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Effect of Panchagavya and Jeevamrit on growth and yield of tomato (*Solanum lycopersicum* L.)

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ABSTRACT

A green house experiment was conducted at Visva-Bharati, Sriniketan (West Bengal) during the rabi season of 2018-19 to study the effect of organics (Panchagavya and Jeevamrit) on growth and yield of tomato cv. Arka Rakshak. Seven treatments were evaluated in complete randomized design with 3 replications. The experimental finding revealed that the application of organics (Panchagavya and Jeevamrit) improved the growth and yield attributes of tomato. Among different treatments of organics, the highest values of growth parameters viz. height (118.4 and 131.7 cm), stem girth (2.56 and 3.25cm), number of leaves per plant (80.5 and 104.2) were recorded maximum with 3% Panchagavya at 50 and 75 DAT, respectively. The yield attributes viz. fruit length (5.60 cm), number of fruits per plant (46.1), fruit diameter (4.41 cm), fruit yield per plant (2.81 kg) were recorded maximum with the application of 3% Panchagavya followed by 5% Panchagavya and 3% Jeevamrit, whereas lowest values of these growth and yield attributes were recorded with 10% Jeevamrit. Panchagavya was found to be superior to Jeevamrit and recorded relatively higher growth and yield attributes of tomato. The values quality parameters i.e., chlorophyll carotenoids, TSS, ascorbic acid and lycopene were maximum under 3% Panchagavya.

Key words: Growth, Jeevamrit, tomato, yield, Panchagavya

INTRODUCTION

Tomato (*Lycopersicon esculentum*) is one of the most important and widely grown vegetable crop of the world. This popular vegetable crop has wider adaptability and can be grown in a wide range of soils and agro-climatic conditions. It is one of the most suitable vegetables for food processing and commonly used in fast food and various processed food products. While firmly ripe fruits of tomato are consumed fresh as salad, unripe green fruits are used for the preparation of pickles and chutney. Ripened fruits of tomato are also cooked with vegetables to enhance the taste and flavour of Indian curries. Tomato is also utilized in the preparation of some value-added products such as juice, ketchup, sauce, puree, soup and canned whole fruits. Tomato is a major source of vitamins and minerals in the human diet. This cash crop has a great demand in the international market owing to its many culinary and dietary uses. The pigments present in ripened fruits of tomato such as β-carotene are important sources of antioxidants in human diet. Over the years, tomato has become an indispensable ingredient of Indian cooking and the productivity of this cash crop should be improved to meet the demand of ever increasing populace under depleting resource base. The inorganic fertilizers are being indiscriminately used to increase the productivity of tomato leading to depletion of soil fertility. The age-old practices of cow based organic farming can serve the dual purpose of increasing productivity of this crop as well as improving soil fertility. Cow dung and cow urine are well known organic fertilizers which have been used since ages. Panchagavya is a traditional organic product produced by using five different products of cow such as cow dung, cow urine, cow milk, cow ghee, cow curd. It has the potential to promote growth and provide immunity in plants thereby confers resistance against pest and diseases. Panchagavya is rich in several mineral nutrients like N, P, K and other micronutrients required for the growth and development of plants (Rakesh *et al.*, 2017). It also contains various amino acids, vitamins, plant growth regulators like Auxins and Gibberellins (Sreenivasa *et al.*, 2010). It is also rich in beneficial micro-organisms like Pseudomonas, Azatobacter and Phosphorous solubilizing bacteria etc. (Singh *et al.*, 2018). Panchagavya can be used as foliar

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spray or pre-sowing or pre-storage treatment of seeds or applied with irrigation water. Panchagavya is commonly used as fertilizer and pesticide. It is used to treat seeds to control seed borne pathogens and pests. Panchagavya was found to be useful in treatment of rhizome of turmeric, ginger and sugarcane and improved their yield. It is also known to improve growth and immunity of plants. Panchagavya can be used as foliar spray or pre-sowing or pre-storage treatment of seeds or applied with irrigation water (Ali *et al.*, 2011). Application of Panchagavya was found to improve the quality of fruits and vegetables (Swaminathan *et al.*, 2007). Jeevamrit is a liquid organic manure prepared by mixing cow dung, cow urine, gram flour, jaggery and soil. The goodness of cow dung and cow urine enriches the fertility of the soil. Application of Jeevamrit was found to increase yield of capsicum (Boraiah *et al.*, 2017). In this experiment cow based organics such as Panchagavya and Jeevamrit were used to study its effect on the growth and productivity of tomato.

MATERIALS AND METHODS

The green house experiment was conducted during rabi season of 2018-19 at Visva-Bharati, Sriniketan which is located at sub-humid and sub-tropical belt of West Bengal. The experimental soil was sandy loam in nature with pH of 6.0, organic carbon 3.2g kg^{-1}, available N 131.6 kg ha^{-1}, available P 14.7 kg ha^{-1} and available K 140 kg ha^{-1}. The experiment was laid out in CRD with 7 treatments replicated thrice in a total of 21 pots. Panchagavya was prepared by mixing 2.5 kg of cow dung, 2.5 kg of cow urine, 0.5 litre of cow milk, 0.5 litre of cow yoghurt, 250g of cow ghee and water. The final volume was made 10 litres with water. Jeevamrit was prepared by mixing 10 kg desi cow dung, 8 litres of desi cow urine, 2kg gram flour, 2 kg jaggery, 800 g mud under the banyan tree and water. The final volume of the mixture was made upto 25 litres with water. Seven levels of organics viz. control, 3%, 5% and 10% of Panchagavya and Jeevamrit were used in the experiment as foliar as well as soil application to tomato plants raised in earthen pots. The crop was grown without NPK fertilizer. Only organics were used as source of nutrient. The growth parameters such as plant height, plant girth and leaves per plant were recorded at 50 and 75 days after transplanting (DAT). The days taken to 50% flowering was worked out by counting the days taken from transplanting to the initiation of flowering in 50% plants. The yield and yield attributes (fruit length, number of fruits /plant, fruit diameter, fruit yield (kg)/ plant) were recorded at harvest. The quality parameters of tomato (total soluble solid, ascorbic acid and lycopene) were analyzed in fully ripened fruits. T.S.S. of the fruits were measured by Digital Refractometer. Ascorbic acid content of tomato fruits was estimated by titration method (Rangana, 1979). Lycopene content was estimated by using the method of Thimmaiah (1999). The chlorophyll content of tomato leaves was measured by adopting the method of Hiscox and Israelstam (1979), using Dimethyl sulfoxide (DMSO). Carotenoids content of leaves was determined as per the method of Lichtenthaler and Wellburn (1983). The chlorophyll as well as carotenoids were estimated by using the method of Arnon (1949) and expressed as mg g^{-1} of fresh leaf.

RESULTS AND DISCUSSION

Growth characters

Application of Panchagavya and Jeevamrit was found to increase the plant height of tomato and the highest plant height (118.4 cm and 131.7 cm at 50 and 75 DAT respectively) was obtained with 3% of Panchagavya followed by 5% Panchagavya and which was at par with 3% Jeevamrit (Table 1). Higher plant height obtained by application of Panchagavya may attributed to presence of growth promotors like auxin and gibberellin in it. The lowest plant height (79.3 cm and 87.6 cm at 50 and 75 DAT respectively) was recorded with 10% Jeevamrit. However, Panchagavya was found to be superior to Jeevamrit in terms of height of plant recorded at 50 and 75 DAT. Reduced growth of plants at higher concentration of Jeevamrit may be attributed to osmotic stress caused by higher concentration of sugar in it. Suresh Kumar *et al.* (2011), Rakesh*et al.* (2017) and Arivazhagan *et al.*(2019) also reported an increase in plant height by application of Panchagavya.

The stem girth of tomato plant increased with the application of Panchagavya and Jeevamrit. The highest stem girth (2.56cm and 3.25cm at 50

and 75 DAT respectively) was obtained from T_2 (3% of Panchagavya) followed by T_3 (5% of Panchagavya). Higher stem girth obtained by application of Panchagavya may attributed to presence of growth promotors and mineral nutrients in it. The lowest stem girth (1.78cm and 2.43cm at 50 and 75 DAT respectively) was recorded with 10% Jeevamrit. Reduced stem girth at higher concentration of Jeevamrit may be attributed to osmotic stress caused by higher concentration of sugar present in it. However, application of Jeevamrit increased the stem girth significantly over control. This result corroborates the findings of Sarkar *et al.* (2014) and Loganathan and Wahab (2014).The application of Panchagavya and Jeevamrit increased the number of leaves of tomato and the highest number of leaves (80.5 and 104.2 at 50 and 75 DAT respectively) was recorded with 3% of Panchagavya. The lowest number of leaves (58.2 and 68.4 at 50 and 75 DAT respectively) was recorded with 10% Jeevamrit. Among different levels of Jeevamrit maximum number of leaves was recorded with 3% Jeevamrit. However Panchagavya was found to be superior to Jeevamrit in terms of number of leaves per plant. Rakesh*et al.* (2017), Gunasekar*et al.* (2018) and Arivazhagan *et al.*(2019) also reported an increase in number of leaves by application of Panchagavya.

Table 1: Effect of organics (Panchagavya and Jeevamrit) on the growth attributes of tomato

Treatments	Plant height (cm)		Stem girth (cm)		Number of eaves/plant		Days to 50% flowering
	50 DAT	75 DAT	50 DAT	75 DAT	50 DAT	75 DAT	
T_1	82.2	90.5	1.84	2.52	60.2	71.2	38.2
T_2	118.4	131.7	2.56	3.25	80.5	104.2	30.5
T_3	114.1	125.5	2.34	3.13	77.1	100.3	31.5
T_4	97.8	110.4	2.12	2.83	72.4	92.1	34.5
T_5	104.8	115.1	2.27	2.95	75.2	84.4	32.9
T_6	90.8	101.4	2.05	2.61	67.3	77.6	35.7
T_7	79.3	87.6	1.78	2.43	58.2	68.4	37.4
SEm (±)	3.0	2.8	0.07	0.07	3.2	4.5	1.0
CD (0.05)	9.0	8.4	0.20	0.21	9.8	13.6	3.0

Yield attributes

The application of Panchagavya and Jeevamrit reduced the days to 50% flowering of tomato inducing early flowering. The least number of days (30.5) to 50% flowering (earliest induction of flowering) was recorded with 3% of Panchagavya and maximum number of days (38.2) in control. Induction of early flowering obtained by application of Panchagavya may be attributed to the presence of growth promotors like auxin and gibberellin in it. Application of 3% of Jeevamrit (T_4) decreased the number of days to 50% flowering significantly over control. Panchagavya was found to be superior to Jeevamrit and recorded earlier flowering in tomato plants. Gunasekar*et al.* (2018) also reported early flowering of the crops by application of panchagavya.Minimum days to flowering of tomato with application Pachagavya was also reported by Arivazhagan *et al.* (2019).

The application of these organics increased the length of tomato fruits. The highest fruit length (5.60cm) was obtained with 3% of Panchagavya followed by T_3 (5% of Panchagavya). Increased length of fruits may be attributed to the presence of growth promotors like auxin and gibberellin in it. The lowest fruit length (4.18cm) was recorded with 10% Jeevamrit. However, application of Jeevamrit (T_4) also increased the fruit length significantly over control. This result corroborates the findings of Gunasekar*et al.* (2018) and Gajjela and Chatterjee (2019). The application of these organics increased the number of tomato fruits per plant and highest number of fruits per plant (46.1) was recorded with 3% of Panchagavya followed by 5% of Panchagavya. Higher number of fruits with application of Panchagavya may be attributed to the presence of growth promotors which helps in fruit setting. Application of Jeevamrit(T_4) also increased the number of fruits per plant significantly but higher concentrations of Jeevamrit (T_6 and T_7) were at par in respect of number of fruits. Panchagavya proved superior to Jeevamrit in terms of number of fruits *Effect of*

recorded per plant. (Arivazhagan *et al.* 2019).Gunasekar *et al.* (2018) and Gajjela and Chatterjee (2019) also reported an increase in number of fruits of blackgram and bitter gourd respectively by application of Panchagavya. The application of these organics increased the diameter of tomato fruits and the highest diameter (4.41cm) was obtained with 3% of Panchagavya. This increase in fruit diameter with Panchagavya may be attributed to the presence of growth promotors like auxin and gibberellin in it.. Application of Jeevamrit (T_4) also increased the diameter of fruit significantly but higher concentrations of Jeevamrit (T_6 and T_7) were at par in respect of the diameter of tomato fruits.

Table 2: Effect of organics (Panchagavya and Jeevamrit) on the chlorophyll and carotenoids content of tomato leaves

Treatments	50 DAT				75 DAT			
	Chl a (mg g^{-1})	Chl b (mg g^{-1})	Total Chl(mg g^{-1})	Carotenoids (mg g^{-1})	Chl a (mg g^{-1})	Chl b (mg g^{-1})	Total Chl(mg g^{-1})	Carotenoids (mg g^{-1})
T_1	1.70	0.67	2.37	0.33	1.43	0.42	1.85	0.23
T_2	2.06	1.05	3.11	0.40	1.84	0.74	2.58	0.32
T_3	1.96	0.95	2.90	0.39	1.72	0.65	2.37	0.31
T_4	1.83	0.78	2.61	0.35	1.60	0.53	2.13	0.27
T_5	1.84	0.87	2.71	0.38	1.61	0.59	2.20	0.29
T_6	1.81	0.72	2.53	0.33	1.50	0.44	1.94	0.25
T_7	1.64	0.64	2.28	0.31	1.34	0.42	1.76	0.22
SEm (±)	0.05	0.06	0.08	0.01	0.06	0.05	0.10	0.01
CD (0.05)	0.17	0.19	0.24	0.03	0.18	0.16	0.31	0.03

Application of these organics increased the yield of tomato fruits and the highest yield (2.81 kg) was recorded with 3% of Panchagavya followed by 5% of Panchagavya. Application of Jeevamrit (T_4) also increased the fruit yield per plant significantly but higher concentrations of Jeevamrit (T_6 and T_7) were at par in respect of yield of tomato fruits. Among different treatments of orgnanics, Panchagavya was found to be superior to Jeevamrit and recorded higher fruit yield. Gore and Sreenivasa (2011) and Arivazhagan *et al.* (2019) also reported an increase in fruit yield of tomato with application of Panchagavya. Swain *et al.* (2015) who reported similar results in chilli by application of Panchagavya.

Biochemical and Quality Parameters

Application of these organics increased the chlorophyll a, chlorophyll b, total chlorophyll and carotenoids content of tomato leaves. The highest value of chlorophyll a (2.06 and 1.84 mg g^{-1} at 50 and 75 DAT respectively), chlorophyll b (1.05 and 0.74 mg g^{-1} at 50 and 75 DAT respectively), total chlorophyll (3.11 and 2.58 mg g^{-1} at 50 and 75 DAT respectively) and carotenoids content (0.40 and 0.32 mg g^{-1} at 50 and 75 DAT respectively) were recorded with 3% of Panchagavya followed by T_3 (5% of Panchagavya) which was at par with T_5 (3% Jeevamrit). Higher chlorophyll and carotenoids content of leaves obtained by application of Panchagavya may be due to presence of mineral nutrients in it. Application of Jeevamrit (T_4) increased the chlorophyll and carotenoids content of leaves significantly but higher concentration of Jeevamrit (T_7) reduced the content of these pigments. Sarkar *et al.* (2014) and Rakesh *et al.* (2017) also reported an increase in the chlorophyll content of leaves with application of Panchagavya.

The TSS content of fruits increased by application of Panchagavya and Jeevamrit. However, the highest TSS content (5.67%) was recorded with 3% of Panchagavya followed by 5% of Panchagavya, where as lowest value (4.13%) was recorded with control. The TSS content of tomato recorded from different treatments of organics (T_2, T_3 and T_5) was significantly higher than the control. Application of Jeevamrit (T_5) increased the TSS content significantly but higher concentrations of Jeevamrit (T_6 and T_7) were found at par with respect to TSS content. These results corroborate the findings of Mishra*et al.* (2015) and Muthukumar *et al.*(2019).

Table 3: Effect of organics (Panchagavya and Jeevamrit) on the yield attributes and quality parameters of tomato

Treatments	Fruit length (cm)	Number of fruits /plant	Fruit diameter (cm)	Fruit yield (kg/ plant	TSS (%)	Ascorbic acid content (mg $100g^{-1}$)	Lycopene (mg $100g^{-1}$)
T_1	4.27	34.9	3.42	1.89	4.23	17.4	7.62
T_2	5.60	46.1	4.41	2.81	5.67	23.6	9.10
T_3	5.42	42.3	4.20	2.53	5.40	21.7	8.65
T_4	5.15	38.0	3.90	2.18	4.87	19.4	8.22
T_5	5.31	40.5	4.02	2.35	5.20	20.9	8.42
T_6	4.70	37.3	3.62	2. 14	4.67	18.2	8.08
T_7	4.18	33.7	3.34	1.78	4.13	17.4	7.54
SEm (±)	0.27	1.1	0.15	0.09	0.25	0.9	0.26
CD (0.05)	0.83	3.3	0.46	0.29	0.77	2.8	0.78

The ascorbic acid content of fruits was increased by the application of organics namely Panchagavya and Jeevamrit and highest value of ascorbic acid content (23.6 mg $100g^{-1}$) was recorded with 3% of Panchagavya and lowest (17.4 mg $100g^{-1}$) with control. Application of Jeevamrit (T_5) also increased the ascorbic acid content of fruit significantly but higher concentration of Jeevamrit was at par with respect to ascorbic acid content. Similar results were reported by Mishra*et al.* (2015) and Muthukumar *et al.*(2019) in tomato by the application of Panchagavya.The lycopene content of fruits increased with the application of Panchagavya and Jeevamrit. The highest lycopene content of fruit (9.10mg $100g^{-1}$) was recorded from 3% of Panchagavya followed by 5% of Panchagavya where as lowest (7.54mg $100g^{-1}$) was recorded from control (Table 3). Application of Jeevamrit (T_5) was found to increase the lycopene content of fruit significantly but higher concentrations of Jeevamrit were at par with respect to the lycopene content of tomato fruits. Similar results was also reported by Muthukumar *et al.*(2019).

The results of the experiment indicated that the application of Panchagavya (3% and 5%) and Jeevamrit (3%) significantly improved most of the growth as well as yield parameters of tomato. However, 3% of Panchagavya was found to be the best treatment in terms of growth and yield parameters of tomato. The yield of fruits also improved with application of these organics. Thus, Panchagavya (3%) can be recommended for achieving significantly higher growth and yield of tomato.

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