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Influence of Soil Physio-chemical Properties and Available Nutrient Status by Organic Growth Promoters under Pea (*Pisum sativum* L.) Cultivation

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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

A field experiment was conducted at Vegetable Farm, Department of Vegetable Science, College of Horticulture and Forestry, Jhalawar (Rajasthan) during *rabi* season 2021-2022 on 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 maximum pod yield (169.93 q/ha) of pea was recorded with foliar spray of *Panchagavya* @ 4 % over control. However, it was found at par with foliar spray of vermiwash @ 10% and vermiwash @15% on pea. The foliar spray of growth promotors did not significantly influence soil physio-chemical properties *i.e.* soil pH, electrical conductivity and organic carbon after harvest of the crop. The maximum available nitrogen (341.0 kg/ha) was recorded under application of *Panchagavya* @ 4% and minimum available nitrogen (337.2 kg/ha) in control. Available phosphorus (kg/ha) and potassium did not significantly influence by different growth promotors in the soil after harvest of the crop.

Keywords: Brahmastra; jeevamrut; panchagavya; pea; vermiwash; nutrient status.

1. 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" [1]. "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 vitamin C, and richest source of calories among the vegetables" [2].

"In India 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" [4].

"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" [5]. "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. The+y contain macro nutrients, essential micro nutrients, many vitamins, essential micro nutrients, essential amino acids, growth promoting factors like IAA, GA and beneficial microorganisms" [6].

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

2.1 Soil Sample Collection and Estimation Techniques for Physio-Chemical Properties

To estimate the fertility status of the soil, after harvesting of the crop the soil sample (0-15 cm depth) from each plot was taken. The procured sample were naturally dried in shadow, grind (using ceramic pestle mortar) and finally passed through 2 mm plastic sieve to avoid metallic contamination thereafter stored in polythene bags for analysis purpose. The soil samples were assessed for pH, electric conductivity (EC) using digital pH meter and EC meters [8], organic carbon [9], available Nitrogen alkaline $KMNO_4$ method [10], Phosphorus [11], Potassium ammonium acetate method [12] by flame photometer and DTPA extraction procedure for micronutrient Cu, Fe, Mn, Zn (0.005 M diethylene triamine Penta acetic acid (DTPA) + 0.01 M $CaCl_2.2H_2o$ + 0.1 M triethanolamine or TEA) buffered at pH 7.3 as described by Lindsay and Norvell [13] using atomic absorption spectrometer. In physical properties analysis bulk density, particle density determined by Piper [14] and cation exchange capacity (CEC) was analysed by ammonium saturation method of [15] while, the total porosity is determined by the using standard formula. The data were statistically analysed by adopting appropriate method of standard analysis of variance [16].

2.2 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 [17].

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 [18].

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 [19].

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 [20].

3. RESULTS AND DISCUSSION

3.1 Effect of Organic Growth Promotors on Soil Physio-Chemical Properties

A perusal of data presented in Table 1 the foliar spray of plant growth promotors did not significantly influence soil physico-chemical properties and available phosphorus and potassium in the soil after crop harvest. Results revealed that there was non-significant effect was found on soil pH after harvest of the crop with foliar spray of different plant growth promotors. The electric conductivity of soil did not significantly influence under different plant growth promotors after pea crop harvest. Foliar spray of plant growth promotors did not significantly influence soil organic carbon after harvest of pea crop. Available phosphorus (kg/ha) and potassium (kg/ha) did not significantly influence by different plant growth promotors in the soil after harvest of the crop. The maximum available nitrogen (341.0 kg/ha) was recorded under application of *Panchagavya* @ 4 % over application of *Panchagavya* @ 2 %, *Panchagavya* @ 4 %, *Brahmastra* @ 2 %, *Brahmastra* @ 4 %, *Brahmastra* @ 6 %, vermiwash @10%, vermiwash @15 % and control. However, it was found at par with foliar spray of plant growth promotors *i.e. Panchagavya* @ 6 % (339.2 kg/ha), *Brahmastra* @ 4 % (339.1kg/ha), *Brahmastra* @ 6 % (339.5 kg/ha), vermiwash @10 % (339.8 kg/ha) and vermiwash @15 % (340.7 kg/ha), respectively.

The result suggested that addition of organic plant growth promoters significantly increased the availability of nitrogen in soil over control after harvest. The maximum value of available soil nitrogen (341.0 kg/ha) was recorded under application of (*Panchagavya* 4%) and the minimum available nitrogen (337.2 kg/ha) was recorded under control. The present findings are in the line with the findings of Boraiah et al. [21] in black gram. *Panchagavya* accounted for significantly altering the soil parameters. This might be due to application of *Panchgavya* contains favourable macro and micro nutrients, growth hormones and microorganism *viz*., *Azospirillum*, *Azotobacter*, *Phosphobacter* and *Pseudomonas* in liquid formulation which played an important role in root development and proliferation resulting in better nodule formation and nitrogen fixation by supplying as similar test other roots and better environment in rhizosphere for growth and development. The findings are in accordance with the findings of Kumar et al. [22] in groundnut, [23] in cowpea.

3.2 Effect of Organic Growth Promotors on Pod Yield

It is evident from data presented in Fig. 1 and 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 *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. Results revealed that foliar spray 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 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 foliar application of *Panchagavya* @ 4% and minimum was found under control (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 nitrogen, phosphorus, potassium, sulphur 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 cuticle of leaves. These results are in close agreement with those of [25] in cowpea, [26] in black gram.

Table 1. Effect of organic growth promoters on soil physio-chemical properties and available nutrient status of soil after harvest of pea crop

Treatments (Foliar spray)	Electrical Conductivity (dS m^{-1})	pH (1:2 soil water suspension)	Organic Carbon (%)	Nitrogen (kg/ha)	Phosphorus (kg/ha)	Potassium (kg/ha)
Control	0.95	7.47	0.59	337.2	16.3	216.5
Panchagavya @ 2%	0.97	7.75	0.60	338.4	7.4	217.6
Panchagavya @ 4%	0.94	7.56	0.60	341.0	17.4	217.6
Panchagavya @ 6%	0.95	7.49	0.59	339.2	18.3	217.1
Vermiwash @ 5%	0.95	7.55	0.60	338.3	17.0	215.7
Vermiwash @ 10%	0.95	7.49	0.59	339.8	17.7	217.7
Vermiwash @ 15%	0.96	7.54	0.58	340.7	19.6	218.8
Jeevamrut @ 2%	0.94	7.50	0.61	337.3	16.9	217.8
Jeevamrut @ 4%	0.97	7.58	0.61	340.3	18.0	216.2
Jeevamrut @ 6%	0.94	7.50	0.61	337.3	17.0	216.5
Brahmastra @ 2%	0.94	7.77	0.61	338.3	16.4	217.8
Brahmastra @ 4%	0.96	7.72	0.58	339.1	18.7	217.6
Brahmastra @ 6%	0.95	7.81	0.59	339.5	17.6	218.7
SEm±	0.01	0.01	0.01	0.85	0.65	0.85
CD at 5%	NS	NS	NS	2.49	NS	NS

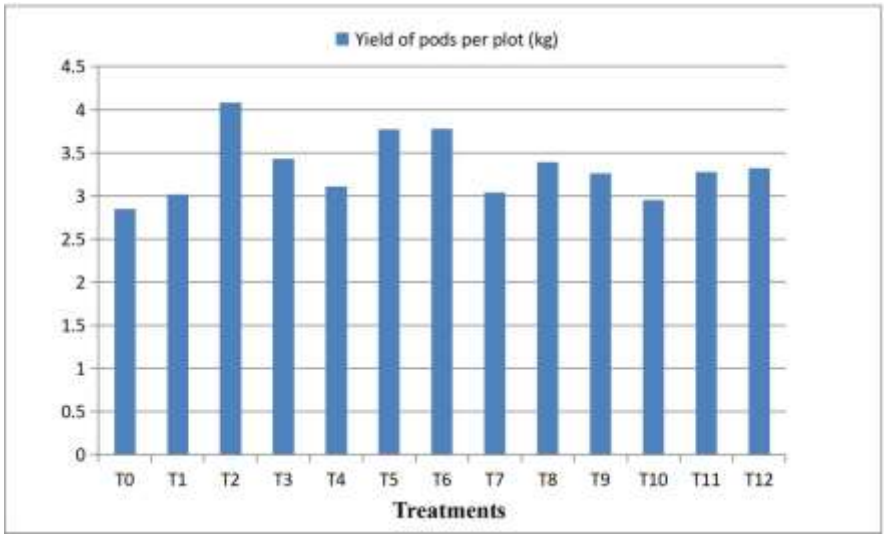

Fig. 1. Effect of organic growth promoters on yield of pods per plot

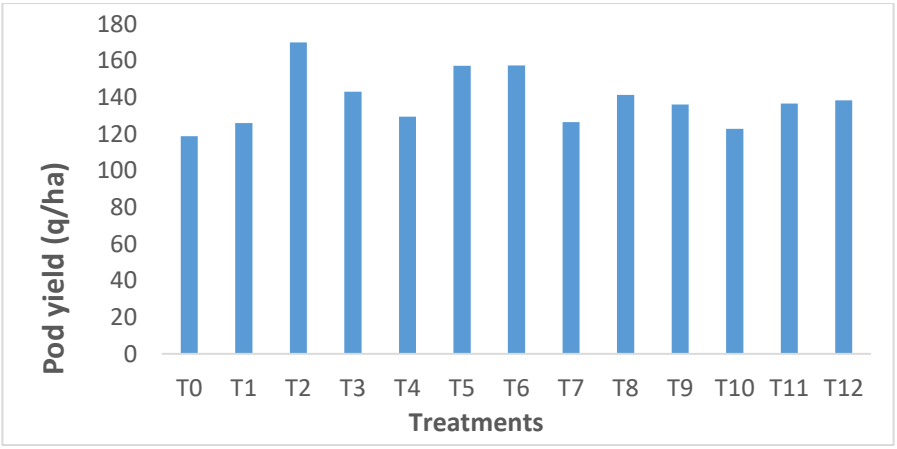

Fig. 2. Effect of organic growth promoters on pod yield of pea

4. CONCLUSION

It is concluded that the 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 of pea crop and also improve soil health at optimum level.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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