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Effect of Organic Manures on Growth and Yield of Cowpea (*Vigna unguiculata* L.) Varieties

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Author's contribution

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A Field experiment was conducted during *Zaid* 2023 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (Uttar Pradesh) on Cowpea (*Vigna unguiculata* L.). The soil of experimental plot was sandy loam in texture, low in organic carbon (0.452%), nearly neutral in soil pH (7.1), high nitrogen (178.48 kg/ha), medium phosphorous (23.6 kg/ha), medium potassium (231.4 kg/ha). The experiment laid out in a randomized block design consists of three replications along with three cowpea varieties (*viz.,* Kashi Nidhi, Kashi Unnati, Kashi Kanchan) and three solid organic manures (i.e. Poultry manure 2 t/ha, Goat manure 10.5 t/ha, Pig manure 15 t/ha) which were replicated thrice. The results revealed that maximum plant height (52.73 cm), dry weight (15.03 g/plant), crop growth rate (12.57 g/m^2/day), number of pods/plant (11.80), number of seeds/plant (11.50), test weight (81.00g), seed yield (2.40 t/ha), stover yield (4.10 t/ha). Maximum

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net returns (INR 79,515.00/ha) and benefit cost ratio (2.30) which was significantly superior over other treatment T_3 (Kashi Kanchan + Poultry manure 2 t/ha). It can be concluded that *Kashi Kanchan* variety with application of poultry manure 2 t/ha brought about significant improvement in the production and also proven economically viable in cowpea crop.

Keywords: Goat manure; Kashi Kanchan; Kashi Nidhi; Kashi Unnati; poultry manure and pig manure.

1. INTRODUCTION

"Cowpea (*Vigna unguiculata* L.) commonly known as black eyed pea, southern pea, crowder pea, lobia or marble pea. It is an important legume vegetable crop as well as pulse grown in India. It is summer season crop of humid tropics and sub-tropical zones, well adapted to many areas of the country including North East India. It has manifold uses such as vegetable, pulse, green manuring and fodder crop" (Punabati et al., 2017). "Cowpea fits very well in a various cropping system and is grown as mixed crop, cover crop, catch crop and manure crop [1-3]. It has ability to withstand a considerable degree of drought and higher rainfall and can be grown in almost all kinds of soils provided there is proper drainage" (Devesh et al., 2020). "During 2022-23 the total coverage under cowpea in Uttar Pradesh 16900 ha with a production will be around 113200 tones and the productivity 6.70t/ha (Agricultural statistics at a glance, GOI 2022). Cowpea is one of the most important vegetable crops in organic farming systems as it improves soil fertility even in marginal lands through provision of ground cover, plant residue, nitrogen fixation and suppressing weed and contributes to the sustainability of cropping systems" (Seema et al., 2021).

The main problem is poor planting arrangement that leads to shading by the companion crops and low plant population, low soil fertility, inappropriate planting time, the use of traditional cowpea cultivars with low yielding potential, pest and disease attack and lack of inputs. Besides, the continuous cropping of the land with no external inputs is mining the nutrients in the soil and has led to a progressive decline in yields. There are various sources of organic manures such as poultry manure, goat manure, etc., helps in disease and pest control of the crop. To overcome the loss in production organic manure act not only as a source of nutrients and organic matter but also influence the soil structure and physical, chemical and biological properties of the soil *(Albiach et al.* 2022*).*

"To achieve sustainability in agricultural production, organic manures play a vital role in maintaining the soil fertility. Besides plant nutrients, the presence of enzymes and hormones in manure make them essential for improvement of soil fertility and productivity" (Seema et al., 2021). "Organic manures provide significant quantities of humus. Humus improves soil structure, drainage, aeration, holding water, buffer and exchange ability, soil mineral solubility, and serves as energy source for microorganism growth" [4-11]. "Slow microbial breakdown of humus triggers a gradual release of plants, thereby ensuring long-term availability of nutrients" (Nigam et al., 2020). "Poultry manure and oilcakes help in the improvement of soil structure, aeration and water holding capacity of soil. Further, it stimulates the activity of microorganisms that makes the plant to get the macro and micro-nutrients through enhanced biological processes, increase nutrient solubility, alter soil salinity and pH" (Deepa et al., 2016). "Goat manure is among the best animal manures, providing a consistent supply of nutrients. The goat manure is expected to add nutrients to soil and it also makes a change in the physical properties of the soil" (Suya et al., 2020). "Swine manure is reported to be effective in increasing the yields of cereals, legumes, oilseeds, vegetables and pastures. It is increasing plant nutrient concentration, especially N, P and K. The efficient use of swine manure can be an agronomically and economically viable management practice for sustainable crop production" [12].

"Cultivable varieties are of non-synchronized maturity due to photo sensitive, spreading type and long duration in nature. As a result, farmers has to do harvesting several pickings, which costs more labour, time, and money, raising the entire cost of cultivation" (Rajneesh et al. 2022). "*Kashi Kanchan* is dwarf and bush type (height 50-60 cm), photo-insensitive, early flowering (40-45 days after sowing) and early picking (50-55 days after sowing) variety suitable for growing in both spring-summer and rainy seasons. Pods are about 30-35 cm long, dark green, soft, fleshy and free from parchment. The cultivar gives green pod yield of about 150-175 q/ha and is resistant to golden mosaic virus. It is suitable for cultivation in Uttar Pradesh, Punjab, Bihar,

Chhattisgarh, Orissa, Andhra Pradesh, Madhya Pradesh states. *Kashi Unnati* is also a photo-insensitive variety, dwarf and bushy with height of 40-50 cm bearing early flowering (30-35 days - after sowing)" [13-19]. "First harvesting done at 40-45 days after sowing. Average pod yield 125-150 q/ha. The cultivar is resistant to golden mosaic virus. It is suitable for the cultivation in Punjab, Uttar Pradesh and Jharkhand" [20-27].

Kashi Nidhi is dwarf, erect and bushy. Fruits and seeds are 20-25 cm long. Seed colour is redish brown. Sowing during summer. Golden mosaic virus and *pseudocerospora cruenta* tolerant. Pod yield of 140-150 q/ha. It is suitable for Uttar Pradesh, Bihar and Punjab states.

1.1 Justification

In India, Cowpea is grown widely throughout the year. It is one of the most essential crop in organic farming system as it contributes to the sustainability of cropping system and soil fertility improvement. Photo insensitive and unsynchronized maturity varieties cost more labour, time, and money which raises the cost of cultivation. The possible way to maximize productivity and to enhance income to farmer is by adopting organic practices and growing improved varieties.

2. MATERIALS AND METHODS

The experiment was conducted during *Zaid* season of 2023, at Crop research farm of department of Agronomy at Sam Higginbottom University of Agriculture, Technology, and Sciences, Prayagraj which is located 98 m altitude above the mean sea level. The soil in the experimental area was sandy loam texture with pH (7.1), low organic carbon (0.452%), low available Nitrogen (178.48 kg/ha), medium available Phosphorous (23.6 kg/ha) and medium available Potassium (231.4 kg/ha) were determined by Jackson's method, Subbaiah and Asija's method, Olsen's method, Flame photometer method, respectively. The experiment was laid out in randomized block design (RBD) consisting of three cowpea varieties and three types of solid organic manures and were replicated thrice when applied in combinations as follows, T_1: *Kashi Nidhi* + Poultry manure 2 t/ha, T_2: *Kashi Unnati* + Poultry manure 2 t/ha, T_3: *Kashi Kanchan* + Poultry manure 2 t/ha, T_4: *Kashi Nidhi* + Goat manure1 10.5 t/ha, T_5: *Kashi Unnati* + Goat manure 10.5 t/ha, T_6: *Kashi Kanchan* + Goat manure 10.5 t/ha, T_7: *Kashi Nidhi* + Pig manure 15 t/ha, T_8: *Kashi Unnati* + Pig manure 15 t/ha and T_9: *Kashi Kanchan* + Pig manure 15 t/ha. The pure, healthy, disease, insect free vigorous and good quality cowpea seeds were used for sowing. Seed rate of cowpea 35-40 t/ha. Seeds were sown at a depth of 3-4 cm in lines at a spacing of 30 cm × 15 cm. Weeding was done manually at 25 and 45 days after sowing with the help of khurpi. First light irrigation was done just after sowing then subsequent irrigations were applied as per the requirement of the crop. The observations on various growth and yield parameters were recorded from the randomly tagged selected plants. The border plants were excluded while tagging the sample plants. Growth parameters at 15, 30, 45 and 60 viz. plant height (cm) and dry weight (g/plant), whereas yield attributes were recorded after the harvest of the crop number of pods/plants, number of seeds/pods, test weight, seed yield and stover yield. The data was statistical analysis by analysis of variance method [28]. The results are presented at 5% level of significance (p=0.05) for making comparison between treatments.

3. RESULTS AND DISCUSSION

3.1 Growth Attributes

At 60 DAS, highest plant height (52.73 cm) and dry weight (15.03 g) were recorded in T_3 with *Kashi Kanchan* variety with application of poultry manure 2 t/ha. "Application of different organic manures create uptake of nutrients by the crop due to availability of nutrients. The plant growth is the function of photosynthetic activity of the plants and translocation of photosynthates within the plant which ultimately depend on their capacity to utilize available nutrients" (Deepa et al.,2016). Total nitrogen and phosphorus content higher in poultry manure. It contributes increase of soil nutrient content due to very high decomposition rate compared to other animal manures [29]. "The increase in plant height by the application of the poultry manure at the first few weeks after planting could be attributed to the quick mineralization of poultry manure as compared to goat dung which later gave higher plant heights at 8 and 10 weeks after planting. When the manure is mineralized, it makes nutrient available in inorganic forms that are easily assimilated by plants" Onwuka and Nsofor [30]. Cultivating suitable variety with the application of organic manures improve growth parameters and soil properties. Poultry manure

Table 1. Effect of organic manures on growth attributes of Cowpea varieties

S. No	Treatment combinations	60 DAS	60 DAS	45-60 DAS
		Plant height (cm)	Dry weight (g/plant)	CGR (g/m^2/day)
1.	*Kashi Nidhi* + Poultry manure 2 t/ha	50.34	12.48	9.10
2.	*Kashi Unnati* + Poultry manure 2 t/ha	51.13	12.21	8.78
3.	*Kashi Kanchan* + Poultry manure 2 t/ha	52.73	15.03	11.99
4.	*Kashi Nidhi* + Goat manure 10.5 t/ha	51.39	14.25	10.96
5.	*Kashi Unnati* + Goat manure 10.5 t/ha	50.41	14.10	11.95
6.	*Kashi Kanchan* + Goat manure 10.5 t/ha	51.66	14.83	12.57
7.	*Kashi Nidhi* + Pig manure 15 t/ha	49.93	14.20	11.24
8.	*Kashi Unnati* + Pig manure 15 t/ha	51.27	14.03	10.80
9.	*Kashi Kanchan* + Pig manure 15 t/ha	49.15	13.70	10.37
	SEm(±)	0.61	0.58	0.82
	CD (p=0.05)	1.83	1.74	-

when applied alone or combined can provide the necessary nutrients needed by plants for growth Adeoye et al. [3]. Combined application of inorganic nitrogen fertilizer and poultry manure could contribute to the significant increase in leaf area index which indicates synthetically active regions on a leaf for interception of solar radiation necessary during the process of photosynthesis Ade and Joseph (2017). "Increase in leaf area was more due to combine application of organic manure. *Kashi Kanchan* variety of cowpea responded well to inorganic and organic sources of plant nutrients better as compared to inorganic nutrients alone" Panda et al. [31]. Due to an improvement in soil organic matter and nutrient availability which resulted in an improvement in soil fertility that led to an improvement in plant growth. Combined application of organic manure and inorganic nitrogen fertilizer to cowpea resulted in a significant increase in plant growth and development than single application of organic manure (Abe and Joseph 2017).

3.2 Yield Attributes and Yield

"According to yield attributes data that was collected and analyzed at harvest, higher number of pods/plant (11.80), number of seeds/plant (11.50), test weight (81.00 g), seed yield (2.40 t/ha) and stover yield (4.10 t/ha) were recorded in T_3 with *Kashi Kanchan* variety with application of poultry manure 2 t/ha. *Kashi Nidhi* recorded higher for chlorophyll content in leaves at 60 DAS. *Kashi Nidhi* and *Kashi Kanchan* recorded high crude fibre content among other varieties" (Kumari et al.,2022). "Plants respond differently to environmental factors based on their genetic makeup and their adaptation capability indicating that variability among species. Maximum test weight occupied by variety *Kashi Unnati* may be due to better availability of nutrients and better translocation of photosynthates from source to sink and may be due higher accumulation of photosynthates in the seeds. Highest fibre content was highly exhibited with variety *Kashi Kanchan"* Yogesh et al. (2016). "The improved physical condition of soil resulting from the addition of organic matter increased the crop yield compared to use of chemical fertilizer, Poultry manure has a beneficial effect on crop growth and yield" Yoganathan et al., [32]. "The application of the amendment resulted in increased grain yields, which could be as the result of harnessing of all the nutrients in the amendments, to produce the grain yield which is the focus of the farmers in embarking on cowpea production" (Onwuka and Nsofor) [30]. "Farmers to fetch high yields they should use chicken manure and pig manure and plant early in time during the first rains and also crops to pick the Nitrogen flash for their vegetative growth" Oya et al. [33].

3.3 Economics

Maximum net return (INR 79,515.00/ha) and benefit cost ratio (2.30) were obtained highest in *Kashi Kanchan* variety with application of poultry manure 2 t/ha [34].

"Additional income attributed to the higher yield of *Kashi Kanchan* is result of increase in net income due to adoption of improved crop management practices. Cultivating improved varieties and improving cultivation techniques have been found to significantly increase yields and incomes for cowpea growers" Rajneesh et al. (2022). Seed production of *Kashi Kanchan* variety of cowpea found to be profitable with application of RDF, Vermicompost and lime under Odisha agro-climatic condition Panda et al. [31].

Table 2. Effect of Organic manures on Yield attributes and Yield of Cowpea varieties

S. No	Treatments	Number of pods/ plants	Number of seeds/ pods	Test weight (g)	Seed yield (t/ha)	Stover yield (t/ha)
1.	*Kashi Nidhi* + Poultry manure 2 t/ha	10.07	10.23	79.67	1.83	3.50
2.	*Kashi Unnati* + Poultry manure 2 t/ha	10.60	10.43	80.33	1.70	3.54
3.	*Kashi Kanchan* + Poultry manure 2t/ha	11.80	11.50	81.00	2.40	4.10
4.	*Kashi Nidhi* + Goat manure 10.5 t/ha	10.50	10.70	79.33	1.90	3.23
5.	*Kashi Unnati* + Goat manure 10.5 t/ha	10.60	10.73	78.67	1.90	3.33
6.	*Kashi Kanchan* + Goat manure 10.5 t/ha	10.47	10.43	80.33	1.87	3.37
7.	*Kashi Nidhi* + Pig manure 15 t/ha	11.23	11.10	79.67	2.33	3.40
8.	*Kashi Unnati* + Pig manure 15 t/ha	11.47	11.27	79.33	2.32	3.27
9.	*Kashi Kanchan* + Pig manure 15 t/ha	11.43	11.20	80.33	2.33	3.17
	SEm (±)	0.25	0.29	0.38	0.04	0.09
	CD (p=0.05)	0.77	-	1.14	0.12	0.28

Table 3. Effect of Organic manures on economics of Cowpea

S. No	Treatments	Net returns (INR/ha)	B:C ratio
1.	*Kashi Nidhi* + Poultry manure 2 t/ha	53115.00	1.53
2.	*Kashi Unnati* + Poultry manure 2 t/ha	47020.00	1.36
3.	*Kashi Kanchan* + Poultry manure 2 t/ha	79515.00	2.30
4.	*Kashi Nidhi* + Goat manure 10.5 t/ha	45560.00	1.02
5.	*Kashi Unnati* + Goat manure 10.5 t/ha	45860.00	1.03
6.	*Kashi Kanchan* + Goat manure10.5 t/ha	44710.00	1.00
7.	*Kashi Nidhi* + Pig manure 15 t/ha	55160.00	1.01
8.	*Kashi Unnati* + Pig manure 15 t/ha	54510.00	1.00
9.	*Kashi Kanchan* + Pig manure 15 t/ha	55060.00	1.01

4. CONCLUSION

It can be concluded that *Kashi Kanchan* variety with application of poultry manure 2 t/ha brought about significant improvement in the production and also proven economically viable in cowpea crop.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Akande MO, Adediran JA, Oluwatoyinbo FI. Effects of rock phosphate amended with poultry manure on soil available p and yield of maize and cowpea. African Journal of Biotechnology. 2005;4(5):444-448.
2. Ansari SMS, Pandey AK, Singh UP. Effect of kinetin on growth parameters of cowpea (*Vigna unguiculata* L.). Journal of Pharmacognosy and Phytochemistry. 2020;9(5):628-630.
3. Adeoye PA, Adebayo SE, Musa JJ. Growth and Yield response of Cowpea (*Vigna unguiculata*) to Poultry and Cattle manure as amendments on Sandy loam soil plot. Agricultural Journal. 2011;6(5): 218-221.
4. Armin W, Zaman Kh A, Zami H, Bhadra AK, Khatun F. Combined Effect of Organic and Inorganic Fertilizers on the Growth and Yield of Mungbean (Bari Mung 6). International Journal of Scientific and Research Publications. 2016;6(7):2250-3153.
5. Chaudhary N, Puri C, Jaisi PN, Basnet S. Effect of Integrated nutrient management on yield and yield attributing characters of Black gram inn Lamahi, Dang. Sustainability in Food and Agriculture. 2020;1(2):106-108.
6. Chauhan A, Mehra B, Abhishali. Effect of Zinc Levels on Growth and Yield of Cowpea (*Vigna unguiculata* L.) Varieties. International Journal of Plant & Soil Science. 2023;35(8):181-187.
7. Choudhary M, Bailey LD, Grant CA. Review of the use of swine manure in crop production: Effects on yield and composition and on soil and water quality. Waste management and Research: The Journal for a Sustainable Circular Economy. 1996;14(6).
8. Choudhary M, Bailey LD, Grant CA. Review of the use of swine manure in crop production: Effects on yield and composition and on soil and water quality. Waste management and Research: The Journal for a Sustainable Circular Economy. 1996;14(6).
9. Dey S, Prasad S, Tiwari P, Sharma P. Effect of urea, KCl, Zinc placement & spray on growth of cowpea. Journal of Pharmacognosy and Phytochemistry. 2017;1:971-973.
10. Diwale SR, BGokhale N, Khobragade NH, Wahane MR, Joke AA, Dhopavkar RV. Effect of organic manures on yield and nutrient uptake by cowpea and changes in soil nutrient status. The Pharma Innovation Journal. 2020;9(9):564-567.
11. Gadi P, Dawson J, Shankar M. Effect of different organic manures, inorganic fertilizers and growth regulator on yield attributes and yield of green gram (*Vigna radiata* L.). Agriculture Update. 2017;12(6): 1567-1572.

12. Haridha RSP, Jeyamangalam F, Jenila RM. Impact of Organic manures on Physico-chemical and Chemical properties of soil and Yield of Black Gram *(Vigna Mungo*. L.). ICEMA 2022: International Conference on Energy Materials and Applications. 2022;263-266.
13. Heisnam P, Sah D, Moirangthem A, Singh MC, Pandey PK, Mahato NK, et al. Effects of Rhizobium, PSB Inoculation and Phosphorus Management on Soil Nutrient Status and Performance of Cowpea in Acid Soil of Arunachal Pradesh, India. International Journal of Current Microbiology and Applied Sciences. 2017; 6(8):937-942.
14. Joshi D, Gediya KM, Patel JS, Birari MM, Gupta S. Effect of organic manures on growth and yield of summer cowpea [*Vigna unguiculata* (L.) Walp] under middle Gujarat conditions. Agriculture Science Digest. 2016;1-4.
15. Mohbe S, Dotaniya CK, Reager ML, Doutaniya RK. Effect of organic manures on productivity of green gram [*Phaseolus radiata* (L.)] under rainfed condition. XXI Biennial National Symposium of Indian Society of Agronomy. 2018;520-521.
16. Msaakpa TS. Effects of Variety and Poultry Manure on Growth and Yield of Selected Cowpea (*Vigna unguiculata* (L)Walp) Varieties at Makurdi, Nigeria. International Journal of Scientific and Research Publications. 2016;6(8):522-528.
17. Nagpal R, David AA, Thomas T, Reddy IS, Barthwal A. Impact of integrated nutrient management on soil properties, growth and yield attributes of green gram (*Vigna radiata* L.) var. MH-421. The Pharma Innovation Journal. 2022;11(6):925-929.
18. Pardhi S, Sharma RK, Kushwah SS, Gallani R. Influence of Varieties and Integrated Nutrient Management Practices on Growth and Yield of Seed in Cowpea (*Vigna unguiculata* L.). Legume Research. 2021;1-5.
19. Pawar Y, Varma LR, Verma P, Kulkarni MV. Varietal performance of cowpea (*Vigna unguiculata* L.) against growth, seed yield and quality attributes. Ecology, Environment and Conservation. 2016; 22(3):579-582.
20. Sivaranjani M, Prabhu T, Lakshmidevi CG, Venkataraman K. Organic Manures Impact on the Development and Production of Pulses - A Review. International Journal of Current Microbiology and Applied Sciences. 2023;12(06):93-99.
21. Srivastva R, Meena K, Singh AP, Singh, Behera TK. Performance of Cowpea Variety (Kashi Kanchan) under Front Line Demonstration in Eastern Part of Uttar Pradesh, India. International Journal of Plant & Soil Science. 2022;34(23):1135-1140.
22. Kannan R, Anandan P, Solaimalai A, Sivakumar T, Raj TS. Vegetable crop production technology in India. Advances in Agricultural Sciences. 2019;18:75-95.
23. Kumar D, Chahar SS, Singh AK. Effect of Naphthalene Acetic Acid on Yield Attributes of Cowpea cultivars. Plant Archives. 2020;20(1):1552-1556.
24. Lata K, Yadav PK, Rathore RS, Pareek NK. Effect of irrigation regimes on quality parameters of Cowpea (*Vigna unguiculata* L. Walp.). The Pharma Innovation Journal. 2022;11(8):2145-2147.
25. Mahamud, Md A, Rahman MM, Hassan Md A, Bahadur Md M, Sabil AS, Imran S, Paul NC. Assessing the influence of integrated nutrient management on growth and yield of Black gram (*Vigna mungo* L.). Archives of Agriculture and Environmental Science. 2022;7(3):407-414.
26. Maurya RK, Rajiv Chaudhary AK, Singh D, Maurya R, Maurya R. Effect of Weed Management Practices on Growth, Yield of Vegetable Cowpea (*Vigna unguiculata* (L.) Walp.) cv. Kashi Kanchan. 2023;13(10): 1781-1787.
27. Menon SS, Savithri KE. Water stress mitigation in vegetable cowpea through seed hardening and moisture conservation practices. Journal of Tropical Agriculture. 2015;53(1):79-84.
28. Miheretu A, Sarkodie-Addo J. Response of cowpea (*Vigna anguiculata* [L.] walp) varieties following application of nitrogen fertilizers and inoculation. IOSR Journal of Agriculture and Veterinary Science. 2017; 10(4):32-38.
29. Mishra SK, Chaturvedi PK. Effect of integrated nutrient management on growth and yield of green gram (*Vigna radiata* L.). The Pharma Innovation Journal. 2023; 12(1):671-673.
30. Onwuka MI, Nsofor HO. The Effect of Kitchen Residue Ash, Poultry manure, nd Goat dung on soil properties and Yield of Cowpea (*Vigna unguiculata*) in a typic Kandidult of South East Nigeria. Journal of

Agriculture and Food Sciences. 2011;9(1): 47-56.

31. Panda RK, Sahu GS, Dash SK, Muduli KC, Nahak S, Pradhan SR, Mangaraj S. Integrated nutrient management for seed production in cowpea [*Vigna unguiculata* L.]. Journal of Pharmacognosy and Phytochemistry. 2017;6(5):1845-1849.
32. Yoganathan R, Gunasekera HKLK, Hariharan R. Integrated Use of Animal Manure and Inorganic Fertilizer on Growth and Yield of Vegetable Cowpea (*Vigna uniquiculata*). International Journal of Agricultural and Biosystems Engineering. 2012;7(8):775-778.
33. Oya, Richard, Murongo, Fabian M. Evaluating the effect of different organic manures on the performance of black eye cowpea variety. Murongo article-Conference proceedings (Agriculture); 2023.
34. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research. 2nd Edition, John Wiley and Sons, New York. 1984;680.

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