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Effect of integrated nutrient management on growth, yield and quality of cowpea

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Abstract
The present investigation entitled "Effect of integrated nutrient management on growth, yield and quality of cowpea" conducted at University Research Farm, GHRU, Saikheda in *Rabi* Season 2023. The trial was conducted in nine treatments with three replication and analyzed in Randomized Block Design and the variety was used in trial is Pusa Komal for observed the growth, yield and economics of the cowpea. The treatment details T_1 - FYM @ 20 t/ha + 25% RDF of NPK/ha (15:20:18.75 kg), T_2 - FYM @ 20 t/ha + 50% RDF of NPK/ha (30:40:37.5 kg), T_3 - FYM @ 20 t/ha + 100% RDF of NPK/ha (60:80:75 kg), T_4 -Neem cake @ 5 q/ha + 25% RDF of NPK/ha (15:20:18.75 kg), T 5 - Neem cake @ 5q/ha + 50% RDF of NPK/ha (30:40:37.5 kg), T_6 - Neem cake @ 5 q/ha + 100% RDF of NPK/ha (60:80:75 kg), T_7 - Vermicompost 5 t/ha + 25% RDF of NPK/ha (15:20:18.75 kg), T_8 - Vermicompost 5 t/ha + 50% RDF of NPK/ha (30:40:37.5 kg) and T_9 - Vermicompost 5 t/ha + 100% RDF of NPK/ha (60:80:75 kg). The observation was recorded and plant i.e. Plant height at 45 and 75 DAS, Number of branches/plant at 45 and 75 DAS, Average Diameter of pod, Average weight per pod, Average fruit yield per plant, Fruit yield per plot and Fruit yield per ha. The result revealed that the maximum Plant height at 45 and 75 DAS (43.10 and 108.60 cm), Number of branches/plant at 45 and 75 DAS (9.22 and 20.38), Average Diameter of pod (1.39 cm), Average weight per pod (20.92 g), Average fruit yield per plant (0.37 kg), Fruit yield per plot (15.63 kg) and Fruit yield per ha (275.68 q/ha), while the minimum was observed under T_1.

Keywords: INM, cowpea, RDF, vermicompost and FYM

Introduction
Vegetable cowpea [*Vigna unguiculata* (L.) Walp.] belongs to the family fabaceae with chromosome number 2n= 22. Cowpea is rich in protein, minerals and vitamins, generally preferred for its tender pods and fresh seeds but in some parts of the country dry seeds are also consumed (Nielsen *et al.*, 1997, Ahenkora *et al.*, 1998 and Timko & Singh 2008) [1, 2, 3]. Cowpea leaves contain 34.91% protein, 31.11% carbohydrates, 5.42% fat, 19.46% prebiotics, 65.21 mg iron, 1.62 g calcium, 1.66 g magnesium, 0.56 g phosphorus and 2.22 g sodium (Enyiukwu *et al.*, 2018) [4]. Cowpea crop can provide up to 88 kg nitrogen per hectare whereas in an effective crop of cowpea inoculated with Rhizobium, it could provide more than 150 kg per hectare of nitrogen which is enough for fulfilling 80-90 percent of total requirement in plants (Kormata *et al.*, 2000) [5]. Integrated nutrient management (INM) system is a phenomenon to use of chemical fertilizers in combination with organic manures and bio-fertilizers (Mahajan and Sharma, 2005) [6]. Due to indiscriminate use of chemical fertilizers long term agriculture feasibility become less. Health of soil difficult to maintain so that only integrated plant nutrient system involving fertilizer, organic manures and bio-fertilizers combination are vital to sustain crop production, realm soil health ecosystem for long time. Recent research activity shows that organic manure increases the effectiveness of inorganic manures (Singh and Biswas, 2000) [7]. The basic concept of integrated nutrient management is the supply of required plant nutrients for sustaining the anticipated crop productivity with minimum harmful effect on soil health environment (Balasubramanian, 1999) [8]. The combining effect of organic and inorganic nutrients source used as integrated nutrient management has been proved superior to the use of each component separately found (Palaniappan and Annadurai, 2007) [9].

Organic manure act not only as a source of nutrients and organic matter but also boost the microbial population, biodiversity, and activity in the soil and also influence the soil structure and physical, chemical, and biological properties of soil (Albiach *et al.,* 2000) [10]. 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) [11]. There are various sources of organic manures such as FYM, poultry, goat manure, oilseed cake, vermicompost, bio-slurry, etc. Among organic sources, the traditional concept of the nutrient application is the utilization of farmyard manure (FYM). Besides FYM, poultry manure, goat manure, mustard cake are other important organic sources of nutrients to the plant. This manure is a good source of essential plant nutrients gives good crop stand-by improvement in physical, chemical, and biological characteristics of the soil. Most vegetable producers use inorganic fertilizer for a better product due to its ease and rapid availability to plants (Moretti *et al.,* 2002) [12]. However, frequent use of fertilizers made from soil can end up damaging the chemical, physical, and organic matter of the soil. On the other hand, organic fertilizers provide beneficial effects to the soil and increase nutrient uptake, which helps maintain the quality and yield of plants and is less expensive than inorganic fertilizers (Moretti *et al.,* 2002) [12].

Materials and Methods

The present investigation entitled "Effect of integrated nutrient management on growth, yield and quality of cowpea" conducted at University Research Farm, GHRU, Saikheda in Rabi Season 2023. The trial was conducted in nine treatments with three replication and analyzed in Randomized Block Design and the variety was used in trial is Pusa Komal for observed the growth, yield and economics of the cowpea. The treatment details T_1 - FYM @ 20 t/ha + 25% RDF of NPK/ha (15:20:18.75 kg), T_2 - FYM @ 20 t/ha + 50% RDF of NPK/ha (30:40:37.5 kg), T_3 - FYM @ 20 t/ha + 100% RDF of NPK/ha (60:80:75 kg), T_4 - Neem cake @ 5 q/ha + 25% RDF of NPK/ha (15:20:18.75 kg), T 5 - Neem cake @ 5q/ha + 50% RDF of NPK/ha (30:40:37.5 kg), T_6 - Neem cake @ 5 q/ha + 100% RDF of NPK/ha (60:80:75 kg), T_7 - Vermicompost 5 t/ha + 25% RDF of NPK/ha (15:20:18.75 kg), T_8 - Vermicompost 5 t/ha + 50% RDF of NPK/ha (30:40:37.5 kg) and T_9 - Vermicompost 5 t/ha + 100% RDF of NPK/ha (60:80:75 kg). The observation was recorded and plant i.e. Plant height at 45 and 75 DAS, Number of branches/plant at 45 and 75 DAS, Average Diameter of pod, Average weight per pod, Average fruit yield per plant, Fruit yield per plot and Fruit yield per ha.

Results and Discussion

Plant height at 45 and 75 DAS

At the growth stage of 45 and 75 DAS of crop, the maximum plant height was observed under the treatment T_6 (Neem cake @ 5 q/ha + 100% recommended dose of NPK/ha (60:80:75 kg) *i.e.* 43.99 and 108.60 cm, which was at par with the treatment T_9 (Plant received @ Vermicompost 5 t/ha + 100% recommended dose of NPK/ha (60:80:75 kg) (43.91, 57.51 and 108.60 cm), while the minimum plant height at 45 and 75 DAS was observed under the treatment T_1 (FYM @ 20 t/ha + 25% recommended dose of NPK/ha (15:20:18.75 kg) i.e. 30.86 and 72.40 cm. The increase in plant height in different treatment did not show any systematic expression. Sharma *et al.,* (2015) [13] recorded plant height with vermicompost 5 T/ha whereas Menon *et al.,* (2010) [14] reported increase in plant height due to application of inorganic fertilizers in Bhagya Laxmi variety of cowpea. An increase in plant height in treatment T_6 might be due to application of major and minor nutrients, through organic manures and chemical fertilizers, increased the photosynthetic activity, chlorophyll formation, nitrogen metabolism and auxin contents in the plants which ultimately improving the plant height. These results are in conformity with the finding of Das *et al.,* (2011) [15] and Kumar and Pandita (2016) [16] in cowpea; Vidhale *et al.,* (2012) [17] and Singh and Kumar (2016) [18] in cluster bean.

The results of the present investigation showed an increase in plant height, might be due to the application of nitrogenous fertilizers applied through inorganic fertilizers might have supplied nutrients in the early stages, whereas in later stages, the mineralized N from organic manures and atmospheric N fixation by Rhizobium contributed to N availability to crop. Additionally it may also be due to the fact that the efficiency of nitrogen might have increased in the presence of phosphorus. Hence, there was continuous supply of nutrients throughout the crop growth period. These findings are in conformity with Ashwinkumar and Pandita (2016) [19] in cowpea, Jubin chauhan *et al.,* (2016) [20] in cowpea, Barcchiya and Kushwah (2017) [21] in French bean.

Number of branches/plant at 45 and 75 DAS

At the growth stage at 45 and 75 DAS of crop, the maximum number of branches/plant was observed under the treatment T_6 (Neem cake @ 5 q/ha + 100% recommended dose of NPK/ha (60:80:75 kg) (9.22 and 20.38), followed by the treatment combination T_9 (Plant received @ Vermicompost 5 t/ha + 100% recommended dose of NPK/ha (60:80:75 kg) *i.e.* 8.17 and 19.88, while the minimum number of branches/plant at 45 and 75 DAS was observed under the treatment T_1 (FYM @ 20 t/ha + 25% recommended dose of NPK/ha (15:20:18.75 kg) i.e. 2.42 and 17.77. Increase in number of branches due to application of inorganic fertilizers because nitrogen play a role for branching, this sentence conformity with Sharma *et al.,* (2015) [13] and Das *et al.,* (2011) [15] in Cowpea with 75% RDF with other organic manure combination. Number of branches per plant was increased with an increase in nitrogen level and enhances the development of strong cell walls. These results are in agreement with those reported by Abayomi *et al.,* (2008) [22], Dekhane *et al.,* (2011) [23], Khandelwal *et al.,* (2013) [24] and Khan *et al.,* (2015) [25].

It might be due to the application of phosphorus through inorganic fertilizer, which increased the availability of phosphorus in root zone, which in turn resulted in better growth and development of roots and shoots and also helped in better nodulation. Similar results were reported by Sajitha *et al.,* (2016) [26] in Dolichus bean.

Days to final harvest

The days to final harvest in cowpea was observed under the treatment T_9 (Vermicompost 5 t/ha + 100% recommended dose of NPK/ha (60:80:75 kg) i.e. 65.92 Days, which was at par with the treatment T_3 (FYM @ 20 t/ha + 100% recommended dose of NPK/ha (60:80:75 kg) i.e. 66.95 Days, while the late days of final harvest was observed under the treatment T_1 (FYM @ 20 t/ha + 25% recommended dose of NPK/ha (15:20:18.75 kg) i.e. 75.68 Days.

Average Diameter of pod

The maximum average diameter of pod was observed under the treatment T_6 (Neem cake @ 5 q/ha + 100% recommended dose

of NPK/ha (60:80:75 kg) (1.39 cm), followed by the treatment combination T_9 (Vermicompost 5 t/ha + 100% recommended dose of NPK/ha (60:80:75 kg) *i.e.* 1.34 cm, while the minimum average diameter of pod was observed under the treatment T_1 (FYM @ 20 t/ha + 25% recommended dose of NPK/ha (15:20:18.75 kg) i.e. 0.91 cm. Application of inorganic and organic fertilizers significantly increased length of pod. The beneficial effect of Neem Cake on yield attribute like length of pod may probably due to enhanced supply of macro as well as micronutrients during entire growing season led to higher assimilation of food and its subsequent partitionary in sink (Mahaly *et al.,* 2018) [27].

Average weight per pod

The maximum average weight per pod was observed under the treatment T_6 (Neem cake @ 5 q/ha + 100% recommended dose of NPK/ha (60:80:75 kg) (20.92 g), followed by the treatment combination T_9 (Vermicompost 5 t/ha + 100% recommended dose of NPK/ha (60:80:75 kg) *i.e.* 16.75 g**,** while the minimum average weight per pod was observed under the treatment T_1 (FYM @ 20 t/ha + 25% recommended dose of NPK/ha (15:20:18.75 kg) i.e. 10.22 g.

Average fruit yield per plant

The maximum average fruit yield per plant was observed under the treatment T_6 (Neem cake @ 5 q/ha + 100% recommended dose of NPK/ha (60:80:75 kg) (0.37 kg/plant), followed by the treatment combination T_9 (Vermicompost 5 t/ha + 100% recommended dose of NPK/ha (60:80:75 kg) *i.e.* 0.29 kg/plant, while the minimum average fruit yield per plant was observed under the treatment T_1 (FYM @ 20 t/ha + 25% recommended dose of NPK/ha (15:20:18.75 kg) i.e. 0.09 kg/plant. Among various manures and their levels, the application of treatments have effects on greater root extension due to phosphorus availability and balance uptake of other nutrients, which ultimately improve the yield attributing characters. Due to better nitrogen and phosphorus availability, better translocation within plants and favourable sink source ratio of photosynthates. These results are in conformity with the finding of Shukla and Dixit (1996) [28] in green gram; Joshi *et al.,* (2016) [29] in cowpea; Reddy *et al.,* (2014) [30], Bhathal and Kumar (2016) [31] and Singh and Kumar (2016) [18] in cluster bean.

Fruit yield per plot and fruit yield per ha

The maximum fruit yield per plot and fruit yield per ha was observed under the treatment T_6 (Neem cake @ 5 q/ha + 100% recommended dose of NPK/ha (60:80:75 kg) (15.63 kg/plot and 275.68 q/ha), followed by the treatment combination T_9 (Plant received @ Vermicompost 5 t/ha + 100% recommended dose of NPK/ha (60:80:75 kg) *i.e.* (12.27 kg/plot and 216.31 q/ha), while the minimum fruit yield per plot (kg) and fruit yield per ha (q) was observed under the treatment T_1 (FYM @ 20 t/ha + 25% recommended dose of NPK/ha (15:20:18.75 kg) i.e. 3.65 kg/plot and 64.40 q/ha. The yield attributes are the symbol of vigorous plant growth and development. The optimum application of nutrients through soil as well as foliar nutrition offered easy availability for the absorption of macro nutrients in cowpea. It might be due to the efficient utilization of nitrogen helped for chlorophyll metabolism and boost of the production of carbohydrate. Phosphorus is essential for respiratory mechanism, which favoured more photosynthesis and vital for seed formation. Potassium plays important role in translocation of starch and protein synthesis. This was reflected in production of higher number of pods per plant of cowpea. The results are in closely associated with the findings of Manasa (2013) [32], Malesha *et al.,* (2014) [33] and Sharma *et al.,* (2015) [13].

Table 1: Effect of integrated nutrient management on growth and yield of cowpea

Trea.	Plant height (cm)		Number of branches / plants		Days to final harvest	Average Diameter of pod in (cm)	Average weight per pod (g)	Average fruit yield per plant (kg)	Fruit yield per plot (kg)	Fruit yield per plot (kg)
	45 DAS	75 DAS	45 DAS	75 DAS						
T_1	30.86	72.40	2.42	17.77	75.68	0.91	10.22	0.09	3.65	3.65
T_2	38.13	100.46	5.10	19.09	73.72	1.19	14.29	0.18	7.47	7.47
T_3	39.23	106.59	5.39	19.20	66.95	1.20	14.75	0.21	8.72	8.72
T_4	32.10	79.19	3.54	18.16	71.50	1.09	11.76	0.11	4.40	4.40
T_5	42.46	103.87	7.20	19.73	71.10	1.24	16.03	0.26	10.69	10.69
T_6	43.10	108.60	9.22	20.38	68.44	1.39	20.92	0.37	15.63	15.63
T_7	33.27	90.13	4.31	18.79	71.46	1.16	12.84	0.14	5.73	5.73
T_8	40.84	94.51	6.98	19.66	70.79	1.24	15.44	0.23	9.78	9.78
T_9	43.91	108.60	8.17	19.88	65.92	1.34	16.75	0.29	12.27	12.27
S.Em.±	0.2175	0.2159	0.273	0.037	0.480	0.005	0.191	0.004	0.159	0.159
CD at 5% level	0.652	0.647	0.817	0.112	1.440	0.015	0.572	0.011	0.476	0.476

Conclusion

The results indicate that the application of Neem cake and Vermicompost, along with the full recommended dose of NPK fertilizer, significantly increased all parameters of growth, yield and economics of the cowpea crop as compared to treatments with lower nutrient inputs (such as FYM and reduced NPK doses). This underscores the importance of integrated nutrient management and the use of organic amendments like Neem cake and Vermicompost in optimizing fruit production in agricultural plots.

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