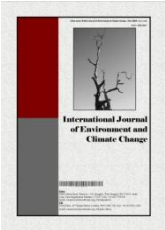

International Journal of Environment and Climate Change

12(11): 397-402, 2022; Article no.IJECC.88832
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Response of Biofertilizer and Foliar Spray of Organic Amendments on Economics and Yield Attributes of Cowpea (*Vigna unguiculata* L.)

Mayank Rabade [a*ω], Rajesh Singh [a#] and Thakur Indu [a†]

[a] Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj Uttar Pradesh, 211007, India.

Authors' contributions

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

Article Information

DOI: 10.9734/IJECC/2022/v12i1130987

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/88832

Original Research Article

Received 24 April 2022
Accepted 28 June 2022
Published 15 July 2022

ABSTRACT

Field experiment was conducted on cowpea during *Kharif* 2021 at (CRF) Crop Research Farm, Department of Agronomy, Naini Agricultural Institute. SHUATS, Prayagraj (U.P) India. The experiment entitled as "Response of biofertilizer and foliar spray of organic amendments on economics and yield attributes of cowpea (*Vigna unguiculata* L.)", to study treatments consisting of three kinds of biofertilizers *viz.Rhizobium,* PSB and *Rhizobium* + PSB and three types of organic amendments *viz*. Panchagavya, Jeevamrutha and Beejamrutha. Each of the nine treatments was replicated three times and laid out in a Randomized Block Design with various treatment combinations. $T_{1:}$ *Rhizobium* 20 g + Panchagavya 3% foliar spray, $T_{2:}$ *Rhizobium* 20 g + Jeevamrutha 5% foliar spray,$T_{3:}$ *Rhizobium* 20 g + Beejamrutha 2% foliar spray ,$T_{4:}$ PSB 20 g + Panchagavya 3% foliar spray,$T_{5:}$ PSB 20 g + Jeevamrutha 5% foliar spray,$T_{6:}$ PSB 20 g + Beejamrutha 2% foliar spray, $T_{7:}$ *Rhizobium* + PSB 20g + Panchagavya 3% foliar spray,$T_{8:}$ *Rhizobium* + PSB 20g + Jeevamrutha 5% foliar spray,$T_{9:}$ *Rhizobium* + PSB 20g + Beejamrutha 2% foliar spray. The results revealed that treatment 9 (*Rhizobium* + PSB 20g + Panchagavya 3% foliar spray) recorded maximum on no. of pods per plant (15.43), length of pod (19.53), seeds per pod (10.68), test weight (133.40), seed

ω M.Sc. Scholar,
#Assistant Professor,
†Ph. D Scholar,
**Corresponding author: E-mail: mayankrabade@gmail.com;*

yield (1025.50), harvest index (41.74), and B:C ratio (2.42).It is concluded that seed treatment with *Rhizobium* + PSB 20g + Panchagavya 3% foliar spray was found more productive and economical.

Keywords: Biofertilizers; economics; Organic amendments; Plant height; yield.

1. INTRODUCTION

Cowpea is called to be drought tolerant in nature, its broad and drooping leaves mostly hold the soil and soil moisture due to the shading effect. Also commonly known as Black-eyed Pea or Southern Pea, etc., it has multiple needs such as food, fodder, cover crops and vegetables. Cowpea seeds add nutrition to the human diet and also cost effective for cattle feed. The dried mature and green seeds are suitable for canning and cooking. Cowpeas have a variety of growth habits, including upright, determinate, non-branching, and ascending or prostrate, indeterminate, with profuse branching. hollow, globular, with a cylindrical stem that is twisted and slightly ribbed. Leaves are alternate, trifoliate, with one symmetrical terminal leaflet and two asymmetrical leaflets [1]. Cowpea seeds are high in nutrients [2]. Because of their high rate of nitrogen fixation [3] and effective symbiotic mycorrhizae developing ability, the plants are well suited to develop in maximum temperature and dry spell [4] and undergo low soil fertility [5].

Organic amendments were used to increase soil quality and fertility for many years. Animal dung and human waste were given to the land by early people. They also saw that wheat got benefited from being produced on areas that had early been cultivated with leguminous plants [5-8]. Other materials such as shells, green waste, farm manure and other waste products are used to enhance plant growth. Today, the common organic soil additives are compost and animal manure, but peat moss, woodchips, straw, sewage sludge, sawdust are also into consideration [9,10]. The different materials are divided into five categories. Animal manure, municipal biosolids, green manure and cover crops, manufacturing waste, and compost are some examples.

Organic farming means picking up steam in the mainstream economy, with commercial, social, and environmental values. The present organic movement is vastly different from its origins. Panchagavya, Beejamrutha, and Jeevamrutha are fermented stocked compounds used for plant growth promoters in organic farming system.

These are major sources of needed micro flora which support, stimulate the plant health and help in getting better physiological and morphological growth and also good yield. Production made from agricultural by-products, namely grain bran, oilcake, farmyard manure, etc., were found to support excellent growth and storage media. It includes growth in interest in the usage of Panchagavya, Beejamrutha, Jeevamrutha and other liquid organic forms in organic farming. Therefore, many ways have been used to lessen the use of chemical by organic growth promoters [11].

2. MATERIALS AND METHOD

A field trial was done during Kharif 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The treatment details Table 1. (Rhizobium, PSB, and Rhizobium + PSB)are three different forms of biofertilizers, whereas Panchagavya, Jeevamrutha, and Beejamrutha are three different types of organic amendments. The nine treatments were distributed in a Randomized Block Design with different treatment combinations, with each treatment being replicated thrice Table 2. (T_1 - *Rhizobium* 20 g + Panchagavya 3% foliar spray,T_2 - *Rhizobium* 20 g + Jeevamrutha 5% foliar spray,T_3 - *Rhizobium* 20 g + Beejamrutha 2% foliar spray ,T_4 - PSB 20 g + Panchagavya 3% foliar spray,T_5 - PSB 20 g + Jeevamrutha 5% foliar spray, T_6 - PSB 20 g + Beejamrutha 2% foliar spray,T_7 - *Rhizobium* + PSB 20g + Panchagavya 3% foliar spray,T_8 - *Rhizobium* + PSB 20g + Jeevamrutha 5% foliar spray ,T_9 - *Rhizobium* + PSB 20g + Beejamrutha 2% foliar spray). The experimental field was thoroughly ploughed followed by harrowing brought to fine tilth. Stubbles and weeds were picked up from the field and the land was levelled with the help of rake and the plots were demarcated according to layout. The irrigation channels and bunds were made manually After germination, the gaps were filled up by dibbling of seed at 10 Days after sowing (DAS). Seedlings were thinned out in order to maintain spacing of 30 x

5 cm. Four hand weedings was done manually with *Khurpi* at 15, 30,45 60 DAS. This was done to control grass as well as broad leaf weeds . Picking was done only when pods were found turning blackish brown or black in colour. So the two pickings were done first 60 and second at 80 DAS. The pods were dried well and then beating was done by means of wooden log to remove all seeds from the pods. Which are then collected for further calculations. Plant height (cm), number of branches per plant, plant dry weight, number of pods per plant, number of seeds per plant, test weight, grain yield, and stover yield were all recorded as growth metrics at harvest.

3. RESULTS AND DISCUSSION

3.1 Yield and Yield Attributes

Number of pods/plant, Length of pod (cm), Number of seeds/pod, Test weight (g): Maximum number of pods per plant (15.43) was observed with treatment (*Rhizobium* + PSB) 20g + Panchagavya 3% foliar spray which was better over rest of all treatment and there was more differentiation among the treatment.

Highest length of the pod (19.53 cm) was seen in the treatment (*Rhizobium* + PSB) 20g + Panchagavya 3% foliar spray which was more over rest of all treatments and had significant difference among the treatments.

Maximum number of seeds per pod (10.68) was seen in the treatment (*Rhizobium* + PSB) 20g+ Panchagavya 3% foliar spray which was maximum over rest of all treatments and the treatment with *Rhizobium* 20 g + Panchagavya 3% foliar spray was statistically on par with the treatment (*Rhizobium* + PSB) 20g + Panchagavya 3% foliar spray.

Highest test weight (133.40) was seen in the treatment (*Rhizobium* + PSB) 20g+ Panchagavya 3% foliar spray which was maximum over rest of all treatments and the treatment with *Rhizobium* 20 g + Panchagavya 3% foliar spray was statistically on par with the treatment (*Rhizobium* + PSB) 20g+ Panchagavya 3% foliar spray.

Seed yield (kg/ha), Stover yield (kg/ha) and Harvest index (%): Highest seed yield (1025.50 Kg/ha) was seen in the treatment *Rhizobium* + PSB 20g + Panchagavya 3% foliar spray which was maximum over all treatments and the treatments with *Rhizobium* 20 g + Panchagavya 3% foliar spray and PSB 20 g + Panchagavya 3% foliar spray were statistically on par with the treatment *Rhizobium* + PSB 20g + Panchagavya 3% foliar spray.

Table 1. Treatment details

Biofertilizer	i.	*Rhizobium* 20 g/kg
	ii.	PSB 20 g/kg (phosphate solubilizing bacteria)
	iii.	(Rhizobium + PSB) 20 g/kg
Natural organic amendments (foliar spray at 15, 25, 35 and 45 DAS)	i.	Panchagavya 3% foliar spray
	ii.	Jeevamrutha 5% foliar spray
	iii.	Beejamrutha 2% foliar spray

Table 2. Treatment combinations

Treatments No.	Treatments combinations
1.	*Rhizobium* 20 g + Panchagavya 3% foliar spray
2.	*Rhizobium* 20 g + Jeevamrutha 5% foliar spray
3.	*Rhizobium* 20 g + Beejamrutha 2% foliar spray
4.	PSB 20 g + Panchagavya 3% foliar spray
5.	PSB 20 g+ Jeevamrutha 5% foliar spray
6.	PSB 20 g + Beejamrutha 2% foliar spray
7.	*Rhizobium* + PSB 20g + Panchagavya 3% foliar spray
8.	*Rhizobium* + PSB 20g+Jeevamrutha 5% foliar spray
9.	*Rhizobium* + PSB 20g + Beejamrutha 2% foliar spray

Table 3. Effect of biofertilizers and foliar spray of organic amendments on yield attributes in Cowpea [12]

Treatments	Number of Pods/Plant	Lengthof pod	No of seeds/ pod	Test Weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest Index (%)
1. Rhizobium 20 gm + Panchagavya 3% foliar spray	14.40	18.43	10.26	132.99	1018.15	1497.50	40.1
2.Rhizobium 20 gm + Jeevamrutha 5% foliar spray	14.23	16.50	9.43	129.38	939.70	1570.73	37.43
3. Rhizobium 20 gm + Beejamrutha 2% foliar spray	11.40	15.78	8.99	126.09	893.40	1575.71	36.18
4. PSB 20 gm + Panchagavya 3% foliar spray	14.40	17.61	9.97	131.62	1013.16	1501.81	39.62
5. PSB 20 gm + Jeevamrutha 5% foliar spray	13.40	16.27	9.22	128.64	921.50	1553.90	37.23
6. PSB 20 gm + Beejamrutha 2% foliar spray	10.40	15.36	8.56	125.55	886.10	1597.26	35.68
7. Rhizobium + PSB 20gm + Panchagavya 3% foliar spray	15.43	19.53	10.68	133.40	1025.50	1431.25	41.74
8. Rhizobium + PSB 20gm + Jeevamrutha 5% foliar spray	14.09	16.84	9.68	130.95	953.40	1492.85	38.97
9. Rhizobium + PSB 20gm + Beejamrutha 2% foliar spray	12.24	15.89	9.03	127.30	906.70	1558.13	36.79
F-Test	S	S	S	S	S	S	S
SEm±	0.08	0.12	0.14	0.14	4.59	8.25	0.26
CD (P=0.05)	0.23	0.35	0.42	0.42	13.75	24.73	0.77

Table 4. Effect of biofertilizers and foliar spray of organic amendments on Economics of Cowpea

Treatments	Cost of Cultivation (INR/ha.)	Gross Returns (INR/ha.)	Net Return (INR/ha.)	B:C ratio
1. Rhizobium 20 gm + Panchagavya 3% foliarspray	35,930.00	1,22,178.00	86,248.00	2.40
2. Rhizobium 20 gm + Jeevamrutha 5% foliarspray	37,430.00	1,12,764.00	75,334.00	2.01
3. Rhizobium 20 gm + Beejamrutha 2% foliar spray	35,230.00	1,07,208.00	71,978.00	2.04
4. PSB 20 gm + Panchagavya 3% foliar spray	35,940.00	1,21,579.00	85,639.00	2.38
5. PSB 20 gm + Jeevamrutha 5% foliar spray	37,440.00	1,10,580.00	73,140.00	1.95
6. PSB 20 gm + Beejamrutha 2% foliar spray	35,240.00	1,06,332.00	71,092.00	2.02
7. (Rhizobium + PSB) 20gm + Panchagavya 3% foliar spray	35,935.00	1,23,060.00	87,125.00	2.42
8. (Rhizobium + PSB) 20gm + Jeevamrutha 5% foliar spray	37,435.00	1,14,408.00	76,973.00	2.06
9. (Rhizobium + PSB) 20gm + Beejamrutha 2% foliar spray	35,235.00	1,08,804.00	73,569.00	2.09

Highest Stover yield (1597.26 kg/ha) was seen in the treatment PSB 20 g + Beejamrutha 2% foliar spray which was maximum over all treatments and the treatment with *Rhizobium* 20 g + Beejamrutha 2% foliar spray was statistically on par with the treatment PSB 20 g + Beejamrutha 2% foliar spray.

Highest Harvest index (41.74 %) was seen in the treatment *Rhizobium* + PSB 20g + Panchagavya 3% foliar spray which were highest overall treatments and there was significant difference among the treatments.

The increase in seed yields obtained in combination with the application of organic and biofertilizers (*Rhizobium* and PSB) are due to the mode of growth hormones such as IAA and cytokinins produced by *Rhizobium* that stimulate root. This enhances nutrient assimilation and rise seed yield. Phosphate-soluble bacteria maximize the availability and greater use of phosphorus in plants. Green gram, Khandelwal et al. [6] and Balachandran et al. [13], Rajkhowa et al. [14] and [15] are cooperating with the discovery.

4. ECONOMICS

Cost of cultivation: Maximum cost of cultivation (Rs.37, 440.00) was observed with treatment PSB 20 g + Jeevamrutha 5% foliar spray and the minimum cost (Rs.35, 230.00) was observed with treatment5.

Gross return: Maximum Gross Returns (Rs.1,23,060.00) was observed with treatment (*Rhizobium* + PSB) 20g + Panchagavya 3% foliar spray and the minimum cost (Rs. 1,06,332.00) was observed with treatment PSB 20 g + Jeevamrutha 5% foliar spray.

Net return: Maximum Net Returns (Rs 87,125.00) was observed with treatment (*Rhizobium* + PSB) 20g + Panchagavya 3% foliar spray and the minimum cost (Rs. 73,140.00) were observed with treatment PSB 20 g + Jeevamrutha 5% foliar spray.

B: C Ratio: Maximum benefit cost Ratio (2.42) was seen with treatment (*Rhizobium* + PSB) 20g + Panchagavya 3% foliar spray and the minimum B:C Ratio (1.95) was recorded with treatment PSB 20 g + Jeevamrutha 5% foliar spray.

5. CONCLUSION

Findings of present study well demonstrated the positive effects of bio-fertilizer particularly organic liquid manures treatment on various growth and yield parameters of cowpea plant. The application *Rhizobium* + PSB 20g + Panchagavya 3% foliar spray show maximum yield attributes and yield of cowpea.

ACKNOWLEDGMENT

I am thankful to my advisor Dr. Rajesh singh for constant support and guidance and I am indebted for the support to all the faculty members of Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, (U.P.) India for providing us necessary facilities to carry out the whole experiment research study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ram HH. Vegetable Breeding: Principles and Practices. Kalyani Publishers, Ludhiana, India. 1998;791.
2. Ehlers JD, Hall AE. Cowpea [*Vigna unguiculata* (L.) Walp.]. Field Crops Research. 1997;53:187–204.
3. Eloward HOA, Hall AE. Influence of early and late nitrogen fertilization on yield and nitrogen fixation of cowpea under well-watered and dry field conditions. Field Crops Research. 1987;15:229–244.
4. Hall AE, Patel PN. Breeding of resistance to drought and heat. In Cowpea research, production and utilization (Eds. S.R. Singh and K.O. Rachie), Wiley, New York. 1985;137- 151.
5. Kwapata MB, Hall AE. Effects of moisture regime and phosphorus on mycorrhizal infection, nutrient uptake and growth of cowpea [*Vigna unguiculata* (L.) Walp.]. Field Crops Research. 1985;12:241–250.
6. Kavitha MP, Balakumbahan R, Prabukumar G. Effect of foliar spray and fertilizer levels on growth and yield of vegetablecowpea [*Vigna unguiculata (L.) Walp*.] Indian Journal of Research. 2018;53(6):745-748.
7. Lyngdoh C, Bahadur V, David AA, Prasad VM, Jamir T. Effect of organic manures, organic supplements and Bio fertilizers on growth and yield of cowpea

(*Vignaunguiculata* L.). Int. J. Curr. Microbiol. App. Sci. 2017;6(8):1029-1036.
8. Meena HP. Verma, Pincholi P. Effect of Fertility Levels and Biofertilizers on Yield, Quality and Economic of Cowpea J. Agriculture for Sustainable Development. 2014;2(2):1-5.
9. Akhila K, Kaswala AR, Priyanka, Dubey PK. Effect of liquid fertilizers on growth yield and economics of the green gram (*Vigna radiata*) crop under organic farming. International Journal of Chemical Studies. 2017;5(6):809-812.
10. Badar R, Batool B, Ansari A, Mustafa S, Ajmal A, Perveen S. Amelioration of salt affected soils for cowpea growth by application of organic amendments. Journal of Pharmacognosy and Phytochemistry. 2015;3(6):87-90.
11. Khandelwal R, Choudhary SK, Khangarot SS, Jat MK, Singh P. Effect of inorganic and bio-fertilizers on productivity and nutrients uptake in Cowpea [*Vigna unguiculata (L.) walp]*. Legume Research. 2012;35(3):235-238.
12. Rabade M, Singh R, Indu T. Response of biofertilizer and foliar spray of organic amendments on the growth and yield of cowpea (*Vigna unguiculata L*.)
13. Balachandran S, Deotale RD, Hatmode CN, Titare PS, Thorat AW. Effect of bio-fertilizers (Pressmud, Rhizobium and PSB) and nutrients (NPK) on morpho-physiological parameters of greengram. Journal of Soils and Crop. 2005;15:442-447.
14. Rajkhowa DJ, Saikia M, Rajkhowa KM. Effect of vermicompost with and without fertilizer on Green gram. Legume Res. 2002;25(4):295-296.
15. Rajkhowa DJ, Saikia M, Rajkhowa KM. Effect of vermicompost and levels of fertilizer on green gram. Legume Res. 2003;26(1):63-65.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/88832