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Impact of organic and inorganic source of nutrient on growth, pod yield and quality of cowpea (*Vigna unguiculata* L.)

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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. At the growth stage of 30, 45, 60 and 75 DAS of crop, the maximum plant height and number of primary branches/plant was observed under the treatment T_7 (50% RDF + 50% FYM), and the minimum plant height at 30, 45, 60 and 75 DAS was observed under the treatment T_1 (Control). The early days to 50% flowering of crop, the days to 50% flowering was observed under the treatment T_2 (100% RDF), The maximum total number of fruit/plant of crop was observed under the treatment T_8 (50% RDF + 50% Vermicompost), the maximum average length of pods was observed under the treatment T_5 (75% RDF + 25% FYM), followed by the treatment T_6 (75% RDF + 25% Vermicompost), T_2 (100% RDF) and T_7 (50% RDF + 50% FYM), while the minimum total number of fruit /plant, average length of pod and average diameter of pod was observed under the treatment T_1 (Control). The maximum average weight per pod, average fruit yield per plant, fruit yield per plot (kg) and fruit yield per (ha) was observed under the treatment T_5 (75% RDF + 25% FYM), while the minimum average weight per pod, average fruit yield per plant, fruit yield per plot (kg) and fruit yield per (ha) was observed under the treatment T_1 (Control). The maximum gross return was found in the treatment T_5 because of the nutrient application is recommended dose and FYM combinations (75% RDF + 25% FYM) they are small in quantity and less in price compare to bulky manure. The average net return or the maximum net profit of was obtained under treatment T_5 (75% RDF + 25% FYM) which was closely followed by treatment T_6 (75% RDF + 25% Vermicompost), minimum gross return and net profit was found in treatment T1 (Control).

Keywords: Fruit, minimum, plant, vermicompost, yield

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. 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.

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 and Abudulai *et al.*, 2016) [2, 1]. Cowpea being a legume crop does not require much nitrogen except in small quantities at the beginning of its life cycle. Nitrogen is an essential element for proper plant growth and development. Nitrogen is an essential constituent of compounds like amino acid, protein, nucleic acid, enzymes, and alkaloids (Anuja *et al.* 2014) [3]. Phosphorus is an important plant nutrient. It is associated with several vital functions like seed germination, flowering cell division, synthesis of fat, starch, and in almost every biochemical activity).

Therefore, the current trend is to explore the possibilities of supplementing organic fertilizer like FYM and Vermicompost etc. along with the use of inorganic fertilizers to reduce the cost and increase the soil fertility and productivity. FYM seems to act directly for increasing cell permeability and hormonal growth action by combination of all these processes.

It supplies nitrogen, phosphorous, potassium, and micronutrients like Fe, S, and Zn, etc. in available form to the plants through biological decomposition, improve physical, chemical properties, and health of soil such as aggregation, aeration, permeability, water holding capacity, slow release of nutrients, increase cation exchange capacity. FYM contains 0.50% N, 0.17% P_2O_5 and 0.55% K_2O. (Gaur *et al.*, 1992) [6].
The escalating cost of fertilizers, their hazardous polluting effects on environment and quality of the produce, there is a growing awareness among the farming community of the advantages of organic fertilizers. Therefore, the present investigation was designed to find out the suitable organic manure for increasing the yield potential in cowpea, keeping in view the above points the present study entitled "Impact of organic and inorganic source of nutrient on growth, pod yield and quality of cowpea (*Vigna unguiculata* L.)". Vermicompost is a rich mixture of major and minor plant nutrients containing 1.2-1.6%N, 1.8-2.0% P2O5 and 0.50 - 0.75% K2o growth- enhancing substance such as auxins and cytokines (Karmegan *et al.*, (2000) [9]. Therefore, continuous use of inorganic fertilizer leads to degradation in soil fertility.

Materials and Methods

The present study entitled "Impact of organic and inorganic source of nutrient on growth, pod yield and quality 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, 100% FYM, 100% Vermicompost, 75% RDF + 25% FYM, 75% RDF + 25% Vermicompost, 50% RDF + 50% FYM and 50% RDF + 50% Vermicompost the details of experiment are given below.

Table 1: Treatment Combination details

Treatment	Treatment Details
T_1	Control
T_2	100% RDF
T_3	100% FYM
T_4	100% Vermicompost
T_5	75% RDF + 25% FYM
T_6	75% RDF + 25% Vermicompost
T_7	50% RDF + 50% FYM
T_8	50% RDF + 50% Vermicompost

Results and Discussion

Impact of organic and inorganic source of nutrient on growth and Flowering parameter

Plant height (cm)

The data of plant height for different treatment were recorded at 30, 45, 60 and 75 DAS, data presented in Table 1. At the growth stage of 30 DAS of crop, the maximum plant height was observed under the treatment T_7 (50% RDF + 50% FYM) i.e. 31.42 cm and minimum plant height at 30 DAS was observed under the treatment T_1 (Control) control i.e. 18.24 cm respectively.
At the growth stage of 45 DAS of crop, the maximum plant height was observed under the treatment T_7 (50% RDF + 50% FYM) i.e. 43.20 cm, and minimum plant height at 45 DAS was observed under the treatment T_1 (Control) control i.e. 30.15 cm respectively.
At the growth stage of 60 DAS of crop, the maximum plant height was observed under the treatment T_7 (50% RDF + 50% FYM) i.e. 57.92 cm, and minimum plant height at 60 DAS was observed under the treatment T_1 (Control) control i.e. 40.22 cm respectively.
At the growth stage of 75 DAS of crop, the maximum plant height was observed under the treatment T_7 (50% RDF + 50% FYM) i.e. 106.20 cm and minimum plant height at 75 DAS was observed under the treatment T_1 (Control) control i.e. 70.59 cm respectively. Similar type of results are finding by Devi *et al.*, (2013) [5], Tahir *et al.*, (2014) [20], Patel *et al.*, (2015) [19], and Singhal *et al.*, (2015) [19].

Number of primary branches/plant

The maximum number of primary branches/plant at 30 DAS of crop, the maximum number of primary branches/plant was observed under the treatment T_7 (50% RDF + 50% FYM) i.e. 4.67, minimum number of primary branches/plant at 30 DAS was observed under the treatment T_1 (Control) control i.e. 1.76 respectively.
The Maximum number of primary branches/plant at 45 DAS of crop, the maximum number of primary branches/plant was observed under the treatment T_7 (50% RDF + 50% FYM) i.e. 10.26, while the minimum number of primary branches/plant at 45 DAS was observed under the treatment T_1 (Control) control i.e. 2.96 respectively.
The maximum number of primary branches/plant at 60 DAS of crop, the maximum number of primary branches/plant was observed under the treatment T_7 (50% RDF + 50% FYM) i.e. 13.01 minimum number of primary branches/plant at 60 DAS was observed under the treatment T_1 (Control) control i.e. 3.99 respectively.
The maximum number of primary branches/plant at 75 DAS of crop, the maximum number of primary branches/plant was observed under the treatment T_7 (50% RDF + 50% FYM) i.e.

Table 2: Impact of organic and inorganic source of nutrient on Plant Height and number of primary Branches

Treatment	Treatment Detail	Plant height (cm)				Number of primary branches/plant				
		30 DAS	45 DAS	60 DAS	75 DAS	30 DAS	45 DAS	60 DAS	75 DAS	Days to 50% flowering
T_1	Control	18.24	30.15	40.22	70.59	1.76	2.96	3.99	17.65	64.83
T_2	100% RDF)	29.58	41.25	52.90	101.54	4.16	8.71	11.55	19.76	48.49
T_3	100% FYM	25.22	36.89	51.66	98.19	2.88	5.93	8.22	18.97	52.83
T_4	100% Vermicompost	19.18	31.17	45.06	77.27	2.11	3.31	3.44	18.04	61.16
T_5	75% RDF + 25% FYM	27.96	39.63	49.48	92.34	3.99	7.52	10.5	19.54	50.83
T_6	75% RDF + 25% Vermicompost	26.33	38.00	54.51	104.22	3.44	7.74	9.66	19.08	54.83
T_7	50% RDF + 50% FYM	31.42	43.20	57.92	106.20	4.67	10.26	13.01	20.26	52.52
T_8	50% RDF + 50% Vermicompost	20.33	32.00	44.50	88.03	2.33	3.53	5.11	18.67	58.83
S.Em.±		0.0997	0.1642	0.2038	0.3733	0.03	0.281	0.10	0.039	0.161
CD at (5%)		0.302	0.498	0.618	1.132	0.09	0.852	0.31	0.117	0.488
CV		0.697	0.779	0.712	0.701	1.67	7.797	2.20	0.352	0.502

20.26, minimum number of primary branches/plant at 75 DAS was observed under the treatment T_1 (Control) control i.e. 17.65 respectively. It might have happened due to increase in auxin with the high level of nitrogen supply brought about increase the branches per plant (Sharma and Dayal, 2005) [16].

Days to 50% flowering

The early days to 50% flowering of crop, the days to 50% flowering was observed under the treatment T_2 (100% RDF) i.e. 48.49%, late days to 50% flowering was observed under the treatment T_1 (Control) 64.83% respectively.

Impact of organic and inorganic source of nutrient on yield parameter of cowpea

Total Number of fruit/plant

Maximum total number of fruit /plant of crop was observed under the treatment T_8 (50% RDF + 50% Vermicompost) i.e. 15.09, minimum total number of fruit /plant was observed under the treatment T_1 (Control) i.e. 6.56 respectively. The application of organic manures and inorganic fertilizers has increased availability of nutrients that might have improved the growth attributes which enhanced the photosynthesis and trans location of carbohydrates to sink site which ultimately led to positive increase yields. This present findings were in line with the findings of Rhohit *et al.*, (2013) [15]. Patel *et al.*, (2003) [13], Singh *et al.*, (2007) [17] and Kumar *et al.*, (2015a) [10].

Average length of pod in (cm)

The maximum average length of pod in (cm) of crop was observed under the treatment T_5 (75% RDF + 25% FYM) i.e. 25.08 cm and minimum average length of pod in was observed under the treatment T_1 (Control) i.e. 16.36 cm respectively. These findings are substantiated with those reported by Chaudhary and Yadav (2011) [4], Devi *et al.*, (2013) [5], Singhal *et al.*, (2015) [19], Prajapati *et al.*, (2016) [14], Gohil *et al.*, (2017) [7], Singh *et al.*, (2017) [18] and Verma *et al.*, (2018) [21].

Average Diameter of pod in (cm)

The maximum average diameter of pod in (cm) of crop was observed under the treatment T_5 (75% RDF + 25% FYM) i.e. 1.16 cm, and minimum average diameter of pod in was observed under the treatment T_1 (Control) i.e. 0.68 cm respectively. These findings are substantiated with those reported by Devi *et al.*, (2013) [5], and Singhal *et al.*, (2015) [19].

Average weight per pod (g)

The maximum average weight per pod was observed under the treatment T_5 (75% RDF + 25% FYM) i.e. 20.69 g and the minimum average weight per pod was observed under the treatment T_1 (Control) i.e. 10.13 g respectively. These findings are substantiated with those reported by Singh *et al.*, (2017) [18] and Verma *et al.*, (2018) [21].

Table 3: Impact of organic and inorganic source of nutrient on Fruit yield parameter

Treatment	Treatment Detail	Total Number of fruit /plant	Average length of pod in (cm)	Average Diameter of pod in (cm)	Average weight per pod (g)	Average fruit yield per plant (kg)
T_1	Control	6.56	16.36	0.68	10.13	0.049
T_2	100% RDF)	6.34	21.25	1.01	15.80	0.165
T_3	100% FYM	10.10	17.48	0.93	12.61	0.105
T_4	100% Vermicompost	12.74	16.92	0.86	11.53	0.070
T_5	75% RDF + 25% FYM	8.29	25.08	1.16	20.69	0.187
T_6	75% RDF + 25% Vermicompost	11.73	21.81	1.11	16.52	0.179
T_7	50% RDF + 50% FYM	13.54	19.75	1.01	15.21	0.135
T_8	50% RDF + 50% Vermicompost	15.09	19.22	0.96	14.06	0.127
S.Em.±		0.059	0.059	0.003	0.095	0.015
CD at (5%)		0.179	0.178	0.009	0.289	0.005
CV		0.968	0.514	0.537	1.133	2.041

Average fruit yield per plant (kg)

The maximum Average fruit yield per plant was observed under the treatment T_5 (75% RDF + 25% FYM) i.e. 0.187 kg, and minimum Average fruit yield per plant was observed under the treatment T_1 (Control) i.e. 0.049 kg respectively. These findings are substantiated with those reported by), Devi *et al.*, (2013) [5], Singhal *et al.*, (2015) [19], Prajapati *et al.*, (2016) [14], and Gohil *et al.*, (2017) [7].

Fruit yield per plot (kg): The maximum Fruit yield per plot (kg) was observed under the treatment T_5 (75% RDF + 25% FYM) i.e. 10.49 kg, and minimum Fruit yield per plot (kg) was observed under the treatment T_1 (Control) i.e. 2.73 kg respectively. These findings are substantiated with those reported by Devi *et al.*, (2013) [5], Gohil *et al.*, (2017) [7], Singhal *et al.*, (2015) [19], Chaudhary and Yadav (2011) [4] and Prajapati *et al.*, (2016) [14].

Fruit yield per ha (q)

The maximum Fruit yield per (ha) was observed under the treatment T_5 (75% RDF + 25% FYM) i.e. 58.94 q/ha, and minimum Fruit yield per (ha) was observed under the treatment T_1 (Control) i.e. 15.31 q/ha respectively. These findings are substantiated with those reported by Gohil *et al.*, (2017) [7], Singhal *et al.*, (2015) [19],

Economic parameter

The economics of various treatments with in T_2 (100% RDF) benefit 5.4:1 cost ratio. The net profit from cultivation under different treatments was worked out after subtracting the cost of cultivation from gross return. Similar views in direction of present finding were also expressed by Kuttimani and Velayutham (2011) [11], Jat *et al.*, (2012) [8], Devi *et al.*, (2013) [5] and Verma *et al.*, (2018) [21].

Table 4: Impact of organic and inorganic source of nutrient on fruit yield and Economic parameter

Treat.	Treatment Detail	Fruit yield per plot (kg)	Fruit yield per ha (q)	Net Return	B:C Ratio
T_1	Control	2.73	15.31	5275	2.6:1
T_2	100% RDF)	9.22	51.74	93529.73	5.4:1
T_3	100% FYM	5.88	33.03	19575	2.7:1
T_4	100% Vermicompost	3.90	21.92	7800	2.6:1
T_5	75% RDF + 25% FYM	10.49	58.94	104734.8	3.1:1
T_6	75% RDF + 25% Vermicompost	10.02	56.31	100749.7	2.5:1
T_7	50% RDF + 50% FYM	7.57	42.47	56764.86	2.4:1
T_8	50% RDF + 50% Vermicompost	7.09	39.85	59625	2.4:1
S.Em.±		0.084	0.465		
CD at (5%)		0.254	1.411		
CV		2.037	2.017		

Conclusion

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.

Author's contribution

Heena Yadav formulated the theory and conducted the calculations. Heena Yadav validated the analytical techniques. Under the guidance of Prakash Ghodeswar, Avdesh Singh Choudhary.

Dr. Navneet Satankar 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.

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