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**Amit Kumar Verma**

Department of Soil Science and  
Agricultural Chemistry,  
Dr. Balasaheb Sawant Konkan  
Krishi Vidyapeeth, Dapoli,  
Maharashtra, India

**Himanshu Trivedi**

Department of Soil Science and  
Agricultural Chemistry,  
Dr. Balasaheb Sawant Konkan  
Krishi Vidyapeeth, Dapoli,  
Maharashtra, India

**Sharvan Kumar**

(1) Department of Vegetable  
Science, NDU & T Kumarganj,  
Faizabad, Uttar Pradesh, India  
(2) Department of Fruit Science,  
NDUA & T Kumarganj,  
Faizabad, Uttar Pradesh, India

**Corresponding Author:****Amit Kumar Verma**

Department of Soil Science and  
Agricultural Chemistry,  
Dr. Balasaheb Sawant Konkan  
Krishi Vidyapeeth, Dapoli,  
Maharashtra, India

## Response of bio-enhancers on plant growth and yield of broccoli (*Brassica oleracea* L. var. *Italica*) F-1 hybrid green magic

**Amit Kumar Verma, Himanshu Trivedi and Sharvan Kumar**

### Abstract

The investigation was carried out during winter season of 2017-18 at Agricultural farm, School of Agricultural Sciences & Engineering, IFTM University, Moradabad (U.P.). The experiment was laid out in Randomized Block Design (RBD) with 7 treatments and was replicated thrice. Different combinations of *Panchgavya* (4%) *Jivamrita* (20%) and vermiwash (1:5 times dilution), RDF (N:P:K @ 120:60:60 Kg/ha) and control were used as treatments. On the basis of above study, it was found that RDF (N:P:K @ 120:30:30 kg/ha) was proved to be a superior treatment in terms of yield of broccoli (19.03 t/ha), but it was found to be significantly similar with T<sub>4</sub> (*Panchagavya* 4% + *Jivamrita* 20%) and T<sub>5</sub> (*Panchagavya* 4% + Vermiwash 1:5 times dilution). The yield recorded in T<sub>4</sub> and T<sub>5</sub> were 15.69 and 17.00 t/ha, respectively. These results show the importance of bio-enhancers in increasing the yield of broccoli. Bio-enhancers being completely organic in nature were capable of producing yield levels significantly comparable to that of RDF supplied through chemical fertilizers. Apart from yield they also have positive and significant effect on various physical, chemical and microbial properties of soil and environment.

**Keywords:** *Panchagavya*, *Jivamrita*, vermiwash, broccoli, growth, yield

### Introduction

Olericulture is one of the important branches of horticulture. Vegetables are considered as protective food. Broccoli (*Brassica oleracea* L var. *italica*) is one of the important cool season vegetables of Brassicaceae family. Broccoli is a herbaceous annual vegetable grown for its green tender head and biennial in respect of seed production. It is a fast growing crop and requires high nitrogen input. Broccoli buds are rich source of minerals especially K, S, P, Mg and micro-elements. It is either consumed raw as salad or cooked to prepare curries, soup and pickles. The commercial product of the broccoli plant is its inflorescence, harvested before the flower buds begin to open, and often including about 10 cm of the crisp fleshy stem. The inflorescence is green and rich in chlorophyll. Broccoli can be stored cold for a period of two weeks only. Organic farming which is a holistic production management system for promoting and enhancing health of agro-ecosystem, has gained wide recognition as a valid alternative to conventional food products and ensures safe food for human consumption. Liquid bio-enhancers are fermented preparations obtained by active fermentation of plants and animal residues over specific duration. *Panchagavya* is used in different ways such as foliar spray, soil application along with irrigation water, seed or seedling treatment etc. (Natarajan, 2002) [21]. *Jivamrita* is beneficial Bio-enhancer which is promotes soil productivity, growth and yield of plant. Vermiwash has great growth promoting as well as pest killing properties (Sinha *et al.* 2010) [25]. Organic manures not only increase the yield but also improve physical, biological and chemical properties of soil which in turn improve fertility, productivity and water holding capacity of soil. The approach of integrated plant nutrient system aims at sustaining productivity with minimum deleterious effects of chemical on soil health and environment. Research work related to bio-fertilizers has been conducted in India and abroad on large scale. However, no such studies has been made on broccoli especially late duration broccoli which is mainly cultivated in plains of India.

### Material and method

The experiment was carried out at experimental farm of Department of Agricultural Sciences & Engineering, IFTM University, Moradabad (UP) which is at 28°-21' to 28°-16' north latitude

and 78°-4' east longitude at an elevation of 186 m above mean sea level. The analytical reports showed that soil was sandy loam in texture having acidic reaction. Soil pH was 7.0-7.5 with 0.6 per cent organic carbon. The experiment was conducted 8 treatments, each with 3 replicates applying combinations *Panchagavya*, *Jivamrita*, Vermiwash were T<sub>0</sub> (Control), T<sub>1</sub> (*Panchagavya* 4%), T<sub>2</sub> (*Jivamrita* 20%), T<sub>3</sub> (Vermiwash 1:5 time dilution), T<sub>4</sub> (*Panchagavya* 4%+ *Jivamrita* 20%), T<sub>5</sub> (*Panchagavya* 4%+ Vermiwash 1:5 time dilution), T<sub>6</sub> (*Jivamrita* 20% + Vermiwash 1:5 time dilution), T<sub>7</sub> RDF (120:80:80: N: P: K).

*Panchagavya* is an organic formulation, in Sanskrit, means the blend of five by product obtained from Cow like cow dung, Cow urine, curd, ghee, milk, and some other important ingredients. Firstly mixed the Cow dung and ghee stirring properly for three days carefully morning and evening three days after mixed all ingredients and stir carefully two times in day for 15 days.

*Jivamrita* is a rich bio-formulation containing consortia of microbes. It is a solution of fermented cow's dung, cow's urine, sugarcane juice, virgin soil and pulse flour.

Vermiwash is a liquid that is collected after the passage of water through a column of worm action and is very useful as a

foliar spray. It is a collection of excretory products and mucous secretion of earthworms along with micronutrients from the soil organic molecules. These are transported to the leaf, shoots and other parts of the plants in the natural ecosystem. Vermiwash, if collected properly, is a clear and transparent, pale yellow coloured fluid. Investigation was statistically analysed in Simple Randomised Block Design (RBD).

### Result and discussion

Maximum plant height was recorded with treatment T<sub>7</sub> (14.6cm, 26.00cm and 34.20) followed by T<sub>5</sub> (13.40cm, 24.40cm and 33.9) at 15, 30 and 45 DAT. Maximum number of leaves also recorded with treatment T<sub>7</sub> (5.53, 7.93 and 14.53) followed by T<sub>5</sub> (5.40, 7.86, and 14.33) at 15, 30 and 45 DAT. Similarly the leaf length and leaf width also have maximum leaf length T<sub>7</sub> (11.10cm, 21.96 and 32.06) followed by T<sub>5</sub> (10.76cm, 19.80cm and 29.16cm) and maximum leaf width T<sub>7</sub> (5.53cm, 9.63cm and 12.36) followed by T<sub>5</sub> (4.90cm, 9.23cm and 11.36) at 15, 30 and 45 DAT (Table.1).

### Vegetative Parameters

**Table 1:** Response of Bio-enhancers on growth of broccoli

Treatments	Plant Height (cm)			No. of Leaves			Leaf length with petiole (cm)			Leaf width (cm)		
	15DAP	30DAP	45DAP	15DAP	30DAP	45DAP	15DAP	30DAP	45DAP	15DAP	30DAP	45DAP
T <sub>0</sub> Control	13.1	20.16	28.96	5.3	7.06	12.33	10.56	13.23	23.9	4.7	8.16	8.4
T <sub>1</sub> <i>Panchagavya</i> 4%	11.1	20.3	29.96	4.8	7.26	12.66	9.16	17.4	25.5	3.8	7.03	9.36
T <sub>2</sub> <i>Jivamrita</i> 20%	12.65	22.36	30.3	5.13	7.4	13.13	9.96	18.41	27.4	4.36	7.03	9.93
T <sub>3</sub> Vermiwash 1:5 time dilution	12.8	22.56	30.56	5	7.46	13.26	10.56	18.77	23.9	4.33	7.3	10.4
T <sub>4</sub> <i>Panchagavya</i> + <i>Jivamrita</i>	13.05	23.3	32.06	4.8	7.7	13.33	9.8	18.96	28.33	4.16	6.5	11.3
T <sub>5</sub> <i>Panchagavya</i> +Vermiwash	13.4	24.4	33.9	5.4	7.86	14.33	10.76	19.8	29.16	4.9	9.23	11.36
T <sub>6</sub> <i>Jivamrita</i> +Vermiwash	12.85	22.36	31.86	4.8	7.53	13.3	10.63	18.41	27.43	4.5	6.93	10.43
T <sub>7</sub> R:D:F(120:80:80:N <sub>2</sub> :P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O)	14.6	26	34.2	5.53	7.93	14.53	11.1	21.96	32.06	5.53	9.63	12.36
C.D	1.007	.609	.849	NS	.542	.477	NS	.758	.637	NS	NS	.539
S.E.(m)	.329	.199	.277	.197	.177	.156	.426	.248	.208	.213	.856	.176

These results may be attributed to conjoin effects of spray of Vermiwash and application of *Panchgavya* and Vermiwash. This might have increased the total beneficial microbial population in the Rhizosphere which improved the growth of the plants by enhancing the availability of nutrients like N, P, K, Zn, Cu, etc. and plant growth hormone as well (Tilak, 1993 and Kaushal, 2006)<sup>[27, 15]</sup>. Similar increase in plant height was also reported by in *Diffenbachia* with vermiwash, Bhalla *et al.* (2006a)<sup>[4]</sup> in gladiolus and Bhalla *et al.* (2006b)<sup>[5]</sup> and Dharma (2006)<sup>[9]</sup> in carnation with *Panchgavya*. A general view of number of leaves collectively of 15 days, 30 days and 45 days reveals that the best combination of bio-enhancers for the character plant height is T<sub>5</sub>(6.60, 13.07, 16.40). Whereas the treatment T<sub>7</sub> (Recommended dose of fertilizer 120:30:30: N: P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O) displayed height value. In case where there is no application of any bio-enhancers T<sub>0</sub> (Control) the plant height recorded was least. Amongst organic treatments, treatment T<sub>5</sub> was recorded best. This might be due to an increase in the nitrogen along with sufficient amount of phosphorus and potassium made available to the plants because of micro-organisms enriched soil as combine effect of *Panchgavya*, Vermiwash and *Jivamrita*. The above results are also corroborated with the findings of Khomami (2004)<sup>[18]</sup> in *Dieffenbachia* and *Aglaonema* in gladiolus, Yelleskumar. *et al.* (2008)<sup>[30]</sup> in mango, Ansari (2008)<sup>[3]</sup> in spinach, onion and potato. Vidhya and Anburani (2008)<sup>[31]</sup> in jasmine, and Radhakrishnan and Mahendran (2009)<sup>[23]</sup> in tea. Similar trend

in increase in number of leaves was also observed by in gladiolus cv. Candyman, Hatti *et al.* (2010)<sup>[12]</sup>, Karuppasamy and Lourdu (2013)<sup>[16]</sup> mulberry, Verma *et al.* (2013)<sup>[28]</sup> in carnation. A general view of leaves width collectively of 15 days, 30 days and 45 days reveals that the best combination of bio-enhancers for the character leaves width is T<sub>5</sub> (6.51, 12.13, 14.67cm respectively). Whereas the treatment T<sub>7</sub> (Recommended dose of fertilizer-120:30:30: N: P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O) displayed heighth value. In case where than no application of any bio-enhancers T<sub>0</sub> (Control) the breadth of leaf recorded was least. The increase in size of leaf with the increase of dose of bio-enhancers may be due to better uptake of nutrient elements, solubilisation and mobilization of insoluble form of phosphorous in the soil by organic acids. The findings are in close conformity with the finding of in anthurium, Vidhya and Anburani (2008)<sup>[31]</sup> in jasmine, Deotale (2008)<sup>[8]</sup> in soybean and Bais *et al.* (2009)<sup>[6]</sup> in cotton. In case where there is application of bio-enhancers T<sub>0</sub> (Control) the leaf length recorded was least. The increase in leaf length with the increase of dose of bio-enhancers may be due to better uptake of nutrient elements, solubilisation and mobilization of insoluble form of phosphorous in the soil by organic acids. The findings are in close conformity with the finding of in anthurium, Vidhya and Anburani (2008)<sup>[31]</sup> in jasmine, Deotale (2008)<sup>[8]</sup> in soybean and Bais *et al.* (2009)<sup>[6]</sup> in cotton.

Whole plant weight was recorded after harvesting the plants in order to observe the effect of various treatments of bio-enhancers with respect to RDF. The maximum plant weight (0.535, 0.480) was due to the RDF application followed by T<sub>5</sub> (*Panchagavya* (4%)+Vermiwash (1:5 times dilution). Similarly the Leaf weight (g). Maximum leaf weight significantly affected T<sub>7</sub> (0.022g) followed by T<sub>5</sub> (0.018g). No. of secondary head also significantly affected. The maximum No. of secondary head was T<sub>7</sub> (4.00), followed T<sub>5</sub> (3.06cm). Maximum Head weight was significantly affected T<sub>7</sub> (0.206g) followed by T<sub>5</sub> (0.180g). Maximum Head length was significantly affected T<sub>7</sub> (17.23cm) followed by T<sub>5</sub> (16.66cm). The maximum head diameter was significantly affected T<sub>7</sub> (16.16cm) followed by T<sub>5</sub> (14.63cm). Similarly,

the stem weight that was also affected with the use of recommended dose of fertilizer and bio-enhancers. The maximum stem weight observed in T<sub>7</sub> (0.096g) followed by T<sub>5</sub> (0.087g). Stem length significantly affected, the maximum Stem length T<sub>7</sub> (14.23cm) followed by T<sub>5</sub> (13.96cm). Stem diameter also significantly affected the maximum Stem diameter T<sub>7</sub> (2.32cm) which followed by T<sub>5</sub> (2.28cm). Root weight also significantly affected the maximum Root weight T<sub>7</sub> (0.035g) which followed by T<sub>5</sub> (0.032g). Root length also significantly affected the maximum Root length T<sub>7</sub> (20.10cm) which followed by T<sub>5</sub> (19.53). Maximum yield significantly affected by T<sub>7</sub> (4.15t/ha.) followed by T<sub>5</sub> (3.54 t/ha.).

### Yield Attributes

**Table 2:** Response of Bio-enhancers on Yield of broccoli

Treatment	Whole plant weight(gm)	Leaf weight(gm)	No. of secondary head	Primary head weight(gm)
T <sub>0</sub> Control	0.277	0.009	2.46	0.089
T <sub>1</sub> <i>Panchagavya</i> 4%	0.333	0.012	2.60	0.109
T <sub>2</sub> <i>Jivamrita</i> 20%	0.336	0.011	2.73	0.122
T <sub>3</sub> Vermiwash 1:5 time dilution	0.365	0.014	2.76	0.133
T <sub>4</sub> <i>Panchagavya</i> + <i>Jivamrita</i>	0.450	0.017	3.00	0.169
T <sub>5</sub> <i>Panchagavya</i> +Vermiwash	0.480	0.018	3.06	0.186
T <sub>6</sub> <i>Jivamrita</i> +Vermiwash	0.431	0.013	2.83	0.139
T <sub>7</sub> R:D:F(120:80:80:N <sub>2</sub> :P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O)	0.535	0.022	4.00	0.206
C.D.	.033	.001	.328	.024
S.E.(m)	.017	.000	.107	.008

**Table 3:** Response of Bio-enhancers on yield of broccoli

Treatment	Head length(cm)	Head diameter(cm)	Stem weight(gm)	Stem length(cm)	Stem diameter(cm)	Root weight(gm)	Root length(cm)	Yield (ton/ha.)
T <sub>0</sub> Control	13.23	11.36	0.055	12.53	1.83	0.017	19.53	12.740
T <sub>1</sub> <i>Panchagavya</i> 4%	13.9	11.40	0.061	12.7	1.92	0.023	18.16	13.050
T <sub>2</sub> <i>Jivamrita</i> 20%	13.9	11.90	0.066	13.7	2.16	0.03	18.06	14.360
T <sub>3</sub> Vermiwash 1:5 time dilution	15.96	12.10	0.079	13.8	2.23	0.023	18.4	15.103
T <sub>4</sub> <i>Panchagavya</i> + <i>Jivamrita</i>	14.3	13.26	0.078	13.83	2.25	0.031	19.53	15.690
T <sub>5</sub> <i>Panchagavya</i> +Vermiwash	16.66	14.63	0.087	13.96	2.28	0.032	19.53	17.000
T <sub>6</sub> <i>Jivamrita</i> +Vermiwash	14.2	12.20	0.072	13.86	2.23	0.031	18.6	15.397
T <sub>7</sub> R:D:F(120:80:80:N <sub>2</sub> :P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O)	17.23	16.16	0.096	14.23	2.32	0.035	20.1	19.037
C.D.	.526	.510	.006	.675	.178	.002	.650	1.650
S.E.(m)	.172	.166	.002	.221	.058	.001	.212	0.539

A liquid that collected after the passage after of water through a column of worm action popularly known as vermiwash. It is a mixture of excretory products and mucus secretion of earthworms along with micronutrients from the soil organic molecules. It contains nitrogen and growth promoting hormones and essential enzymes that influence resistance in the plants. It is transported to the shoots and other plant parts in the natural ecosystem. It contains cocktail of enzymes viz. Proteins, amylase, urease and phosphates. These are beneficial for growth and development of plant finally stimulate the yield attributing characters and productivity of crops (Kaur, P. *et al.* 2015)<sup>[17]</sup>. In the present investigation, an increase in yield of cabbage is the outcome of increase in the dimension of all the yield attributing traits as well know yield is a complex trait which is solely dependent on the component characters such as, whole plant weight, head weight, head length, head diameter, stem length, stem diameter, stem weight, root weight.

In the present experiment a non significant difference for yield was observed. Although the effect of RDF was found to be at higher side as compare to treatment T<sub>5</sub>.

(Kaur, P. *et al.* 2015)<sup>[17]</sup> reported that application of inorganic fertilizers leads to increases the yield 35 fruits more than organic fertilizers in case of tomato. They reported that shoot

length, number of leaves, dry matter, weight of shoot, root weight, fruit number and fruit weight, were influenced significantly ( $P<0.5$ ) by the action of N:P:K fertilizers as compare to inorganic, vermicompost and *Panchagavya*. Similar result were also reported by (Jadhav and Kulkarni, 2016) works on green gram and (*Capsicum annum* L.). These reports are in well accordance with the findings of the present works.

In contrast to the present finding (Bharadwaj, *et al.* 2015) reported that application of vermicompost at 0, 5,15, 20% increased the height of plant, leaf length, leaves per plant, content of chlorophyll in leaves, fresh weight in (*Capsicum annum* L).

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