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Effect of organic growth promoters on productivity and profitability of pea (*Pisum sativum* L.)

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ABSTRACT

An experiment was conducted at Vegetable Farm, Department of Vegetable Science, College of Horticulture and Forestry, Jhalawar (Rajasthan) during *rabi* season of 2021-2022 pea. The experiment consisted thirteen treatments of organic growth promoters *viz*. *Panchagavya* @ 2 %, *Panchagavya* @ 4%, *Panchagavya* @ 6 %, *Jeevamrut* @ 2%, *Jeevamrut* @ 4%, *Jeevamrut* @ 6 % and *Brahmastra* @ 2%, *Brahmastra* @4%, *Brahmastra* @6% and vermiwash @ 5%, vermiwash @10%, vermiwash @15% and Control) and laid out in randomized block design with three replications. Results revealed that under foliar spray of *Panchagavya* @ 4 % was recorded length of pod (10.13 cm), breadth of pod (2.56 cm), number of pods per plant (27.92), number of seeds per pod (10.94) and also the weight of pods per plant (187.57 g), yield per plot (4.08 kg) and estimated yield (169.93 q/ha.). Further the application of *Panchagavya* 4%) resulted maximum net return of ₹269775/- ha^{-1} with B:C ratio (3.84). While minimum net returns of ₹170875/- ha^{-1} was found in control with B:C ratio of 2.57, respectively. However, it was found at par with foliar spray of vermiwash @ 10% and vermiwash @15% of pea.

Key words: *Brahmastra, Jeevamrut, Panchagavya, Pea, Vermiwash.*

Introduction

Pea (*Pisum sativum* L.) is an important vegetable crop grown throughout the world. In India, it is grown as herbaceous winter annual in the plains of North India and as summer vegetable in the hills. Pea being leguminous crop also fixes atmospheric nitrogen in symbiosis with nitrogen fixing bacterium (*Rhizobium leguminosarum*) in the root nodules and thus has low nitrogen requirement. Besides, it is also consumed as a pulse (Joshi and Varma, 2020). Pea is very palatable and nutritious for human consumption and contains higher proportion of digestible proteins, carbohydrates, vitamins (A, B and C) and minerals like phosphorus, iron, *etc*. Each 100 g of fresh edible portion of pea contains 72 g water, 0.1 g fat, 4.0 g fiber, 34 mg magnesium, 139 mg phosphorus, 7.8 mg sodium, 0.23 mg copper, 139 IU vitamin A, 0.01 mg riboflavin, 7.2 g protein, 0.8 g minerals, 15.8 g carbohydrates, 20 mg calcium, 14 mg oxalic acid, 1.5 mg iron, 79 mg potassium, 95 mg sulphur, 0.25 mg thiamine, 0.8 mg nicotinic acid, 9 mg vita-

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min C, and richest source of calories among the vegetables (Ali *et al*., 2014).

In India total area under pea crop is 575 thousand ha with the production of 5855 thousand MT and 10.18 tonnes/ha productivity (Anonymous 2020-2021). It is mainly cultivated in Uttar Pradesh, Madhya Pradesh, Bihar, Maharashtra, Punjab, Haryana, Orissa, Assam, West Bengal, Karnataka, Himachal Pradesh and Uttarakhand states in India. In Rajasthan, total area under pea crop is 11329 ha with a production of 0.28 lac MT and productivity 2.47 tonnes/ha (Anonymous 2020-21).

At present ever increasing population is exerting tremendous pressure on agriculture to meet their nutritional food requirement across the world. In order to achieve the current demand of food requirement, farmers are relying more on chemical fertilizers to achieve higher productivity per unit area. However, the efficiency of the chemical fertilizers already reached a plateau due to their indiscriminate use and resulted in poor soil fertility status of the agriculture fields in addition to accumulation of toxic substances in the harvested produces. Also the cost of inorganic fertilizers is increasing enormously to an extent that they are not affordable by the small and marginal farmers. In this regard there is a need to identify the suitable substitute in place of chemical fertilizers which are economically cheaper and ecofriendly. In this juncture, the use of organic growth promoters plays an important role to sustain the soil health as well as productivity of the crops (Verma *et al*., 2018). The use of organic liquid products such as *Beejamrit*, *Jeevamrit*, *Panchagavya* and vermiwash results in higher growth, yield and quality of crops. Theses liquid organic solution are prepared from cow dung, urine, milk, curd, ghee, legume flour and jaggary. They contain macro nutrients, essential micro nutrients, many vitamins, essential micro nutrients, essential amino acids, growth promoting factors like IAA, GA and beneficial microorganisms (Sreenivasa *et al*., 2010).

The organic growth promoters easily disperse in water and are readily available to plants compared to bulky organic manures and interestingly plants can absorb nutrients through the leaves about 20 times faster when applied as foliar spray than applied through the soil, thereby helps to overcome temporary and acute nutrient shortages in the crops (Dhanoji *et al*., 2018). The *Jeevamrutha*, *Beejamrutha*, *Panchagavya*, *Sanjivak*, *Amrithpani*, Vermiwash, *Brahmastra*, cow urine and enriched biodigester organic growth promoters are easily available ecofriendly liquid organic manures which contains macro nutrients, essential micro-nutrients, amino acids, vitamins, growth promoting substances like IAA, GA and beneficial micro-organisms (Chongre *et al*., 2019). So looking to the importance of organic growth promoters and looking to the daily need of today's life it has become necessary to use these liquid organic manures to sustain human health as well as soil health. In view of the above facts and realizing the importance of organic growth promoters the present study to find out effect of organic growth promoters on growth of pea and yield of pea.

Materials and Methods

An experiment was conducted at Vegetable Farm, Department of Vegetable Science, College of Horticulture and Forestry, Jhalawar (Rajasthan) during *rabi* season of 2021-2022 pea. According to Agro-ecological region map brought out by National Bureau of Soil Survey and Land Use Planning, Jhalawar falls in Agro-ecological region No.06. Geographically, is situated at is situated between 23.20^0 N latitud and 75.35^0 E longitude at an altitude of 632.2 meters above MSL.

The soil of experimental site was clay loam in texture (sand 23.6 %, silt 37.6 % and clay 39.8 %), slightly saline in reaction EC (0.54 dS m^{-1}). The experimental soil was medium in available nitrogen (217 kg ha^{-1}), phosphorus (16.93 kg ha^{-1}) and high in potassium (336 kg ha^{-1}) and sufficient in DTPA extractable micronutrients (Zn 0.42 mg kg^{-1}, Fe 5.21 mg kg^{-1}, Cu 0.85 mg kg^{-1} and Mn 2.90 mg kg^{-1}) with pH (7.6). The recommended dose of NPK (25:40:50 kg ha^{-1}), nitrogen was applied half as basal dose and remaining half at 30 days after sowing. Phosphorus and potash were applied just before sowing as basal dose. Source of nutrients applied were urea for nitrogen, diammonium phosphate for phosphorus and mutate of potash for potassium. The experiment consisted thirteen treatments of organic growth promoters *viz*. *Panchagavya* @ 2 %, *Panchagavya* @ 4%, *Panchagavya* @ 6 %, *Jeevamrut* @ 2%, *Jeevamrut* @ 4%, *Jeevamrut* @ 6 % and *Brahmastra* @ 2%, *Brahmastra* @4%, *Brahmastra* @6% and vermiwash @ 5%, vermiwash @10%, vermiwash @15% and Control) and laid out in randomized block design with three replications. Foliar spray solution was prepared ac-

cording to the treatments by dissolving it in water and spray was done at 30 and 45 DAS.

Methodology for preparation of organic growth promoters

Panchagavya: Take 7.0 kg fresh cow dung and 1.0 kg cow ghee than mix thoroughly and incubate them for two days. Next, add 3.0 liter cow urine along with 10 liter of water and stir them properly for one week daily at morning and evening. Then add 3.0 liter sugarcane juice or jaggery mixed in water at the rate of 1:6 ratio for increase fermentation in *Panchagavya* solution. Add cow milk (2.0 liter), cow curd (2.0 liter), tender coconut water (3.0 liter), yeast (100 g) and ripened banana (12). stir the solution thoroughly and properly for three weeks daily at mornings and evenings. Finally, *Panchagavya* was ready and used thereafter for spraying at 30 DAS and 45 DAS (Natarajan, 2002).

Vermiwash: Vermiwash is a liquid that is obtained after the passage of water through a column of worm action. It is a collection of excretory products and mucous secretion of earthworms along with micronutrients from the soil organic molecules. All available litter and refuse are mixed with soil and spread in the shed of animal so as to absorb urine. The next morning, urine soaked refuse along with dung is collected and placed in the trench. Trench size is 6-7.5 m length, 1.5-2 m width and 1.0 m deep are dug. A section of the trench from one end should be taken up for filling with daily collection. When the section is filled up to a height of 45 to 60 cm above the ground level, the top of the heap is made into a dome and plastered with cow dung earth slurry. The manure is ready for use in about four to five months after plastering (Pal and Bala, 2020).

Jeevamruth: Take 100 liters of water in the barrel then add 10 kg cow dung and stir well for 5 minutes then add 5.0 liter of cow urine and stir well. Add 1.0 kg jaggery, 1.0 kg gram flour and 1.0 kg soil add in this solution and stir well for 15 minutes. Add another 100 liters of water in it and stir well. The solution should be stored in cool place and away from sunlight for 6-7 days (Swain *et al*., 2009).

Brahmastra: Take a barrel then add 10 liter of cow urine, 3.0 kg neem leaves paste, 2.0 kg each of custard apple, pomegranate, papaya and guava leaves paste and boil the solution for 5 times and then filter solution using cloth and ferment for 24 hours. This could be stored in bottles for 6 months (Palekar, 1995).

The observations on yield attributes recorded from five selected tagged plants from each plot, yield and economics were analysis as per standard procedure. The data of different parameters were recorded for statistically analysed by adopting appropriate method of standard analysis of variance (ANOVA) using technique for factorial randomized block design. The least significant difference test was used to decipher the effects of treatments at 5% level of significance ($P < 0.05$) by using least significant test (Gomez and Gomez, 1984).

Results and Discussion

Effect of organic growth promotors on yield attributes

A perusal of data presented in Table 1.0 revealed that the pod length of pea was significantly affected by the application of organic growth promoters. The data on different levels of organic growth promoters indicated that the application of *Panchagavya* @ 4% produced maximum pod length (10.13 cm) and minimum pod length (7.20 cm) was produced when no organic growth promoters was applied (control) of pea. However, it was found at par with application of vermiwash @ 15% (9.67 cm) and vermiwash @ 10 % (9.16 cm). The increase pod length to the tune of 28.9 % over control. Significantly maximum breadth of pod (2.56 cm) was recorded with application of *Panchagavya* @ 4% over rest of the treatments. However, it was found at par with application of vermiwash @ 15% (2.53 cm) and vermiwash @ 10% (2.19 cm). The increase in breadth of pod to the tune of 84.1 %) over control. Data indicated that *Panchagavya* @ 4% had highest pods per plant (27.92) as compared to control and rest of the treatments. However, it was found at par with application of vermiwash 15% (27.67) and vermiwash 10% (26.82) at harvest. It was further noted that number of pods per plant in *Panchagavya* @ 4% was 16.23% higher over control. The maximum number of seeds per pod was recorded with application of *Panchagavya* 4% (10.94) and minimum seeds per pod was observed under control (7.39). However, it was found at par with application of vermiwash @ 15% (10.03) and vermiwash @ 10% (9.62). The enhanced seeds per pod with application of *Panchagavya* @ 4% to the tune of 48.03 % over control. Significantly higher pods weight per plant (187.57 g) was recorded with

application of *Panchagavya* 4% and minimum pods weight per plant was observed under control (118.82 g). However, it was found at par with application of vermiwash @ 15% and 10 % (176.40 g and .167.66 g). It was further noted that weight of pods per plant in *Panchagavya* 4% was 57.86% higher over control.

The result of present study showed that foliar application of organic growth promoters (*Panchagavya*, Vermiwash, *Jeevamrut* and *Brahmastra*) had significantly increased yield parameters over control like length of pod (cm), breadth of pod (cm), number of pods per plant, number of seeds per pod and weight of pods per plant (g) compared to control. These results are conformity with the result obtain by Patel *et al*., (2013) in cowpea and Basavaraj *et al*., (2015) in french bean. The foliar application of organic growth promoters (*Panchagavya* 4%) increased the yield characters and the pronounced increase in yield might be due to sustained availability of nutrients (N, P, K, S, Zn and Fe) at growth phases and also due to enhanced carbohydrate synthesis and effective translocation of photosynthates to the developing sink (Swaminathan *et al.,* 2007). *Panchagavya* increased synthesis of growth promoting substances which is turn helped in increased growth and yield attributes and finally pod yield. The number of fruits and single fruit weight are the most important traits in determining the yield. Highly significant differences were observed by application of *Panchagavya* on the above parameters which was reflected in total yield per plant as well. Taller plants with more number of branches have increased photosynthetic area, favourable physiological activities might have resulted in more production and translocation of photosynthates which in turn accelerated the formation of more fruits with larger size ultimately leading to higher fruit yield (Naik and Srinivas, 1992) in okra.

The fermented solutions of *Panchagavya* contains various salts rich in N, P, K, S and micronutrients in plant available form which helps in the formation of chlorophyll in the leaves. Besides, cow dung and urine which are the components of *Panchagavya* contains calcium (0.4%) and silica (1.5%) that plays an important role in the chlorophyll synthesis by increasing protein formation and cell division in the leaves.The increased biological efficiency of the plants by higher chlorophyll synthesis, supply of plant nutrients and growth promoting substances enhanced the pod yield (Kumawat *et al*., 2009) in groundnut. Further the foliar spray of *Panchagavya* improves all the yield parameters. This might be due to the faster absorption of nutrients like urea present in *Panchagavya* through cuticle of leaves. These results are in close agreement with those of Ali *et al*., (2014) in cauliflower, Choudhary *et al*. (2017) in black gram Sutar *et al*. (2018) in cowpea.

Effect of organic growth promotors on pod yield

A perusal of data presented in Table 1.0 revealed that the pod yield of pea was significantly affected

Table 1. Effect of organic growth promoters on yield attributes, yield and economics of pea

Treatments (Foliar spray)	Length of pod (cm)	Breadth of pod (cm)	Number of pods/ plant	Number of seed/ pod	Weight of pods/ plant (g)	Pod yield (q/ha)	Net returns (Rs./ha)	B:C ratio
Control	7.20	1.39	24.02	7.39	118.82	118.76	170875	2.57
Panchagavya @ 2%	8.65	2.02	24.67	8.76	126.29	125.88	183255	2.68
Panchagavya @ 4%	10.13	2.56	27.92	10.94	187.57	169.93	269775	3.84
Panchagavya @ 6%	8.71	2.08	25.57	9.26	148.56	142.98	213815	2.97
Vermiwash @ 5%	8.41	1.83	25.28	9.11	129.45	129.43	189805	2.74
Vermiwash @ 10%	9.16	2.19	26.82	9.62	167.66	157.20	242055	3.36
Vermiwash @ 15%	9.67	2.53	27.67	10.03	176.40	157.34	240125	3.21
Jeevamrut @ 2%	8.15	1.61	24.59	8.76	127.35	126.48	185715	2.75
Jeevamrut @ 4%	8.67	2.06	25.56	9.24	141.39	141.26	213875	3.12
Jeevamrut @ 6%	8.31	2.01	25.45	9.11	136.04	136.01	202055	2.90
Brahmastra @ 2%	7.93	1.56	24.34	8.73	123.39	122.77	178415	2.65
Brahmastra @ 4%	8.07	1.88	25.46	9.05	136.65	136.59	05115	3.01
Brahmastra @ 6%	8.65	1.96	25.48	9.13	139.44	138.27	207655	3.01
SEm±	**0.46**	1.96	**0.77**	**0.45**	**9.38**	**8.78**	10400	0.25
CD at 5%	**1.35**	0.12	**2.27**	**1.33**	**27.38**	**25.64**	30500	0.65

by the application of organic growth promoters. The data indicated that with application of *Panchagavya* @ 4 % had significant effect on pod yield plot^{-1} as compared to different organic growth promoters and control. The highest pod yield plot^{-1} was recorded with application of *Panchagavya* @ 4 % (4.08 kg plot^{-1}) and lowest was found in under control (2.85 kg plot^{-1}), but it was found at par with application of vermiwash 15 % and vermiwash @ 10 %. It was further noted that pod yield (kg plot^{-1}) in *Panchagavya* @ 4 % was 43.15 % higher over control. The maximum pod yield (169.93 q/ha) was recorded with application of *Panchagavya* @ 4% and minimum was found under control *i.e.*, 118.76 q/ha. However, it was found at par with application of vermiwash @15% and vermiwash @ 10% (157.34 and 157.20 q/ha), respectively. It was further noted that pod yield (q/ha) in *Panchagavya* @ 4% was 43.08% higher over control.

The fermented solutions of *Panchagavya* contains various salts rich in N, P, K, S and micronutrients in plant available form which helps in the formation of chlorophyll in the leaves. Besides, cow dung and urine which are the components of *Panchagavya* contains calcium (0.4%) and silica (1.5%) that plays an important role in the chlorophyll synthesis by increasing protein formation and cell division in the leaves.The increased biological efficiency of the plants by higher chlorophyll synthesis, supply of plant nutrients and growth promoting substances enhanced the pod yield (Kumawat *et al*., 2009) in groundnut. Further the foliar spray of *Panchagavya* improves all the yield and quality parameters. This might be due to the faster absorption of nutrients like urea present in *Panchagavya* through cuticle of leaves. These results are in close agreement with those of Sutar *et al*. (2018) in cowpea, Choudhary *et al*. (2017) in black gram.

Effect of organic growth promotors on economics

A reference data presented in Table 1 significantly influence net returns and B: C ratio with the application of organic growth promotors as compare to control. The data shows that higher net returns and B: C ratio was obtained with application of *Panchagavya* @4% over rest of the treatments. The maximum net returns (₹269775/- ha) and B:C ratio (3.84) were recorded with application of *Panchagavya* @ 4% and minimum net returns (₹170875/- ha) and B:C ratio (2.57) was found in under control treatmen. The result of present investigation showed that foliar application of organic growth promoters (*Panchagavya*, Vermiwash, *Jeevamrut* and *Brahmastra*) when applied had significant effect on net returns and B:C ratio in pea for different treatments. The computation of cost of cultivation is important because it decides the option for the farmers to choose the production practices, according to their investment capacity. The higher net returns and B:C ratio were associated with its higher grain and haulm yield per unit of added cost (Govindan and Thirungan, 2000). Similar finding reported earlier by (Gajendra *et al*., 2016).

Conclusion

It is concluded that the yield attributes and pod yield of pea showed considerable increment due to foliar application of *Panchagavya* @ 4 %, vermiwash @ 10 % and vermiwash @ 15 %. Hence this dose of organic growth promotors proved as beneficial for increasing productivity, profitability and good health. These levels of organic growth promotors may be passed on to the farmers for obtaining higher monetary returns of zone Vth of Rajasthan.

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Conflict of interest statement

The author declares that there is no conflict of interest.

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