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# Response of biofertilizer and foliar spray of organic amendments on the growth and yield of cowpea (*Vigna unguiculata* L.)

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**Abstract**
A field experiment was conducted during *Kharif* 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.6), low in organic carbon (0.51%), available N (230 kg/ha), available P (17.80 kg/ha) and available K (245.10 kg/ha). on the topic "Response of biofertilizer and foliar spray of organic amendments on growth and yield of cowpea (*Vigna unguiculata* L.)", to study Treatments consisting of 3 kinds of Biofertilizers *viz. Rhizobium*, PSB and *Rhizobium* + PSB and 3 types of organic amendments *viz*. Panchagavya, Jeevamrutha and Beejamrutha There were 9 treatments each being replicated thrice and laid out in Randomized Block Design. The results revealed that treatment 7 (Rhizobium + PSB 20gm + 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 yield (1025.50), harvest index (41.74), and B:C ratio (2.42). From the basis of one year experimentation, it is concluded that seed treatment with Rhizobium + PSB 20gm + Panchagavya 3% foliar spray was found more productive and economical.

**Keywords:** Biofertilizers, organic amendments, plant height, yield

## Introduction
Cowpea is well-known to be drought tolerant in nature, its broad and drooping leaves hold the soil and soil moisture due to the shading effect. Also known as Black-eyed Pea or Southern Pea, etc., it has multiple uses such as food, fodder, fodder, fodder, cover crops and vegetables. Cowpea seeds are a nutritious part of the human diet and also a cheap cattle feed. Both the green and dried seeds are suitable for canning and cooking. Growth habit of cowpea ranges from erect, determinate, non-branching type to prostate or climbing, indeterminate, with profuse branching. It has strong tap root system with several lateral roots. Stems are cylindrical and slightly ribbed, twisting, sometimes hollow and glares. Leaves are alternate, trifoliate, with one symmetrical terminal leaflet and two asymmetrical leaflets (Ram, 1998) [16]. Cowpea seeds possess high nutritive value (Ehlers and Hall, 1997). The plants are well adapted to grow under high temperature and drought (Hall and Patel, 1985) [4] and tolerate low soil fertility due to their high rate of nitrogen fixation (Eloward and Hall, 1987) and ability to form effective symbiotic mycorrhizae (Kwapata and Hall, 1985) [11].

In Indian context, it is a minor pulse cultivated mainly in arid and semiarid tracts of grown in pockets of Punjab, Haryana, Delhi, and West UP along with considerable area in Rajasthan, Karnataka, Kerala, Tamil Nadu, Maharashtra and Gujarat. Climatic requirements Cowpea is warm weather and semiarid crop, where temperature ranging from 20 $^0$C to 30 $^0$C. Minimum temperature for seed establishment is 20 $^0$C and above 32 $^0$C temperatures development of root is cease. For maximum production day temperature 27 $^0$C and night temperature 22 $^0$C required.

The use of organic amendments to improve soil quality and fertility dates back to thousands of years ago. Greeks and Romans applied animal manure and human sewage to soil. At that time they also knew that wheat took advantages if grown on fields previously cultivated with leguminous plants (Goss *et al.*, 2013). Various materials suchs shells, vegetable waste, farm manure and other waste products have been used to encourage plant growth. Nowadays, the most common organic soil additives are compost and animal manure, but peat moss, woodchips, straw, sewage sludge, sawdust are also used. The different materials can essentially be divided into five categories. Animal manure, municipal bio solids, green manure and cover crops, waste from manufacturing processes and compost.

Organic farming is now finding a place in the mainstream of development and showing promise commercially, socially and environmentally. While there is a continuum of thought from then to now, the modern organic movement differs radically from its original form. Liquid formulations used in organic farming such as Panchagvya, Beejamrutha and Jeevamrutha are fermented products used as plant growth-promoting substances made with material available from farmers.

They are the rich sources of beneficial micro flora which support, stimulate the plant growth and help in getting better vegetative growth and also good quality yield. Formulations made from agricultural by-products, namely grain bran, oilcake, farmyard manure, etc., which have been found to support excellent growth supports and storage media. In recent years there has been an increasing interest in the use of Panchagavya, Beejamrutha, Jeevamrutha and other liquid organic formations in organic farming. Therefore, various ways and means have been tried to reduce the use of chemical by organic growth promoters.

## Materials and Methods

A field experiment was conducted during Kharif 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.6), low in organic carbon (0.51%), available N (230 kg/ha), available P (17.80 kg/ha) and available K (245.10 kg/ha). $T_1$ - Rhizobium 20 gm + Panchagavya 3% foliar spray,$T_2$ - Rhizobium 20 gm + Jeevamrutha 5% foliar spray,$T_3$ - Rhizobium 20 gm + Beejamrutha 2% foliar spray, $T_4$ - PSB 20 gm + Panchagavya 3% foliar spray,$T_5$ - PSB 20 gm + Jeevamrutha 5% foliar spray,$T_6$ - PSB 20 gm + Beejamrutha 2% foliar spray,$T_7$ - Rhizobium + PSB 20gm + Panchagavya 3% foliar spray,$T_8$ - Rhizobium + PSB 20gm + Jeevamrutha 5% foliar spray, $T_9$ - Rhizobium + PSB 20gm + Beejamrutha 2% foliar spray. 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.

## Results and Discussion

### Growth and Yield Attributes

### Plant height and Branches / plant

Data in table 1 furnished that At 60 DAS, treatment with Rhizobium + PSB 20gm+ Panchagavya 3% foliar spray was recorded significantly highest plant height (59.70 cm) which was superior to all the treatments and the treatment with Rhizobium 20 gm + Panchagavya 3%foliarspray, PSB 20 gm +Jeevamrutha 5% foliar spray, Rhizobium 20 gm +Jeevamrutha 5% foliar spray, PSB 20 gm +Panchagavya 3% foliar spray and Rhizobium + PSB 20gm+ Jeevamrutha 5% foliar spray were statistically on par with the treatment Rhizobium + PSB 20gm+ Panchagavya 3% foliar spray.

At 60 DAS treatment with Rhizobium + PSB 20gm+ Panchagavya 3% foliar spray was recorded maximum Number of branches/plant (6.69) which was superior to all the treatments and there was significant difference among the treatments.

**Table 1:** Effect of biofertilizers and foliar spray of organic amendments on Growth attributes in Cowpea. At 60 DAS

| Treatments | Plant Height (cm) | Branches/plant | Dry weight (g/plant) | Crop growth rate g/m$^2$/day |
|---|---|---|---|---|
| 1. Rhizobium 20 gm + Panchagavya 3% foliar spray | 59.52 | 6.10 | 16.03 | 0.54 |
| 2. Rhizobium 20 gm + Jeewamrutha 5% foliar spray | 58.86 | 4.78 | 14.68 | 1.02 |
| 3. Rhizobium 20 gm + Beejamrutha 2% foliar spray | 57.84 | 5.64 | 13.50 | 0.96 |
| 4. PSB 20 gm + Panchagavya 3% foliar spray | 59.38 | 3.88 | 15.72 | **1.72** |
| 5. PSB 20 gm + Jeewamrutha 5% foliar spray | 58.98 | 4.39 | 14.26 | 1.08 |
| 6. PSB 20 gm + Beejamrutha 2% foliar spray | 57.67 | 3.43 | 13.06 | 0.89 |
| 7. Rhizobium + PSB 20gm + Panchagavya 3% foliar spray | 59.70 | 6.69 | 16.55 | 0.52 |
| 8. Rhizobium + PSB 20gm + Jeewamrutha 5% foliar spray | 59.16 | 5.03 | 15.38 | 2.01 |
| 9. Rhizobium + PSB 20gm + Beejamrutha 2% foliar spray | 57.88 | 4.06 | 13.83 | 0.96 |
| F-Test | S | S | S | S |
| S.Em± | 0.39 | 0.03 | 0.13 | 0.30 |
| CD (P=0.05) | 1.18 | 0.1 | 0.40 | 0.91 |

**Table 2:** Effect of biofertilizers and foliar spray of organic amendments on yield attributes in Cowpea

| Treatments | Number of Pods/Plant | Length of pod (cm) | 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 |
| S.Em± | 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 |

The factors which are responsible for growth (branches per plant, plant height were increased significantly due to better supply of nutrients from integrated nutrient use of organic manures along with biofertilizers (Singh *et al*., 2014). Kumar *et al*. (2011) [9] reported that the efficacy of panchagavya foliar spray on the physiological growth and yield of the black gram. Plant fresh weight at maturity stage is influenced more by manure in combination of biofertilizer Similar results were observed by Tiwari *et al*., (2008).

**Plant dry weight (g/plant) and Crop Growth Rate (g/m$^2$/day):** Treatment with Rhizobium + PSB 20gm + Panchagavya 3% foliar spray was recorded maximum Plant Dry Weight (16.55 g) which was superior to all the treatments and there was significant difference among the treatments.

During 45-60 DAS, treatment with Rhizobium + PSB 20gm + Jeevamrutha 5% foliar spray was recorded significantly highest Crop growth rate (2.01 g/m$^2$/day) which was superior over rest of all treatments and treatment with PSB 20 gm + Panchagavya 3% foliar spray was statistically on par with the treatment Rhizobium + PSB 20gm + Jeevamrutha 5% foliar spray. biofertilizer plays an important role in root development and proliferation resulting in better nodule formation and nitrogen fixation by supplying assimilates to the roots, better environment in rhizosphere for growth and development. Since, the addition of fertility to the soil enhanced the availability of nutrients required for healthy growth and development of plants, since it represented nearly all the essential plant nutrients, These results corroborate with the finding of Kimti (2011), Kumar (2011), Mahetele and Kushwaha (2011) [8, 10, 13].

**Yield attributes**

**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 20gm + Panchagavya 3% foliar spray which was superior over rest of all treatments and the treatments with Rhizobium 20 gm + Panchagavya 3% foliar spray and PSB 20 gm + Panchagavya 3% foliar spray were statistically on par with the treatment Rhizobium + PSB 20gm + Panchagavya 3% foliar spray.

Highest Stover yield (1597.26 Kg/ha) was seen in the treatment PSB 20 gm + Beejamrutha 2% foliar spray which was superior over rest of all treatments and the treatment with Rhizobium 20 gm + Beejamrutha 2% foliar spray was statistically on par with the treatment PSB 20 gm + Beejamrutha 2% foliar spray.

Highest Harvest index (41.74%) was seen in the treatment Rhizobium + PSB 20gm + Panchagavya 3% foliar spray which was superior over rest of all treatments and there was significant difference among the treatments.

The increased seed yield was obtained in organic manures combination with biofertilizers application (Rhizobium and PSB) could be attributed to the effect of growth hormones like IAA and cytokinins produced by Rhizobium which stimulated root morphology. This in turn, would have improved assimilation of nutrients and thus seed yield. The phosphate solubilizing bacteria increase the availability of phosphorus to the plants and its greater uptake. The present results are in collaboration with the findings of Rajkhowa *et al*., (2002 and 2003) in green gram, Khandelwal *et al*., (2012) and Balachandran *et al*., (2005) [3].

## Conclusion

It can be concluded that higher yield with better quality of cowpea (VBN 3) was found with application of Rhizobium + PSB 20gm+ Panchagavya 3% foliar spray in terms of more productivity (1025.50 Kg/ha) as well as net returns (87,125.00 INR/ha).

## Future Scope

The conclusions drawn are based on one season data only which requires further confirmation for recommendation.

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