Original Research Article

EFFECT OF LIQUID ORGANIC MANURE ON GROWTH AND YIELD OF FIELD PEA

ABSTRACT

The field experiment was conducted during *Rabi* season of 2022 at the Crop Research Farm(CRF),DepartmentofAgronomy,SHUATS,Prayagraj(UP)toexamine theeffectofliquid organic manure on growth and yield of Field Pea. The finding showed that field pea growth characteristics steadily improved with the maximum application of Dasagavya (250 l/ha) + spraying, Which resulted in Significantly higher plant height (97.14 cm), Maximum number of nodules (28.13) ,plant dry weight (33.18 g), number of pods/plant (22.18), number of seeds/pod (4.16), seed yield (2.02 t/ha), and harvest index (40.16%). Stover yield in the Dasagavya (250 l/ha) + seed inoculation and Spraying (4.27 t/ha) was significantly greater.

Keywords:*Fieldpea,Panchagavya,Dasagavya, Jeevamrutha, Growth,yield,Economics.*

INTRODUCTION

This paper is on (1) field peas cultivated with (2) liquid manor as fertilzers.

1. Field pea (Pisum sativum L.) holds significant popularity as a pulse crop in India, ~~where it ranks as the second largest producer globally, just behind Russia.~~This nutritious leguminous It ~~crop~~ boasts a wealth of protein, carbohydrates, vitamin A, vitamin C, calcium, and phosphorus. As a legume, it fulfills a major portion of its nitrogen requirements through biological nitrogen fixation. ~~Consumers often express a preference for organic crops, citing the perceived transparency and sustainability of organic food production, which involves the use of organic fertilizers and crop rotations that include legumes, resulting in improved soil and plant health. Field pea belongs to the Leguminous family and is characterized as a self-pollinating, annual cool-season leguminous crop, widely cultivated across the world. It plays a vital role as a pulse crop at the global level and ranks as the third most popular rabi pulse in India, following chickpea and lentil.~~

Field pea (Pisum sativum L.) is a pulse crop grown and consumed globally. Approximately 7.5 million hectares of field pea were harvested in 2018, with the top producers consisting of Canada, Russia, China, India, and Ukraine, followed by the United States (FAOSTAT, 2018). Currently, field pea is increasing in popularity within the organic and health food markets, as it is a nutrient-dense crop, naturally rich in iron, zinc, prebiotic carbohydrates, and protein, ideal for animal feed and as an alternative protein source to animal products (Powers and Thavarajah, 2019) The superior nutritional value of field pea gives it the potential to combat 'hidden hunger', which is the global prevalence of micronutrient deficiencies due to cereal-dominated diets. As such, increasing the production of field pea to diversify diets could help alleviate hidden hunger (F) as well as benefit organic agriculture. Canada rank first in area (21%) and production (35%) at Global level, while China stands second position in area (13.70%) followed by Russia (12.94 %). India occupy forth position in area (10.53 %) and 5th position in production (5.36 %). Highest productivity is recorded in Ireland (5000 kg/ha) followed by Netherland (4766 kg/ha), and Denmark (4048 kg/ha). While, India's productivity is only 955 kg/ha.

Reduce the redundancy of informations. The underlined sentences are the essentials about the crop. Then explain concisely the research question.

Field pea is primarily utilized for human consumption, and the market for field pea is characterized by high segmentation, with demand varying based on the end use. The sale of field pea occurs in primary or secondary wholesale markets, directly facilitated by the producers. Three main marketing segments have been identified: the direct food use market, the split (dal) market, and the feed substitute market for animals. Field pea is commonly consumed as whole seeds, either separately or incorporated into various dishes. Consumers typically prefer certain quality traits, such as creamish green and white seed color, as well as bold and heavy seeds.Citation needed or skip it

2.The global demand for organically produced crops has been steadily increasing, with retail sales reaching a substantial $81.6 billion in 2015. Organic farming, an age-old traditional practice passed down by our ancestors, (citation needed, e.g. Vavilov and Harlan on the neolithic revolution by organic farming based on crop biodiversity (Brush etc.) solely relies on organic manures or natural inputs available on the farm. Unlike agrochemicals they are not to be paid for.

leading to reduced production costs compared to chemical inputs. This farming approachOrganic farmingemphasizes balanced nutrition and takes care of the soil's self-reproducing capacitieshealth by enhancing its physical, chemical, and biological properties through nutrient cycling. Furthermore, organic farming guarantees the safety of thekeeps the environment safe and produces food and the production of food free fromwithoutharmful substances by doung with readily available inputs, release nutrients slowly, provide a supply of macro and micro nutrients, and create a favorable soil environment for microbial populations. Reduce it to the essentials

Research question: Can liquid manure boost the yields of organic farming

Insert 1: (from below)

Hitherto organic farming relies on Farmyard Manure (FYM) and compost as nutrient sources, depletes soil productivity during the transitional period until the soil, especially the fauna's essential activity to provide soil fertility is restored. During the soil reconstruction process the yield per acre is reduced. (Natarajan, 2002). Facing the challenges of environmental safety and the global demand for pesticide-free food, eco-friendly products that are easily biodegradable and leave no harmful toxic residues are gaining considerable interest in crop production, ~~while also contributing to nature conservation~~.

Can liquid manure overcome the drawback of the reduced yield during the soil reconstruction proces? (This is the crucial question)

~~In modern farming~~, ~~Therefore liquid manure plays a crucial role in significantly increasing yields while simultaneously reducing the need for fertilizers.~~ Liquid organic preparations like Panchagavya, Jeevamruta, and Sanjivak, made from cow products such as cow dung, urine, milk, curd, ghee, legume flour, and jaggery, have demonstrated positive results in promoting higher growth, increased yield, and improved crop quality. Such a liquid manure contains essential macro and micro nutrients, vitamins, essential amino acids, growth-promoting factors like IAA (Indole-3-acetic acid) and GA (Gibberellic acid), and beneficial microorganisms.

~~In contrast the existing technology of organic farming, which relies on Farmyard Manure (FYM) and compost as nutrient sources, depletes soil productivity during the transitional period until the soil's fertility, structure, and microbial activity are restored, leading to lower initial yield levels (Natarajan, 2002). As the concern for environmental safety and the global demand for pesticide-free food continue to grow, eco-friendly products that are easily biodegradable and leave no harmful toxic residues have gained considerable interest in crop production, while also contributing to nature conservation.~~ (cut it and paste it above, see the first insert).

In Sanskrit, "panchgavya" refers to a blend of five substances obtained from desi cows, with each individual product referred to as "Gavya," and when combined, it is known as "Panchagavya." This mixture comprises cow dung, cow urine, milk, ghee, and curd in a proper ratio (5:3:2:2:1). To this mixture, banana, jaggery, and coconut water are added to facilitate fermentation, resulting in the final product known as "panchgavya."Make clear if that is a newly discovered product or already known.

This highly effective organic product is recommended for crop improvement in organic agriculture (Sangeetha and Thevanathan, 2010). Panchagavya has proven to be instrumental in providing resistance to pests and diseases, leading to increased overall yields (Tharmaraj et al., 2011). When sprayed on crops, Panchagavya induces early flowering and high seed setting percentage, while also enhancing growth and yield components through its growth-promoting activity, all of which come at a low cost. Additionally, it exhibits properties similar to fertilizers and biopesticides (Sireesha, 2013), resulting in positive effects on crop growth and productivity (Somasundaram et al., 2003). Panchagavya also plays a vital role in improving the quality of fruits and vegetables and is applied as a foliar spray, soil application, irrigation supplement, and seed treatment (Natarajan, 2002). As an eco-friendly alternative to chemical fertilizers and pesticides, Panchagavya offers promising solutions to address environmental degradation concerns while acting as a growth promoter and immunity booster, as reported by P Panchal et al. (2017).

Material and Methodology

The experimental setting

Taking all these factors into consideration, the present investigation titled "Effect of liquid manures on growth and yield of field pea (Pisum sativum L.)" was carried out during the Rabi season of 2022-23 at Crop Research Farm, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh. The study aimed to explore the impact of various liquid organic manures on enhancing the growth and yield of field pea, with the ultimate goal of providing valuable insights to further advance sustainable agricultural practices.

The test site

The experiment was conducted during *Rabi* season of 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P).

Definition of the Rabi season in the international calendar is missing. The coordinates (longitude and latitude and altitude in meters above sea level of the Crop Research Farm is missing. Check it with Google Earth)

The soil of the field constituting a part of central ~~Gangetic alluvium~~ is neutral and deep.

Does that mean alluvial regions with sediments deliverd by the River Ganges? If yes make it clear.

The soil of the experimental field (how many square meters?) was sandy loam in texture, nearly neutral in soil reaction (pH 7.8),low level of organic carbon (0.62%), available N (225 Kg/ha), P (38.2 kg/ha), K (240.7 kg/ha) and zinc (2.32 mg/kg). How many meters to reach the subsoil?

The experiment was laid out in Randomized Block Design along with 9 treatment combination and replicated thrice. Treatment were randomly arranged in each replication, divided into 27 plots.

The treatment combination are as follows;

T_1-Panchagavya (3 %) + Seed Inoculation, T_2-Panchagavya (3 %) + Spraying, T_3-Panchagavya (3 %) + Seed Inoculation and Spraying, T_4-Jeevamrutha (300 l/ha) + Seed Inoculation, T_5-Jeevamrutha (300 l/ha) + Spraying, T_6-Jeevamrutha (300 l/ha) + Seed Inoculation and Spraying, T_7-Dasagavya (250 l/ha) + Seed Inoculation ,T_8-Dasagavya (250 l/ha) + Spraying ,T_9-Dasagavya (250 l/ha) + Seed Inoculation and Spraying. The growth parameters and yield, production was recorded at harvest from randomly selected plants in each plot. The data was computed and analysed by ~~following~~ statistical method of Gomez and Gomez (1984).

RESULTS A~~ND DISCUSSIONS~~

GROWTH PARAMETERS

Put that into a table

Plant Height (in centimeters)

At 100 DAS, treatment with application of Dasagavya (250 l/ha) + Spraying (97.14 cm) recorded significantly maximum plant height. However treatment with application of Panchagavya (3%) + Spraying (95.50 cm), Dasagavya (250 l/ha) + Seed inoculation and spraying (95.98 cm) were statistically at par with the Dasagavya (250 l/ha) + Spraying.

The plant height of field pea increased significantly during all crop growth stages, thismightbeduetotheapplicationofPanchagavyaatfrequentintervalsleadstobetteradaptionofplants and also supplied the plant with required nutrients throughout the cropping season, thisallowedtheplanttogrowwithlessernutrientcompetition,becauseofwhichproductionofmore number of branches and leaves per plant were observed and thus enhanced the plant height.Similarfindingswerereported by**Choudhary *et al*. (2017)**.

Numberofnodules/plant

At 60 DAS, treatment with application of Dasagavya (250 l/ha) + Spraying (28.13)recordedsignificantlymaximumnumberofnodulesperplant.However,treatmentwithapplication of Panchagavya (3%) + Spraying (27.81) and Dasagavya (250 l/ha) + Seed inoculation and spraying (27.53) werestatistically atpar withtheDasagavya (250 l/ha) + Spraying.

The increase in number of nodules per plant might be due to the better availability ofnutrients that were supplied by regular application of panchagavya. The foliar application ofpanchagavyasuppliesmicronutrientswhichcreatesastimuliintheplantsystemandenhancingthe cell division increased number of nodule production in plants, ultimately promoting therequiredgrowthanddevelopment.Similarfindingswerereportedby**KumaraveluandKadamban(2009)**

Plantdryweight(g/plant)

At Harvest, significantly higher plant dry weight was obtained with application of Dasagavya (250 l/ha) + Spraying (33.18g/plant).However,Panchagavya (3%) + Spraying (30.94 g/plant), Panchagavya (3%) + Seed inoculation and spraying (31.45 g/plant), Jeevamrutha (300 l/ha) + Spraying (32.14 g/plant) and Dasagavya (250 l/ha) + Seed inoculation and spraying (31.26 g/plant) statically at par with Dasagavya (250 l/ha) + Spraying

Dry matter production in plant of Field pea was significantly influenced due to differentinterval and concentration of panchagavya. The inoculation of panchagavya supplied the plant withenoughmacronutrients(N,P&K)andmicronutrient(Zn,Fe,CuandMn)thatarerequiredforoverallplantgrowthanddevelopmentthustheapplicationofpanchagavyaincreasedthedrymatter productioninplants.Similar findingswere reportedby**Kumar *etal.*(2011)**.

CropGrowthRate (g/m^2/day)

At 60 - 80 DAS, treatment Dasagavya (250 l/ha) + Seed inoculation (19.16 g/m^2/day) was significantly higher. However, treatment Panchgavya (3%) + Seed inoculation and spraying (18.83 g/m^2/day) and Dasagavya (250 l/ha) + Seed inoculation and spraying (17.61 g/m^2/day) were statically at par with treatment Dasagavya (250 l/ha) +

Seed inoculation.

RelativeGrowthRate(g/g/day)

At 60-80 DAS, data was found non-significant, However maximum relative growth rate is observed in Panchagavya (3%) + Seed inoculation and spraying (0.036g/g/day) and lower found in Dasagavya (250 l/ha) + Spraying (0.027 g/g/day).

YieldParamaters

Numberofpodsperplant(No.)

The treatment with application of Dasagavya (250 l/ha) + Spraying (22.18) recordedsignificantly maximum number of pods per plant. However, Panchagavya (3%) + Seed inoculation (19.12), Jeevamrutha (300 l/ha) + Seed inoculation and spraying (21.65) and Dasagavya (250 l/ha) + Seed inoculation and spraying (21.33) were statisticallyat parwith the Dasagavya (250 l/ha) + Spraying.

Increase in number of pods/plant could be attributed to the fact that application ofpanchagavya concentrations at different intervals must have created a stimuli in the plantsystemthatalteredphysiologicalprocessandbiochemicalactivitieswhichmodifyplantanatomyandmorphologyoftheyieldattributesinplantsasreportedby**Latha**and**Sharanappa(2014)**.

Numberofseedsperpod(No.)

The treatment with application of Dasagavya (250 l/ha) + Spraying (4.16) recordedsignificantly maximum number of pods per plant. However, treatment with application ofPanchagavya (3%) + Spraying (4.05) and Panchagavya (3%) + Seed inoculation and spraying (3.65)werestatisticallyatparwiththeDasagavya (250 l/ha) + Spraying.

The increases in number of seeds per pod might be due to more vigorous and luxuriantvegetative growth which in turn favoured a better partitioning of assimilates from source tosink.Similar findingswerereportedby**Kumawat *et al*.(2011)**.

SeedIndex(g)

SeedIndex data was non-significant, However maximum seed index was found in Dasagavya (250 l/ha) + Seed inoculation (21.36 g) and lower in Panchagavya (3%) + Seed inoculation and spraying (20.83 g). The balance supplement of major and minor nutrient might have induced cell division,expansion of cell wall, meristematic activity, photosynthetic efficiency that help to produce ahealthyseed. ~~Similarfindingswere reported~~

~~by~~**~~Kumawat~~** ~~***et al***~~**~~.(2011)~~**~~.~~Misplaced. Section “Discussion”

Economics

The result showed that maximum gross return (132,600 ₹ /ha), net return (119,600 ₹ /ha) and benefit cost ratio (1.59) were recorded in Dasagavya (250 l/ha) + Spraying.

Okay the tables will follow

Table 1.Influence of Liquid organic manures and method of Application on growth attributes of Field pea.

Sl. No	Treatments	AT Harvest		AT 60DAS	During 60-80 DAS	
		Plant Height (cm)	Dry weight (g/plant)	Number of Nodules/plant	CGR (g/m²/day)	RGR (g/g/day)
1.	Panchagavya (3%) + Seed inoculation	93.19	31.58	26.80	16.33	0.035
2.	Panchagavya (3%) + Spraying	95.50	30.94	27.81	13.99	0.034
3.	Panchagavya (3%) + Seed inoculation and spraying	89.36	31.45	22.43	18.83	0.036
4.	Jeevamrutha (300 l/ha) + Seed inoculation	91.06	31.84	25.73	16.93	0.033
5.	Jeevamrutha (300 l/ha) + Spraying	92.42	32.14	26.86	14.77	0.032
6.	Jeevamrutha (300 l/ha) + Seed inoculation and spraying	90.97	29.82	25.93	13.67	0.033
7.	Dasagavya (250 l/ha) + Seed inoculation	93.28	30.04	23.66	19.16	0.034
8.	Dasagavya (250 l/ha) + Spraying	97.14	33.18	28.13	15.04	0.027
9.	Dasagavya (250 l/ha) + Seed inoculation and spraying	95.98	31.26	27.53	17.61	0.030
	F-test	S	S	S	S	NS
	SEm(±)	0.71	0.74	0.21	0.56	0.0002
	CD (P=0.05)	2.14	2.24	0.77	1.69	-

Table 2.Influence of Liquid organic manures and method of Application on yield attributes of Field pea

SI NO	Treatment	Pods/Plant (No)	Seeds/Pod (No)	Seed Index (g)	Seed yield (t/ha)	Stover Yield (t/ha)	Harvest Index(%)
1.	Panchagavya (3%) + Seed inoculation	19.12	2.67	21.05	1.25	2.81	30.79
2.	Panchagavya (3%) + Spraying	15.25	4.05	20.93	1.47	2.56	36.48
3.	Panchagavya (3%) + Seed inoculation and spraying	13.92	3.65	20.83	1.04	2.73	27.59
4.	Jeevamrutha (300 l/ha) + Seed inoculation	15.25	3.30	21.13	1.37	2.92	31.93
5.	Jeevamrutha (300 l/ha) + Spraying	16.32	2.67	21.01	1.54	3.14	32.91
6.	Jeevamrutha (300 l/ha) + Seed inoculation and spraying	21.65	3.27	20.97	1.14	2.84	28.64
7.	Dasagavya (250 l/ha) + Seed inoculation	17.45	2.51	21.36	1.43	3.06	31.85
8.	Dasagavya (250 l/ha) + Spraying	22.18	4.16	21.25	2.04	3.04	40.16
9.	Dasagavya (250 l/ha) + Seed inoculation and spraying	21.33	3.11	21.17	1.84	4.27	30.11
	F-test	S	S	NS	S	S	S
	SEm(±)	1.23	0.17	0.65	0.19	0.39	1.22
	CD (P=0.05)	3.61	0.51	-	0.57	1.17	3.68

Table 3.Influence of Liquid organic manures and method of Application on Economics of Field pea

Sl NO	Treatment	Cost of Cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	B:C
1.	Panchagavya (3%) + Seed inoculation	40,150	81,250	41,100	1.02
2.	Panchagavya (3%) + Spraying	47,650	95,550	47,850	1.00
3.	Panchagavya (3%) + Seed inoculation and spraying	48,900	87,600	38,700	0.80
4.	Jeevamrutha (300 l/ha) + Seed inoculation	39,525	89,050	49,525	1.25
5.	Jeevamrutha (300 l/ha) + Spraying	43,275	100,100	56,825	1.29
6.	Jeevamrutha (300 l/ha) + Seed inoculation and spraying	43,900	84,100	40,200	0.91
7.	Dasagavya (250 l/ha) + Seed inoculation	40,775	92,950	52,175	1.28
8.	Dasagavya (250 l/ha) + Spraying	51,025	132,600	81,575	1.59
9.	Dasagavya (250 l/ha) + Seed inoculation and spraying	53,900	119,600	65,700	1.21

CONCLUSION

Theconcludedexperimentshowedthatspraying ofDasagavyawas foundto be remunerative, profitable and economicallyefficient.

Theconclusiondrawnarebasedononeseasondataonlywhichrequiresfurtherconfirmation for recommendation.

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