Biological Forum – An International Journal **15(12): 406-410(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Influence of Integrated Nutrient Management on Growth and Seed Yield of Cowpea (*Vigna unguiculata*) (L)

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(Received: 18 September 2023; Revised: 24 October 2023; Accepted: 25 November 2023; Published: 15 December 2023)

(Published by Research Trend)

ABSTRACT: Among various pulse crops cowpea [*Vigna unguiculata* (L.) Walp.] is an important food legume and grown over an area of 0.5 million ha, it is adapted to wide range of soils, rainfall situations and fits as an crop in multiple and intercropping systems. The present investigation was carried on Rabi-2022 cv. Pusa Komal at the Horticultural Research Farm, Sardar Patel University, Balaghat (M.P.). The experiment was laid out in a Randomized Block Design (RBD) with eight treatments in three replications. The applications of organic and inorganic nutrient applications like T1- Control, T_2-100% RDF, T_3- 75% RDF + 25% FYM, T_4-75% RDF + 25% Vermicompost, T_5-50% RDF + 50% FYM, T6-50% RDF + 50% Vermicompost, T_7-25% RDF + 75% FYM, T_8-25% RDF + 75% Vermicompost was used for the experiment. At the growth stage of 25, 50 and 75 DAS of crop, the maximum plant height was observed under the treatment the treatment T_2 (100 % RDF), followed by the treatment T_3 (75% RDF + 25% FYM) and T_5 (50% RDF + 50% FYM), at the growth stage of 25, 50 & 75 DAS of crop, the maximum number of primary branches/plant was observed under the treatment T_2 (100 % RDF), followed by the treatment T_3 (75% RDF + 25% FYM) and T_5 (50% RDF + 50% FYM), while the minimum plant height and number of primary branches/plant at 25, 50 & 75 DAS was observed under the treatment T_1 (Control), the early days for 1st flowering in cowpea was observed under the treatment T_2 (100 % RDF), followed by the treatment T_3 (75% RDF + 25% FYM) and T_5 (50% RDF + 50% FYM), the early days for 1st Fruiting in cowpea was observed under the treatment T_2 (100 % RDF), followed by the treatment T_3 (75% RDF + 25% FYM) and T_5 (50% RDF + 50% FYM), the Days to maturity of Fruits in cowpea was observed under the treatment T_2 (100 % RDF), followed by the treatment T_3 (75% RDF + 25% FYM) and T_5 (50% RDF + 50% FYM), the maximum total Number of pods per plant at maturity and pod length was observed under the treatment T_2 (100 % RDF), followed by the treatment T_3 (75% RDF + 25% FYM), the maximum pod diameter was observed under the treatment T_2 (100 % RDF), followed by the treatment T_7 (25% RDF + 75% FYM) and T_5 (50% RDF + 50% FYM), the maximum seed yield per plant, seed yield per plot (kg) and seed yield (q/ha) was observed under the treatment T_2 (100 % RDF), followed by the treatment T_3 (75% RDF + 25% FYM) and T_5 (50% RDF + 50% FYM), the maximum Seed Weight (g) was observed under the treatment T_8 (25% RDF + 75% Vermicompost), followed by the treatment T_7 (25% RDF + 75% FYM) and T_6 (50% RDF + 50% Vermicompost), the maximum gross return was found in the treatment T_2 because of the nutrient application is 100% recommended dose (100% RDF) they are small in quantity and less in price compare to other manures, the average net return or the maximum net profit was obtained under treatment T_2 (100% RDF) which was closely followed by treatment T_3 (75% RDF + 25% FYM), while the minimum was found in all the treatments under the treatment T_1 (Control). Limited focus on integrated approaches, optimizing nutrient ratios, lack of long-term studies, and socio-economic constraints are key challenges.

Keywords: RDF, FYM, cowpea, Crop, Manure, Nutrients, Pulses and Pusa Komal.

INTRODUCTION

Among various pulse crops cowpea [*Vigna unguiculata* (L.) Walp.] is an important food legume and grown over an area of 0.5 million ha, it is adapted to wide range of soils, rainfall situations and fits as an crop in multiple and intercropping systems. It is the most versatile pulse crop because of its smoothening nature, drought tolerance and multiple uses such as green vegetable, food legumes to tackle malnutrition as it is rich in proteins and vitamins and is also used as hay, silage, pasture, fodder, soil cover and green manure. Cowpea also has ability to withstand drought, which make it suitable for drought-prone areas with low rainfall. An age old practice of mixed cropping of cowpea for vegetable purpose with widely spaced crop such as cotton, pigeon pea maize, sorghum, pearl millet, sunflower, castor and plantation crops or its cultivation in cropping systems, is now being practiced with

improved package of practices in term of spacing, choice of appropriate varieties, nutrient, water and weed management and plant protection, which has resulted in enhanced productivity and profitability, besides effective use of land and other resources (Patel *et al.,* 2022).

Cowpea is a major grain legume grown in Madhya Pradesh regions. It is a major source of protein and a cheap source of quality protein for both rural and urban dwellers in Africa (Ajeigbe *et al.,* 2012; Dube and Fanadzo 2013). Cowpea leaves and green pods are consumed as vegetable and the dried grain is used in many different food preparations.

Protein content of cowpea leaves range from 27 to 43% and protein concentration of the dry grain range from 21 to 33% (Ahenkora *et al.,* 1998; Abudulai *et al.,* 2016). It is estimated that cowpea can fix up to 200 kg N ha^{-1} (Dakora *et al*., 1987; Giller, 2001; Rusinamhodzi *et al.,* 2006; Adjei- Nsiah *et al.,* 2008) and can leave a positive soil N balance of up to 92 kg ha^{-1} (Chikowo *et al.,* 2004; Rusinamhodzi *et al.,* 2006). Among the various technologies to boost up the productivity, nutrient management assesses greater significance in maximizing the yield of the crop. Balanced use of chemical fertilizers alone will not able to sustain high productivity due to emergence of multi – nutritional deficiencies besides, indiscriminate and continuous application of chemical fertilizers and pesticides render the soil life less. Hence, a shift back to our traditional organic farming by the use of organic manures is the need of the hour to attain sustenance in production system. Hence the present study will help to find out the dosage of organic nutrients to be supplied to vegetable cowpea, in order to increase the growth and yield. In this background, the present study was carried out with the objective to study the effect of soil and foliar application of organic nutrients on growth and yield of vegetable cowpea.

MATERIAL AND METHODS

The present study entitled "Influence of integrated nutrient management on growth and seed yield of cowpea (*Vigna unguiculata*) (L)" was conducted at the Horticultural Research Farm, Sardar Patel University, Balaghat (M.P.) in *Rabi* season 2022. The experiment was laid out in a Randomized Block Design (RBD) with eight treatments in three replications. The details of treatments are 100% RDF, 75% RDF + 25% FYM, 75% RDF + 25% Vermicompost, 50% RDF + 50% FYM, 50% RDF + 50% Vermicompost, 25% RDF + 75% FYM and 25% RDF + 75% Vermicompost, follow on Table 1.

RESULTS AND DISCUSSION

A. Plant Height

At the growth stage of 25 DAS of crop, the maximum plant height was observed under the treatment the treatment T_2 (100 % RDF) i.e. 29.75 cm, followed by the treatment T_3 (75% RDF + 25% FYM) i.e. 27.91 cm and T_5 (50% RDF + 50% FYM) i.e. 26.29 cm, while the minimum plant height at 25 DAS was observed under the treatment T_1 (Control) i.e. 16.57 cm respectively. At the growth stage of 50 DAS of crop, the maximum plant height was observed under the treatment the treatment T_2 (100 % RDF) i.e. 44.30 cm, followed by the treatment T_3 (75% RDF + 25% FYM) i.e. 41.79 cm and T_5 (50% RDF + 50% FYM) i.e. 40.17 cm, while the minimum plant height at 50 DAS was observed under the treatment T_1 (Control) i.e. 31.25 cm respectively. As we know that nitrogen accelerates photosynthetic rate henceforth increase the supply of carbohydrate to plant which ultimate increase the dry major production in plant findings of improvement in overall vegetative growth and development of crop with NPK in the investigation is in close conformity of Upadhyay and Anita (2016); Balai *et al.* (2017).

B. Number of primary branches/plant 25, 50 & 75 DAS

At the growth stage of 25 DAS of crop, the maximum number of primary branches/plant was observed under the treatment T_2 (100 % RDF) i.e. 4.54, followed by the treatment T_3 (75% RDF + 25% FYM) i.e. 4.03 and T_5 (50% RDF + 50% FYM) i.e. 3.86, while the minimum number of primary branches/plant at 25 DAS was observed under the treatment T_1 (Control) i.e. 1.63 respectively. At the growth stage of 50 DAS of crop, the maximum number of primary branches/plant was observed under the treatment T_2 (100 % RDF) i.e. 9.92, followed by the treatment T_3 (75% RDF + 25% FYM) i.e. 8.37 and T_7 (25% RDF + 75% FYM) i.e. 7.40, while the minimum number of primary branches/plant at 50 DAS was observed under the treatment T_1 (Control) i.e. 2.49 respectively. At the growth stage of 75 DAS of crop, the maximum number of primary branches/plant was observed under the treatment T_2 (100 % RDF) i.e. 18.83, followed by the treatment T_3 (75% RDF + 25% FYM) i.e. 18.33 and T_7 (25% RDF + 75% FYM) i.e. 17.75, while the minimum number of primary branches/plant at 75 DAS was observed under the treatment T_1 (Control) i.e. 16.22 respectively.

The above findings of improvement in overall vegetative growth and development of crop with NPK in the investigation is in close conformity of Upadhyay and Anita (2016); Balai *et al.* (2017).

C. Days required for 1st Flowering

At the growth stage of cowpea crop, the early days for 1st flowering in cowpea was observed under the treatment T_2 (100 % RDF) i.e. 32.220 days, followed by the treatment T_3 (75% RDF + 25% FYM) i.e. 33.430 days and T_5 (50% RDF + 50% FYM) i.e. 34.540 days, while the late days observed for 1st Flowering was observed under the treatment T_1 (Control) i.e. 42.230 days respectively. Satodiya *et al.* (2015) concluded that application of fertilizer resulted in significant decrease in days to flowering. Concluded that inorganic fertilizer along with Rhizobium seed in inoculation recorded earliness in flowering in Pusa Phalguni variety of cowpea.

D. Days required for 1st Fruiting

At the growth stage of cowpea crop, the early days for 1st Fruiting in cowpea was observed under the treatment T_2 (100 % RDF) i.e. 37.33 days, followed by the treatment T_3 (75% RDF + 25% FYM) i.e. 38.76 days and T_5 (50% RDF + 50% FYM) i.e. 39.33 days, while the late days observed for 1stFruiting was observed under the treatment T_1 (Control) i.e. 53.21 days

respectively. Similar result were found, Satodiya *et al.* (2015).

E. Total no. of pods per Plant at maturity

In the cowpea crop, the maximum Total No. of pods per plant at maturity was observed under the treatment T_2 (100 % RDF) i.e. 30.71, followed by the treatment T_3 (75% RDF + 25% FYM) i.e. 29.39 and T_5 (50% RDF + 50% FYM) i.e. 27.44, while the minimum Total No. of pods per plant at maturity was observed under the treatment T_1 (Control) i.e. 21.44 respectively. This type of observation had been reported by Ramana *et al.* (2011); Jat *et al.* (2013) in pod length and number of seeds per pod and number of pods per plant. Prasad *et al.* (2012) recorded increase in pod length and number of pods per plant due to inorganic fertilization treatment. Similarly, result were also reported by Singh *et al.* (2011) in French bean and in cowpea. Similar result found, however, find out in Mishra (1999); Parmar *et al.* (1999).

F. Pod length

In the cowpea crop, the maximum pod length was observed under the treatment T_2 (100 % RDF) i.e. 34.21 cm, followed by the treatment T_3 (75% RDF + 25% FYM) i.e. 34.21 cm and T_5 (50% RDF + 50% FYM) i.e. 31.67 cm, while the minimum pod length was observed under the treatment T_1 (Control) *i.e.* 21.32 cm respectively. However, find out in Chhipa *et al.*, (2012).

G. Pod Diameter

In the cowpea crop, the maximum pod diameter was observed under the treatment T_2 (100 % RDF) *i.e.* 1.67 cm, followed by the treatment T_7 (25% RDF + 75% FYM) i.e. 0.87 cm and T_5 (50% RDF + 50% FYM) i.e. 0.82 cm, while the minimum pod diameter was observed under the treatment T_1 (Control) *i.e.* 0.38 cm respectively. Smilar result also found the Babaji *et al.* (2011); Magdi *et al.* (2011); Chhipa *et al.* (2012).

H. Seed Yield per Plant

In the cowpea crop, the maximum seed yield per plant was observed under the treatment T_2 (100 % RDF) i.e. 394.28 g, followed by the treatment T_3 (75% RDF + 25% FYM) i.e. 363.20 g and T_5 (50% RDF + 50% FYM) i.e. 331.67 g, while the minimum seed yield per plant was observed under the treatment T_1 (Control) i.e. 202.26 g respectively. However Anuja and Vijayalakshmi (2014); Kumar and Pandita (2016); Abd El Lateef *et al.* (2018); Issoufa *et al.* (2020); Chhipa *et al.* (2012).

I. Seed yield per plot (kg)

In the cowpea crop, the maximum seed yield per plot (kg) was observed under the treatment T_2 (100 % RDF) i.e. 22.08 kg, followed by the treatment T_3 (75% RDF + 25% FYM) i.e. 20.34 kg and T_5 (50% RDF + 50% FYM) i.e. 18.57 kg, while the minimum seed yield per plot (kg) was observed under the treatment T_1 (Control) i.e. 11.33 kg respectively. Yadav *et al.* (2019) also obtained similar results in cowpea. Similar result were declared by Chhipa *et al.*, (2012); Abd El Lateef *et al.*, (2018).

J. Seed Yield (q/ha)

In the cowpea crop, the maximum seed yield was observed under the treatment T_2 (100 % RDF) i.e. 13.25 q/ha, followed by the treatment T_3 (75% RDF + 25% FYM) i.e. 11.41 q/ha and T_5 (50% RDF + 50% FYM) i.e. 9.88 q/ha, while the minimum seed yield was observed under the treatment T_1 (Control) i.e. 3.53 q/ha respectively. However Anuja and Vijayalakshmi (2014); Kumar and Pandita (2016); Chhipa *et al.* (2012).

K. Economic parameter

The maximum gross return was found in the treatment T_2 because of the nutrient application is 100% recommended dose (100% RDF) they are small in quantity and less in price compare to other manures. The minimum gross return was found in the treatment T_1 Control.

The average net return or the maximum net profit was obtained under treatment T_2 (100% RDF) which was closely followed by treatment T_3 (75% RDF + 25% FYM). Minimum net profit was found in treatment combination T_1 (Control). Nutrients are directly related with the growth and yield of cowpea. Application of nutrients through integrated approach reduce the cost of cultivation and also maintain as well as improve soil health by increasing the fertility, whereas, non-monetary inputs like spacing also play an important role for boosting the yield by increasing the plant population per unit area (Biswan *et al.*, 2002); Kumar and Pandita (2016); Dutta *et al.* (2021).

Table 1: Effect of Integrated Nutrient Management on Different Parameter on Cow pea.

Treatment	Treatment Detail	Plant height (cm)			Number of primary branches/plant			Days required for 1st Flowering	Day required for 1st Fruiting
		25 DAS	50 DAS	75 DAS	25 DAS	50 DAS	75 DAS		
T_1	Control	16.57	31.25	68.83	1.63	2.49	16.22	42.23	53.21
T_2	100% RDF	29.75	44.30	104.44	4.54	9.92	18.83	32.22	37.33
T_3	75% RDF + 25% FYM	27.91	41.79	99.78	4.03	8.37	18.33	33.43	38.76
T_4	75% RDF + 25% Vermicompost	23.55	37.43	96.43	2.75	5.66	17.54	39.41	44.65
T_5	50% RDF + 50% FYM	26.29	40.17	90.58	3.86	7.18	18.11	34.54	39.33
T_6	50% RDF + 50% Vermicompost	17.51	32.27	75.51	1.98	2.84	16.61	41.11	48.78
T_7	25% RDF + 75% FYM	24.66	38.54	102.46	3.31	7.40	17.75	37.22	41.22
T_8	25% RDF + 75% Vermicompost	18.66	32.54	86.27	2.20	3.056	17.24	40.67	47.33
S.Em.±		0.100	0.486	0.373	0.031	0.281	0.054	0.110	0.162
CD at (5%)		0.302	1.473	1.132	0.093	0.853	0.163	0.335	0.491
CV		0.747	2.257	0.714	1.746	8.309	0.528	0.508	0.640

Table 2: Effect of Integrated Nutrient Management on different parameter on cow pea.

Treatment	Treatment Detail	Total No. of pods per plant at maturity	Pod Length (cm)	Pod Diameter (cm)	Seed yield per plant (g)	Seed yield per plot (kg)	Seed Yield (q/ha)
T_1	Control	21.44	21.32	0.38	202.26	11.33	3.53
T_2	100% RDF	30.71	34.21	1.67	394.28	22.08	13.25
T_3	75% RDF + 25% FYM	29.39	32.22	0.72	363.20	20.34	11.41
T_4	75% RDF + 25% Vermicompost	23.34	26.77	0.56	253.83	14.21	5.94
T_5	50% RDF + 50% FYM	27.44	31.67	0.82	331.67	18.57	9.88
T_6	50% RDF + 50% Vermicompost	22.15	23.21	0.72	223.14	12.50	4.40
T_7	25% RDF + 75% FYM	24.56	28.45	0.87	282.83	15.84	7.19
T_8	25% RDF + 75% Vermicompost	22.89	25.56	0.64	236.33	13.23	5.35
S.Em. ±		0.101	0.131	0.011	3.236	0.181	0.244
CD at (5%)		0.306	0.399	0.034	9.816	0.550	0.739
CV		0.693	0.815	2.410	1.960	1.960	5.540

Table 3: Effect of Integrated Nutrient Management on economic parameter.

Treat.	Common cost of cultivation	Treatment cost	Total Cost	Seed Yield q/ha (250/kg)	Gross income	Net income	B:C Ratio
T_1	33000	0	33000	3.53	88250	55250	2.7:1
T_2	33000	4601.45	37601.45	13.25	331250	293648.6	8.8:1
T_3	33000	10950.95	43950.95	11.41	285250	241299.1	6.5:1
T_4	33000	8450.95	41450.95	5.94	148500	107049.1	3.6:1
T_5	33000	17287.14	50287.14	9.88	247000	196712.9	4.9:1
T_6	33000	12287.14	45287.14	4.4	110000	64712.86	2.4:1
T_7	33000	24650.37	57650.37	7.19	179750	122099.6	3.1:1
T_8	33000	16150.37	49150.37	5.35	133750	84599.63	2.7:1

CONCLUSIONS

From above experimental findings on Effect of Integrated Nutrient Management on it is concluded that treatment T_1, 100% RDF performed best for yield, quality parameters and economics in Cow pea.

FUTURE SCOPE

The following are some potential future research scopes based on the findings:

1. Evaluate different organic manure sources like compost, pressmud etc. in combination with chemical fertilizers.
2. Study the effect of integrated nutrient management on nutritional quality parameters of cowpea.
3. Assess the long-term sustainability of integrated approaches on soil properties.
4. Test the feasibility of reducing chemical fertilizer dose by 25-50% in combination with organics.
5. Elucidate the scientific mechanisms behind synergistic effects of organic and inorganic sources.

Acknowledgement. Vibha Shrivastava formulated the theory and conducted the calculations. Vibha Shrivastava, Prakash Ghodeswar validated the analytical techniques. Under the guidance of Avadhesh Singh Choudhary, Dr. Navneet Satankar and Prakash Ghodeswar explored and oversaw the outcomes of this research. The results were collectively deliberated by all authors, and each played a role in shaping the final manuscript.
Conflict of Interest. None.

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How to cite this article: Vibha Shrivastava, Prakash Ghodeswar, Avdesh Singh Choudhary and Navneet Satankar (2023). Influence of Integrated Nutrient Management on Growth and Seed Yield of Cowpea (*Vigna unguiculata*) (L). *Biological Forum – An International Journal*, *15*(12): 406-410.