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Effects of Spacing and Varieties on the Growth and Yield of Cowpea (Vignauguiculata L.). Grown in Makurdi, Benue State, Nigeria

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Abstract

A field experiment was carried out at the Agronomy Teaching and Research Farm of Joseph Sarwun, Tarka, University Makurdi, Benue State Nigeria at 7⁰ 41N and Longitude 8⁰ 37E, 400m above sea level in Southern Guinea Savannah Agro-ecological zone of Nigeria to investigate the Effects of Spacing and Variety on the Growth and Yield of Cowpea (Vignauguiculata L.). Two spacing were used 25 and 30cm intra row spacing and three medium maturing varieties of IT07K-274-2-9, IAR-07-1050 and UAM-1051-1 were used for study. The treatment were combined and laid in a randomized complete block design with three replications. During the research, growth characters such as plant height, number of leaves, days of maturity, 50% flowering were measured. Other yield and yield related characters like number of pod, number of seed, 1000 seed weight and seed yield were also recorded. The use of 30cm intra row spacing produced significantly (P≤0.05) in both growth and yield related parameters except in plant height where 25cm spacing had taller plants (61.21), days to maturity (79.45) and 50% flowering (60.21) while spacing 30cm had higher number of leaves (50.11) higher number of pod per plants (46.01), number of seeds per pod (10.99), weightier pod (900.11), weightier 100 seeds (120.56) and over all yield (681.16) The use of medium maturing varieties was also observed to produce significantly (P≤0.05) with 1T07K-274-2-9 recorded early days of maturity (79.11), 50% days of flowering (61.21) and number of pod (47.21) while UAM-1050-1 produced taller plant (62.01), higher number of leaves (51.21) higher number of seeds per pod(11.50) pod weight(1084.01),100 seed weight (22.68) and overall yield (698.82).Form the result cowpea farmers in Makurdi are advice to grow UAM-105-1 at 30cm intra row spacing for optimum yield.

Keywords: *Spacing, Variety and Yield*

INTRODUCTION

Cowpea [Vignaunguiculata(L.)] is one of the most ancient crops known to man. Its origin and domestication occurred in Africa near Ethiopia and subsequently was developed mainly in the farms of the African Savannah. Nowadays it is a legume widely adapted and grown through-out the world (Summerfield et al., 1999), Cowpea is considered more tolerant to drought than soybean or mug-bean because of its tendency to form a deep taproot. It has a competitive niche in sandy soils, does not tolerate excessively wet conditions, and should not be grown on poorly drained soils. One of the most remarkable things about cowpea is that it thrives in dry environments; available cultivars produce a crop with as little as 300 mm of rainfall. This makes it the crop of choice for the Sahelian zone and the dry savannahs, though cultivars that flourish in the moist savannahs are available as well. Varieties of cowpea are said to be tolerant of Aluminium and to be adapted of poor soil if P his between 5.5 and 6.5. On the whole, it is less tolerant of alkaline and salinity condition, but intolerant of excess amount of Boron. (IITA 2000). Cowpea crop often responds favourably to added Phosphorus, although there was non-significant increase in cowpea grain yield up to Nitrogen application rate of 30 kg/ha (Okike 2000). Length of growing season varies with type: 100 days in determinate type, 110 days in semi determinate, 120 days in ranking type. The climate will also have an effect on the length of the growing season: the hotter the weather, the shorter the maturity period. (Van Rij, N.,1999). Cowpeais the most important source of vegetable protein in rural and urban diets across West and Central Africa and in parts of East and Southern Africa (Bressani, 1985; Singh, B. B.,et al., 1997). It is consumed in many forms. Young leaves, green pods, and seeds are eaten as vegetables and dry seeds are used in various food preparations (Nielsen, S. S.,et al., 1997). Cowpeas are of vital importance to the livelihood of several millions of people in West and Central Africa. Rural families that make up the larger part of the population of these regions derive from its production, food, animal feed, alongside cash income. Food habits in West and Central Africa are mainly based on tuber crops (cassava, yam) and cereal (maize, rice, millet).Cowpea is an important food legume and an integral part of traditional cropping systems in the semi-arid regions of the tropics (Singh, B. B.,et al., 2003). It is used for human consumption and animal feed and also it improves soil fertility when grown, thus it has become very valuable in areas where land use has become intensified. Cowpea has outstanding features: viz., drought tolerance, shade tolerance, quick growth, and rapid provision of ground cover (Singh, B. B.,et al., 1997). These characteristics have made cowpea an important component of subsistence agriculture in the dry savannahs of the sub-Saharan Africa where it is grown as a companion crop with cereals and other food crops (Singh, B.B.,et al., 2003). According to Kergna, A., et al (2013) cowpea is grown on an estimated worldwide area of 14 million ha. However, the bulk of cowpea production comes from the drier regions of northern Nigeria (5 million ha and 2.3 million tons), Niger Republic (3 million ha and 0.4 million tons) and North East Brazil (about 1.9 million ha and 0.7 million tons) In spite of its importance and wide cultivation, the overall productivity of cowpea is very low with average yield particularly in Africa ranging from 100 to 400 kg ha-1. Singh, B. B.,(2000). This is due to several biotic, abiotic and physiological constraints. The abiotic factors include erratic rainfall, high soil temperature, low soil fertility, the biotic factors are insect pest, parasitic weed, disease induced by fungi, viruses and nematodes.

Nigeria remains the largest producer and consumer of cowpea in the world according to Kergna, A., et al (2013) Nigeria accounts for 61% of production in Africa and 58% worldwide. In many areas of the world, the cowpea is the only available high quality legume hay for livestock feed. Digestibility and yield of certain cultivars have been shown to be comparable to alfalfa. (Davis, W. et al., 1991). In Niger, the haulm (or halm) of the plant is consumed as dietary habits and traditions, and cowpea plants are widely used for animal fodder. They are also a source of cash income when they can be marketed along the roadside to passing travellers. Women handle most of the cowpea green pod marketing. However, green pod area is limited because it is labour intensive and green pods must be consumed fresh. The appreciating economic importance may be due to its food value which made it a good supplement/complimentary source of protein. Cowpea contains 20-25% of protein and 64% carbohydrate (Bresanni, R., 1985). It therefore has a tremendous potential to contribute to the alleviation of malnutrition specifically amongst the poor. Cowpea is an important legume in Sub-Saharan Africa compared to other regions, where the consumption has grown at the rate of 3.2% per annum between 1980 and 2009. The average level of consumption is 4.5 kg/person/year in Sub-Saharan Africa. Nedumaran, S., et al (2015). Cowpeas contribution to ecological stability is usually underestimated. Cowpea, through its symbiotic association with beneficial bacteria, fixes nitrogen from the atmosphere to the soil and hence enhances soil fertility which also benefits other crops succeeding it. The broadleaf nature of cowpea and soil covering effect ameliorates soil erosion. Singh, B.B., et al (1999). Cowpeas contribution to ecological stability is usually underestimated. Cowpea, through its symbiotic association with beneficial bacteria, fixes nitrogen from the atmosphere to the soil and hence enhances soil fertility which also benefits other crops succeeding it. The broadleaf nature of cowpea and soil covering effect ameliorates soil erosion. Cowpea is a legume that is extensively grown throughout sub-Saharan Africa. It is a subsistence crop, often intercropped with sorghum, maize and pearl millet. The grain provides valuable protein and the leaves are used as a nutritious vegetable. (IPM CRSP, 2000).Millions of African farmers grow cowpea, some two hundred million Africans consume cowpea, many, maybe a majority of these farmers are women. Cowpea grain, nutritious and inexpensive, serves as a source of cheap protein for both rural and urban consumers. The cowpea grain contains about 25% protein and 64 percent carbohydrate (Bresanni, R., 1985). Even the goats and the cattle benefit from cowpea, this genuinely African crop, for the hay left over after the grain is harvested as a high-value nutritious forage.(A BIOTECH, 2002). The protein in cowpea seed is rich in amino acids, lysine and tryptophan in comparison with cereal grain; however, it is deficient in methionine and cystine in comparison with animal protein. (Davis,W.,etal.,1991).

Cowpea is an indigenous crop that has evolved from the native wild types and its genetic diversity is greater than that of any other crop in the dry African savannah. (IFAD, 2000). In semiarid zones of West and Central Africa, farmers traditionally cultivate two main types of cowpea: early maturing varieties grown for grain and late maturing varieties that are grown for fodder production. (Inaizumi, H.,et al., 1999) Cowpea is the most economically important indigenous African legume crop. (Langyntuo,A.S., et al., 2003). Cowpeas are of vital importance to the livelihood of several millions of people in West and Central Africa. Rural families that make up the larger part of the population of these regions derive from its production, food, animal feed, alongside cash income. Cowpea is referred to as the “hungry-season crop” given that it is the first crop to be harvested before the cereal crops are ready. It is a crop that offers farmers great flexibility. They can choose to apply more inputs and pick more beans, or if cash and inputs are scarce -they can pick fewer beans and allow the plant to produce more foliage. This means more fodder for livestock, so that lower bean yields are balanced by more livestock feed, which in turn translates into more meat and milk. This flexibility in use makes cowpea an excellent crop under the challenging climatic conditions faced by African farmers. (Okike, I., 2000). Cowpea also contributes to the sustainability of cropping systems and soil fertility improvement on marginal lands through nitrogen fixation, provision of ground cover and plant residues, which minimize erosion and subsequent land deterioration. The deep root systems of cowpea help to stabilize soil, and the ground cover it provides preserves moisture; these traits are particularly important in the drier regions where moisture is always needed, soil is fragile and subject to erosion. (Bean/Cowpea CRSP West Africa Mission 1998).

In Nigeria the major constraints to the adoption of dry season dual -purpose cowpea include insect attack both in the field and in storage, insufficient water, nematodes, lack of land, lack of seed, spacing and improve varieties. The magnitude of these problems also varies with location. (Inaizumi, H., et al, 1999).Cowpeas plays a significant role as a major source of protein among the rural poor, source of income, improvement of soil fertility though nitrogen fixation and protect the soil therefore research to find out the most productive varieties in our agro-ecological zone would not be over emphasized A lot of cowpeas germplasm has being developed by IITA and IAR there is therefore the need to evaluate the performance of these new varieties under our ecological condition. Molecular biologists at IITA are also working to develop improved cowpea varieties, through transfer of useful genes such as those encoding plant and bacterial proteins that kill insect pests of cowpea. This is still at the experimental stage, and rigorous field testing will be carried out before transgenic cowpeas are released. IITA holds the world's largest collection of cowpea germplasm in its gene bank, more than 16 000 accessions, or plant samples. (IITA Research, 2001). One promising avenue to introduce new sources of insect resistance into cowpea involves genetic transformation, using resistance genes taken from other plants that may not be easy to cross or that may even come from bacteria or fungi. Cowpea yields are low often due to early cessation of rains therefore introducing varieties of cowpea of medium duration maturity would boost production, food security and livelihood of millions of small scale farmers that grows cowpeas in this ecological zone.

MATERIALANDMETHOD

The experiment was conducted during the rainy season of 2023 at the Teaching and Research farm, Joseph Sarwun, Tarka, University Makurdi,(7 ^{0} 41N and 8^{0}37E and 400m above sea level). The experiment that was laid in a randomized complete block design (RCBD) with three replicate, a $4m^2$ plot was laid out with 1m between plots and 0.5m between blocks. There were 6 plots each within a block which gave the total number of 18 plots for the study. The treatment where; Spacing (20 and 30 cm) and three medium maturing varieties (IT07K-272-2-9-5, IAR-07-1050 and UAM-1051-1). Agronomic practice such as weeding was done manually at 2 and 6 weeks after planting to ensure weed free plots, all the data were collected within the net plot of $4m^2$/where a total of 5 plants were tagged for data collection within each net plot. The parameters recorded were plant height (was taken with the aid of measuring tape from the base of the plant to the tip), number for leaves (were counted fortnightly) from 10 plants that was tagged and the average used fortnightly thus; 2, 4, 6, 8, 10 and 12 weeks after sowing (WAS) and days of maturity, days of 50% flowering, yield and yield related characters such as number of pod, number of seed per pod, pod weight and 1000 seed weight was recorded. All data collected were subjected to analysis of variance (ANOVA), while least significant difference (LSD) at 5% level of probability was used in separating the means.

Result and Discursion

Table1. Shows the influence of spacing and varieties on plant height of cowpea grown in Makurdi during the 2019 rainy season. The results show significant difference exists among the treatment during the work, spacing 30cm had taller plant than spacing 25cm which could be as a result of wider spacing enabling that, this is in conformity with the finding of Baker (2000) who stated in his earlier work that wider spacing lead to utilization of both environment resources and soil nutrient leading to vigorous growth in plant. Madina et al., (2024) reported similar result where he stated that closer spacing had taller plants in his work of groundnut which could be as a result of plants competing in intercepting solar radiation and utilizing the available nutrients. On varieties difference also was recorded where UAM-1051-1 had taller plant when compared with the other two varieties used this could as a result of its genetic make-up and its ability to adopt to environment as reported by Dugje el al,.(2009).

Table 1. Influence of spacing and variety on plant height of cowpea during the 2023 rainy season grown in Makurdi.

Treatment	**Plant height (cm) WAS**					
Spacing (S)	2	4	6	8	10	12
25	5.02	10.42	26.24	42.21	52.78	61.21
30	6.12	12.56	27.99	44.32	54.90	59.11
LSD	1.01	1.24	1.91	1.89	1.91	1.21
Variety (V)						
IT07K-272-2-9	5.21	12.12	29.45	35.78	48.96	60.26
IAR-07-1050	4.01	11.90	25.12	32.18	45.91	53.11
UAM-1051-1	6.21	13.67	31.28	39.34	50.21	62.01
LSD	1.01	1.21	1.82	1.98	1.99	1.71
Interaction						
SXV	NS	NS	NS	NS	NS	NS

S= spacing, N= nutrient source, V= varieties, LSD= Least Significant Differences at 5% Level of Probability.

Table 2 shows the influence of spacing and varieties on number of leaves of cowpea grown in Makurdi during the 2019 rainy season. The finding show significant difference where spacing 30cm had the highest number of leaves when compared with spacing 25cm, this could be attributed to wider spacing leading not only to plant height but also higher number of leaves, this assertion is supported by the finding of NRC (2000) who reported closer spacing could lead to mutual shading and ineffectiveness in utilization of soil resources such as water and nutrient.Madina et al., 2023 reported that closer spacing reduce weed population there supressing weed growth but could lead to mutualshading and low reproductive characters leading to reduction in the over-all yield of the plant. Significant difference was also observed in variety where UAM-1050-1 produced higher number of leaves than the other treatment used, this could be attributed to ability of the UAM—1050-1 to adopt to the environment as reported by Singh el al (1997) who stated that most improved indigenous variety strafe well due to their ability to adopt to the environment.

Table 2. Influence of spacing and variety on number of leaves on cowpea during the 2023 rainy season grown in Makurdi.

Treatment	**Number of leaves WAS**					
Spacing (S)	2	4	6	8	10	12
25	4.21	9.40	16.24	21.21	32.18	45.21
30	5.12	10.61	18.29	24.32	34.40	50.11
LSD	1.01	1.64	1.72	1.85	1.99	2.21
Variety (V)						
IT07K-272-2-9	4.51	8.12	15.75	20.78	31.16	42.16
IAR-07-1050	5.01	10.90	18.02	21.18	32.41	46.41
UAM-1051-1	6.00	12.11	20.28	25.34	35.21	51.21
LSD	1.01	1.21	1.92	1.98	1.99	2.71
Interaction						
SXV	NS	NS	NS	NS	NS	NS

S= spacing, N= nutrient source, V= varieties, LSD= Least Significant Differences at 5% Level of Probability.

Table 3 shows the influence of spacing and varieties on days of maturity and days of 50% flower of cowpea grown in Makurdi during the 2019 rainy season. Significant difference was observed in both days of maturity and days of 50% flower where spacing 30cm recorded early maturing and 50% flower, this could be attributed to environment factors, soil factor and wider spacing as reported by Nyankori (2002). Significant difference was observed on varieties used, were IAR-07-1050 matured early and had early 50% flowers which could be attributed to the inherent genetic make-up of the variety as reported by Dugji el al (2009).

Table 3. Influence of spacing and variety on days of maturity and days to 50% flower of cowpea during the 2023 rainy season grown in Makurdi.

Treatment		
Spacing (S)	Days of maturity	Days to 50% flower
25	79.45	60.21
30	80.21	62.01
LSD	0.90	0.91
Variety (V)		
IT07K-272-2-9	79.11	61.21
IAR-07-1050	84.21	65.91
UAM-1051-1	81.46	63.84
LSD	0.91	0.82
Interaction		
SXV	NS	*

S= spacing, N= nutrient source, V= varieties, LSD= Least Significant Differences at 5% Level of Probability, *= 95% level of probability.

Table 4 shows the influence of spacing and varieties on yield and yield related parameters of cowpea grown in Makurdi during the 2019 rainy season. Significant difference was observed on number of pod where spacing 30cm had higher number of pod than 20cm this could as a result of wider spacing giving it more room to produce more pod, this was supported by Kew (2012) who reported that closer spacing lead to mutual shading and affect pod production and over all yield. Significant difference was also observed in Varieties where IT07K-274-2-9 produced higher number of pod than the other varieties used, this could be both genetic and environmental effect as reported by Onyibe at el (2006). Significant difference was observed on number of seed per pod where spacing 30cm recorded higher seeds per pod than 20cm which is attributed to wider spacing allowing the plant utilized assimilate from the plant environment as reported by Ngonagjio (2000). Significant difference was also observed among the varieties on number of seed per pod where UAM-1051-1 produced the highest seeds per pod which could be due to its ability to adopt and its genetic make-up. Significant difference was observed on pod weight where spacing 30cm had heavier pod than 20cm, this could be attributed to the fact that spacing 30cm had higher number of pod and higher number of seed per pod. Significant difference was also observed on pod weight where UAM-1051-1 had heavier pod than the other treatment used, this is not far from the fact that inherent and environment factors might have contributed to it as reported by IITA (2000). Significant difference was observed in 100 seed weight where spacing 30cm recorded heavier seeds than spacing 20cm which could be as a result of pod weight which could affect the overall yield. Significant difference was also observed on varieties where UAM-1051-1 had heavier 100 seed this is not far from the fact that environment, genetics and probably cultural practice might have led to that as reported by Lambot (2002). Significant difference was observed in yield where spacing 30cm had higher yield when compared with spacing 20cm, this is not far from the fact that wider spacing plays an important role in assimilation soil nutrients and climatic factors, also avoiding over population of plant contribute to the over-all yield of crop as suggested by Okike (2000) and Madina (2020) . Significant difference was also observed on the yield where UAM-1051-1 had the highest yield when compared with the other treatment used, this could be as the result of adaptation, genetic make-up and couple with the facts that number of pod, number of seed per pod, pod weight and 100 seed weight all led to the over-all yield as reported by Sanusi (2014), Yusuf and Paul (2018) reported that any increase in yield related parameters is directly increase in yield.

Table 4. Influence of spacing and variety on plant height of cowpea during the 2023 rainy season grown in Makurdi.

Treatment					
Spacing (S)	No. of pod	No. of seed/pod	pod weight	100 seed weight(g)	Yield(Kg)
25	40.21	9.11	761.01	118.01	562.13
30	46.01	10.99	900.11	120.56	681.16
SE	2.01	0.21	111.11	1.45	70.12
Variety (V)					
IT07K-272-2-9	47.21	9.21	901.91	120.93	587.01
IAR-07-1050	45.01	10.09	727.01	118.45	428.70
UAM-1051-1	36.01	11.50	1084.01	122.68	696.82
SE	2.01	0.92	121.21	1.21	80.47
Interaction					
SXV	*	NS	*	*	*

S= spacing, N= nutrient source, V= varieties, LSD= Least Significant Differences at 5% Level of Probability, * = 95% level of probability.

Discursion on Interaction between Spacing and Varieties

There was no interaction between spacing and varieties on plant height and number of leaves. Table 5 present the interaction between spacing and variety on days of maturity and days of 50% flower, where spacing 30cm and IAR-70-1050 matured early and had early flowering percentage respectively. This could be due to genetic make-up of the crop and plant population; this is supported by the finding of Hall et al (2000) who reported days of maturity and flowering decreases at wider spacing and varietal differences. Table 5 also shows the interaction between spacing and variety on number of pods and number of seed per pod, where spacing 30cm and UAM-1050-1, this is not far from the facts that wider spacing, adaptation and climaticcondition might have favouredUAM-1050-1 over the other treatments used, Cisse el al (2000) is in conformity with the above assertion stating that this might be due to varietal difference which respond differently to different spacing. More so table 5equally shows the interaction of spacing and variety on pod weight and 100 seed weight, the finding in this work shows spacing 30cm and UAM-1050-1 had heavier pod and 100 seeds respectively, this could be attributed to the facts that wider spacing produce heavier pod hence 100 seed weight which in turn affects overall yield. This is in agreement with the finding of Inaizumi et al (1999) who stated that wider spacing and have ability to convert biological yield to economic yield and stored in seed yield. Madina and Akinyemi (2023) add that wider spaced plant improve the supply of assimilate that are converted and stored in seeds, it also improve varietal adoptability to environment condition and agronomic practice. Soil nutrient play an important role in seed weight which later increase crop yield as reported by Kormawa at al (2000). Same table 5 recorded the interaction between spacing and variety on yield where spacing 30cm andUAM-1050-1 recorded the highest yield followed by ITO7K-274-2-7, this is not far from the fact that increase in yield related parameters could also increase crop yield, with wider spacing and improved varieties there will be proper utilization of both soil and environmental resources hence optimum yield, A BIOTECH (2002).

Table 5. Interaction between spacing and variety on yield and yield related character at harvest of cowpea grown during the rainy season of 2023 at Makurdi

Spacing (cm)	Variety	50% flowering	Number of pods	Pod weight(g)	100 seeds weight(g)	Yield kg/ha
25	IT07K-272-2-9	60.21	47.21	911.21	120.43	567.21
	IAR-07-1050	63.61	45.02	782.12	118.46	412.70
	UAM-1051-1	62.48	36.98	1012.02	123.26	682.91
30	IT07K-272-2-9	61.01	48.27	928.12	121.23	571.28
	IAR-07-1050	66.82	46.09	799.21	119.04	424.12
	UAM-1051-1	63.42	37.11	1211.13	125.01	700.12
	LSD (0.05)	1.01	1.03	99.01	1.01	60.10

CONCLUSION

Form the result obtained from these investigation it can be concluded that cowpea farmers in Makurdi are advice to grow UAM-105-1 at 30cm intra row spacing for optimum yield. While other varieties like IT07K-272-2-9 is early maturing and spacing 25cm can give vegetation if the farmers is more concern in livestock feed.

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