It was further noted that crude protein content in treatment V_2 (VC @ 5 t/ha) was 45.51% higher over control.

Further, liquid bioenhancers was also found maximum crude protein in B_2 (*Panchagavya* 6%) *i.e.* 2.02% and minimum crude protein was found in control (B_0) *i.e.* 1.68%. It was further noted that crude protein content in treatment B_2 (*Panchagavya* 6%) was 20.23% higher over control.

Similarly, the combined effect of vermicompost and bioenhancers also showed maximum crude protein 2.57% in treatment V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%) whereas minimum crude protein (1.46)% was found in control (V_0B_0). However, the treatment V_2B_4 (VC @ 5 t/ha + *Jeevamrut* 6%) and V_2B_1 (VC @ 5 t/ha + *Panchagavya* 3%) was found at par with treatment V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%). It was further noted that crude protein content in treatment V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%) was 70.02% higher over control.

Table 1: Effect of vermicompost and liquid bioenhancers on plant height at 60 DAS (cm)

Treatments	B_0	B_1	B_2	B_3	B_4	Mean
V_0	42.24	45.31	47.67	44.61	46.76	45.32
V_1	47.93	48.90	49.50	48.61	49.08	48.80
V_2	50.37	52.37	52.92	50.97	52.77	51.88
Mean	46.84	48.86	50.03	48.07	49.53	48.67
	S.E.M ±		CD (p = 0.05)			
V	0.19		0.56			
B	0.25		0.72			
V x B	0.43		1.25			

Table 2: Effect of vermicompost and liquid bioenhancers on plant height at 90 DAS (cm)

Treatments	B_0	B_1	B_2	B_3	B_4	Mean
V_0	51.03	53.83	55.01	51.90	54.87	53.33
V_1	56.70	58.50	60.31	57.11	59.30	58.38
V_2	63.41	69.58	70.08	65.18	69.68	67.59
Mean	57.04	60.64	61.80	58.07	61.29	59.77
	S.E.M ±		CD (p = 0.05)			
V	0.18		0.52			
B	0.23		0.68			
V x B	0.40		1.18			

Table 3: Effect of vermicompost and liquid bioenhancers on number of nodes 60 DAS

Treatments	B_0	B_1	B_2	B_3	B_4	Mean
V_0	9.22	10.24	11.16	9.53	10.56	10.14
V_1	11.47	12.21	12.74	11.94	12.52	12.18
V_2	12.93	16.91	17.64	13.59	17.09	15.63
Mean	11.21	13.12	13.85	11.69	13.39	12.65
	S.E.M ±		CD (p = 0.05)			
V	0.25		0.74			
B	0.33		0.95			
V x B	0.57		1.65			

Table 4: Effect of vermicompost and liquid bioenhancers on number of nodes 90 DAS

Treatments	B_0	B_1	B_2	B_3	B_4	Mean
V_0	10.77	11.67	12.20	10.87	11.93	11.49
V_1	13.17	14.73	15.23	13.83	15.12	14.42
V_2	15.73	18.92	19.30	16.93	19.05	17.99
Mean	13.22	15.11	15.58	13.88	15.37	14.63
	SEm ±		CD (p = 0.05)			
V	0.13		0.38			
B	0.17		0.49			
V x B	0.29		0.85			

Table 5: Effect of vermicompost and liquid bioenhancers on number of flowers per plant 60 DAS

Treatments	B_0	B_1	B_2	B_3	B_4	Mean
V_0	15.84	16.29	16.38	16.04	16.32	16.17
V_1	16.85	17.19	17.39	16.87	17.36	17.13
V_2	17.73	18.04	18.37	17.89	18.34	18.07
Mean	16.80	17.17	17.38	16.93	17.34	17.13
	SEm ±		CD (p = 0.05)			
V	0.014		0.041			
B	0.018		0.054			
V x B	0.032		0.093			

Table 6: Effect of vermicompost and liquid bioenhancers on number of flowers per plant 90 DAS

Treatments	B_0	B_1	B_2	B_3	B_4	Mean
V_0	23.78	23.96	24.15	23.86	24.05	23.96
V_1	24.23	24.74	24.91	24.64	24.89	24.68
V_2	25.23	25.56	25.67	25.33	25.62	25.48
Mean	24.42	24.75	24.91	24.61	24.85	24.71
	SEm ±		CD (p = 0.05)			
V	0.019		0.054			
B	0.024		0.070			
V x B	0.042		0.122			

Table 7: Effect of vermicompost and liquid bioenhancers on number of fruits per plant

Treatments	B_0	B_1	B_2	B_3	B_4	Mean
V_0	16.70	16.91	17.05	16.76	16.97	16.88
V_1	17.57	18.56	19.04	18.37	18.91	18.49
V_2	19.47	20.40	20.50	19.80	20.45	20.12
Mean	17.91	18.62	18.86	18.31	18.78	18.50
	SEm ±		CD (p = 0.05)			
V	0.06		0.19			
B	0.08		0.24			
V x B	0.14		0.42			

Table 8: Effect of vermicompost and liquid bioenhancers on crude protein content (%)

Treatments	B_0	B_1	B_2	B_3	B_4	Mean
V_0	1.46	1.52	1.67	1.51	1.62	1.56
V_1	1.74	1.80	1.83	1.77	1.82	1.79
V_2	1.85	2.49	2.57	1.91	2.51	2.27
Mean	1.68	1.94	2.02	1.73	1.98	1.87
	SEm ±		CD (p = 0.05)			
V	0.02		0.08			
B	0.03		0.10			
V x B	0.06		0.18			

B_0- Control, B_1 - *Panchagavya* 3%, B_2 - *Panchagavya* 6%, B_3 - *Jeevamrut* 3%, B_4 - *Jeevamrut* 6%, V_0 - Control, V_1 - Vermicompost 2.5 t/ha, V_2 - Vermicompost 5 t/ha

Discussion

The application of vermicompost played an important role in enhancing the growth parameters yield and quality of okra over control. The maximum plant height (51.88 cm and 67.59 cm), number of nodes (15.63 and 17.99), number of flower per plant (18.07 and 25.48) at 60 and 90 DAS, respectively, number of fruit per plant (20.12) and crude protein (2.27%) were recorded under treatment V_2 (VC @ 5 t/ha) and the minimum values for parameters plant height (45.32 cm and 53.33 cm), number of nodes (10.14 and 11.49), number of flower per plant (16.17 and 23.96) at 60 and 90 DAS, respectively, number of fruit per plant (16.88) and crude protein (1.56%) were recorded under treatment V_0 (control). These findings clearly indicated that application of V_2 (VC @ 5 t/ha) played a significant role on enhancing the vegetative growth of okra. The application of vermicompost improvement in plant height may be due to better moisture holding capacity, supply of micronutrients and availability of major nutrients due to favorable soil conditions. The increased nitrogen nutrition may also have accelerated the process of cell division and differentiation (Barani and Anburani 2004 in okra) [3]. Increase in number of nodes might be due to better availability and uptake of plant nutrients, more specially N, P, K resulting in better photosynthesis and protein synthesis. Thus, these increased amount of NPK nutrients in plants, lead to increase plant metabolites that help to build up plant tissues of okra (Barani and Amburani 2004) [3]. The increased in number of fruits per plant might due to the better availability and uptake of nutrients by plants. Vermicompost improved the physical properties of soil and thereby improved the water and nutrient holding capacity of soil as well as soil fertility condition (Subba Rao and Shankar, 2001 in Brinjal) [10].

The maximum values of growth parameters *i.e*., plant height (50.03 cm and 61.80 cm), number of nodes (13.85 and 15.58), number of flower per plant (17.38 and 24.91) at 60 and 90 DAS, respectively, number of fruit per plant (18.86) and crude protein (2.02%) were recorded under treatment B_2 (*Panchagavya* 6%) and minimum plant height (46.84 cm and 57.04 cm), number of nodes (11.21 and 13.22), number of flower per plant (16.80 and 24.42) at 60 and 90 DAS, respectively, number of fruit per plant (17.91) and crude protein (1.68%) were recorded under treatment B_0 (control). In increase plant height and number of flower per plant may be due to *panchagavya* treatment it contain micronutrients like auxin, IAA which is responsible for the cell division and cell elongation by enhancing auxin hypothesis in these treatments (Perumal *et al.* 2006) [7] and (Anburani 2008) [1]. Increase number of nodes per plant might be due to the application of *panchagavya* at frequent intervals leads to better adaption of plants and also supplied the plant with required nutrients throughout the cropping season; this allowed the plant to grow with lesser nutrient competition, because of which production of more number of nodes (Choudhary *et al*. 2017) [4]. Increase number of fruit might be due to an increased allocation of photosynthates towards economic part due to increased leaf area. The increased leaf area may increase the synthesis of cytokinin and its accumulation in the active sinks which could have caused increased number of fruits as reported by (Harish DK, 2009 in Brinjal) [5]. The improvement in crude protein content might be attributed due to higher uptake of nitrogen during growth period which increased photosynthesis, synthesis of protoplasm and protein (Patil *et al*. 2012) [6].

The results of present investigation shows that the

application of vermicompost with liquid bioenhancers (*panchagavya* 6%) had significant effect on growth, yield and quality parameters over control. The maximum value of parameters *i.e.* the maximum plant height (52.92 cm and 70.08 cm), number of nodes (17.64 and 19.30), number of flower per plant (18.37 and 25.67) at 60 and 90 DAS, respectively, number of fruit per plant (20.50) and crude protein content (2.57%) was recorded under treatment V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%). Whereas, the minimum values of parameters *i.e.*, plant height (42.24 cm and 51.03 cm), number of nodes (9.22 and 10.77), number of flower per plant (15.84 and 23.78) at 60 and 90 DAS, respectively, number of fruit per plant (16.70) and crude protein content (1.46%) were recorded under treatment V_0B_0 (control). The application of vermicompost and liquid bioenhancers V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%) increased the growth, yield and quality attributes. Application of vermicompost helped the plants to attain maximum height to the slow release of major nutrients to the plant especially nitrogen and also *panchagavya* application supplies almost all essential plant nutrients for the growth and development of a plant which eventually resulted in the increase in plant height Singh *et al*. (2005) [9] and Patil *et al*. (2012) [6]. Maximum number of nodes may be due to greater photosynthesis production of metabolites and enzymatic activities due to vermicompost and *panchagavya* application which might have influenced into increased the availability of nutrients through organic source helped in higher and stronger root growth. The results were in confirmatory with (Singh *et al*. 2017) [8].

Conclusion

It could be inferred that the individual application of vermicompost @ 5 t/ha (V_2) and *Panchagavya* 6% (B_2) exhibited maximum plant height (67.59 and 61.80 cm), number of nodes (17.99 and 15.58), number of flower per plant (25.48 and 24.91) at 60 and 90 DAS, respectively, number of fruit per plant (20.12 and 18.86), and crude protein (2.27 and 2.02%), and minimum plant height (55.33 and 57.04 cm), number of nodes (11.49 and 13.22), number of flower per plant (23.96 and 24.42) at 60 and 90 DAS, respectively, number of fruit per plant (16.88 and 17.91) and crude protein (1.56 and 1.68%) under control, respectively.

Combined application of V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%) was found suitable in terms of growth, yield and quality over control. The treatment V_2B_2 (VC @ 5 t/ha + *Panchagavya* 6%) was found maximum plant height (52.92 and 70.08 cm), number of nodes (17.64 and 19.30), number of flower per plant (18.37 and 25.67) at 60 and 90 DAS, respectively, number of fruit per plant (20.50) and crude protein (2.27%) and minimum plant height (42.24 and 51.03 cm), number of nodes (9.22 and 10.77), number of flower per plant (15.84 and 23.78) at 60 and 90 DAS, respectively, number of fruit per plant (16.70) and crude protein (1.46%) under control, respectively.

Author's contribution

Conceptualization and designing of the research work (SJ, KA, RS), Execution of field experiments and data collection (SJ, RC), Analysis of data and interpretation (SJ, BN), preparation of manuscript (BN, SJ).

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