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## Response of organic manures and varieties on growth and yield of cowpea (*Vigna unguiculata* (L.) Walp) at Bharatpur, Chitwan, Nepal

Aashma Paudel<sup>1</sup>, Bishnu Bilas Adhikari<sup>2</sup>, Asmita Amgai<sup>1,\*</sup>

<sup>1</sup>Nepal Polytechnic Institute, Chitwan, Nepal

<sup>2</sup>Institute of Agriculture and Animal Science, Rampur Campus, Chitwan, Nepal

\*E-mail address: [amgai.asmita21@gmail.com](mailto:amgai.asmita21@gmail.com)

### ABSTRACT

An experiment entitled “Response of organic manures and varieties on growth and yield of cowpea at Bharatpur, Chitwan” was conducted in Agronomy farm of Nepal Polytechnic Institute during spring season 2022. The experiment was conducted in two factorial Randomized Complete Block Design with three replications and ten treatments. The treatments were set as two variety: V<sub>1</sub>: Surya and V<sub>2</sub>: Prakash as factor A and 20 kg N from different sources of organic manures (OM): OM<sub>1</sub>: FYM (0.5%N) 4 t ha<sup>-1</sup>, OM<sub>2</sub>: Poultry manure (5%N) 0.4t ha<sup>-1</sup>, OM<sub>3</sub>: Vermicompost (2.5% N) 0.8 t ha<sup>-1</sup>, OM<sub>4</sub>: Suchit biofertilizer (8.72% N) 0.23 t ha<sup>-1</sup>, OM<sub>5</sub>: Mustard oil cake (5.2% N) 0.39 t ha<sup>-1</sup> as factor B. The main objective of the experiment was to find out the best variety and good organic manure for getting better yield of cowpea under rainfed condition. Results revealed that the variety Surya produced the highest grain yield (1.01 t ha<sup>-1</sup>) followed by Prakash (0.91 t ha<sup>-1</sup>). In case of organic manures, the highest grain yield (1.37 t ha<sup>-1</sup>) was obtained in 4 t ha<sup>-1</sup> of FYM applied plot. The interaction effect between variety and organic manures showed that the variety Surya along with 4 t ha<sup>-1</sup> FYM showed maximum grain yield (1.41 t ha<sup>-1</sup>). From this experiment, it is concluded that the use of variety Surya with 4 tons of FYM ha<sup>-1</sup> gives the highest productivity with better economic return compared to all other treatments.

**Keywords:** Harvest index, profitability, growth analysis, test weight, biological yield, *Vigna unguiculata*

## 1. INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp) is an important legume crop belongs to family Fabaceae with sub family Papilionaceae. It has been growing from tropical and subtropical areas primarily for grains, as a vegetable, green pods, a cover crop, for fodder and atmospheric nitrogen fixer (Horn, 2022). Cowpea is of immense important multipurpose grain legume crop. It is grown across the world on an estimated 14.5 million ha of land with total annual production 6.2 million metric tons (Kebede, 2020).

The USA is the top exporter and India is a top importer of cowpea in the world, where Nepal possesses 95<sup>th</sup> ranking about 0.01% of market share in global export (Chhetri, 2014). Among pulses crops, cowpea being a drought-tolerant crop, which is better adapted in different types of soil and is widely cultivated in Nepal from Terai to Mid-hills. The cowpea cultivation covers about 6,572 ha with the production of 9,186 ha and productivity of only 1.36 MT per ha (MoALD, 2020).

Cowpea has heavy biomass and add more amount of organic manure in the soil, which improves soil tilth, infiltration rate and water holding capacity of soil (Bill, 2001). Further, it stimulates the activity of microorganisms that makes the plant to get the macro and micro-nutrients through enhance biological processes, increase nutrient solubility, alter soil salinity, and soil pH [6]. Shaw (2007) reported that the cowpea seed contains 24.8 % protein, 63.6 % carbohydrate, 1.9 % fat, 6.3 % fiber, 0.00074 % thiamine, 0.00042 % Riboflavin and 0.00281 % Niacin. Soils with a high concentration of organic matter have been proven to improve the growth and yield of various plants as well as soil infiltration, soil compaction, and increase water retention capacity for seed germination and plant root development (Thapa, 2021). Cowpea is also grown as catch crop, mulch crop, intercrop, mixed crop and green crop. Nepalese farmers have been using imbalance doses of fertilizers with very less amount of organic manures like FYM, Compost or poultry manure.

The deficiency of N, P and K are major constraints on higher crop productivity in tropical regions (Jagadale *et al.*, 2017). Farmers are not followed the recommended dose of fertilizer (20:40:20 kg NPK ha<sup>-1</sup>) and have been using the low fertilizer level. The soil fertility status has deteriorated over the years which resulted in low productivity of cowpea. Therefore, this study was focused to evaluate the response of different source of organic manures with two cowpea varieties for the production of better yield and also to find out the best interaction between varieties and organic manures.

## 2. MATERIALS AND METHODS

The present field experiment was conducted in Agronomy farm of Nepal Polytechnic Institute (NPI) Bharatpur, Chitwan during spring season 2022. Geographically, the site is situated at 27° 70' North latitude and 84° 45' East longitude with elevation of 208m from the mean sea level. The soil sample was taken in the experimental field from the 15-20 cm depth before field preparation to find out the status of pH, available plant nutrients and organic carbon in the soil. The soil texture was sandy clayey, low in available nitrogen (0.61%), available phosphorus (17.41 mg kg<sup>-1</sup>) and available potassium (70.08 mg kg<sup>-1</sup>), medium in organic carbon (4.72%) with acidic in soil reaction (5.65 pH). The experiment was carried out in two Factorial Randomized Complete Block Design with three replications.

The individual plot size was 3m × 2m (6 m<sup>2</sup>) with ten treatments. There were two different factors in the experiment such as variety and organic manure. Factor A was variety: V<sub>1</sub>: Surya and V<sub>2</sub>: Prakash and factor B was organic manures like OM<sub>1</sub>: FYM (0.5%N) 4 t ha<sup>-1</sup>, OM<sub>2</sub>: Poultry manure (5%N) 0.4t ha<sup>-1</sup>, OM<sub>3</sub>: Vermicompost (2.5% N) 0.8 t ha<sup>-1</sup>, OM<sub>4</sub>: Suchit biofertilizer (8.72% N) 0.23 t ha<sup>-1</sup>, OM<sub>5</sub>: Mustard oil cake (5.2% N) 0.39 t ha<sup>-1</sup>.

The experimental field was levelled and well drained. After the preparation of the plots, seeds were sown 2-3 cm below the soil surface by dibbling method with 2 seeds per spot on 17<sup>th</sup> February 2022. Gap filling was undertaken 10 days after sowing to maintain the optimum plant stand per unit area. The plant geometry between row to row was 60 cm and between plant to plant was 20 cm. The recommended dose of nitrogen 20 kg /ha through different sources of organic manures plus 40 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> and 20 kg K<sub>2</sub>O ha<sup>-1</sup> was applied as basal dose just before sowing. The additional N was applied through top dressing. The P<sub>2</sub>O<sub>5</sub> was supplied through single super phosphate (16% P<sub>2</sub>O<sub>5</sub>) while K<sub>2</sub>O through muriate of potash (60% K<sub>2</sub>O).

The crop plants were harvested from each net plot, dried for 3-4 days and pods were pick up from the plant and threshed, cleaned by using winnowing. The whole plants including pods were weighted as biological yield. Then, grain weights were subtracted from the biological yield and mentioned as biomass yield.

### **3. RESULTS AND DISCUSSIONS**

#### **Effects on growth characters**

The mean number of green leaves plant<sup>-1</sup>, plant height, leaf area index and pod length of cowpea as influenced by the varieties and organic manures is shown in Table 1. The effect of varieties on number of green leaves plant<sup>-1</sup> and plant height (cm) were statistically significant whereas pod length and leaf area index were statistically non-significant. Highest no. of green leaves per plant (25), plant height (63.02 cm), pod length (18.43 cm) and leaf area index (0.06) were found superior in Surya compared to Prakash variety. These results are in close conformity with the findings of Aryal (2021), who has reported that the lowest number of green leaves, plant height and leaf area of cowpea was observed in variety Prakash compared to other varieties. He also revealed that the differences in growth characters between varieties may be due to genetic make-up of the seed. Pandey (2006) reported that the variety Prakash produced relatively shorter pods (16.21 cm) compared to other varieties. This result is more in conformity with the findings obtained by NGLRP, which reported variety Prakash produced lower grain yield than all the other tested varieties.

Similarly, effect of organic manures on plant growth characters showed significant differences on green leaf number per plant, plant height and pod length, while non-significance effects seen on leaf area index. The highest no. of green leaves (25), plant height (60.4 cm), pod length (20.06 cm) and leaf area index (0.068) were observed in FYM applied plot. These results are in close conformity with the findings of Abd (2018), whose results indicated that the application of FYM at 10 tons ha<sup>-1</sup> gave maximum yield of cowpea compared to others. This finding is in close conformity with Singh (2018), who reported that the increasing FYM levels increased plant height and number of leaves plant<sup>-1</sup> over control. Similarly, Singh (2016) also reported that the use of FYM increased growth characters of cluster bean. Yadav (2019) observed significant increment in pod length (27.50 cm) by the application of FYM 5 t ha<sup>-1</sup> along with Vermi compost 2t ha<sup>-1</sup>, Rhizobium and PSB.

**Table 1.** Growth characters of cowpea as influenced by varieties and organic manures at Bharatpur, Chitwan, 2022.

Treatments	No. of green leaves plant <sup>-1</sup>	Plant height (cm)	LAI	Pod length (cm)
Factor A: Variety				
V <sub>1</sub> : Prakash	18 <sup>b</sup>	45.47 <sup>b</sup>	0.04	17.30
V <sub>2</sub> : Surya	25 <sup>a</sup>	63.02 <sup>a</sup>	0.06	18.43
LSD value	1.80	3.06	0.02	4.91
Sem (±)	0.07	0.13	0.01	0.20
F test (0.05)	**	**	NS	NS
CV%	5.35	3.59	14.99	17.50
Factor B: Organic manure				
OM <sub>1</sub> : FYM	25 <sup>a</sup>	60.49 <sup>a</sup>	0.07	20.06 <sup>a</sup>
OM <sub>2</sub> : Poultry manure	19 <sup>b</sup>	58.50 <sup>a</sup>	0.05	18.72 <sup>b</sup>
OM <sub>3</sub> : Vermicompost	20 <sup>b</sup>	46.41 <sup>d</sup>	0.05	18.22 <sup>ab</sup>
OM <sub>4</sub> : Suchit biofertilizer	24 <sup>a</sup>	49.62 <sup>c</sup>	0.05	16.61 <sup>bc</sup>
OM <sub>5</sub> : Oil cake	20 <sup>b</sup>	56.23 <sup>b</sup>	0.04	15.72 <sup>c</sup>
LSD value	1.31	2.06	0.03	2.29
Sem (±)	0.18	0.01	0.09	0.31
F test (0.05)	***	***	NS	**
CV%	4.99	3.11	15.76	10.48
Grand mean	21.42	54.25	0.05	17.87

Mean followed by the same letter (s) in a column do not differ at 5% level of significance by DMRT, CV = Coefficient of variance, SEM = Standard error of mean, LSD = Least significant difference.

### Effect on yield and yield attributing characters

The yield and yield attributing characters like, test weight, no. of grains/pods, grain yield, biological yield and harvest index of cowpea as influenced by the varieties and different combination of organic manures is shown in Table 2. The effect of varieties showed that test weight, grain yield, biological yield and harvest index were significantly influenced, whereas no. of grains pod<sup>-1</sup> was found non-significantly influenced. The highest test weight (140.42 gm),

no. of grains pod<sup>-1</sup> (17), grain yield (1.01 t ha<sup>-1</sup>), biological yield (5.15 t ha<sup>-1</sup>) and harvest index (19.61%) was recorded in variety Surya. The shorter pods were produced by variety Prakash which is directly leads to lower yield while the longer pods of variety Surya produced higher yield. Results also revealed that higher no. of grains/pod is directly related to higher yield of cowpea which is supported by the results of Pandey (2006).

Similarly, in case of use of different source of organic manures, the maximum test weight (149.94 gm), no. of grains pod<sup>-1</sup> (17), biological yield (5.48 t ha<sup>-1</sup>), grain yield (1.37 t ha<sup>-1</sup>) and harvest index (25.14 t ha<sup>-1</sup>) was obtained from FYM used plots. This is in conformity with the results obtained by Satpathy (2008), who has reported that the application of 10 t/ha of FYM recorded higher test weight (33.1g) in rice bean. This result shows more in agreement with the findings obtained from Lawal (2013), who reported that the increment in dry matter content upto 54% with the application of FYM. Pandey (2011) also gives close conformity to the finding of increment in pod yield of garden pea with the application of 20t ha<sup>-1</sup> of FYM. Datt (2003) also supported this result by reporting 10 ton/ha of FYM application increased the pod yield in vegetable pea by 16 percent over the control. Singh (2010) also gave agreement to this result by observing increased grain yields as well as net returns of kabuli chickpea with the application of 5 t FYM.

**Table 2.** Effects of varieties and different source of organic manures on yield attributes and yield of cowpea at Bharatpur, Chitwan during 2022

Treatments	Test wt. (g)	No. of grains pod <sup>-1</sup>	Bio yield (t ha <sup>-1</sup> )	Grain yield (t ha <sup>-1</sup> )	Harvest index (%)
Factor A: Variety					
V <sub>1</sub> : Prakash	131.53 <sup>b</sup>	15	4.85 <sup>b</sup>	0.91 <sup>b</sup>	18.54 <sup>b</sup>
V <sub>2</sub> : Surya	140.42 <sup>a</sup>	17	5.15 <sup>a</sup>	1.01 <sup>a</sup>	19.61 <sup>a</sup>
LSD value	3.64	2.51	0.14	0.02	0.86
Sem (±)	0.15	0.11	0.01	0.01	0.04
F test (0.05)	**	NS	*	**	*
CV%	1.70	9.98	1.81	1.85	2.87
Factor B: Organic manure					
OM <sub>1</sub> : FYM	149.94 <sup>a</sup>	17 <sup>a</sup>	5.48 <sup>a</sup>	1.37 <sup>a</sup>	25.14 <sup>a</sup>
OM <sub>2</sub> : Poultry manure	144.00 <sup>b</sup>	17 <sup>a</sup>	5.17 <sup>b</sup>	1.10 <sup>b</sup>	21.28 <sup>b</sup>
OM <sub>3</sub> : Vermicompost	127.67 <sup>d</sup>	16 <sup>ab</sup>	4.75 <sup>d</sup>	0.84 <sup>c</sup>	17.65 <sup>c</sup>
OM <sub>4</sub> : Suchit biofertilizer	138.57 <sup>c</sup>	15 <sup>b</sup>	4.94 <sup>c</sup>	0.81 <sup>c</sup>	16.55 <sup>d</sup>
OM <sub>5</sub> : Oil cake	119.70 <sup>e</sup>	15 <sup>b</sup>	4.68 <sup>d</sup>	0.69 <sup>d</sup>	14.76 <sup>e</sup>

LSD value	1.40	1.93	0.07	0.03	0.65
Sem ( $\pm$ )	0.19	0.26	0.01	0.001	0.08
F test (0.05)	***	*	***	***	***
CV%	0.84	9.82	1.17	2.64	2.77
Grand mean	135.98	16	5.01	0.96	19.07

Mean followed by the same letter (s) in a column do not differ at 5% level of significance by DMRT, CV = Coefficient of variance, SEM = Standard error of mean, LSD = Least significant difference.

### Interaction Effects

Interaction effect of cowpea varieties and different source of organic manure is given in Table 3. It is found that the interaction between variety and different source of organic manures showed significant differences on yield and yield attributing characters. The higher test weight (152.39 gm), no. of grains pod<sup>-1</sup> (19), biological yield (5.56 t ha<sup>-1</sup>), grain yield (1.41 t ha<sup>-1</sup>) and harvest index (26.17 %) were found in variety Surya along with 4 tons FYM ha<sup>-1</sup> application. Similarly, lowest test weight (109.99 gm), no. of grains pod<sup>-1</sup> (14), biological yield (4.49 t ha<sup>-1</sup>), grain yield (0.64 t ha<sup>-1</sup>) and harvest index (14.36 %) were found in variety Prakash along with mustard oil cake.

**Table 3.** Interaction effects of varieties and different source of organic manures on yield attributes and yield of cowpea at Bharatpur, Chitwan during 2022

Treatments	Test wt. (g)	No. of grain pod <sup>-1</sup>	Bio-yield (t ha <sup>-1</sup> )	Grain yield (t ha <sup>-1</sup> )	Harvest index (%)
V <sub>1</sub> : Prakash × OM <sub>1</sub> (FYM)	147.49 <sup>b</sup>	16	5.39 <sup>b</sup>	1.34 <sup>b</sup>	24.10 <sup>b</sup>
V <sub>1</sub> : Prakash × OM <sub>2</sub> (Poultry manure)	147.49 <sup>b</sup>	17	5.17 <sup>c</sup>	0.92 <sup>d</sup>	17.88 <sup>cd</sup>
V <sub>1</sub> : Prakash × OM <sub>3</sub> (Vermicompost)	120.58 <sup>h</sup>	15	4.55 <sup>f</sup>	0.75 <sup>f</sup>	16.62 <sup>e</sup>
V <sub>1</sub> : Prakash × OM <sub>4</sub> (Suchit Biofertilizer)	132.11 <sup>f</sup>	15	4.66 <sup>e</sup>	0.82 <sup>e</sup>	17.65 <sup>d</sup>
V <sub>1</sub> : Prakash × OM <sub>5</sub> (Oil cake)	109.99 <sup>i</sup>	14	4.49 <sup>f</sup>	0.64 <sup>g</sup>	14.36 <sup>g</sup>
V <sub>2</sub> : Surya × OM <sub>1</sub> (FYM)	152.39 <sup>a</sup>	19	5.56 <sup>a</sup>	1.41 <sup>a</sup>	26.17 <sup>a</sup>
V <sub>2</sub> : Surya × OM <sub>2</sub> (Poultry manure)	140.51 <sup>d</sup>	18	5.17 <sup>c</sup>	1.27 <sup>c</sup>	24.67 <sup>b</sup>
V <sub>2</sub> : Surya × OM <sub>3</sub> (Vermicompost)	134.76 <sup>e</sup>	17	4.94 <sup>d</sup>	0.92 <sup>d</sup>	18.69 <sup>c</sup>
V <sub>2</sub> : Surya × OM <sub>4</sub> Suchit Biofertilizer)	145.04 <sup>c</sup>	15	5.21 <sup>c</sup>	0.80 <sup>e</sup>	15.45 <sup>f</sup>
V <sub>2</sub> : Surya × OM <sub>5</sub> (Oilcake)	129.42 <sup>g</sup>	16	4.87 <sup>d</sup>	0.73 <sup>f</sup>	15.15 <sup>g</sup>

LSD value	1.98	2.73	0.10	0.04	0.91
Sem ( $\pm$ )	0.38	0.52	0.02	0.01	0.18
F test (0.05)	***	NS	***	***	***
CV%	0.844	9.82	1.16	2.64	2.77
Grand mean	135.98	16	5.01	0.96	19.07

Mean followed by the same letter (s) in a column do not differ at 5% level of significance by DMRT, CV = Coefficient of variance, SEM = Standard error of mean, LSD = Least significant difference.

These findings are in close conformity with the result reported by Babaji (2011), who concluded that the three varieties along with application of 5 t ha<sup>-1</sup> of FYM produced highest pod yield compared to other treatments. Babaji (2011) and Miko (2007a) also reported that the crop matured early are believed to produced lower yield due to shorter green leaf duration which supports the finding of our result where the variety Surya along with application of 4 tons ha<sup>-1</sup> of FYM plots matured delay compared to variety Prakash. This may be the reason of higher yield of Surya along with FYM applied treatments.

#### 4. CONCLUSION

The study showed that the performance of Cowpea in almost every vegetative and reproductive aspect, the variety Surya provide better outcome compared to Prakash. Similarly, in case of organic manures, the 4 ton FYM ha<sup>-1</sup> gave maximum growth and yield parameters rather than other sources of organic manure. Interaction effect between variety and organic manure showed highest productivity of cowpea in Surya variety along with 4 tons of FYM ha<sup>-1</sup> with greater effect in resulting highest growth, yield attributes and yield parameters under rainfed condition in inner Terai regions of Nepal.

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