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Effect of organic manures on growth and floral characteristics of pomegranate (*Punica granatum* L.) cv. Bhagwa

Ramesh Chand Choudhary, HL Bairwa, SS Lakhawat, Gajanand Jat, SK Yadav and Mohan Singh

Abstract
The experiment was carried out on entitled "effect of organic manures on growth and floral characteristics of pomegranate (*Punica granatum* L.) cv. Bhagwa" during *Mrig bahar* (July to December) in 2019 and 2020 at Technology park, CTAE and laboratories of Department of Horticulture, Rajasthan College of Agriculture, MPUAT, Udaipur (Rajasthan). The selected 42 pomegranate plants of 6 years old consisted of 14 treatments with different organic manures which are tested with randomized block design with three replications. The findings of experiment showed that in the various treatments, combination of organic sources like *Jeevamrut* (16.08 L/plant) + Vermicompost (24.79 kg/plant) have significantly effect on growth characteristics [plant height (m) and canopy volume (m^3)] and floral characteristics [earliest first floral bud initiation (days), days to 50% flowering (days), duration of fruit set (days) from flowering, while maximum number of hermaphrodite flowers, fruit set percent (%) and duration of flowering (days)] of pomegranate plants.
The excessive use of chemical fertilizers adversely affected the soil fertility, biodiversity, quality of the produce, human health, increased soil acidity, deteriorate soil physical condition, decrease organic matter, created micronutrient deficiencies and increased plant susceptibility to pest and diseases, decreased soil microbial population, increased soil, water, air pollution, runoff and leaching. To solve these problems, the future of agriculture should be diverting in to organic farming direction.

Keywords: Bhagwa, organic, growth, floral, vermicompost, *Jeevamrut*, NADEP and FYM

Introduction
Pomegranate (*Punica granatum* L.) is an important commercial fruit crop ranks 6th in India belonging to the family Punicaceae and diploid chromosome number (2n=18), growing in the tropical and sub-tropical area of the world, a native from Iran. The plant is drought-tolerant, salinity tolerant, winter hardy and also thrives well under rainfed conditions. In India, commercial pomegranate orchards are found in rainfed areas, which characteristically have nutrient-deficient soils, low in organic matter, irregular distribution of rainfall and generally experience water deficiency during plant growth period. Pomegranate is a heavy feeder and for better yield, the soil must be kept fertile.
After starting of green evolution the farmers uses chemical fertilizers to increase the production and productivity of crop. The excessive use of chemical fertilizers adversely affected the soil fertility, biodiversity, quality of the produce, human health, increased soil acidity, deteriorate soil physical condition, decrease organic matter, created micronutrient deficiencies and increased plant susceptibility to pest and diseases, decreased soil microbial population, increased soil, water, air pollution, runoff and leaching. To solve these problems, the future of agriculture should be divert in to organic farming direction. Because, the addition of organic matter will not only provide needed nutrients (including micronutrients) but also improve physical and biological condition of soils, improve aeration, provide better scope for root growth and production. It is a sound practice for sustainable horticulture based on low chemical inputs. The use of vermicompost not only increases the rate of water intake into the soil but also improves the soil's ability to hold water. Its use enhances colour, smell, taste, flavour and keeping quality of fruits. The use of organic manures is being to maintain and improve soil quality and productivity levels at low input cost.

Use of organic sources of nutrients helps to conserve soil health by maintaining the equilibrium of organic matter and soil microflora, ultimately helping to improve physical, chemical and biological properties of the soil [1].

FYM being a bulky organic manure improves soil aeration in addition to the supply of essential plant nutrients and organic matter thereby increasing the soils biological activities. FYM also provided room for better microbial establishment along with the accumulation of excess humus content [2].

Compost improve drainage and absorption of moisture in soils with structural deficiencies or lack of nutrients. They also make it possible to increase crop productivity, promote plant growth by incorporating essential nutrients, facilitate implementation in different types of soil, reduce runoff and obtain economic benefits for farmers. Adding organic composts to apple orchard soils has been shown to improve the blooming and growth of newly planted trees and fruit yields [3].

According to Boraiah *et al.* (2017) [4] the application of Jeevamrit promotes biological activity in the soil and makes the nutrients available to the crop. Higher microbial load and growth hormones which might have enhanced the soil biomass thereby sustaining the availability and uptake of applied as well as native soil nutrients which ultimately resulted in better growth and yield of crops. *Jeevamrut* contains an enormous amount of microbial load which multiplies in the soil and acts as a tonic to enhance microbial activity in soil.

Materials and Methods

The experiment was carried out at Technology park, CTAE and laboratories of Department of Horticulture, Rajasthan College of Agriculture, MPUAT, Udaipur (Rajasthan) located at 582.17 m above mean sea level with coordinates of 24º 34´ N latitude and 73º 42´ E longitudes, during *Mrig bahar* (July to December) in 2019 and 2020. The Randomized Block Design was used for laid out of experiment. There were 14 treatment combinations [T_1-Control, T_2- RDF (600: 200: 200g NPK/Plant/year), T_3- FYM (120.72 kg/plant), T_4- Compost (54.10 kg/plant), T_5- Vermicompost (49.58 kg/plant), T_6- NADEP Compost (70.83 kg/plant), T_7- *Jeevamrut* (32.17 L/plant), T_8- FYM (60.36 kg/plant) + Compost (27.05 kg/plant), T_9- FYM (60.36 kg/plant) + Vermicompost (24.79 kg/plant), T_{10}- FYM (60.36 kg/plant) + NADEP compost (35.41 kg/plant), T_{11}- *Jeevamrut* (16.08 L/plant) + FYM (60.36 kg/plant), T_{12}- *Jeevamrut* (16.08 L/plant) + Compost (27.05 kg/plant), T_{13}- *Jeevamrut* (16.08 L/plant) + Vermicompost (24.79 kg/plant) and T_{14}- *Jeevamrut* (16.08 L/plant) + NADEP (35.41 kg/plant)] with 3 replications and in each replication one tree served as a treatment unit. Thus 42 trees were selected for the experiment.

Results and Discussion

Growth Characteristics

The effect of use of organic manures on growth characteristics of pomegranate like plant height and canopy volume were presented in Table 1. It was inferred that the application of T_2 - recommended dose of fertilizer (RDF- 600: 200: 200 g NPK plant^{-1}) significantly increased the plant height (2.62 m) and canopy volume (6.61 m^3) which was statistically at par with organic combination level T_{13} - *Jeevamrut* 16.08 L plant^{-1} + Vermicompost 24.79 kg plant^{-1} recorded plant height (2.61 m) and canopy volume (6.37 m^3) in pooled data analysis.

The inorganic fertilizer has recorded highest vegetative growth as compare to organic manures application. This might be due to nitrogen is an essential part of nucleic acid this play vital role in promoting the plant growth. It is obvious that phosphorus is a constituent of chlorophyll and is involved in many physiological process including cell division, development of meristematic tissue, photosynthesis, metabolism of carbohydrates, fats and proteins etc. Marathe *et al.* (2017) [5] was reported that the application of RDF (500: 125: 250 g NPK) significantly increase the plant height and plant spread of pomegranate. Similar results was recorded by Ghosh *et al.* (2012) [6] in pomegranate and [7] in papaya.

On the application of organic manures like vermicompost and *Jeevamrut* significantly enhanced the growth of the pomegranate as compare to other treatments. This was due to the organic manures are bulky in nature, lower down soil compaction and improve soil aeration in addition to the supply of essential plant nutrients, organic matter and thereby increasing the soil's biological activities. Earlier, increased release of growth factors like auxins, gibberellins and cytokinin in root zone due to increased microbial inoculants in rhizosphere soil was observed with the addition of various organics in pomegranate [8] and guava [9] orchards. It also provides room for better microbial establishment along with the accumulation of excess humus content [10] in potato. Vermicompost is a rich source of micro and macro nutrients, Fe and Zn might have enhance the microflora and enzymatic activity which might have augmented the vegetative growth in strawberry [11]. This might be due to earthworm activity as they increase microbial populations that produce plant growth hormones and enhance plant growth in tomato [12]. The improvement in growth may also be due to better moisture retention capacity and supply of nutrients due to favourable soil condition brought out by vermicompost application. The beneficial effects of *Jeevamrut* reported by Palekar (2006) [13] [14] and [15] was attributed to higher microbial load and growth hormones which might have enhanced the soil biomass thereby sustaining the availability and uptake of applied as well as native soil nutrients which ultimately resulted in better growth of crops. Organic manures improve the aeration in the soil which ultimately might have improved the physiological activities inside the plant like plant height and canopy volume [16] in papaya.

Garhwal *et al.* (2014) [17] found that the application of organic manures increase the vegetative and reproductive growth of of kinnow mandarin due to supply of better nutrients. It does not only add organic matter, macro and micro nutrients to soil, but also improves the physico-chemical properties of soil and hence provides better conditions for plants growth and development. Similar results were earlier obtained by [18] in pomegranate and [19] in sapota.

The growth parameters like plant height and canopy volume significantly influenced by the organic manure. The production of auxin and gibberellin in plant growth regulators is known to help in higher plant height and canopy volume, which were released more in application of vermicompost and further affected in vegetative growth of plant. Apart from the reasons mentioned earlier, enhanced growth parameters like plant height and canopy volume due to *Jeevamrut* may also be attributed to the influence of nitrogen, the chief constituent of protein – essential for formation of protoplasm, which enhances cell division and cell enlargement in strawberry [11].

Floral Characteristics

The data presented in Table 1 & 2 earliest first floral bud initiation (26.17 days), days to 50% flowering (35.17 days), duration of fruit set (31.00 days) from flowering, while maximum number of hermaphrodite flowers (150.00), fruit set percent (54.58%), duration of flowering (34.50 days) were recorded in treatment T_2 - recommended dose of fertilizer (RDF- 600: 200: 200 g NPK plant^{-1}), which was statistically at par with organic treatment combination T_{13} - *Jeevamrut* 16.08 L plant^{-1} + Vermicompost 24.79 kg plant^{-1} recorded days to first floral bud initiation (26.50 days), days to 50% flowering (35.50 days), duration of fruit set (31.50 days) from flowering and maximum number of hermaphrodite flowers (149.00), fruit set percent (54.41%), duration of flowering (34.17 days), respectively.

The floral characteristics has better resulted with the application of inorganic fertilizer as compare to organic manures. Because this could be attributed to a higher C/N ratio and increased plant metabolism. The increased vegetative growth and balance C/N ratio could lead to increased synthesis of florigen which ultimately promoted greater flowering. Ghosh *et al.* (2012) [6] was found that the application inorganic fertilizer RDF (400: 100: 300 g NPK) in pomegranate that resulted increase in plant height. Similar results was recorded by [20] in strawberry, [21] in fig and [22] in banana.

The organic manures also affected significantly to the floral characteristics of plants. The combination of vermicompost and *Jeevamrut* was resulted better after inorganic fertilizer. It was might be due to vermicompost and *Jeevamrut* application accelerated the development of inflorescence, leaf numbers in autumn, which are positively correlated with number of flowers, number of fruits as well as per cent fruit set [23] in cape gooseberry. Similar results were also obtained by [20], [24] in strawberry. The earliness in flowering might be due to the higher net assimilation rate on account of better growth leading to the production of endogenous metabolites earlier in optimum level enabling early flower reported by [25] and [26] in papaya. These results are in conformity with the findings reported by [27] and [28] in papaya. The increase in number of flowers (hermaphrodite), fruit set percent, duration of flowering (days) and decrease in days to first floral bud initiation, days to 50% flowering, duration of fruit set (days) from flowering can be accredited to increased various endogenous hormonal levels in plant tissue responsible for enhancing flowering, pollen germination and pollen tube growth due to increased nutrient availability from vermicompost and *Jeevamrut* which might have ultimately increased fruit set and number of flowers [29] in guava. The better vegetative growth due to organics might have reflected in increased flowers and results in higher per cent fruit set. The increased fruit set due to vermicompost could be attributed to the presence of B group vitamins, plant hormones and chemical exudates released during biological activity promoted by the vermi-compost in the soil [30] in guava.

Table 1: Effect of organic manures on growth and floral characteristics of pomegranate (*Punica granatum* L.) cv. Bhagwa

Treatment	Plant height (m)			Canopy volume (m^3)			Days to first floral bud emergence			Days to 50% flowering		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
T_1	2.11	2.24	2.18	2.33	3.04	2.68	29.67	29.33	29.50	39.00	38.33	38.67
T_2	2.53	2.72	2.62	5.74	7.48	6.61	26.67	25.67	26.17	35.67	34.67	35.17
T_3	2.35	2.51	2.43	3.26	4.31	3.78	28.67	28.33	28.50	37.67	37.00	37.33
T_4	2.37	2.53	2.45	3.37	4.48	3.93	28.67	28.00	28.33	37.33	36.67	37.00
T_5	2.40	2.56	2.48	3.75	5.01	4.38	28.33	27.67	28.00	37.00	36.33	36.67
T_6	2.26	2.42	2.34	2.72	3.62	3.17	29.33	29.00	29.17	38.67	38.00	38.33
T_7	2.30	2.48	2.39	2.88	3.89	3.39	29.33	29.00	29.17	38.67	37.67	38.17
T_8	2.41	2.59	2.50	3.84	5.37	4.60	28.00	27.33	27.67	37.00	36.00	36.50
T_9	2.45	2.62	2.54	4.31	5.19	4.75	27.67	27.00	27.33	36.67	35.67	36.17
T_{10}	2.35	2.51	2.43	3.20	4.33	3.77	29.00	28.33	28.67	38.00	37.33	37.67
T_{11}	2.45	2.64	2.55	4.84	6.30	5.57	27.33	26.67	27.00	36.67	35.67	36.17
T_{12}	2.48	2.70	2.59	5.21	6.80	6.00	27.33	26.33	26.83	36.33	35.33	35.83
T_{13}	2.50	2.71	2.61	5.49	7.24	6.37	27.00	26.00	26.50	36.00	35.00	35.50
T_{14}	2.32	2.49	2.40	3.08	4.16	3.62	29.00	28.67	28.83	38.33	37.67	38.00
S.Em±	0.04	0.04	0.03	0.20	0.33	0.18	0.51	0.56	0.35	0.57	0.60	0.38
CD p=0.05%	0.11	0.13	0.08	0.57	0.97	0.51	1.49	1.63	1.00	1.66	1.74	1.09

Table 2: Effect of organic manures on floral characteristics of pomegranate (*Punica granatum* L.) cv. Bhagwa

Treatment	Hermaphrodite flowers plant-1			Fruit set (%)			Duration of flowering (days)			Duration of fruit set (days)		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
T1	119.67	131.00	125.33	47.32	46.64	46.98	31.00	31.67	31.33	34.67	34.33	34.50
T2	148.00	152.00	150.00	54.16	55.00	54.58	34.00	35.00	34.50	31.67	30.33	31.00
T3	125.33	132.67	129.00	49.29	49.17	49.23	32.00	33.00	32.50	33.67	32.67	33.17
T4	126.00	136.00	131.00	49.30	49.19	49.25	32.33	33.33	32.83	33.33	32.33	32.83
T5	126.33	138.67	132.50	50.26	50.00	50.13	32.67	33.67	33.17	33.00	32.00	32.50
T6	121.67	132.33	127.00	48.43	48.74	48.58	31.33	32.00	31.67	34.33	34.00	34.17
T7	123.00	134.67	128.83	49.32	49.59	49.46	31.33	32.00	31.67	34.00	33.67	33.83
T8	130.67	145.67	138.17	50.31	50.54	50.42	32.67	33.67	33.17	33.00	32.00	32.50
T9	131.00	146.67	138.83	50.36	50.75	50.55	33.00	34.00	33.50	32.67	31.33	32.00
T10	125.33	136.67	131.00	50.00	50.42	50.21	32.00	32.67	32.33	33.67	32.67	33.17
T11	131.00	143.33	137.17	52.83	53.46	53.15	33.33	34.00	33.67	32.33	31.33	31.83

T12	135.67	147.00	141.33	53.82	54.14	53.98	33.33	34.33	33.83	32.33	31.00	31.67
T13	146.33	151.67	149.00	53.99	54.82	54.41	33.67	34.67	34.17	32.00	31.00	31.50
T14	125.00	125.00	125.00	49.69	50.33	50.01	31.67	32.33	32.00	34.00	33.33	33.67
S.Em±	2.23	1.15	1.16	0.88	0.87	0.57	0.49	0.61	0.36	0.51	0.55	0.35
CD p=0.05%	6.47	3.35	3.29	2.55	2.52	1.62	1.42	1.78	1.03	1.47	1.60	0.98

Conclusion

The conclusion of this experiment is that the use of organic sources also at par with inorganic sources. We can say that the combination of *Jeevamrut* (16.08 L/plant) + Vermicompost (24.79 kg/plant) increase the growth and floral characteristics of pomegranate cv. Bhagwa. Based on the experimental findings, it could be recommended that pomegranate growers or farmers should be apply *Jeevamrut* (16.08 L/plant) + Vermicompost (24.79 kg/plant) to better growth and floral characteristics of pomegranate cv. Bhagwa.

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