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Effects of Genotype and Intra-Row Spacing On the Performance of Cowpea at Mubi, Northern Guinea Savanna, Nigeria.

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ABSTRACT: A field study was undertaken to assess the effect of genotype and intra-row spacing on the performance of cowpea. This study was conducted during the 2013 and 2014 rainy seasons at the Teaching and Research of Adamawa State University Mubi (10^o 08' – 10^o 30'N and 13^o 10' – 13^o 25'E) in the Northern Guinea Savanna ecological zone of Nigeria. The experiment was laid out in a split-plot design with three genotypes (Iron, Kanannado and IAR- 00 – 1074) in the main plots at five intra-row spacings (75 x 15cm, 75 x 30cm, 75 x 45cm, 75 x 60cm, 75 x 75cm) in the sub-plots. These were replicated three times. Results showed that at $P \leq 0.05$, iron produced the longest vines (189.7cm) at 9 weeks after sowing, while IAR-00-1074 recorded the shortest vines (164.3cm). IAR-00-1074 exhibited the longest pods (18.3cm) and Kanannado the highest shelling percentage (79.4cm) In the combined analysis, IAR-00-1074 out-yielded all the other genotypes, in terms of pod and grain yields. The spacing of 75 x 75cm recorded the longest mean vine length (163.5cm). The spacing of 75 x 15cm produced the highest mean grain yield (1192 kg/ha) However interactive effect of genotype and spacing showed that iron achieved its highest grain yield at the spacing of 75 x 75cm, Kanannado at the spacing of 75 x 45cm and IAR-00-1074 at the spacing of 75 x 15cm. the genotype IAR-00-1074 appears to be a promising genotype for cultivation in the ecology. It seems that spreading habit and its magnitude determine at which spacing cowpea genotype gives its best yield.

Keywords**:** *Cowpea, Genotype, Spacing, Spreading habit.*

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I. INTRODUCTION

Cowpea (*Vigna unguiculata* L *Walp)* a member of the family fabaceae is one of the major pulses grown in Savanna region of Nigeria. Different species are cultivated in the Savanna ecological zone of Nigeria (Ng, 1995). The crop is can do well as sole crop or in crop mixtures, especially the local spreading cultivars that produce pods later after the harvest of other components crop in the mixture. Blade (2005) remarked that the crop is shade tolerant. The crop is a good source of protein. The grain composition reported by Davies *et al*. (1991) is; protein (24,8%), fat(1.9%) fiber(6.3%), carbohydrate (63.6%) thiamin (0.00074%) riboflavin (0.00042%) niacin (0.00281%). As a legume, the crop fixes atmospheric nitrogen and can reduce the depletion of the nutrient from the soil compared to fields that are under continuous cereal production (Bation *et al* 2002).
Spacing has significant role in the performance of cowpea just like any other crop. It was observed by Ahmed *et al.* (2012) that increase in plant population of cowpea decreased plant height, number of branches per plant and stem girth. The spacing of 75 x 25cm has been recommended by Enwezor *et al.* (1989). However Anonymous (2011) recommended the spacing of 20 x 75cm for erect and semi-erect but 50 x 75cm for prostrate types. Amgad *et al.* (2010) noted that varying intra-row spacing of 50 – 125cm at the inter-row spacing of 60cm had no marked effect on growth attributes of cowpea, when they used three varieties.. Nevertheless they noted that the closest intra-row spacing of 50 x 60cm produced the highest grain yield. In contrast Malami and Samaila remarked that the widest spacing of 75 x 100cm spacing produced the highest grain yield when they used Kanannado which is a prostrate variety. In a guideline on cowpea production, it was remarked that prostrate varieties require wider spacing. Therefore it appears that there is no definite spacing for all varieties of cowpea, hence the need to undertake this study.

II. MATERIALS AND METHODS

A field study was conducted in 2013 and 2014 rainy seasons at the Teaching and Research Farm of Adamawa State University; Mubi, to assess the performance of three cowpea genotypes under five varied intra-row spacing, . Mubi is in the Northern Guinea Savanna ecological zone of Nigeria. The soil of the area is mainly afisols (Brady and Weil, 1999).

The study was conducted in a split-plot design, whereby the three genotypes (Iron, Kanannado and IAR-00-1074) were laid out in the main plots and the five spacing (75 x 15cm, 75 x 30cm, 75 x 45cm, 75 x 60cm and 75 x 75cm) assigned to the sub-plots. Two of the genotypes Iron and Kananado are spreading genotypes, whereas IAR-00-1074 is semi-erect. The crop was sown on August, 8, 2013 and July, 19, 2014. About three to four seeds were sown per hill at the intra-row spacing for each treatment and thinned to two plants per stand at two weeks after sowing (WAS). Each gross plot consisted of four rows 75cm apart and 9m long ($27m^2$)., while the two inner rows comprised the net plot ($13.5m^2$). Fertilizer was applied at the rate of 40kg P_20_5/ha using single superphosphate. At 2 WAS by side placement. The trial was hoe-weeded at 3, 6, 9 WAS.

Each genotype was harvested by hand picking when the pods got ripe. Data were collected on vegetative and yield characters. Data collected were subjected to statistical analysis using SAS 9.1 2005 version. Means differences that were found to be significant using Fisher test were separated using Duncan Multiple Range Test (Duncan, 1955).

III. RESULTS

The results on effect of genotype and intra-row spacing on vine length at 6 and 9 WAS are presented in Table 1. At 6 WAS in 2013 Iron exhibited the longest vines which were comparable to those of Kanannado, whereas IAR-00-1074 produced vines that were significantly shorter than those of these two genotypes. In 2014 and combined analysis, Iron produced appreciably longer vines than any of the other two genotypes, while Kanannado in turn exhibited longer vines than IAR-00-1074. At 9 WAS in the two years, Iron still produced the longest vines, but were comparable to those of kannanado.

. Furthermore, in the combined analysis, Iron had markedly longer vines than the other two genotypes, while kanannado produced considerably longer vines than JAR-00-1074.

At 6 WAS intra-row spacing had no significant effect on vine length in the two years and the combined analysis. Similarly at 9 WAS in 2914, spacing had no marked effect on vine length. However in 2013 and the combined analysis, intra-row spacing of 75x30 – 75x75cm had similar pod length. The intra-row spacing of 75 x 15cm produced the shortest vines throughout the study. Significant interactive effect of genotype and intra-row spacing on vine length was only recorded at 6 WAS in 2013. The results on effect of genotype and intra-row spacing on pod length and shelling percentage are given in Table 2. Pod length was significantly affected by genotype in 2014 and the combined analysis only; whereby IAR-00-1074 exhibited longest pods but similar to that of Iron. Throughout the investigation kanannado recorded the shortest pods. However intra-row spacing had no marked effect on pod length in the study. Also, there was no significant interactive effect observed between genotype and intra-row spacing.

Genotype had no significant effect on shelling percentage in 2014, but in 2013 and the combined analysis; kanannado gave the highest shelling percentage that was higher than that of IAR-00-1074 but at par with that of Iron. The genotype IAR-00-1074 recorded least percentage throughout the period of the research. There was no significant interactive effect between genotype and intra-row spacing on shelling percentage except in 2013. The results on effect of genotype and intra-row spacing on pod and grain yields are presented in Table 3. Throughout the study IAR-00-1074 recorded the highest pod yield, but at par with Iron in 2013. However spacing had no significant effect on pod yield. Interactive effect of genotype and intra-row spacing on pod yield was noted in the combined analysis. The result of this interactive effect is presented in Table 4. The result showed that the 75 x 75cm spacing gave the highest pod yield in Iron which out-yielded the 75 x 45cm only. In Kanannado, spacing had no significant on pod yield. However in IAR-00-1074 genotype, 75 x 75cm spacing gave the highest pod yield that was appreciably higher than the pod yields of 75 x 60cm and 75 x 75cm spacing.

Genotype only influenced grain yield significantly in 2014 and the combined analysis (Table 5). In both instance IAR-00-1074 out- yielded the other two genotypes The genotypes Iron and Kanannado had similar grain yield in 2014, but in the combined analysis Iron recorded higher grain yield than Kanannado. Spacing had no significant effect on grain yield. However, there was significant interactive effect of genotype and spacing on grain yield in the combined analysis. The result of the interaction showed that Iron produced the highest grain yield at the spacing of 75 x 75cm, which was markedly higher than the grain yield obtained at 75 x 45cm only. Spacing had no significant effect on grain yield in Kanannado. The genotype IAR-00-1074 recorded the highest grain yield at the spacing of 75 x 15cm, but at par with grain yields obtained at 75 x 30cm and 75 x 45cm spacing. The remaining spacing had similar grain yields.

Table 1. Influence of Genotype and Intra-Row Spacing on Vine Length (cm) at 6 and 9 WAS of three Cowpea genotypes, grown at Mubi, 2013 and 2014 rainy seasons.

	6WAS			9WAS		
Treatment	2013	2014	Combined	2013	2014	combined
Genotype						
Iron	86.5a	138.1a	112.3a	201.1a	178.4a	189.7a
Kanannado	74.8a	103.6b	89.2b	190.0a	138.5ab	164.3b
IAR-00-1074	44.9b	61.5c	53.2c	126.6b	100.7b	113.6c
SE±	4.55	4.96	3.37	6.17	11.92	6.72
Level of significance	*	*	*	*	*	*
Spacing (cm)						
75x15	65.8	92.8	79.3	156.3b	131.6	144.0b
75x30	66.7	97.5	82.1	175.9a	133.4	154.6ab
75x45	68.2	99.6	83.9	170.9ab	137.1	154.0ab
75x60	71.2	109.6	90.4	180.4a	146.2	163.3a
75x75	71.8	106.0	88.9	179.2a	147.7	163.5a
SE±	2.17	6.88	3.61	5.87	6.71	4.46
Level of sign.	ns	ns	ns	*	ns	*
Interaction						
Gen. x spacing	*	ns	ns	ns	ns	*

Means followed by common letter(s) in each treatment group are not significantly different at 5% level of probability using Duncan Multiple Range Test.
* = Significant at 5% level of probability
ns = Net significant at 5% level of probability
WAS = weeks after saving.

Table 2. Effect of Genotype and Intra-row spacing on the pod length and shelling percentage of cowpea grown at Mubi 2013 and 2014 rainy seasons

	Pod length (cm)			Shelling Percentage		
Treatment	2013	2014	Combined	2013	2014	Combined
Genotype						
Iron	18.1	17.1b	17.6a	76.9ab	76.7	76.78ab
Kanannado	16.9	15.7b	16.3b	80.4a	78.5	79.4a
IAR-00-1074	18.9	17.7a	18.3a	74.0b	75.2	74.5b
SE±	0.62	0.27	0.39	74.0b	1.10	0.78
Level of significance	Ns	*	*	*	ns	*
Spacing (cm)						
75 x 15	17.8	17.1	17.5	77.2	80.2	78.7
75 x 30	18.3	16.6	17.4	76.4	74.6	75.5
75 x 45	18.5	17.0	17.7	78.0	74.4	76.2
75 x 60	17.8	16.8	17.3	75.4	75.5	75.5
75 x 75	17.5	16.7	17.1	78.0	79.2	78.6
SE±	0.47	0.32	0.28	0.87	1.83	1.01
Level of significance	ns	Ns	ns	ns	ns	Ns
Interaction	Ns	Ns	ns	*	ns	Ns
Gen. x Spacing						

Means followed by common letter(s) on each treatment group are not significantly different at 5% level of probability using Duncan Multiple Range Test.
* = Significant at 5% level of probability
ns = Net significant at 5% level of probability

Table 3. Effect of Genotype and Intra-row Spacing on the Pod and Grain Yields of Cowpea grown at Mubi 2013 and 2014 rainy seasons

	Pod yield (kg ha^{-1})			Grain yield(kg ha^{-1})		
Treatment	2013	2014	Combined	2013	2014	Combined
Genotype						
Iron	120.2a	997b	1099b	927	771b	849b
Kanannado	930b	725c	828c	748	577b	663c
IAR-00-1074	1326a	1876a	1600a	982	1403a	1192a
SE±	61.43	68.07	45.90	49.17	59.46	38.62
Level of significance	*	*	*	ns	*	*
Spacing (cm)						
75 x 15	1284	1203	1243	985	985	985
75 x 30	1137	1172	1155	865	864	865
75 x 45	1055	1275	1165	825	949	887
75 x 60	1161	1090	1126	877	815	846
75 x 75	1126	1256	1191	875	971	923
SE±	54.03	99.43	56.57	47.89	90.54	51.21
Level of significance	ns	Ns	ns	ns	ns	ns
Interaction Gen. x Spacing	ns	Ns	ns	*	ns	*

Means followed by common letter(s) in each treatment group are not significantly different at 5% level of probability using Duncan Multiple Range Test.
* = Significant at 5% level of probability
ns = Net significant at 5% level of probability

Table 4 Interactive Effect of Variety and Intra-row spacing on the combined pod yield (kg/ha) of cowpea grown at Mubi 2013 and 2014

	Genotype		
Spacing (cm)	Iron	Kanannado	IAR-00-107
75 x 15	1066 c – f	803ef	1861a
75 x 30	1074 c – f	753f	1636ab
75 x 45	908ef	985def	1603ab
75 x 60	1130cde	850ef	1398bc
75 x 75	1320bcd	747f	1505b
SE±		98.02	

Means followed by common letter(s) are not significantly different at 5% level of probability using Duncan Multiple Range Test.

Table 5. Interactive effect of variety and intra-row spacing on the combined grain yield (kg/ha) of cowpea at Mubi 2013 and 2014 rainy seasons.

	Genotype		
Spacing (cm)	Iron	Kanannado	IAR-00-107
75 x 15	820def	675f	1449a
75 x 30	821def	599f	1174abc
75 x 45	680f	768ef	1214ab
75 x 60	864c – f	671f	1002b – e
75 x 75	1049b – e	597f	1122bcd
SE±		88.72	

Means followed by common letter(s) are not significantly different at 5% level of probability using Duncan Multiple Range Test.

IV. DISCUSSION

In the two years and the combined analysis, the genotypes differed significantly with respect to vine length at 6 and 9 weeks. The genotypes Iron and Kanannado are both prostrate types of cowpea as regards growth habit. Generally they exhibited significantly longer vines than IAR-00-1074 which is semi-erect in growth habit. The genotype Iron exhibited appreciably longer vines than Kanannado and IAR-00-1074 in the combined analysis at the two growth stages, while IAR-00-1074 had the shortest vines. This agrees with the findings of Amagad *et al.* (2010) who noted that cultivars had significant effect on height of cowpea plants. Prostrate genotypes usually produce longer vines than the erect or semi-erect cowpea types. The prostrate types have indeterminate growth habit, that produce primary, secondary and tertiary or even more successive branches. This is genetically inherent trait. As a result of their continuous branching and growth habit, they cover larger area and can overcrowd and result mutual shading of foliage if sown closely like the upright types. This is in consonance with remarks made by Anonymous (2011) that prostrate cowpea types require more space.

The improved semi-erect genotype IAR-00-1074 exhibited the longest pods throughout the period of the trial than . This may be attributed to its inherent genetic potential with respect to this trait. However the genotype Kanannado gave the highest shelling percentage . This implies that partitioning of assimilates is more in favour of grain than to other parts of the pod in this genotype than the other two genotypes. The combined analysis for the two years showed that the semi-erect genotype IAR-00-1074 out-yielded the two prostrate genotypes with respect to pod and grain yields. It was noted by Kwaga (2014) that the semi-erect genotype IAR-00-1074 which bears its pods conspicuously above the canopy, which places their green pods in an advantageous position for better interception of solar radiation than the prostrate cultivars that bear their pods at lower plant strata within the plant canopy. According to Reddy and Reddy (2011) dry matter production enhances with higher light intensity that could influence yield attributes and finally yield.

Spacing did not have significant effect on vine length in the study at 6 weeks, but at 9 weeks in 2013 and the combined analysis the wider spacing of 75 x 75cm produced the longest vines although only appreciably longer than those of the closest spacing of 75 x 15cm. Amgad *et al.* (2010) noted that varying intra-row spacing from 50 – 125cm at the inter-row spacing of 60cm had no significant effect on plant height. Differences in genotypes used may account for the difference between their findings and that of this study at 9 weeks. It is noteworthy that even in the present study that the variation in spacing had no marked effect on vine length at 6 weeks until the plants attend the age of 9 weeks. At this latter growth stage, the vines are reaching towards their maximum growth potential whereby spacing can become more of a limiting factor. The wider intra-row spacing could have given the plants ample opportunity to make maximum use of the greater available space which resulted in reduced competition for growth resources. This is more so in the case of prostrate genotypes which require wider spacing (Anonymous, 2011).

Yield and yield attributes such as shelling percentage and pod length were not significantly affected by intra-row spacing in the study. This is inconsonance with the findings of Malami and Samaila (2012) who observed that factorial combination of 50 – 100cm x 25 – 75cm had no significant effect on dry matter yields. However, in the present study, there was significant interactive effect of genotype and intra-row spacing noted on pod and grain yields. The highest pod and grain yields in this study was exhibited by IAR-00-1074 at the spacing of 75 x 15cm; while the lowest was recorded by Kanannado at the spacing of 75 x 75cm. The highest grain yield produced by the semi-erect genotype IAR-00-1074 which also recorded the shortest (113.6cm) vines was at the closest intra-row spacing of 75 x 15cm. However the highest grain yield recorded by Iron which had the longest vines (189.7cm) was at the widest intra-row spacing of 75 x 75cm. Nevertheless the highest grain yield exhibited by Kanannado which had medium vine length (164.3cm) was at the intra-row spacing of 75 x 45cm. Therefore it appears that the vine length has considerable influence on the optimum spacing required for maximum yield of the crop.

V. CONCLUSION

The field trial has shown that the semi-erect genotype IAR-00-1074 is a promising genotype for use in the ecology. The spreading habit of cowpea genotypes has significant influence on the optimum spacing required for maximum grain yield. The longer the vine length implying the greater the spreading habit, the wider the spacing required for achieving maximum grain yield.

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