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Utilization of Selected Animal Wastes in the Production of Improved Cowpea Varieties (*Vigna unguiculata* L. Walp)

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Abstract

Application of inorganic fertilizer incrop production has been criticized in environmental and health management. This research therefore studied the effects of three animal based wastes products as alternative manure on the growth parameters of three selected cowpea varieties (UAM-1051-1, IT99K-573-2-1 and UAM-1055-6). Pot experiment was set up in a randomized complete block design using bone meal (BM), crab shell (CS), earthworm cast (EC) as treatments. Inorganic fertilizer (NPK) was used as negative control while pots without any treatment were set up as positive control. The total experimental unit was 108.. Data were collected at intervals on growth and flowering parameters and analysed. The largest variation was found in percentage germination (3WAP) ($F=3745.43$, $P=0.05$) followed by day to flowering (2WAMA) ($F=2607.29$, $P<0.05$). UAM-1055-6 had the highest percentage germination (78.7%) significantly different from UAM-1051-1 (60.18%). The height of UAM-1055-6 and IT99k-573-2-1 was significantly more enhanced at two weeks and five weeks after manure application (2-5WAMA). Number of leaves were also significantly higher in IT99k-573-2-1 (13.88) and UAM-1051-1 (13.5) than in UAM-1055-6 (11.64) after manure application. Day to flowering was highest in UAM-1055-6 (57.11 days). Combination of Bm+Cs+Ec (5g) gave the longest leaves (7.13 cm) while the application of Bm+Ec (7.5g) resulted in the widest plant spread (8.46cm). Highest number of leaves (17.08) was produced by Bm+Ec (5g). The quickest flowering time (<50 days) was achieved in Cs+Ec (5g), Bm (7.5g) and NPK (1.3g). Therefore, animal based organic manure under consideration performed better than NPK and control treatments and should be explored in cowpea production to address the challenges associated with high cost of inorganic fertilizer and its hazardous effects on the environment.

Keywords

Cowpea Production, Animal Wastes, Manure, Environmental Management

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1. Introduction

Cowpea (*Vigna unguiculata* L. Walp) (2n=2x=22) is a member of the Phaseoleae tribe of the Leguminosae family. It is a major source of protein for both rural and urban dwellers in Africa [1, 2]. The 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% [3]. In the savannas of West Africa, cowpea may be a valuable source of livestock fodder making the twin purpose cultivars very attractive to farmers [4]. Cowpea is additionally a crucial component of the normal cropping systems because it fixes atmospheric nitrogen and contributes

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to soil fertility improvement particularly in smallholder farming systems where little or no fertilizer is used. Cowpea is of major importance to the livelihoods of millions of relatively poor people in under developed countries of the tropics [5]. West and central Africa is the leading cowpea producing regions in the world, accountable for 64% of the annual estimation of 3 million tons of cowpea seed. Other major producers of cowpea outside Africa are Asia and Central and South America.

As in other regions in Africa, local farmers use insufficient nutrient input, inappropriate quality and inefficient combination of fertilizers that resulted in less productivity. Therefore, this trend results in a deeply unbalanced soil nutrient composition that eventually leads to a reduction in a crop growth and yield potential. Hence it is important that an integrated plant nutrient management should be practiced for balanced soil nutrient that resulted in sustainable cowpea yield and soil fertility as well. Organic fertilizers can be used in place of inorganic fertilizers as some of them are costly to purchase. Use of inorganic fertilizers to enhance yield have been criticized in causing environmental problems [6], hence the need to seek friendlier sources that help to maintain the environment. Researchers have advocated the bioconversion of plant and animal wastes into manure for crop production, at the same time, helping to eliminate wastes in the environment.

Bone meal may be a mixture of finely and coarsely ground animal bones and slaughter-house waste products. It is used as an organic for plants and as a nutritional supplement for animals. The crab shell increases soil organic matter content, improves soil physical properties, and supplies essential plant nutrients, in particular nitrogen and phosphorus. Crab shell, however, may contain materials that are potentially toxic to the legume symbiosis. The first of these are soluble salts, because the shell is a by-product of a marine organism. Activities of earthworm in the soil build casts that help to bind soil aggregates together thereby making nutrients available to plants apart from direct addition of nutrients to the soil by the cast. The aim of this work was therefore to study the effects of bone meal, crab shell and earthworm casts as animal based organic manure on the growth parameters of three selected cowpea varieties (UAM-1051-1, IT99K-573-2-1 and UAM-1055-6).

2. Materials and Methods

2.1. Study Area

This research work was carried out in the Botanical garden of the Federal University of Agriculture, Makurdi Benue State, Nigeria. Makurdi lies within 7°41′ 262" N and 8°37′ 66" E. The soil at the experimenter site was sandy loam. Farming activities and animal rearing are predominant and the soil is used majorly for agricultural purposes. The swampy areas are habitations of crabs and earthworms that are in abundance around the university campus.

2.2. Sample Collection

The soil used for this experiment was dug from the university botanical garden. Improved seed varieties were sourced from the seed bank of the Federal University of Agriculture, Makurdi, Nigeria. Bone waste was sourced from abattoir while crabs and earthworms were collected within the swampy area of the University campus. Samples (bone and crab) were dried and processed into powdered forms while earthworm formed casts. NPK 15: 15: 15 inorganic fertilizer was purchased.

2.3. Experimental Design

Pot experiment was set up [7]. The design was a randomized complete block design with three varieties of cowpea and 5 treatments: bone meal (BM), crab shell (CS), earthworm cast (EC), NPK fertilizer and control pots (no treatment). There were 18 treatments combinations per variety. The specific levels of treatment combinations were: BM @ 5g and 7.5g; CS @ 5g and 7.5g; EC @ 5g and 7.5g; NPK 15: 15: 15 @ 1.3g and 2.4g; BM+CS @ 5g and 7.5g; BM+EC @ 5g and 7.5g; CS+EC @ 5g and 7.5g; BM+CS+EC @ 5g and 7.5g, NPK @ 1.3g; NPK @ 2.4g and Control @ 0.0g. The total experimental unit was 108 (18 treatment combinations*3 varieties*2 replicates).

2.4. Data Collection and Analysis

Data were collected (at different intervals after planting) on growth and flowering parameters including: germination, seedling vigour, leaf production, plant spread, stem diameter, leaf sizes, number of branches, days to flowering, number of flowers. Both descriptive and inferential statistical tools were applied using the Minitab (16.0) application. Statistical differences in the treatment of the growth parameters were tested using analysis of variance (ANOVA). Means were compared using Tukey's Honest Significance Difference (HSD) at 95% confidence limit.

3. Results and Discussion

Based on the ANOVA tables (Table 1 and Table 2), the three cowpea varieties differed significantly in percentage germination and plant height before manure application at three weeks after planting (3WAP). The three varieties of cowpea evaluated have shown inherent genetic characters in some growth and flowering parameters. The result was similar to that of Agbogidi and Egho [8] who evaluated eight varieties of cowpea in Asaba agro-ecological environment of Nigeria

and reported significant difference among the tested varieties in all growth characters measured. Shivraj [9] also reported that variety effects were highly significant for all growth and yield characters studied, indicating that the presence of sufficient amount genetic diversity in the existing material. Varietal difference in emergence could be attributed to difference in seed size, imbibition rate and, seed coat thickness, numbers of seed coat pores, size of micropyle and hilum [10]. Varieties also showed significant differences after manure application at different intervals (three weeks and five weeks after manure application (WAMA)) in plant height, stem circumference, number of leaves, number of branches day to flowering and number of flower produced. The largest F-value was found in percentage germination (3WAP) (F=3745.43, P=0.05) followed by day to flowering (2WAMA) (F=2607.29, P<0.05).

Table 1. Analysis of variance showing the behavior of the varieties before and after manure application.

Source of Variation		Percentage germination 3WAP	Number of leaves 3WAP	Plant spread 3WAP	Plant height 3WAP	Seedling vigour 3WAP	Plant height 2WAMA	Plant height 5WAMA	Stem circumference 5WAMA
Replicate	1	10.28	0.43	10.16	1.59	20.56	226.30	571.24	0.03
Variety	2	3745.43**	4.29^{ns}	3.03^{ns}	106.37**	4.14^{ns}	233.57**	102.50*	2.04**
Manure	16	5.62^{ns}					18.51^{ns}	19.13^{ns}	0.20^{ns}
Variety x Manure	32						9.40^{ns}	8.49^{ns}	0.19^{ns}
Error	50	555.44	3.78	2.45	15.04	22.43	11.70	20.84	0.34
Total	101								

Table 2. Analysis of variance showing the effect of the three organic manures on the growth parameters of cowpea varieties.

Source of Variation	DF	Leaf length 5WAMA	Leaf width 5WAMA	Plant spread 5WAMA	Number of leaves 5WAMA	Day of flowering (2WAMA)	Number of flowers 5WAMA	Number of branches 5WAMA
Replicate	1	0.42	1.33	0.45	48.45	0.15	4.90	1.86
Variety	2	0.91	0.49^{ns}	6.17*	51.63**	2607.29**	3.45*	2.42**
Manure	17	0.97	0.65^{ns}	0.85^{ns}	10.44^{ns}	2607.29**	0.16^{ns}	0.08^{ns}
VarietyxManure	34	1.52	0.75*	1.59^{ns}	8.82^{ns}	3.70^{ns}	0.12^{ns}	0.15^{ns}
Error	53	1.62	0.44	1.38	9.13	4.43	0.24	0.12
Total	107							

The four fertilizers type (organic and inorganic) did not show significant differences (P>0.05) in any parameter after application. There was no observable interaction between variety and manure in the growth and flowering. UAM-1055-6 had the highest percentage germination (78.7%) significantly different from UAM-1051-1 (60.18%). Two weeks and five weeks after manure application (2-5WAMA), the height of UAM-1055-6 and IT99k-573-2-1 was significantly more enhanced (Table 3). Post manure application also gave difference varietal responses to the number of leaves which were significantly higher in IT99k-573-2-1 (13.88) and UAM-1051-1 (13.5) than in UAM-1055-6 (11.64). Day to flowering was highest in UAM-1055-6 (57.11 days) (Table 4). Experimental studies on different types of organic amendments have been reported on cowpea by several authors [11, 12]. Although the findings of this study showed no significant response of cowpea growth parameters to the different organic manure (bone meal, crab shell and earthworm cast) applied at 5 grams and 7 grams, further studies can be carried out to evaluate them at higher application rates alongside other sources of organic amendment. Combination of the three organic manure type at 5g gave the long leaves while bone meal and earthworm cast gave more leaves. The quickest flowering time (<50 days) was achieved in Cs+Ec (5g), Bm (7.5g) and NPK (1.3g).

Bm+Cs+Ec (5g) gave the longest leaves (7.13 cm) while the application of Bm+Ec (7.5g) resulted in the widest plant spread (8.46 cm). Highest number of leaves (17.08) was produced by Bm+Ec (5g). The quickest flowering time (<50 days) was achieved in Cs+Ec (5g), Bm (7.5g) and NPK (1.3g) as shown in Table 5. Differences in leaf width may result in differences in photosynthate accumulation. Nwokwu [13] reported that growth attributes such as plant height, leaf area index, number of leaves and Days to 50% flowering were significantly increased by the application of NPK fertilizer. This result is in conformity to the results observed by [14] and [15]. This could be attributed to the fact that NPK is required in large quantities in shoot and root tips where metabolism is high and cell division is rapid [16]. Thus, an indication that the cowpea varieties utilized the NPK fertilizer applied judiciously in growth and development processes. Ahmed *et al.* [11] reported significant differences in plant height, number of leaves per plant, number of branches and leaf area per plant as influenced by organic manure application. They indicated that the pigeon manure either alone or combined with chicken manure, cattle manure or rabbit manure significantly increased plant height, number

of leaves per plant, number of branches per plant and leaf area per plant. Similar finding was observed in the present work which substantiates the potential use of animal wastes as manure.

Table 3. Mean performance of varietie based on selected growth parameters before and after manure application.

Varieties	Percentage germination 3WAP	Number of leaves 3WAP	Plant spread 3WAP	Plant height 3WAP	Seedling vigour 3WAP	Plant height 2WAMA	Plant height 5WAMA	Stem circumference 5WAMA
UAM-1051-1	60.18b	5.50a	4.20 a	9.78 b	7.07 a	16.48 c	22.90 b	1.18 a
IT99k-573-2-1	76.85a	5.54a	3.71a	12.40 a	7.51a	18.62 b	24.56 a	1.23 a
UAM-1055-6	78.70a	4.92a	4.22 a	13.01 a	6.85 a	21.55 a	26.27 a	0.79 b

Table 4. Mean performance of varieties based on growth and flowering parameters after manure application.

Varieties	Leaf length 5WAMA	Leaf width 5WAMA	Plant spread 5WAMA	Number of leaves 5WAMA	Day of flowering 2WAMA	Number of flowers 5WAMA	Number of branches 5WAMA	Flower length 5WAMA
UAM-1051-1	6.34 a	3.39 a	7.54 b	13.50 a	41.25 c	1.58 a	1.53 a	1.20 a
IT99k-573-2-1	6.54 a	3.53 a	8.31 a	13.88 a	54.53 b	1.11 b	1.29 b	1.12 a
UAM-1055-6	6.23 a	3.62 a	7.65 ab	11.64 b	57.11 a	1.00 b	1.01 c	0.83 b

Table 5. Effect of different treatment combinations on the growth of three cowpea varieties.

Manure	Leaf length 5WAMA	Leaf width 5WAMA	Plant spread 5WAMA	Number of leaves 5WAMA	Day of flowering 5WAMA	Number of flowers 5WAMA	Number of branches 5WAMA	Plant height 2WAMA	Plant height 5WAMA	Number of plants stems 5WAMA	Stem circumference 5WAMA
Bm+Cs+Ec(5g)	7.13b	3.44a	7.81a	12.61a	50.17a	1.33a	1.33a	17.28a	24.22a	2.17a	0.93a
Bm+Cs+Ec(7.5g)	6.44a	3.41a	8.22b	13.08a	50.83a	1.00a	1.25a	16.44a	23.81a	2.17a	1.24a
Bm+Cs(5g)	6.07a	3.23a	7.92a	13.42a	50.17a	1.33a	1.39a	20.72b	25.47a	2.17a	0.92a
Bm+Cs(7.5g)	6.34a	3.08a	7.92a	13.58a	51.50a	1.17a	1.50a	20.19a	25.40a	1.67a	0.92a
Bm+Ec(5g)	6.07a	3.30a	7.90a	17.08c	51.67a	1.50a	1.19a	20.94b	25.97a	1.83a	1.00a
Bm+Ec(7.5g)	6.31a	3.36a	8.46b	11.92a	51.50a	1.50a	1.28a	17.94a	23.22a	2.17a	0.96a
Bm(5g)	6.81a	4.12b	7.13a	13.36a	50.33a	1.50a	1.25a	17.92a	22.00a	2.17a	1.08a
Bm(7.5g)	5.97a	4.18b	8.06a	12.11a	49.50a	1.33a	1.33a	16.67a	22.08a	2.33a	1.17a
CLT1	6.62a	3.76a	7.83a	12.61a	52.67a	1.17a	1.17a	19.14a	24.00a	2.17a	0.99a
CLT2	6.81a	3.93a	7.32a	12.92a	51.33a	1.17a	1.17a	23.42b	26.43b	2.17a	1.15a
Cs+Ec(5g)	7.04b	3.11a	7.71a	13.58a	49.33a	1.00a	1.33a	17.53a	25.64a	2.00a	1.51a
Cs+Ec(7.5g)	6.26a	3.41a	8.19a	14.42b	49.67a	1.33a	1.50a	18.58a	25.44a	1.83a	1.37a
Cs(5g)	6.53a	3.34a	7.67a	12.36a	51.83a	1.17a	1.33a	18.56a	23.42a	1.67a	1.13a
Cs(7.5g)	5.92a	3.20a	8.25a	13.67a	52.50a	1.17a	1.08a	19.58a	25.38a	2.00a	1.11a
Ec(5g)	6.01a	3.69a	8.17a	11.97a	51.50a	1.00a	1.17a	17.78a	22.17a	2.00a	1.17a
Ec(7.5g)	5.89a	3.62a	7.31a	12.83a	52.17a	1.17a	1.25a	19.47a	23.53a	1.83a	0.91a
NPK(1.3g)	6.61a	3.35a	7.31a	11.17a	49.83a	1.17a	1.17a	17.61a	25.08a	2.50a	0.81a
NPK(2.4g)	5.85a	3.77a	7.83a	11.47a	50.83a	1.17a	1.33a	20.11b	29.11b	2.83a	0.86a

4. Conclusion

The three varieties showed significant in some growth and flowering parameters after manure application, and indication that manure application influenced the growth and flowering of cowpea. The four fertilizers type (organic and inorganic) behaved in a similar way. Double or triple combination of organic manure treatments performed better than single treatments although bone meal alone at 7.5g influenced flowering time while combination of bone meal with others influenced leaf sizes, plant spread and number of leaf produced per plant. Therefore, animal based organic manure under consideration performed better than NPK and control treatments and should be utilized in the production of improved cowpea varieties for health and environmental safety.

References

[1] Ajeigbe H. A., Saidou, A. K., Singh, B. B., Hide, O. and Satoshi, T. (2012). Potentials for cowpea (*Vigna unguiculata*) for dry season grain and fodder production in the Sudan and Sahel zones of WestAfrica, in Innovative Research Along the Cowpea Value Chain, eds Boukar O., Coulibaly O., Fatokun C. A., Lopez K., Tamo M., editors. (Ibadan: International Institute of Tropical Agriculture (IITA), 189-202.

[2] Dube, E. and Fanadzo, M. (2013). Maximizing yield benefits from dual-purpose cowpea. *Food Security*, 5: 769-779.

[3] Abudulai, M., Seini, S. S., Haruna, M., Mohammed, A. M. and Asante, S. K. (2016). Farmer participatory pest management evaluations and variety selection in diagnostic farmer field Fora in cowpea in Ghana. *African Journal of Agricultural Research*, 11: 1765-1771.

[4] Singh, B. B. (2002). Recent genetic studies in cowpea. In: Fatokun CA, Tarawali SA, Singh BB, Kormawa PM, Tamo M (eds) Challenges and Opportunities for Enhancing Sustainable Cowpea Production. Intl Inst Tropical Agric, Ibadan, Nigeria, pp. 3–13.

[5] FAO (2002). *World Agriculture: towards 2015/2030.* Summary report, Rome.

[6] Aguoru, C U., Azua E. T and Olasan J. O. (2015) Approaches to mininmizing and overcoming current biodiversity loss. *British Journal of Environmental Sciences*, 3 (3): 12-26.

[7] Olasan, J. O., Zara, M. and Atim, H. L. (2020). Effect of Chlorine Treated Water on Germination and Growth of Cowpea Cultivars (*Vigna unguiculata* L. Walp). *International Journal of Environmental and Agriculture Research*, 6 (9), 27–34.

[8] Agbogidi, O. M. and Egho, E. O. (2012). Evaluation of eight varieties of cowpea (*Vigna unguiculata* (L.) Walp) in Asaba agro-ecological environment, Delta State, Nigeria. *European Journal of Sustainable Development.* 1 (2): 303-314.

[9] Shivraj, S. R. (2016). Genetic Variability, Correlation and Path Coefficient Analysis for Yield and Its attributing Traits in Cowpea. Master of Science Thesis. Department of Horticulture College of Agriculture, Jawaharlal Nehru KrishiVishwaVidyalaya, Jabalpur, Madhya Pradesh.

[10] Borji, M., Ghorbanli, M. and Sarlak, M. (2007). Some seed traits and their relationships to seed germination, emergence rate electrical conductivity in common bean (*Phaseolus vulgaris* L.). *Asian Journal of Plant Science*. 6: 781-787.

[11] Ahmed, M. E. and Elzaawely, A. A. (2010). Growth and Yield of Cowpea Plants in Response to Organic Fertilization. *Australian Journal of Basic and Applied Sciences*, 4 (8): 3244-3249, 2010.

[12] Badar, R., Khan, M., Batool, B. and Shabbir, S. (2015). Effects of organic amendments in comparison with chemical fertilizer on cowpea growth. *International Journal of Applied Research*. 1 (5): 66-71.

[13] Nwokwu, G. N. (2020). Effect of NPK (12: 12: 17) Fertilizer Rates on the Growth and Yield of Cowpea (*Vignaunguiculata*) Varieties. *Journal of Biology, Agriculture and Healthcare.* 10 (2): 1-5.

[14] Krasilnikoff, G., Gahoonia, T., and Erik-Nelson, N., (2003). Variation in Phosphorus Uptake by Genotypes of cowpea (*Vignaunguiculata* (L.) Walp) due to differences in root and root hair length and induced rhizosphere processes. *Journal of Plant and Soil*. 251: 8391.

[15] Nyoki, D., Patrick, A., Ndakidemi, R., (2013). Economic benefits of Brady rhizobium Japonicum Inoculation and phosphorus Supplementation in cowpea (*Vignaunguiculata* (L.) Walp) Grown in Northern Tanzania. *American Journal of Research communication*. 1 (11): 173-189.

[16] Ndakidemi, P. A. and Dakora, F. D., (2007). Yield components of nodulated cowpea (*Vigna unguiculata* (L.) Walp) and maize (*Zea mays*) plants grown with exogenous phosphorus in different cropping systems. *Australian Journal of Experimental Agriculture*, 47: 587-590.