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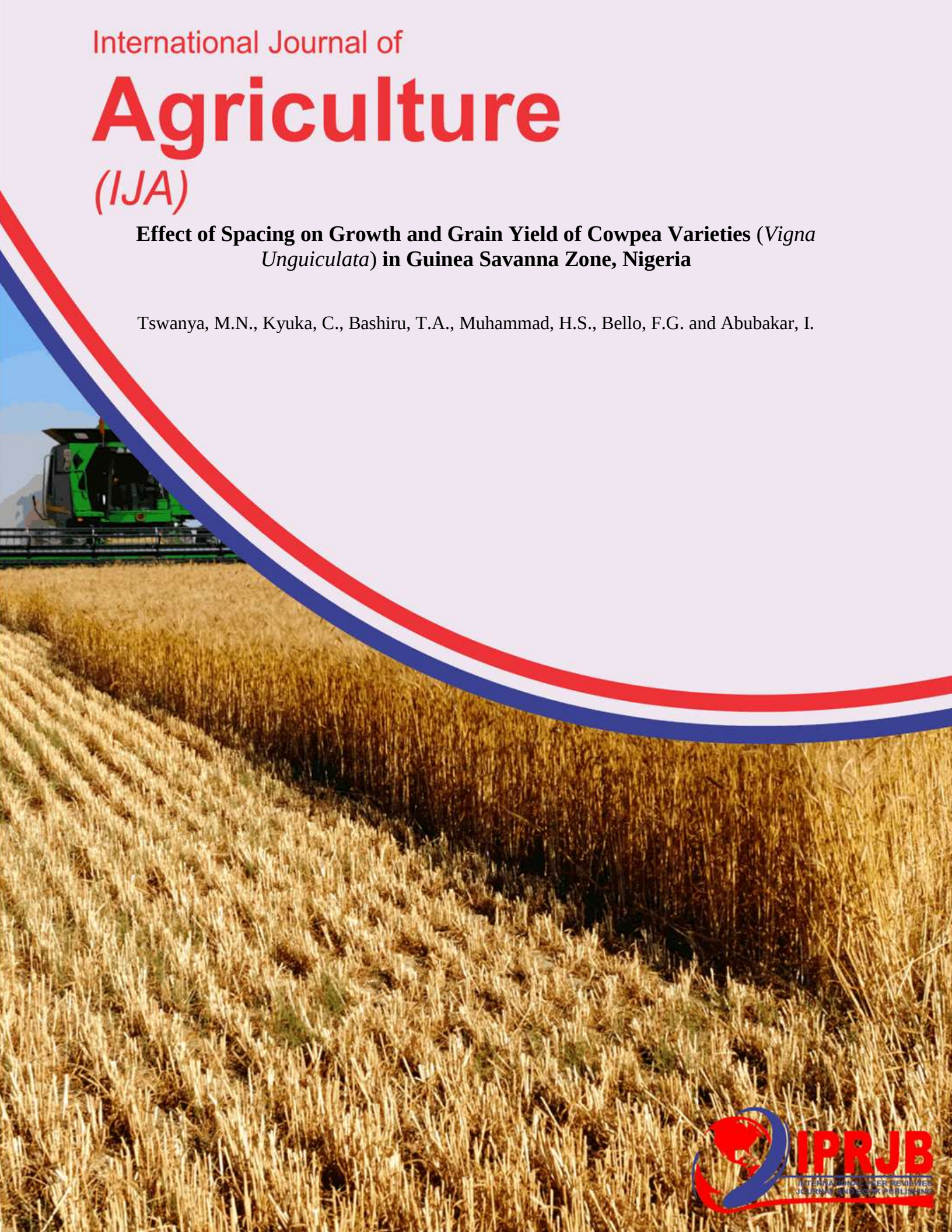

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Abstract

Purpose: Field experiment was conducted at the Biotechnology Advanced Research Centre Farm, Garki-Abuja during 2022 cropping season to evaluate the effect of spacing on growth and grain yield of cowpea varieties. The experimental plot was ploughed and harrowed after which lining out was carried out. There were 24 plots with three replications. Each replicate consisted of 8 plots. Each treatment was in a plot size of 2.0 m x 2.0 m (4.0 m^2). The alley way between replicates plots was 1.0 m and within replicates was 1.0 m. The treatments consisted of four spacing, (65 x 20 cm, 75 x 20 cm, 85 x 20 cm and 95 x 20 cm) designated as S1, S2, S3, and S4 and two cowpea varieties (TVU 14346 and TVU 14788). The treatments were 4 x 2 factorial experiment and fitted into a Randomized Complete Block Design (RCBD), replicated three times and data were collected on plant height per plant, number of leaves per plant, number of pods, pod length, number of seeds per plant, 100 seed weight, seed weight and grain seed yield. The seeds were sourced from the International Institute of Tropical Agriculture IITA) Ibadan. Two seeds were planted at the depth of 4 cm and later thinned to one three weeks after planting.

Methodology: The treatments were subjected to analysis of variance (ANOVA) using CROP STAT statistical package and significant means compared using Duncan Multiple Range Test (DMRT).

Findings: Results obtained revealed that the growth parameters of the plants increased as the plant aged with the highest number of leaves obtained from TVU 14788 (40.20) variety. There was significant ($p \leq 0.05$) difference in the yield performance with the highest grain yield gotten from TVU 14788 (7.42 t/ha) and the plants spaced with S1 (8.79 t/ha) gave the highest mean grain yield while the least mean value was received from S4 (3.98 t/ha).

Unique Contribution to Theory, Practice and Policy: From this study, it could be stated that for optimum yield performance TVU 14788 and S1 thrived better than other treatments evaluated and could be recommended for farmers within this ecological zone.

Keywords: *Cowpea, Varieties, Plants, Growth, Grain Yield*

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INTRODUCTION

Cowpea (*Vigna unguiculata* (L) Walp) is an important tropical, annual herbaceous grain legume that belongs to the family Papilionaceae (Fabaceae), order Leguminosae and genus vigna. The genus vigna is made up of over one hundred different species that are widely distributed within the tropics and the sub-tropics, and has great morphological and ecological diversity (Oyewale and Bamaiyi, 2013). Cowpea is an ancient crop, with the origin and first point of domestication assumed to be Africa but it is adapted to different environmental conditions thus grown worldwide (Leonard *et al*., 2018). The main cowpea production areas in Africa are the Sudan Savanna region in North Nigeria as well as the Sahel region (central Mali, South Niger, Senegal and Sudan). Additionally, significant production has been recorded in the regions of North Eastern Brazil, East and Southern part of Africa and South East Asia (Hall, 2012). The leading producer and consumer of cowpea worldwide is Nigeria, with an estimated annual population of 2.4 million tons grown on 5 million hectares (Okeyo-Ikawa *et al*., 2016).

Economically, cowpea is an important and most versatile indigenous legume crop in the continent of Africa, often being referred to as a "hungry-season" because it used to be the first crop to be harvested before the cereal crops. It feeds the people, livestock and improves the soil fertility because of its ability to fix nitrogen (Agbicodo *et al*., 2009). Average yield of cowpea (0.42 t/ha) is too low in Nigeria (Singh *et al*., 2002) when compared to achievable average yield of that ranked from 1.50 t/ha to 3.00 t/ha (Dzemo *et al*., 2010). Cowpea has a high potential averaging between 1,500 and 6,000 kg/ha depending on the genotype but the actual yields are the lowest globally compared to other pulses, averaging at 300 kg/ha and with the annual total population being ranked 8th among the pulse crops (Lemma *et al*., 2009). In sub-saharan part of Africa, yields of cowpea rank as the lowest among all food legume crops averaging at 450 kg/ha (Hutchinson *et al*., 2016).

Increased spacing was found to increase number of pods per plant and number of seeds per pod. Increased yield was note at lower spacing i.e. when row spacing was decreased (Jakusko *et al*., 2013). Low yield in the tropics including Nigeria is as a result of lack of appropriate spacing measures among many other factors in which this study tends to address. Many researchers across the globe have indicated that spacing as one of the management tools would contribute a lot if the desired high yield of cowpea is to be obtained by the farmers (Uguru, 2011; Dominic and Bassey, 2016).

In areas where cowpea is produced, the farmers are known to face problem of spacing probably due to their conservativeness or inadequate knowledge. This inadequate knowledge of crop spacing makes them to plant cowpea at a wider spacing which often encourages weed growth and low yield. The shortcoming on proper spacing can be addressed through the adoption of agronomic manipulation/ cultural practices such as seed rate and seed sowing. Adequate spacing suppresses weed growth and increases crop yield, when compared with wider spacing. Furthermore, lack of technical packages along the entire value change, unavailability of quality seeds, and the general lack of awareness of the potential of cowpea thereby mitigating its maximum growth and grain yield. This research was therefore conducted to determine the appropriate spacing that would enhance growth and grain yield of cowpea varieties in the Guinea Savanna Zone of Nigeria.

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MATERIALS AND METHODS

Field experiment was conducted at the Biotechnology Advanced Research Centre Farm, Garki-Abuja during 2022 cropping season to evaluate the effect of spacing on growth and grain yield of two cowpea varieties. Abuja is located at $8^{O}10$'N and 7^{O} 10'N and the climate is cold and dry from November to March and then warm and moist from April to October. The maximum and minimum temperature is 35 and 27^{O}C, respectively. The humidity of this area is high (74%) all the year round except in January when dry wind blows from the north. The average annual rainfall is over 1250 mm. The soil is of a sandy loam texture, moderately well drained and was previously under cassava cultivation before fallowing for one cropping season.

The experimental plot was ploughed and harrowed after which lining out was carried out. There were 24 plots with three replications. Each replicate consisted of 8 plots. Each treatment was in a plot size of 2.0 m x 2.0 m (4.0 m^2). The alley way between replicates plots was 1.0 m and within replicates was 1.0 m. The treatments consisted of four spacing, (65 x 20 cm, 75 x 20 cm, 85 x 20 cm and 95 x 20 cm) designated as S1, S2, S3, and S4 with two cowpea varieties (TVU 14346 and TVU 14788). The treatments were 4 x 2 factorial experiment and fitted into a Randomized Complete Block Design (RCBD), replicated three times and data were collected on plant height, number of leaves, number of pods, pod length, number of seeds, 100 seed weight, seed weight and grain seed yield.

The seeds were sourced from the International Institute of Tropical Agriculture IITA) Ibadan. Two seeds were planted per hole at the depth of 4 cm and later thinned to one three weeks after planting (WAP). Pesticide in form of cypermethrin was applied at the dosage of 100 ml per 15 litres of knapsack sprayer fortnightly to check caterpillars, worms and grasshoppers. Manual weeding was also carried out using hoe at three weeks interval starting from 3 WAP to reduce competition between weeds and plants. Data were collected on growth and fruit yield from five selected plants per plot. Data collected were subjected to Analysis of Variance (ANOVA) using CROP STAT statistical package. Treatment means were separated using Duncan Multiple Range Test (DMRT) at 5% probability level.

RESULTS AND DISCUSSION

Plant height of the two cowpea varieties evaluated were not significantly ($p \geq 0.05$) different from each other at the sampling occasions. However, sampling occasion at 9 WAP gave the tallest plant height. The plant height of cowpea was significantly ($p \leq 0.05$) influenced by spacing at two sampling occasions (Table 1). At 3 WAP, S1 was significantly ($p \leq 0.05$) different from S2 and S4 but was at par with S3 while S2, S3 and S4 were not significantly different from each other. At 6 WAP, S1 (17.08 cm) proved its superiority over all other spacing. This was followed by S4 (15.55 cm) and the least mean value was obtained from S3 (13.95 cm). The increase in plant height at the narrow spacing could be attributed to competition for light and space. Similar observations were noticed in a study by El Naim and Jeberelder (2010). They observed that increased plant densities led to increase in plant height. The interaction effect between variety and spacing were not significantly ($p \geq 0.05$) different from each other.

Number of leaves of cowpea variety had significant ($p \leq 0.05$) difference only at 6 and 9 WAP. At 6 WAP, TVU 14788 (35.97) recorded the highest number of leaves and least mean value was obtained from TVU 14346 (29.49). Results from this study agrees with Sayyidah *et al* (2021) who emphasised that difference in genotypes could cause variation in the number of leaves formation of winged bean. At 9 WAP, the trend was similar in which TVU 14788 (40.20) had the highest number of leaves and TVU 14346 (33.28) gave the least mean value. Spacing had no significant ($p \geq 0.05$) effect on number of leaves at the sampling periods. Moreso, the interaction between variety and spacing was not significant ($p \geq 0.05$).

Number of pods was significantly ($p \leq 0.05$) influenced by variety. Number of pods recorded from TVU 14788 (44.20) was significantly greater than that of TVU 14346 (25.28). This could be due to varietal differences. Findings from this study corroborates with the report by Tswanya *et al* (2022) on the study conducted in winged bean. Spacing had no significant ($p \geq 0.05$) effect on cowpea. The interaction effect between variety and spacing was also not significantly ($p \geq 0.05$) influenced.

Pod length were not significantly ($p \geq 0.05$) influenced. However, various spacing used were significantly ($p \leq 0.05$) different from each other in which S1 recorded the longest pod length (13.58 cm). This was closely followed by S2 (12.56 cm) while S3 and S4 were at par with each other. This agrees with the findings by Jakusko *et al* (2013) who stated that increased spacing can significantly give rise to pod length. The interaction between variety and spacing was insignificant ($p \geq 0.05$).

Number of seeds per plot had significant ($p \leq 0.05$) effect on variety. Imperatively, TVU 14788 (181.58) recorded the highest number of seeds while the least mean value was obtained from TVU 14346 (134.63). The interaction effect between variety and spacing had no significant ($p \geq 0.05$) effect. Results from this study agrees with Lawal *et al* (2019) who indicated that number of seeds per pod varied from 7 to 15 seeds per pod among the accessions of winged bean with a mean of 12.5 seeds per pod.

100 seed weight was significantly ($p \leq 0.05$) affected by variety. The heaviest weight was obtained from TVU 14788 (25.20 g) and the least mean value was gotten from TVU 14346 (22.65 g). The variation among varieties could be due to the growth habit and genetic potential of each genotype. Similar observations were reported in a study by Jakusko *et al* (2013). There was no significant ($p \geq 0.05$) effect on the spacing used. The interaction effect between variety and spacing was not significant ($p \geq 0.05$).

Seed weight was significantly ($p \leq 0.05$) influenced by variety with the heaviest seed weight obtained from TVU 14788 (121.78 g) while the least mean value was recorded from TVU 14346 (114.11 g). Findings from the current study is in conformity with Tswanya *et al* (2022) who reported that heaviest seed weight is achievable. Evidently, spacing had significant effect on each other in which S1 (132.52 g) recorded the heaviest seed weight. This was followed by S4 (117.74 g) and the least mean value was observed from S2 (106.85 g). The increase in mean seed weight with increase in inter-row spacing could be due to less competition for nutrients in wider spaced plants. This agrees with the findings by El Naim and Jeberelder (2010) who reported that

increasing plant population decreases seed yield. The interaction effect between variety and spacing was not significantly ($p \geq 0.05$) influenced.

Grain yield was significantly ($p \leq 0.05$) affected by variety with the highest yield obtained from TVU 14788 (7.42 t/ha) while the least mean value was received from TVU 14346 (4.29 t/ha). The highest grain yield obtained from this study is higher than 7.28 t/ha reported by Mohammed et al, (2016). The reason could be as a result of genetic make-up and edaphic factor. Spacing had significant ($p \leq 0.05$) on each other. S1 (8.79 t/ha) gave the highest yield which proved its superiority over other spacing evaluated while the least mean values followed each other in this descending order: S3 (5.34 t/ha), S2 (5.32 t/ha) and S4 (3.98 t/ha) respectively. Findings from the study proved that higher yield could be obtained when maximum spacing is used for cowpea production. Furthermore, result from this study is not in agreement with Dzemo *et al* (2010) who revealed that the achievable average yield ranged from 1.50 t/ha to 3.00 t/ha. The interaction effect between variety and spacing was not significantly ($p \geq 0.05$) influenced.

CONCLUSION AND RECOMMENDATION

The result of this study proved that TVU 14788 with the mean grain yield of 7.42 t/ha performed better than the other variety evaluated. Morealso, the plants spaced with S1 gave the highest mean grain yield of 8.79 t/ha. Therefore, these treatments could be recommended for farmers within this ecological zone.

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Table 1: Effect of Spacing on Plant Height (Cm) of Two Cowpea Varieties in 2022 Cropping Season

	Plant height (cm)		
Variety	**3WAP**	**6WAP**	**9WAP**
TVU 14346	5.42	14.89	20.03
TVU 14788	5.57	15.63	20.64
S	ns	ns	ns
SE	0.12	0.27	0.24
Spacing			
65×25	5.97a	17.08a	20.92
75×25	5.33b	14.47bc	19.97
85×25	5.57ab	13.95c	20.02
95×25	5.10b	15.55b	20.43
S	*	*	ns
VXS	ns	ns	ns
SE	0.17	0.38	0.33

NS= Non significant, * Significant at 5%, SE= Standard Error, DMRT= Duncan Multiple Range Test. Any two means letter having a common letter within the same column are not significantly different at the 5% level of significant.

Table 2: Effect of Spacing on Number of Leaves of Two Cowpea Varieties in 2022 Cropping Season

	Number of leaves		
Variety	**3WAP**	**6WAP**	**9WAP**
TVU 14346	27.90	29.49b	33.28b
TVU 14788	28.85	35.97a	40.20a
S	ns	*	*
SE	1.85	1.32	1.56
Spacing			
65×25	23.97	30.24	37.58
75×25	31.48	35.17	37.78
85×25	27.15	32.87	36.18
95×25	30.90	32.65	35.40
S	ns	ns	ns
VXS	ns	ns	ns
SE	2.61	1.87	2.21

NS= Non significant, * Significant at 5%, SE= Standard Error, DMRT= Duncan Multiple Range test. Any two means letter having a common letter within the same column are not significantly different at the 5% level of significant.

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www.iprjb.org

Table 3: Effect of Spacing on Number of Pods, Pod Length and Number of Seeds per Plant of Two Cowpea Varieties in 2022 Cropping Season

Variety	Number of pods	Pod length (cm)	Number of seeds/plant
TVU 14346	25.28b	12.08	134.63b
TVU 14788	44.20a	12.59	181.58a
S	*	ns	*
SE	4.11	0.18	8.61
Spacing			
65x25	42.85	13.58a	192.31a
75x25	27.46	12.56b	156.03ab
85x25	26.04	11.80c	133.79b
95x25	42.38	11.40c	150.30b
S	ns	*	*
VXS	ns	ns	ns
SE	5.82	0.25	12.17

NS= Non significant, * Significant at 5%, SE= Standard Error, DMRT= Duncan Multiple Range Test. Any two means letter having a common letter within the same column are not significantly different at the 5% level of significant.

Table 4: Effect of Spacing on 100 Seed Weight, Seed Weight and Grain Yield of Two Cowpea Varieties in 2022 Cropping Season

Variety	100 seed weight (g)	Seed weight/plant (g)	Grain yield (t/ha)
TVU 14346	22.65b	114.11b	4.29b
TVU 14788	25.20a	121.78a	7.42a
S	*	*	*
SE	0.56	2.22	0.77
Spacing			
65x25	24.28	132.52a	8.79a
75x25	23.50	106.85c	5.32b
85x25	23.50	114.68bc	5.34b
95x25	24.42	117.74b	3.98b
S	ns	*	*
VXS	ns	ns	ns
SE	0.79	3.14	1.09

NS= Non significant, * Significant at 5%, SE= Standard Error, DMRT= Duncan Multiple Range Test. Any two means letter having a common letter within the same column are not significantly different at the 5% level of significant.

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