**Response of biofertilizer and foliar spray of organic amendments on economics and yield attributes of cowpea (*Vigna unguiculata* L.)**


***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). 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 economics and yield attributes of cowpea (*Vignaunguiculata* L.)",** to study Treatments consisting of 3 kinds of Biofertilize rs *viz.Rhizobium,* PSB and *Rhizobium* + PSB and 3 types of organic amendments *viz.* Panchagavya, Jeevamrutha and Beejamrutha Each of the 9 treatments was replicated three times and laid out in a Randomized Block Design with various treatment combinations. $T_1$ - 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. The results revealed that treatment 9 (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).It is concluded that seed treatment with Rhizobium + PSB 20gm + Panchagavya3% foliar spray was found more productive and economical.



***Keywords***: *Biofertilizers, economics, Organic amendments, Plant height, yield.*

## 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. Growth habit of cowpea ranges from erect, determinate, non-branching type to prostate or climbing, indeterminate, with profuse branching. cylindrical stem and slightly ribbed, twisting, hollow and globous. 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. 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. 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.

## MATERIALS AND METHOD

A field trial was done during Kharif 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). $T_1$ - Rhizobium 20 gm + Panchagavya3% 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% foliarspray ,$T_9$ - 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.

**Table 1. Treatment Details**

| | |
|---|---|
| **Biofertilizer** | i. Rhizobium 20 gm/kg |
| | ii. PSB 20 gm/kg (phosphate solubilizing bacteria) |
| | iii. (Rhizobium + PSB) 20 gm/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 gm + Panchagavya 3% foliar spray |
| 2. | Rhizobium 20 gm + Jeevamrutha 5% foliar spray |
| 3. | Rhizobium 20 gm + Beejamrutha 2% foliar spray |
| 4. | PSB 20 gm + Panchagavya 3% foliar spray |
| 5. | PSB 20 gm+ Jeevamrutha 5% foliar spray |
| 6. | PSB 20 gm + Beejamrutha 2% foliar spray |
| 7. | Rhizobium + PSB 20gm + Panchagavya 3% foliar spray |
| 8. | Rhizobium + PSB 20gm+Jeevamrutha 5% foliar spray |
| 9. | Rhizobium + PSB 20gm + Beejamrutha 2% foliar spray |

## RESULTS AND DISCUSSION

### 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)20gm + 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) 20gm + 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) 20gm+ Panchagavya 3% foliar spray which was maximum over rest of all treatments and the treatment with Rhizobium 20 gm + Panchagavya 3% foliar spray was statistically on par with the treatment (Rhizobium + PSB) 20gm + Panchagavya 3% foliar spray.

Highest test weight (133.40) was seen in the treatment (Rhizobium + PSB) 20gm+ Panchagavya 3% foliar spray which was maximum over rest of all treatments and the treatment with Rhizobium 20 gm + Panchagavya 3% foliar spray was statistically on par with the treatment (Rhizobium + PSB) 20gm+ 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 20gm + Panchagavya 3% foliar spray which was maximum over all treatments and the treatments with Rhizobium 20 gm + Panchagavya 3% foliar spray and PSB 20 gm + Panchagavya 3% foliarspray 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 maximum over 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 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. [7], Rajkhowa et al. [8] and [9] are cooperating with the discovery.

**ECONOMICS**

***a) Cost of cultivation***

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

***b) Gross return***

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

***c) Net return***

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

***d) B: C Ratio***

Maximum benefit cost Ratio (2.42) was seen with treatment (Rhizobium + PSB) 20gm + Panchagavya 3% foliar spray and the minimum B:C Ratio (1.95) was recorded with treatment PSB20 gm + Jeevamrutha

5% foliar spray.

## 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 20gm + Panchagavya 3% foliar spray show maximum yield attributes and yield of cowpea.

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Table No.3: Effect of biofertilizers and foliar spray of organic amendments on yield attributes in Cowpea.

| Treatments | Number of Pods/Plant | Length of 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 |