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Influence of Organic Growth Promoters on Yield and Quality of Pea (*Pisum sativum* L.)

Raju Yadav [a*], Kavita Arvindakshan [a] and Bhagawati Ghosalya [b]

[a] Department of Vegetable Science, College of Horticulture and Forestry, Jhalawar, Rajasthan, India.
[b] Department of Fruit Science, College of Horticulture and Forestry, Jhalawar, Rajasthan, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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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 the foliar spray of *Panchagavya* @ 4% was recorded higher chlorophyll content (2.81 mg/100g) in leaves over different growth promotors and control but it was found at par with the application of *Panchagavya* @ 4% , Vermiwash @ 5%,Vermiwash @ 10%,

**Corresponding author: E-mail: yraju4436@gmail.com;*

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Vermiwash @ 15%,*Jeevamrut* @ 4%and Brahmastra @ 6% in pea. Significantly higher crude protein content (24.97%),ascorbic acid content (27.52 mg/100 g) and TSS content 19.0 ˚Brix were recorded with foliar application of Vermiwash @ 10% over control, Vermiwash @ 5%, *Jeevamrut*@2%**,** *Jeevamrut* @ 4%, *Brahmastra* @ 2%, *Brahmastra* @ 4% in pea. However, it was found at par with application of *Panchagavya*@ 2%, *Panchagavya*@ 4%, *Panchagavya*@ 6%, Vermiwash@ 10%, Vermiwash @ 15%, *Jeevamrut* @ 6% and *Brahmastra* @ 6% in the pea. Results revealed that under foliar spray of Vermiwash @ 15% (157.34 q/ha) and lowest was found in under control (118.76 q/ha), but it was found at par with application of *Panchagavya*@ 4%, *Panchagavya* @ 6%, Vermiwash @ 10%, *Jeevamrut* @ 4%, *Jeevamrut* @ 6%, *Brahmastra* @ 4% and *Brahmastra* @ 4% yield of pea.

Keywords: Brahmastra; foliar spray; jeevamrut; panchagavya; pea; vermiwash.

1. INTRODUCTION

Pea (*Pisum sativum* L.) is an important vegetable crop grown throughout the world. In India, it is grown as a 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 [1]. Pea is very palatable and nutritious for human consumption and contains higher proportion of digestible proteins, carbohydrates, vitamins(A, BandC) 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 gprotein,0.8g minerals,15.8g carbohydrates,20 mg calcium,14mgoxalicacid, 1.5 mg iron, 79 mg potassium, 95 mg sulphur, 0.25 mg thiamine, 0.8 mg nicotinic acid, 9 mg vitamin C, and richest source of calories among the vegetables [2].

In India, the total area under pea crop is 575 thousand ha with the production of 5855 thousand MT and 10.18 tonnes/ha productivity [3]. 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 [3].

“At present, the ever increasing population is exerting tremendous pressure on agriculture to meet their nutritional food requirements across the world. In order to achieve the current demand of food requirement, farmers are relying more on chemical fertilizers to achieve higher crop 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 the 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 that are economically cheaper and eco friendly. 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” [4]. “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 solutions are prepared from cow dung, urine, milk, curd, ghee, legume flour and jaggery. They contain macro nutrients, essential micro nutrients, many vitamins, essential micro nutrients, essential amino acids, growth promoting factors like IAA, GA and beneficial microorganisms” [5].

“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 when applied through the soil, thereby helps to overcome temporary and acute nutrient shortages in the crops” [6]. The *Jeevamrutha*, *Beejamrutha*, *Panchagavya*, *Sanjivak*, *Amrithpani*, Vermiwash, *Brahmastra*, cowurine and enriched biodigester organic growth promoters are easily available eco-friendly liquid organic manures which contains macro nutrients, essential micro-nutrients, amino acids, vitamins, growth promoting substances like IAA, GA and beneficial micro-organisms [7]. 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 the effect of organic growth promoters on growth of pea and yield of pea.

2. 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 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 asbasal dose and remaining half at 30 days after sowing. Phosphorus and potash were applied just before sowing as basal dose. Sources 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. Foliarspraysolutionwaspreparedaccordingtothetr eatmentsbydissolvingitinwater and spray was done at 30 and 45 DAS.

2.1 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 3.0liter 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 [8].

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 withs oil 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 mlength, 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 topof 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 [9].

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 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 [10].

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 [11].

The observations on different quality parameters and pod yield were recorded from five selected tagged plants from each plot after foliar spray of organic growth promoters at 30 DAS and 45 DAS as per standard procedure. Chlorophyll content was measured at 60 DAS as per method suggested by [12]. The total soluble solids(TSS) content was determined with the help of Zeiss Hand Refractometer at the time of harvesting of

pod. Ascorbic acid determined by volumetric method by using2,6-dicholorophenol-indophenols dye [13]. Estimation of nitrogen was done by colorimetric method as suggested by [14] using the Spectronic-20 (MSLPUV-1200). 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 main and interaction effects of treatments at 5% level of significance ($P < 0.05$) by using least significant test [15].

3. RESULTS AND DISCUSSION

Effect of organic growth promotors on quality parameters: A perusal of the data presented in Table 1 revealed that the chlorophyll content in leaves of pea was significantly affected by the application of organic growth promoters. Under foliar spray of *Panchagavya* @ 4% was recorded higher chlorophyll content (2.81 mg/100g) in leaves over control (1.70 mg/100 g), *Panchagavya*@2% (2.0 mg/100 g), *Panchagavya*@ 6% (2.13 mg/100 g), *Jeevamrut*@2%(2.03 mg/100 g),*Jeevamrut*@ 6%(2.13 mg/100 g), *Brahmastra*@ 2%(2.07 mg/100 g), *Brahmastra*@ 4% (2.18 mg/100 g) in the plant leaves. However, it was found at par with application of *Panchagavya* @ 4%(2.81 mg/100 g), Vermiwash@5%(2.50 mg/100 g),Vermiwash @ 10%(2.68 mg/100 g), Vermiwash @ 15%(2.70 mg/100 g), *Jeevamrut*@ 4%(2.40 mg/100 g) and Brahmastra@ 6% (2.37 mg/100 g), respectively. The crude protein content percent in pea is presented in Table 1 and Fig. 1. Significantly higher crude protein content per cent was recorded with foliar application of Vermiwash @ 10%(24.97%) over control (22.59%), Vermiwash@5% (23.05%), *Jeevamrut*@ 2%(23.09%), *Jeevamrut* @ 4%(23.66%), *Brahmastra*@ 2%(23.00%), *Brahmastra*@ 4% (23.18%) in pea. However, it was found at par with application of *Panchagavya*@2% (23.87%), *Panchagavya* @ 4% (23.97%), *Panchagavya* @ 6% (23.82%), Vermiwash @ 10% (24.97%), Vermiwash @ 15%(24.56%), *Jeevamrut* @ 6%(23.75%) and *Brahmastra*@ 6% (23.81%) in the pea.

Results revealed that the ascorbic acid content was significantly affected by organic growth promoters. The maximum value of ascorbicacid content with 27.52 mg/100 g was noticed under application of Vermiwash @ 10% and minimum24.00 mg/100 g was found in the control. However, it was found at par with *Panchagavya* @ 24% (26.33%), *Panchagavya* @ 6% (27.28%) and Vermiwash @ 15%(26.72%) but it was found significantly superior over application of *Panchagavya* @ 2% (25.28%), Vermiwash@5%(25.55%), *Jeevamrut* @ 2% (25.26%), *Jeevamrut* @ 4%(25.93%), *Jeevamrut*@ 6%(25.68%), *Brahmastra* @ 2%(24.65%), *Brahmastra*@ 4% (25.63%) and *Brahmastra*@ 6% (26.04%) in the pea. The TSS (˚Brix) content of pea is depicted in presented in Table 1. Data showed that the maximum TSS content in vermiwash @ 10% with 19.0 ˚Brix was recorded over control (16.1 ˚Brix), Vermiwash @ 5% (17.8 ˚Brix) and *Brahmastra*@ 2% (17.8 ˚Brix). However, it was found at par with application of *Panchagavya*@2% (18.1˚Brix),

Table 1. Effect of organic growth promoters on quality parameters and yield of pea

Treatments (Foliar spray)	**Chlorophyll content of leaves (mg/100g)**	**Crude protein (%)**	**Ascorbic acid (mg/100g)**	**Total Soluble Solid (°Brix)**	**Green pod yield (q/ha)**
Control	1.70	22.59	24.00	16.1	118.76
Panchagavya@2%	2.00	23.87	25.28	18.1	125.88
Panchagavya@4%	2.81	23.97	26.33	18.3	169.93
Panchagavya@6%	2.13	23.82	27.28	18.2	142.98
Vermiwash@5%	2.50	23.05	25.55	17.8	129.43
Vermiwash@10%	2.68	24.97	27.52	19.0	157.20
Vermiwash@15%	2.70	24.56	26.72	18.5	157.34
Jeevamrut@2%	2.03	23.09	25.26	17.9	126.48
Jeevamrut@4%	2.40	23.66	25.93	18.2	141.26
Jeevamrut@6%	2.13	23.75	25.68	18.0	136.01
Brahmastra@ 2%	2.07	23.00	24.65	17.8	122.77
Brahmastra@ 4%	2.18	23.18	25.63	18.0	136.59
Brahmastra@ 6%	2.37	23.81	26.04	18.1	138.27
SEm±	**0.20**	**0.43**	**0.50**	**0.40**	**8.78**
CD at 5%	**0.60**	**1.28**	**1.46**	**1.19**	**25.64**

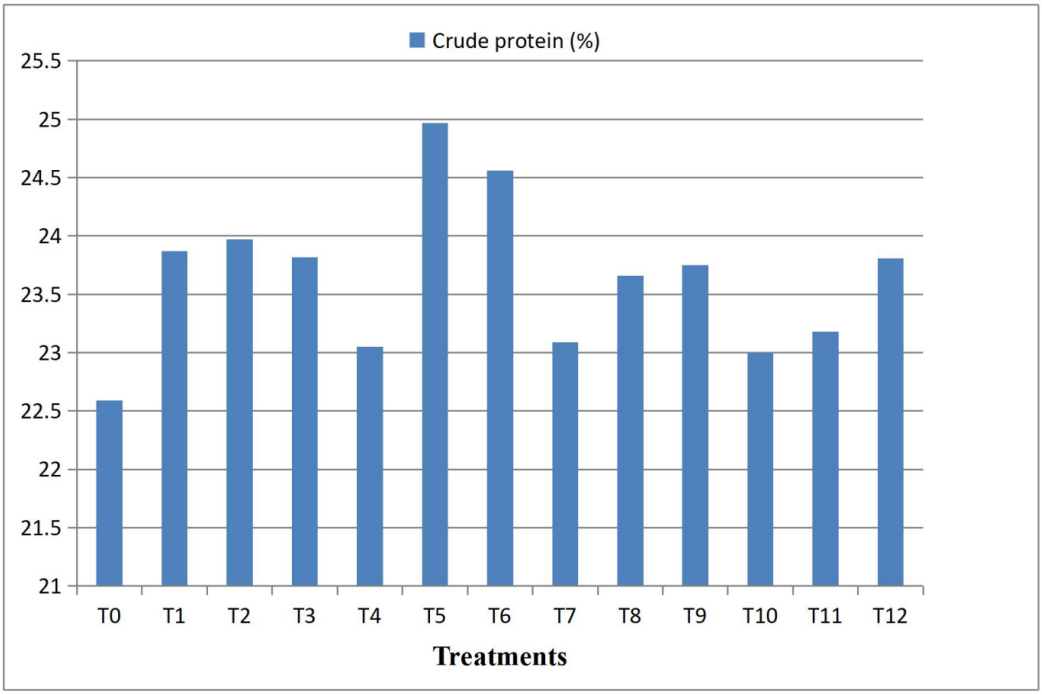

Fig. 1. Effect of organic growth promoters on crude protein in pea

T_0: Control T_1: Panchagavya@ 2 %, T_2: Panchagavya@ 4%, T_3: Panchagavya@ 6 %,
T_4: Jeevamrut@ 2%, T_5: Jeevamrut@ 4%, T_6: Jeevamrut@ 6 %
T_7: Brahmastra@ 2%, T_8: Brahmastra@4%, T_9: Brahmastra @6%
T_{10}: vermiwash @ 5%, T_{11}: vermiwash @10%, T_{12}: vermiwash @15%

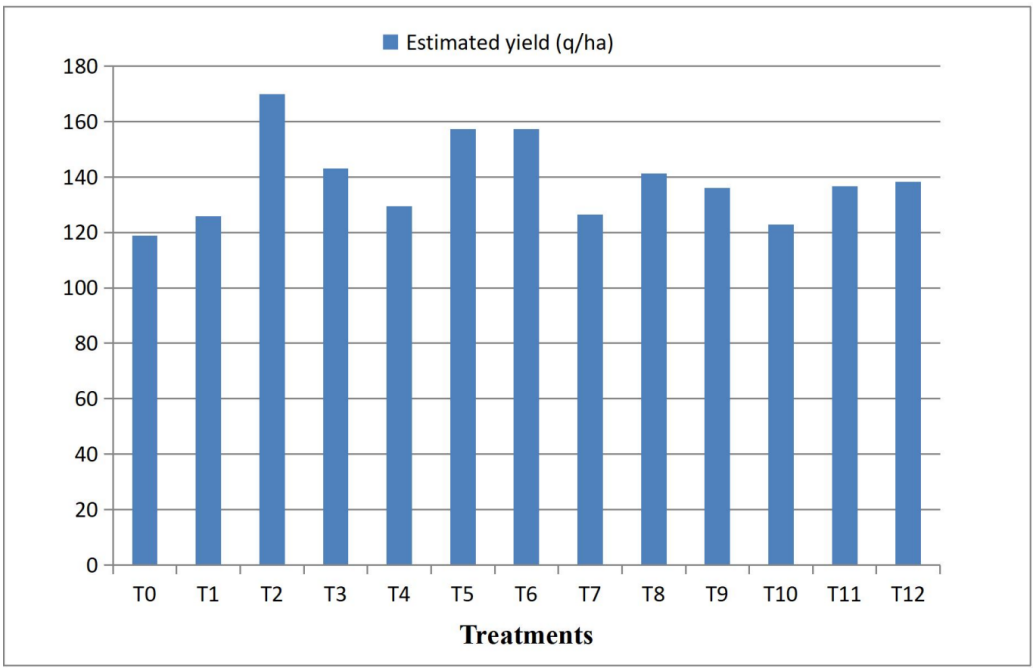

Fig. 2. Effect of organic growth promoters on estimated yield of pea

T_0: Control, T_1: Panchagavya@ 2 %, T_2: Panchagavya@ 4%, T_3: Panchagavya@ 6 %
T_4: Jeevamrut@ 2%,T_5: Jeevamrut@ 4%, T_6: Jeevamrut@ 6 %
T_7: Brahmastra@ 2%, T_8: Brahmastra@4%, T_9: Brahmastra @6%
T_{10}: vermiwash @ 5%, T_{11}: vermiwash @10%, T_{12}: vermiwash @15%

Panchagavya @ 4% (18.3˚Brix), *Panchagavya* @ 6% (18.2˚Brix), Vermiwash @ 15%(18.5 ˚Brix), *Jeevamrut* @2%(17.9 ˚Brix), *Jeevamrut* @ 4%(18.2 ˚Brix), *Jeevamrut* @ 6%(18.0 ˚Brix), *Brahmastra*@ 4%(18.0 ˚Brix) and *Brahmastra*@ 6% (18.1˚Brix)in pea.

The result of present investigation showed that application of organic growth promoters (*Panchagavya*, Vermiwash, *Jeevamrut* and *Brahmastra*) had significantly increased quality parameters over control like crude protein (%), ascorbic acid (mg/100g) and TSS(°Brix). The maximum value for quality attributes *i.e.,* crude protein (24.97%), TSS (19.03 °Brix) and ascorbic acid (27.52 mg/100g) were recorded under treatment T5 (vermiwash 10%) and minimum value of quality parameters *i.e*., crude protein (22.59%), ascorbic acid (24.00mg/100g) and TSS (16.13 °Brix) were recorded under treatment T0(control). These results are conformity with the result obtain [16] by in tomato, [17] in okra, [18] in grape, [19] in fenugreek. Vermiwash contain sulphur which is involved in the synthesis of fatty acids and also increased protein quality through the synthesis of certain amino acids such as cystine and methionine, this might be also reason for increase in protein content in pea [20]. Total soluble solids might have increased due to better role of nutrients which is involved in the carbohydrate synthesis, breakdown and translocation of starch, synthesis of protein and neutralization of physiologically important organic acids. Foliar application of vermiwash might have increased the uptake and availability of nutrient and its further assimilation for biosynthesis of protein [21] in bitter gourd. The application of organic growth promoters recorded higher ascorbic acid content. The improvement in the ascorbic acid content might be due to increased synthesis of metabolites which can stimulate the synthesis of the ascorbic acid precursor. These results are conformity with the result obtain by [16] in tomato, [17] in okra, [22].

3.2 Effect of Organic Growth Promotors on Pod Yield

A perusal of data presented in Table 1 and Fig. 2 revealed that the pod yield of pea was significantly affected by the application of organic growth promoters. The data indicated that with application of Vermiwash @ 15% 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 Vermiwash @ 15% (157.34 q/ha) and lowest was found in under control (118.76 q/ha), but it was found at par with application of *Panchagavya*@ 4% (169.93 q/ha), *Panchagavya*@ 6% (142.98 q/ha), Vermiwash @ 10% (157.20 q/ha),*Jeevamrut*@ 4%(141.26 q/ha), *Jeevamrut*@ 6%(136.01q/ha), *Brahmastra*@ 4%(136.59 q/ha) and *Brahmastra*@ 4%(138.27 q/ha) yield of pea during experimentation.

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 [23]. *Panchagavya* increased synthesis of growth promoting substances which is turn helped in increased growth and yield attributes and finally pod yield. 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 [24] 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 cuticleof leaves. These results are in close agreement with those of [25] in cowpea, [26] in black gram.

4. CONCLUSION

It is concluded that the quality parameters 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 and good health.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models

(ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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