**Influence of integrated nutrient management on growth and seed yield of cowpea [*Vigna unguiculata* (L.) Walp] under Balaghat (M.P.) condition**

**ABSTRACT**

The present investigation was conducted to understand the effect of integrated nutrient management on the growth and seed yield of the cowpea variety Pusa Komal. The investigation was carried out at Field of Horticulture Department, School of Agriculture Science, Technology and Research, Sardar Patel University, Balaghat, (M.P.) during the *Kharif* season of 2023. The experiment was laid out in a Randomized Block Design (RBD) with 9 treatments comprising three replications each. The overall results obtained from this present investigation revealed that the application of T1 (RDF 100% i.e. NPK 25:50:25) showed the better performance for vegetative growth (plant height, number of branches per plant), yield attributes (number of pods per plant, pod weight, pod yield) of cowpea followed by T6 (75% RDF + 25% VC). T1 also recorded the highest net return and benefit cost ratio. Thus, integrated use of nutrients may be suggested for higher crop productivity along with over all betterment of okra under Balaghat (M.P.) conditions.

**Keywords:** Cowpea, growth, seed yield, benefit cost ratio, FYM, vermicompost*.*

**INTRODUCTION**

Cowpea botanically known as *Vigna unguiculata* (L.) Walp, is annual herbaceous legume that belongs to the genus *Vigna*. Its ability to thrive in sandy soil and low rainfall conditions makes it a vital crop in the semiarid regions of Africa and Asia. Cowpea requires minimal inputs since its root nodules can fix atmospheric nitrogen, making it beneficial for resource-poor farmers and ideal for intercropping with other crops. The entire plant serves as forage for animals, with its use as cattle feed likely leading to its name. There are numerous varieties of cowpea, each with distinct fruit shapes. As a diploid species with a somatic chromosome number of 2n=22, cowpea is one of the most significant pulse crops originating from West Africa **(Vavilov, 1951; Venkatesan *et al.,* 2003)**. Known as the "poor man’s meat" or "vegetable meat" due to its high protein content, cowpea's young leaves, pods, and peas are rich in vitamins and minerals, making them valuable for both human consumption and animal feed. Cowpea can endure significant drought and high rainfall, and it can be cultivated in almost any soil type, provided there is adequate drainage. Cowpea is primarily cultivated in tropical and subtropical regions worldwide for both vegetable and grain purposes, and to a lesser extent as a fodder crop. It is considered a highly versatile pulse crop due to its smothering nature, drought tolerance, soil-restoring properties, and multipurpose uses. Cowpea integrates well into various cropping systems and is grown for its seeds (both green and dried), pods, and leaves, which are consumed fresh as green vegetables. Additionally, snacks and main dishes are prepared from the dried grain (**Kumar and Srikant, 2017**). There are four recognized subspecies of cowpea, with three being cultivated. The species exhibits significant morphological diversity, characterized by substantial variations in plant size, shape, and structure. Cowpeas can grow erect, semi-erect (trailing), or climbing. While the crop is mainly cultivated for its protein-rich seeds, the leaves and immature seed pods are also edible. Growth conditions and preferences for each variety vary by region (**Padulosil, 1997**). Despite its morphological diversity, cowpea's genetic diversity within varieties is relatively low due to its primarily self-pollinating nature (**Egbadzor *et al.*, 2014**). Organic manures *viz*., FYM, Vermicompost (VC), poultry manure (PM) and oilcakes help in the improvement of soil structure, aeration and water holding capacity of soil. Further, it stimulates the activity of microorganisms that enable the plant to get the macro and micro-nutrients through enhanced biological processes, increase nutrient solubility, alter soil salinity, sodicity and pH (**Alabadan *et al.,* 2009**). Nitrogen is a vitally plant nutrient. Nitrogen is essential constituent of protein and is present in many other compounds of great physiological importance in plant metabolism. Integrated Nutrient Management (INM) is a process that involves the use of chemical fertilizers in conjunction with organic manures and bio fertilizers. Long-term agriculture feasibility has decreased as a result of the uncontrolled use of chemical fertilizers thus an integrated plant nutrient system incorporating fertilizer, organic manures and bio-fertilizers is essential for long-term crop productivity and ecosystem soil health. Organic manure improves the efficiency of inorganic manure, according to recent studies (**Singh and Biswas, 2000**). The combined effect of organic and inorganic nutrient sources used as integrated nutrient management has been proved superior to the use of each component separately (**Palaniappan and Annadurai, 2007**). Integrated Nutrient Management (INM) is essential for sustainable cowpea cultivation, combining organic and inorganic sources to enhance soil health and crop productivity. Cowpea, known for its nitrogen-fixing ability, benefits significantly from organic inputs like farmyard manure and vermicompost, which improve soil structure, water retention, and microbial activity. These organic amendments supply essential nutrients and enhance the availability of soil phosphorus and potassium, fostering a conducive environment for microbial growth and nutrient cycling. Additionally, the judicious use of chemical fertilizers ensures that crops receive the necessary nutrients in adequate proportions, promoting optimal growth and yield. INM practices help mitigate the environmental impact of excessive chemical fertilizer use, reducing soil degradation and groundwater contamination. Studies have shown that INM increases cowpea yield, improves soil fertility, and sustains agricultural productivity. By integrating various nutrient sources, INM promotes a balanced nutrient supply, enhances crop resilience to pests and diseases, and supports long-term soil health, making it a cornerstone for sustainable cowpea farming.

**MATERIALAND METHODS**

The present investigation was done to understand the effect of organic manures and inorganic fertilizers combinations on growth and seed yield of cowpea variety Pusa Komal. The details of the materials used and the procedures adopted in the investigation, which was carried out at the Field of Horticulture Department, School of Agriculture Science, Technology and Research, Sardar Patel University, Balaghat, (M.P.) during the *Kharif* season of 2023. Balaghat District is located in the south-eastern portion of the Satpura Range and the upper valley of the Wainganga River. The district extends from 21°19’ to 22°24’ north latitude and 79°31’ to 81°30’ east longitude. The treatments were T0 (Control-Water spray); T1 (RDF 100% [NPK: 25:50:25 Kg/ha]); T2 (Farmyard manure (FYM) 100%); T3 (vermicompost (VC) 100%); T4 (Poultry Manure (PM) 100%; T5 (75% RDF + 25% FYM); T6 (75% RDF + 25% VC); T7 (75% RDF + 25% PM) and T8 (25% RDF + 25% FYM + 25% VC + 25% PM). Using a metre scale, the height of five randomly chosen tagged plants from each plot was measured in centimetres at 30 and 50 DAS (days after sowing) starting from the ground and ending at the tip of the shoot. At maturity, the number of branches on randomly chosen plants from each plot was counted. Each replication's average number of branches per plant was noted and then statistically examined. Days to first pod setting in experimental plots were measured as the number of days from seeding to the first appearance of pods. For each replication, the data were collected, averaged, and analysed.

Number of fruits that set-in vine was counted and recorded as number of pods per plant for each treatment and replication. The yield was calculated by weighing the marketable pods. The readings for all the two plants plot-1 were recorded. The average yield/plant was calculated by dividing the total yield of the treatments by the total number of plants in plot.

Pod yield per hectare = $\frac{Pod Yield per plot}{Size of individual plot}$ X 10,000 m2

The statistical analysis was conducted using **Fisher and Yates (1967)**.Net return refers to the profit or income generated from a business or investment after deducting all expenses, costs, and taxes. In the context of cowpea cultivation, net return represents the actual profit obtained from selling produce considering all the production costs associated with their cultivation. To calculate net return in cowpea cultivation, the total revenue from the sale of produce of cowpea was subtracted from the total production costs. A Benefit cost Ratio greater than 1 indicates that the benefits of the project outweigh the costs, suggesting that the project is financially viable and potentially profitable and vice versa. Benefit Cost ratio from each treatment was calculated using the following formula:

Benefit cost ratio = Gross return (Rs/ha) / Total cost of cultivation (Rs/ha).

**RESULTS AND DISCUSSION**

1. **Growth Parameters**
2. **Plant height (cm)**

The maximum plant height (57.85 and 96.28 cm) at 30, 50 DAS respectively was observed with treatment T1 (RDF 100% [NPK: 25:50:25 Kg/ha]) followed by T6 (75% RDF + 25% VC) with 54.95 and 95.31 cm at 30, 50 DAS respectively. Minimum height of plant (42.29 and 80.43 cm) was observed in T0 (control) at 30, 50 DAS respectively, while the remaining treatments were moderate in their growth habit (Table 1 & Fig. 1). In cowpea cultivation, the treatment combination of 75% Recommended Dose of Fertilizers (RDF) + 25% Vermicompost (VC) typically results in improved plant height, ranking second only to the RDF 100% treatment among various combinations of organic manure and inorganic fertilizers. This outcome is primarily due to the synergistic benefits of vermicompost and reduced but balanced application of synthetic fertilizers. Vermicompost enhances soil health by improving its structure and nutrient retention capacity. It provides a slow-release source of nutrients, promoting steady plant growth and development throughout the crop cycle. The 75% RDF ensures that essential nutrients are adequately supplied without overloading the soil, thus preventing nutrient imbalances that can hinder plant growth. This balanced approach supports optimal root development, nutrient uptake, and overall physiological processes in cowpea plants, contributing to enhancing plant height compared to other treatment combinations using different ratios of organic and inorganic inputs. Similar findings were reported by **Panda *et al.,* (2017); Patel *et al.,* (2021)** in Cowpea.

**2. Number of branches per plant**

Number of branches per plant of cowpea showed statistically significant differences among various doses of combination applied. The maximum number of branches per plant (15.85 branches) was observed with treatment T1 (RDF 100% [NPK: 25:50:25 Kg/ha]) followed by T6 (75% RDF + 25% FYM) with 15.30 branches. Minimum number of branches per plant (6.28 branches) was observed in T0 (control) (Table 1 & Fig. 1). In cowpea cultivation, the treatment combination of 75% Recommended Dose of Fertilizers (RDF) + 25% Vermicompost (VC) often results in a higher number of branches per plant, ranking second only to the RDF 100% treatment among various integrated nutrient management strategies. This outcome can be attributed to the combined benefits of vermicompost and balanced fertilizer application. Vermicompost enriches the soil with organic matter and beneficial microorganisms, enhancing soil fertility and nutrient availability. The gradual release of nutrients from vermicompost supports sustained plant growth and encourages lateral shoot development, leading to increased branching in cowpea plants. Additionally, the 75% RDF ensures an adequate but not excessive supply of essential nutrients, promoting healthy and vigorous growth without causing nutrient imbalances that can affect plant branching patterns. Overall, the 75% RDF + 25% VC treatment combination optimizes nutrient uptake efficiency and promotes robust vegetative growth in cowpea, resulting in a greater number of branches per plant compared to other combinations of organic and inorganic fertilizers. Similar findings were reported by **Singh *et al.,* (2018); Patel *et al.,* (2023)** in Cowpea.

**3. Days to 50% flowering**

The minimum days to 50% flowering (42.15 days) was observed with treatment T1 (RDF 100% [NPK: 25:50:25 Kg/ha]) followed by T8 (25% RDF + 25% FYM + 25% VC + 25% PM) with 43.64 days. Maximum days to 50% flowering (51.21 days) were observed in T0 (control).In cowpea cultivation, the treatment combination of 25% Recommended Dose of Fertilizers (RDF) + 25% Farmyard Manure (FYM) + 25% Vermicompost (VC) + 25% Poultry Manure often shows earlier flowering, ranking second only to the RDF 100% treatment among various integrated nutrient management strategies (Table 1 & Fig. 1). This early flowering can be attributed to the diverse and balanced nutrient supply provided by this combination. Farmyard Manure (FYM) and Poultry Manure enrich the soil with organic matter and beneficial microorganisms, improving soil structure, fertility, and water-holding capacity. Vermicompost complements this by providing a steady release of nutrients essential for plant growth and development. The balanced application of RDF ensures that necessary macro and micronutrients, such as nitrogen, phosphorus, and potassium, are adequately supplied without excess, promoting early root establishment and vigorous vegetative growth, which in turn triggers earlier flowering in cowpea plants. Similar findings were reported by **Begam *et al.,* (2023); Indianraj *et al.,* (2023)** in Cowpea.

**4. Days to 50% pod setting and days to first pod picking**

The minimum days to 50% pod setting (50.59 days) was observed with treatment T1 (RDF 100% [NPK: 25:50:25 Kg/ha]) followed by T8 (25% RDF + 25% FYM + 25% VC + 25% PM) with 52.50 days. Maximum days to 50% pod setting (62.41 days) were observed in T0 (control). Days to first pod picking in cowpea showed statistically significant differences among various doses of combination applied. The minimum days to first pod picking (62.03 days) was observed with treatment T1 (RDF 100% [NPK: 25:50:25 Kg/ha]) followed by T8 (25% RDF + 25% FYM + 25% VC + 25% PM) with 63.87 days. Maximum days to first pod picking (74.85 days) were observed in T0 (control) (Table 1 & Fig. 1). In cowpea farming, the blend of 25% Recommended Dose of Fertilizers (RDF), 25% Farmyard Manure (FYM), 25% Vermicompost (VC), and 25% Poultry Manure often results in earlier pod formation and harvesting, typically ranking second after the RDF 100% treatment among various integrated nutrient management strategies. This early pod development is facilitated by the combined advantages of both organic and inorganic inputs within this mixture. Farmyard Manure (FYM) and Poultry Manure enhance soil quality by enriching it with organic matter, beneficial microorganisms, and essential nutrients, thereby improving soil structure, fertility, and moisture retention. Vermicompost complements these benefits by providing a balanced release of nutrients crucial for reproductive growth and the development of pods in cowpea plants. The 25% RDF ensures a sufficient, yet not excessive, supply of nutrients, promoting robust vegetative growth and initiating early reproductive processes. Overall, the 25% RDF + 25% FYM + 25% VC + 25% Poultry Manure combination optimizes nutrient availability, supports root development, and facilitates early flowering and pod formation in cowpea, thereby enhancing overall yield and harvest efficiency compared to other integrated nutrient management strategies. Similar findings were reported by **Singh *et al.,* (2017); Patel *et al.,* (2023)** in Cowpea.

**5. Number of pods per plant**

Number of pods per plant of cowpea showed statistically significant differences among various doses of the combination applied. The maximum number of pods per plant (27.40 pods) was observed with treatment T1 (RDF 100% [NPK: 25:50:25 Kg/ha]) followed by T6 (75% RDF + 25% VC) with 24.94 pods. Minimum number of pods per plant (13.89 pods) was observed in T0 (control).In cowpea cultivation, the treatment combination of 75% Recommended Dose of Fertilizers (RDF) + 25% Vermicompost (VC) often results in a higher number of pods per plant, ranking second only to the RDF 100% treatment among various integrated nutrient management strategies (Table 1 & Fig. 1). This increase in pod production can be attributed to several factors. Vermicompost enriches the soil with organic matter, beneficial microorganisms, and essential nutrients, improving soil structure, fertility, and water-holding capacity. This creates favourable conditions for root development and nutrient uptake in cowpea plants. The 75% RDF ensures a balanced supply of essential nutrients, including nitrogen, phosphorus, and potassium, promoting healthy vegetative growth and reproductive development. The synergistic effects of VC and balanced RDF application optimize flowering and pod setting, leading to an increased number of pods per plant. This combination supports robust plant health, enhances nutrient efficiency, and ultimately contributes to higher pod yields compared to other integrated nutrient management approaches. Similar findings were reported by **Panda *et al.,* (2017); Patel *et al.,* (2023)** in Cowpea.

**6. Pod length and individual pod weight**

The maximum pod length (21.57 cm) was observed with treatment T1 (RDF 100% [NPK: 25:50:25 Kg/ha]) followed by T6 (75% RDF + 25% VC) with 19.88 cm. Minimum pod length (12.89 cm) was observed in T0 (control). The maximum pod weight (16.51 grams) was observed with treatment T1 (RDF 100% [NPK: 25:50:25 Kg/ha]) followed by T6 (75% RDF + 25% VC) with 15.77 grams. Minimum pod weight (11.15 grams) was observed in T0 (control).In cowpea cultivation, the treatment combination of 75% Recommended Dose of Fertilizers (RDF) + 25% Vermicompost (VC) often results in better pod length and individual pod weight, ranking second only to the RDF 100% treatment among various integrated nutrient management strategies (Table 2 & Fig. 2). This improvement can be attributed to the balanced nutrient supply and soil health benefits provided by this combination. Vermicompost enriches the soil with organic matter, beneficial microorganisms, and nutrients, which improve soil structure, fertility, and nutrient availability. This supports healthy root development and efficient nutrient uptake by cowpea plants. The 75% RDF ensures adequate but not excessive provision of essential nutrients such as nitrogen, phosphorus, and potassium, crucial for pod formation and growth. The synergistic effects of VC and balanced RDF application enhance plant visor, promote uniform flowering, and facilitate optimal pod development. These results in longer pods with higher individual pod weights compared to other integrated nutrient management approaches, thereby contributing to improved yield and quality in cowpea cultivation. Similar findings were reported by **Pushpa *et al.,* (2022); Patel *et al.,* (2023)** in Cowpea.

**7. Pod yield and Vitamin C content**

The maximum pod yield per plant (452.88 g/plant) was observed with treatment T1 (RDF 100% [NPK: 25:50:25 Kg/ha]) followed by T6 (75% EDF + 25% VC) with 393.42 g/plant. Minimum pod yield per plant (154.43 g /plant) was observed in T0 (control). The maximum pod yield per hectare (6.52 t/ha) was observed with treatment T1 (RDF 100% [NPK: 25:50:25 Kg/ha]) at par with T6 (75% RDF + 25% VC 50%) with 6.39 t/ha. Minimum pod yield per hectare (3.79 t/ha) was observed in T0 (control). Vitamin C content of cowpea showed statistically significant differences present among various doses of combination applied. The maximum vitamin C content (7.40 mg) was observed with treatment T6 (75% RDF + 25% VC 50%) followed by T8 (25% RDF + 25% FYM + 25% VC + 25% PM) with 7.24 mg. Minimum vitamin C content (3.53 mg) was observed in T0 (control). In cowpea farming, the combination of 75% Recommended Dose of Fertilizers (RDF) and 25% Vermicompost (VC) typically leads to higher pod yields, ranking second only to the RDF 100% treatment among various integrated nutrient management strategies. This enhanced pod yield can be attributed to the synergistic benefits of organic and inorganic inputs in this blend (Table 2 & Fig. 2). Vermicompost enriches the soil with organic matter, beneficial microorganisms, and essential nutrients, which improve soil structure, fertility, and water retention. This creates favourable conditions for root growth and nutrient uptake in cowpea plants. The 75% RDF ensures a balanced supply of crucial nutrients like nitrogen, phosphorus, and potassium, promoting healthy vegetative growth and reproductive development. The combined effect of VC and balanced RDF application optimizes flowering, pod formation, and filling, resulting in increased pod yield per plant. This approach enhances nutrient utilization efficiency and overall plant health, contributing to improved pod yield in cowpea compared to other integrated nutrient management strategies. Similar findings were reported by **Indianraj *et al.,* (2023)** in Cowpea.

1. **Economics parameters**

Maximum cost of cultivation incurred in treatment T2 (Farm yard manure (FYM) 100%) with (Rs 1,04,125 ha-1) and the minimum (Rs 85,375 ha-1) was recorded in treatment T0 (Control). Maximum gross returns were recorded in treatment T1 (RDF 100% [NPK: 25:50:25 Kg/ha]) with (Rs 195700 ha-1) followed by T6 (75% RDF + 25% VC) having Rs 191700 ha-1 and the minimum (Rs 113600 ha-1) was recorded in treatment T0 (Control). Maximum net returns were recorded in treatment T1 (RDF 100% [NPK: 25:50:25 Kg/ha]) with (Rs 1,06,431 ha-1) followed by T6 (75% RDF + 25% VC) having Rs 1,00,391 ha-1 and the minimum (Rs 28,225 ha-1) was recorded in treatment T2 (100% Vermicompost). Maximum benefit cost ratio was recorded in treatment T1 (RDF 100% [NPK: 25:50:25 Kg/ha]) with (2.19) followed by T6 (75% RDF + 25% VC) having 2.10 and the minimum (1.33) was recorded in treatment T2 (100% Vermicompost).Similar findings were reported by **Singh *et al.,* (2018)** in Cowpea (Table 3).

**Conclusion**

The overall results obtained from this present investigation revealed that the application of T6 (75% RDF + 25% VC) showed the better performance for vegetative growth *viz.,* plant height (57.85 and 96.28 cm) at 30, 50 DAS respectively, number of branches per plant (15.85 branches), yield attributes i.e., number of pods per plant (27.40 pods), pod weight (16.51 grams), pod yield (6.52 t/ha) of cowpea next to T1 (RDF 100% [NPK: 25:50:25 Kg/ha]). T6 also recorded the highest net return (Rs 1,06,431 ha-1) and benefit cost ratio of 2.19. Thus, integrated use of nutrients may be suggested for higher crop productivity along with over all betterment of cowpea under Balaghat (M.P.) conditions.

**Disclaimer (Artificial Intelligence)**

I hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

**Competing Interests**

Authors have declared that no competing interests exist.

**References**

**Alabadan, B. A., Adeoye, P. A. and Folorunso, E. A. (2009).** Effect of different poultry wastes on physical, chemical and biological properties of soil. *Caspian Journal of Environmental Science.***7**: 31-35.

**Begam, A., Pramanick, M., Dutta, S., Ray, M., & Sengupta, K. (2023).** Growth and yield responses of cowpea (*Vigna unguiculata* L.) as influenced by crop geometry and nutrient management practices. *Legume Research - An International Journal,***46**(9): 1184-1191.

**Egbadzor, K. F., Ofori, K., Yeboah, M., Aboagye, L. M., Opoku, A., Michael, O., Danquah, E. Y. and Offei, S. K. (2014)**. Diversity in 113 cowpea *Vigna unguiculata* (L) Walp] accessions assessed with 458 SNP markers. *Springer Plus*. **3**: 541.

**Fisher, R. A. and Yates, F. (1967).** Statistical Tables for Biological, Agricultural and Medical Research. *Oliver and Boyd, London*: 143 p.

**Indianraj, N., Dheeraj, G., Pavadharini, P., Priyadharshini, A., Kamal, R. R., & Subhalakshmi, K. (2023).** Response of integrated nutrient management on growth and yield of cowpea. *The International Journal of Analytical and Experimental Modal Analysis,***15**(8): 29-33.

**Kumar, S. and Srikant, J. N. (2017).** Evaluation of Cowpea Cultivars using Morphological Indices, *Asian Journal of Multidisciplinary Studies*. **4**(6): 65-69.

**Padulosil, S.; Ng, N. Q. (1997).** "Origin, taxonomy, and morphology of *Vigna unguiculata* (L.) Walp." (PDF). In Singh, B. B.; Mohan, D. R.; Dashiell, K. E.; Jackai, L. E. N. (eds.). Advances in Cowpea Research. Ibadan, Nigeria: *International Institute of Tropical Agriculture and Japan International Research Center for Agricultural Sciences*.

**Palaniappan, S. P. and Annadurai, K. (2007).** Organic farming: theory and practices. Scientific Publishers, Jodhpur, India. pp. 169.

**Panda, R. K., Sahu, G. S., Dash, S. K., Muduli, K. C., Nahak, S., Pradhan, S. R., & Mangaraj, S. (2017).** Integrated nutrient management for seed production in cowpea (*Vigna unguiculata* L.). *Journal of Pharmacognosy and Phytochemistry*, **6**(5): 1845-1849.

**Patel, D. M., and Kumari, S. (2018).** Varietal evaluation of vegetable cowpea (*Vigna unguiculata* (L.) walp) with respect to yield under North Gujarat condition. *Journal of Pharmacognosy and Phytochemistry.***7**(4): 424-427.

**Patel, A. J., Chudasama, V. R., Patel, R. C., Kumar, M., & Rathod, K. D. (2021).** Effect of integrated nutrient management on growth and yield of vegetable cowpea (*Vigna unguiculata* L.). *International Journal of Chemical Studies*. **9**(1): 1265-1268.

**Patel, P., Ghodeshwar, P., Choudhary, A. S., & Satankar, N. (2023).** Impact of integrated nutrient management on the yield of cowpea (*Vigna unguiculata* L. walp). *International Journal of Theoretical & Applied Sciences,***15**(2): 103-108.

**Pushpa, K., Pruthviraj, N., & Vinay, M. G. (2022).** Integrated nutrient management for improving growth and yield of cowpea. *Journal of Crop and Weed.***18**(3): 26-30.

**Singh, G. B. and Biswas. B. P. (2000).** Balanced and integrated nutrient management for sustainable crop production: Limitations and future strategies. *Fertilizer News*. **45**(2): 55- 60.

**Singh, P., Swaroop, N., Thomas, T., & David, A. A. (2017).** Effect of integrated nutrient management on chemical and physical properties of soil and yield of cowpea (*Vigna unguiculata* L.). *Chemical Science Review and Letters,***6**(22): 967-970.

**Singh, P., Swaroop, N., Jajoria, M., & Ola, R. (2018).** Effect of integrated nutrient management on growth and yield of cowpea (*Vigna unguiculata* L.). *International Journal of Current Microbiology and Applied Sciences*, **Special Issue**: 3509-3512.

**Venkatesan, M., Prakash, M. and Ganesan, J. (2003).** Genetic variability, heritability and genetic advance analysis in Cowpea (*Vigna unguiculata* L). *Legume Research.***26**:155-156.

**Table 1: Effect of integrated nutrient management on growth and earliness parameters of cowpea**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment Symbols** | **Treatment combination** | **Plant height (cm)** | **No of branches per plant** | **Days to 50% flowering** | **Days to 50% pod setting** | **Days to first pod picking** | **No of pods per plant** |
|  | **At 30 DAS** | **At 50 DAS** |
| **T0** |  Control  | 42.29 | 80.43 | 6.28 | 51.21 | 62.41 | 74.85 | 13.89 |
| **T1** |  RDF 100% [NPK: 25:50:25 Kg/ha]  | 57.85 | 96.28 | 15.85 | 42.15 | 50.59 | 62.03 | 27.40 |
| **T2** |  Farmyard manure (FYM) 100%  | 43.05 | 82.89 | 7.15 | 50.41 | 57.18 | 68.96 | 17.10 |
| **T3** |  Vermicompost (VC) 100%  | 51.72 | 88.99 | 13.33 | 44.04 | 52.48 | 64.25 | 21.85 |
| **T4** |  Poultry Manure (PM) 100%  | 50.38 | 88.12 | 11.65 | 44.63 | 53.16 | 64.20 | 21.61 |
| **T5** |  75% RDF + 25% FYM  | 46.61 | 84.82 | 8.73 | 48.17 | 57.37 | 66.41 | 17.41 |
| **T6** |  75% RDF + 25% VC  | 54.95 | 95.31 | 15.30 | 45.48 | 54.34 | 64.72 | 24.94 |
| **T7** |  75% RDF + 25% PM  | 54.43 | 85.84 | 8.92 | 45.74 | 54.40 | 65.65 | 16.94 |
| **T8** |  25% RDF + 25% FYM + 25% VC + 25% PM  | 51.57 | 91.66 | 14.33 | 43.64 | 52.50 | 63.87 | 23.88 |
| **CD0.05** | **2.97** | **3.22** | **0.58** | **1.81** | **1.93** | **3.14** | **1.56** |
| **SE. m (±)** | **1.00** | **1.08** | **0.19** | **0.64** | **0.65** | **1.06** | **0.53** |

**CD- Critical difference**

**SE. m- Standard error of the mean**

**Table 2: Effect of integrated nutrient management on yield and quality parameters of cowpea**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Treatment Symbols** | **Treatment combination** | **Pod length (cm)**  | **Individual Pod weight (grams)** | **Pod yield per plant (g/plant)** | **Pod yield per hectare (t/ha)** | **Vitamin C content (mg)** |
| **T0** |  Control  | 12.89 | 11.15 | 154.43 | 3.79 | 3.53 |
| **T1** |  RDF 100% [NPK: 25:50:25 Kg/ha]  | 21.57 | 16.51 | 452.88 | 6.52 | 6.50 |
| **T2** |  Farmyard manure (FYM) 100%  | 15.23 | 12.47 | 213.15 | 4.23 | 4.43 |
| **T3** |  Vermicompost (VC) 100%  | 18.51 | 14.10 | 307.68 | 6.10 | 6.14 |
| **T4** |  Poultry Manure (PM) 100%  | 17.89 | 14.63 | 316.30 | 5.37 | 5.65 |
| **T5** |  75% RDF + 25% FYM  | 16.29 | 13.64 | 237.57 | 4.32 | 4.86 |
| **T6** |  75% RDF + 25% VC  | 19.88 | 15.77 | 393.42 | 6.39 | 7.40 |
| **T7** |  75% RDF + 25% PM  | 16.95 | 14.07 | 238.40 | 5.27 | 5.34 |
| **T8** |  25% RDF + 25% FYM + 25% VC + 25% PM  | 19.03 | 15.22 | 363.60 | 6.32 | 7.24 |
| **CD0.05** | **0.55** | **0.81** | **29.90** | **0.25** | **0.39** |
| **SE. m (±)** | **0.18** | **0.27** | **10.06** | **0.08** | **0.13** |

**Figure 1: Graphical representation of effect of integrated nutrient management on growth parameters of cowpea**

**Figure 2: Graphical representation of effect of integrated nutrient management on yield parameters of cowpea**

**Table 3. Economics as influenced by different treatments applied in Cowpea**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatment Symbols** | **Treatment combination** | **Cost of cultivation (Rs)** | **Gross return (Rs)** | **Net return (Rs)** | **BC ratio** |
| **T0** |  Control  | 85,375 | 1,13,600 | 28,225 | 1.33 |
| **T1** |  RDF 100% [NPK: 25:50:25 Kg/ha]  | 89,269 | 1,95,700 | 1,06,431 | 2.19 |
| **T2** |  Farmyard manure (FYM) 100%  | 1,04,125 | 1,26,800 | 22,675 | 1.22 |
| **T3** |  Vermicompost (VC) 100%  | 97,375 | 1,83,000 | 85,625 | 1.88 |
| **T4** |  Poultry Manure (PM) 100%  | 1,03,375 | 1,61,200 | 57,825 | 1.56 |
| **T5** |  75% RDF + 25% FYM  | 92,997 | 1,29,600 | 36,603 | 1.39 |
| **T6** |  75% RDF + 25% VC  | 91,309 | 1,91,700 | 1,00,391 | 2.10 |
| **T7** |  75% RDF + 25% PM  | 92,809 | 1,58,100 | 65,291 | 1.70 |
| **T8** |  25% RDF + 25% FYM + 25% VC + 25% PM  | 98,529 | 1,89,700 | 91,171 | 1.93 |
| Selling price of Cowpea: Rs 30/kg  |