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Effect of different bio-enhancers on growth & yield of cauliflower (*Brassica oleracea* L. Var. *Botrytis*)

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Abstract

The present investigation entitled, "Response of bio-enhancers on the plant growth and yield of cauliflower (*Brassica oleracea* var. *botrytis*)" was carried out during winter season of 2016-17 at Agricultural farm, Department of Agricultural Sciences & Engineering, IFTM University, Lodhipur Rajput, Moradabad (U.P.) in Randomized Block Design with three replications. Different combinations of *Panchgavya* (4%) *Jivamrita* (20%) and vermiwash (1:5 times dilution) with RDF (N:P:K::120:30:30) and control were used as treatment. Observations were recorded on vegetative and yield parameters. On the basis of observations recorded, it is found that the performance of the RDF (N:P:K::120:30:30) was better in all vegetative and yield parameters such as plant height (26.73cm), number of leaves (14.67), at 15, 30 and 45 DAT, whole plant weight(1341g) curd weight(544g) and yield (29.04t/ha.). The values for the characters plant height(26.30cm), number of leaves (14.53cm), at 15, 30 and 45 DAT, whole plant weight (1290g), curd weight (488g) and yield (27.06t/ha.) were recorded nearly similar in a treatment combination of bio-enhancers T₅ *Panchagavya* (4%) + Vermiwash (1:5 times dilution) to the RDF. The treatment T₅ (4% *Panchagavya* + 1:5 times dilution of Vermiwash) came out as the best combination for growth and yield characters of cauliflower for commercial production because organically produced vegetables fetch higher price in the market therefore, even if the yield is slightly low with organic inputs, it can be recommended for the commercial production of cauliflower in account of human health, soil health, environmental health and quality product instead of quantity.

Keywords: Bio-enhancers, Cauliflower, Growth, Yield

Introduction

Vegetables are considered as protective food. Vegetables supply essential constituents like vitamins and minerals, which are needed essentially for human body's growth, reproduction and maintenance of good health. According to ICMR, for a well-balanced diet, about 300g vegetables are needed per capita per day which contains 100g root vegetables, 125g green leafy vegetables and 75g other vegetables but the availability of vegetables in our country is only 145g per capita, per day (Thamburaj, 2010). According to this standard, vegetable production in the country is less than even half of the requirement. India is the second largest vegetable producer after China and producing 169.478 million metric tons on an area of 9.542 million hectare which is about 14% of total world production (Indian Horticulture Database 2015).

Cauliflower is one of the popular vegetables around the world with respect to area, availability and production. The name cauliflower consists of two Latin words namely 'caulis' means cabbage and 'floris' means flower. The Cauliflower (*Brassica oleracea* L var. *botrytis*) is an herbaceous annual or biennial vegetable of the family Cruciferae grown for edible tender curds.

Cauliflower is primarily grown for consumption as a vegetable eaten after bowel or steaming or drying as pickling (Choudhury, 1996). Cauliflower has an anti-cancer property, it protects against bowel cancer due to presence of indol-3 - Corbinol with anti-inflammatory properties due to its omega-3 and vitamin K. Indiscriminate use of agrochemicals in vegetable production has adversely affected the soil fertility, crop productivity, produce quality and particularly the environment. Annually, India is losing nearly 0.8 million tonnes of nitrogen, 1.8 million tonnes of phosphorus and 26.3 million tonnes of potassium (Anonymous, 2011). Because of the excessive use of chemicals vegetables grown in India are banned to import by many countries. 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. This farming system avoids excess use of synthetic fertilizers, pesticides, growth regulators and livestock

feed additives and relies on green manures, crop rotations, crop residues, animals manures, bio-fertilizers, bio-pesticides, different kinds of cow based liquid organic manure such as *Panchagavya*, *Jivamrita*, Vermiwash, *Sanjibani*, *Kunapajala*, *Amrit Pani*, etc. Organic manures have dual role, increasing the productivity of soil as well as crop quality and yield. 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). *Panchagavya* is one of the liquid bio-enhancers which is prepared from five products obtained from cow i.e dung, urine, milk, curd & ghee).

Jivamrita is another beneficial liquid bio-enhancer which promotes soil productivity, growth and yield of plant. *Jivamrita* is prepared by fermenting cow dung, urine, jaggery, pulse flour and virgin soil together. *Jivamrita* which is prepared by fermenting cow dung, urine, jaggery, pulse flour, virgin soil) by simple facilities created in the village with minimum expenditure.

Vermiwash is an enriched bio-enhancer prepared from heavy population of earthworms reared in earthen pots/plastic or cemented container of suitable size. The extract contains major, micronutrients, vitamins (such as B₁₂) and hormones (gibberellins & cytokinins) secreted by the earthworms. Vermiwash can be sprayed on plants for better growth, yield and quality production. In fact, vermiwash is a cocktail of enzymes such as proteases, amylases, urease and phosphatase. Microbial study of vermiwash revealed that it contains nitrogen-fixing bacteria like *Azotobacter* sp. *Agrobacterium* sp. *Rhizobium* sp. and some phosphate solubilizing bacteria. Vermiwash has great growth promoting as well as pest killing properties. (Sinha *et al.* 2010). It is an established fact that inorganic is not good for human health compared with organic ones because it is harmful for human health and environment residual effects (Laczi E. *et al* and Hasan, Solaiman 2012, Indira *et al.* 2012). Organic manures not only increases the yield but also improve physical, biological and chemical properties of soil which in turn improve fertility, productivity and water holding capacity of soil (Kalalbandi, *et al.* 2007).

Vegetable production calls for strategies to ensure their round the year availability to the increasing population at reasonable prices besides safeguarding the interest of the farmers. There has been substantial increase both in the production and productivity of the vegetables with the adoption of high yielding varieties and improved production technologies.

Material and Method

A field experiment entitled "Effect of Different Bio-enhancers on Growth & Yield of Cauliflower. was conducted during 2016-2017 in the experimental farm of Department of Agricultural Sciences & Engineering, IFTM University, Moradabad (UP). The details of experimental site. The experiment was laid out in randomized block design (RBD). All treatments were randomly allocated among the plots and replicated three times.

Total 8 treatments [T₀, control; T₁, *Panchagavya* (4%) ; T₂, *Jivamrita* (20%); T₃, Vermiwash (1:5 time dilution); T₄, *Panchagavya*(4%)+ *Jivamrita*(20%); T₅, *Panchagavya*(4%)+ Vermiwash (1:5 time dilution); T₆, *Jivamrita*(20%) + Vermiwash (1:5 time dilution); including standard control T₇, RDF (120:30:30: N: P: K).

Preparation of *Panchagavya*

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.

In Sanskrit, *Panchgavya* means the blend of five products viz. ghee, milk, curd, cow dung and cow urine obtained from cow. All these products are individually called *Gavya* and collectively termed as *Panchgavya*. For preparing 20 liters of *Panchgavya* following ingredients were used.

Preparation of *Jivamrita*

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. The required quantities of fresh cow dung and cow urine were mixed thoroughly in 200 litres of water in a mud pot. Then 4 litres of sugarcane juice, 2 kg pulse flour and 1 kg of virgin soil were added in it. The soil under a tree or undisturbed location (chemicals free soil) is considered as a virgin soil. This solution was stirred well and kept for 3 days for fermentation under shade. The pot of *Jivamrita* solution was covered with a muslin cloth to avoid any undesirable contamination. After 3 days of fermentation, solution of *Jivamrita* was prepared and was used according to treatments.

Preparation of Vermiwash

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.

Microbial load in different bio-enhancers

Microorganisms	Population (cfu ml ⁻¹)	
	<i>Panchgavya</i>	<i>Jivamrita</i>
Bacteria	26.1 x 10 ⁵	15.4 x 10 ⁵
Fungi	18.0 x 10 ³	10.5 x 10 ³
<i>Actinomycetes</i>	4.2 x 10 ³	6.8 x 10 ³
P solublizers	5.7 x 10 ²	2.7 x 10 ²
Free living N ₂ fixers	2.7 x 10 ²	3.1 x 10 ²

Statistical Analysis

The data obtained during the experimentation was subjected to statistical analysis as per procedure described by Gomez and Gomez (1984). The significance of the treatments was tested through F test at 5% and 1% level of significance. Whereas, the mean analysis was done after testing the significance of the variance ratio of error mean squares.

Results and Discussion

Application of different bio-enhancers improved the vegetative growth significantly. Maximum plant height was recorded with treatment T₇ (18.60cm, 26.73cm) followed by T₅ (17.97cm, 26.30cm) at 30 and 45 DAT. Maximum number of leaves also recorded with treatment T₇ (10.17, 14.67) followed by T₅ (10.03, 14.53) at 30 and 45 DAT (Table1). These results may be attributed to conjoint 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 (Copper, 1984; Tilak, 1993 and Kaushal, 2006). Similar increase in plant height was also reported by Khomani (2004) in *Diffenbachia* with vermiwash, Bhalla *et al.* (2006a), Kumar *et al.* (2009) in *gladiolus* and Bhalla *et al.* (2006b) and Dharma (2006) in carnation with *Panchgavya*.

Table 1: Effect of on Different Bio-enhancers Growth & Yield of Cauliflower

Treatment	Plant height (cm)			No. of leaves per plant		
	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS
T ₀ :C	12.06	14.20	24.93	5.53	8.80	12.40
T ₁ :P (4%)	13.56	15.93	25.53	6.26	9.67	12.60
T ₂ :J (20%)	13.10	16.13	25.83	5.78	9.77	12.83
T ₃ :V (1:5 times dilution)	13.43	16.53	25.90	5.71	9.80	12.87
T ₄ :P +J	13.50	17.13	26.23	6.37	9.90	14.00
T ₅ :P+V	13.60	17.97	26.30	6.24	10.03	14.53
T ₆ :J+V	13.10	16.97	26.07	5.77	9.83	12.93
T ₇ :R.D.F	13.90	18.60	26.73	6.61	10.17	14.67
SE(m)±	0.416	0.507	0.244	0.288	0.197	0.304
C.D.	NS	1.553	0.746	NS	0.602	0.932

The results are also corroborated with the findings of Khomani (2004) in *Dieffenbachia* and *Aglaonema*, Kumar *et al.* (2008) in *gladiolus*, Yelleskumar. *et al.* (2008) in mango, Ansari (2008) in spinach, onion and potato. Vidhya and Anburani (2008) in jasmine, and Radhakrishnan and Mahendran (2009) in tea. Similar trend in increase in number of leaves was also observed by Kumar *et al.* (2010) in *gladiolus* cv. Candyman, Hattiet *et al.* (2010), Karuppsamy and Lourdu (2013) mulberry, Verma *et al.* (2013) in carnation.

Table 2: Effect of Different Bio-enhancers on Growth & Yield of Cauliflower

Treatment	Whole plant weight (g)	Curd weight (g)	Yield (t/ha.)
T ₀ :C	770.33	237.33	21.49
T ₁ :P (4%)	909.00	310.67	23.49
T ₂ :J (20%)	929.67	315.33	24.49
T ₃ :V (1:5 times dilution)	1090.67	331.33	25.14
T ₄ :P +J	1234.33	424.00	26.08
T ₅ :P+V	1290.00	488.00	27.06
T ₆ :J+V	1106.00	378.33	24.90
T ₇ :R.D.F	1341.00	544.00	29.04
SE(m)±	37.944	12.142	1.362
C.D. (5%)	116.207	112.411	4.172

However, the whole plant weight was significantly higher in plants supply of RDF. The higher whole plant weight was recorded T₇(1341.0g), followed T₅(1290.0g). Similarly, curd weight also affected significantly. Maximum curd weight T₇ (544g) which followed the T₅ (488g). Yield of curd also affected significantly and shows maximum yield T₇ (29.04t/ha)), followed the T₅ (27.06g). 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 pants. It is transported to the shoots and other pant 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).

In the present investigation, an increase in yield of cauliflower 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, curd 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 T₅.

(Kaur, P. *et al.* 2015) 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, where influenced significantly (P<0.5) by the action of N:P:K fertilizers as compare to inorganic, vermicompost and *Panchagavya*. Similar result where 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).

Nath.G.*et al.* (2009) Reported increased growth yield and fruit quality of trails in case of tomato at (5.10-15) t/ha.

Atiyeh *et al* 2000. Prove the impact of organic fertilizer vermiwash + *Panchgavya* in case of groundnut yield and quality.

(Garg and Chauhan 2003) and (Saxena *et al.*, 2004) advocated that traditional *Panchagavya* and vermiwash, when mixed the soil @ ratio of 1:100 and used as growth medium promoted quit increased, shoot and root weight of the seedling pulses, cereal and vegetables. There by increasing their yield many workers *viz.* Yoshida *et al.* (1976), Dutta *et al.* (2005), Smith and Staden (1983-84), have reported many form of increases in yield attributing traits as aresult of application of vermiwash and *Panchagavya* in number of vegetable crops.

Conclusion

On the basis of above findings it can be concluded that recommended dose of fertilizer, has proved to potential in case of whole plant weight, curd weight, curd length, curd diameter, stem weight, stem diameter, stem length and yield of cauliflower displayed heighth value amongst the treatment of various combination of bio-enhancers *viz.*, *Panchagavya*, *Jivamrita* and vermiwash. The treatment T₅ *Panchagavya* (4%) + Vermiwash (1:5 times dilution) came out the best combination for growth and yield characters.

T₅ (*Panchagavya* 4% + 1:5 times dilution of Vermiwash) and RDF displayed approximately similar values, although the values of RDF are at quite higher side. The revenue gained through organic tags is much more than inorganic. Therefore, even if the amount of produce is low, revenue generation is not affected. The emphasis nowadays is given to human health, soil health, environmental health and quality product instead of quantity. Hence, the treatment number five (*Panchagavya* (4%) + Vermiwash (1:5 times dilution) can be

recommended for organic cultivation of Hybrid Shritha for quality cauliflower production

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