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EFFECTS OF ROW SPACING ON THE YIELD AND YIELD COMPONENTS OF FOUR CULTIVARS OF VEGETABLE COWPEA (*VIGNA UNGUICULATA* [L.] WALP)

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ABSTRACT

Field experiments were conducted at the Research Farm of Michael Okpara University of Agriculture, Umudike in 2002 and 2003 to investigate the influence of intra-row spacing on the yield and yield components of four varieties of vegetable cowpea. The cowpea varieties (Akidiani, Akidienu, IT86F-2014-1 and IT81D-128-14) were grown at intra-row spacing of 10, 20, 30, and 40 cm. Akidiani and IT86F-2014-1 had the highest dry matter, number of pods and yield at wider spacing. At narrower spacing, Akidienu and IT81D-128-14 produced more dry matter, number of pods and fresh pod (yield). The results suggest that Akidienu and IT86F-2014-1 are more suitable than the other varieties in the humid forest ecology especially as sole crop and should be plant at 50 cm inter-row and 30 cm intra-row spacing.

INTRODUCTION

Vegetable cowpea refers to varieties of *Vigna unguiculata* [L.] Walp., grown for their immature succulent pods, differently known as long bean, bodi, bora, sito, suapea, snake pea and asparagus bean in different parts of the world. The indigenous varieties are the climbing and prostrate types but in recent times, many erect bushy varieties have been developed (Acosta and Petrache 1960; Mital *et al.*, 1980; Redden, 1981; Umaharan *et al.*, 1997). Yield in vegetable cowpea is usually defined as green pod yield expressed in kg ha^{-1} or t ha^{-1} (Braithwaite, 1982; Umaharan *et al.*, 1997). Yield also can be thought of as a function of components such as average pod weight (Braithwaite, 1982), number of pods per cluster (Fernandez and Miller, 1985) and number per pods per plant (Umaharan *et al.*, 1997).

Optimal plant population and row spacing vary with plant types (Muleba and Ezumah, 1985). Prostrate cowpea shows little increase in yield when planted at populations greater than 22, 000 plants ha^{-1} (Nangju, 1974; IITA-SAFGRAD, 1981; 1982) whereas semi-erect and erect cowpeas respond to intermediate (50,000 80,000 plants ha^{-1}) and high (>100,000 plants ha-1) populations, respectively (Ezedinma, 1974; Nangju *et al.*, 1975; Fadayomi, 1979, IITA-SAFGRAD, 1982). Despite the popularity of this nutritionally important vegetable legume little information exists on optimal plant population and row spacing for this crop. However, such information on vegetable cowpea production practices rely on work on grain cowpea and this is unsatisfactory. The objective of this study was therefore to investigate the effect of row spacing on yield and yield components in four cultivars of vegetable cowpea.

MATERIAL AND METHODS

Field experiments were conducted at the Michael Okpara University of Agriculture, Umudike Research Farm (05° 29' N, 07° 33' E, 122 m) in 2002 and 2003 cropping seasons on soil classified as a sandy loamy

Ultisol (Agboola, 1979). The experiment was laid out in a split plot randomized complete block design with four vegetable cowpea cultivars (Akidiani a prostrate cultivar, Akidienu a climbing cultivar, IT86F-2014-1-an erect cultivar and IT81D-128-14- a semi-bushy cultivar) in the main plots and four intra-row spacings (10, 20, 30, and 40 cm) corresponding to population densities of 200,000; 100,000; 66,666 and 50,000 plants ha^{-1} in the subplots. The inter-row spacing was kept constant at 50 cm. The experiment was replicated three times in both years. Subplot size was 3 m x 3 m with 1 m alley between main plots and replicates.

The soil was disc-ploughed and harrowed in both years and the seeds were sown on the flat on 18 April, 2002 and 20 April, 2003. Two seeds were sown per hill and later thinned to one plant per hill at two weeks after planting (WAP) in both years. Insect attack was controlled using Cypermethrin® EC at 100 ml in 20 L of water. Two hand weeding was done at 4 WAP and 8 WAP. No fertilizer was applied to the plots in keeping with the practice of farmers in this area in both years.

Three plants were sampled at 7 WAP for dry matter yield and at pod maturity data were taken on pod length, pod width, number of seeds pod^{-1}, 100 seed weight, number of pods m^{-2} and pod yield (t ha^{-1}). Data on pod weight was taken in 2003 only. All the data were subjected to analysis of variance using GLM procedure in SAS. Mean separation was done using the standard error of the difference between means.

RESULT AND DISCUSSION

The analysis of variance showed that the cultivar effect was highly significant ($P < 0.001$) in both years for all the attributes Except dry matter yield per plant. Row spacing did not significantly influence any of the attribute assessed in both years ($P > 0.05$). However, the interaction between cultivar and row spacing in 2003 was significant for dry matter yield per plant, number of pods m^{-2} and pod yield ha^{-1} ($P < 0.05$) but was not significant in 2002 for all the attributes.

The effect of vegetable cowpea cultivar and intra-row spacing on dry matter yield per plant in 2002 and 2003 is shown in Table

[1]S.E.D = Standard error of the difference between two means

The vegetable cowpea cultivars differed markedly in dry matter production in 2003. The prostrate cultivar (Akidiani) produced the highest dry matter (31.7 g $plant^{-1}$) at 40 cm intra-row spacing. Dry matter was much lower (12.7 g $plant^{-1}$) in the cultivar at 20 cm intra-row spacing.1

A reversed trend was observed with the climbing cultivar Akidienu) which had produced a higher biomass at 20 cm and 30 cm row spacing but produced a much lower dry matter at 40 cm row spacing. The erect cultivar (IT86F-2014-1) had low biomass at 10 cm (14.41 g/plant) and 40 cm (14.82 g/plant) but high at 20 and 30 cm row spacing. The semi bushy cultivar (IT81D-128-14) had high biomass at 10 cm (27.29 g/plant) which decreased as the intra-row spacing was increased. This result suggests that the growth habit of these vegetable cowpeas affect their response to row spacing. Remison (1980) reported a similar trend in grain cowpea.

Table 1: Effect of vegetable cowpea cultivars and intra-row spacing on dry matter yield (g plant^{-1}) in 2002 and 2003

Cultivar	Intra-row spacing (cm) 10	20	30	40	Mean
2002					
Akidiani	30.87	22.54	23.36	18.24	23.75
Akidienu	14.09	15.52	35.80	24.30	22.43
IT86F-2014-1	13.41	22.33	19.94	25.63	20.33
IT81D-128-14	31.11	53.38	26.01	18.59	32.27
Mean	22.37	28.44	26.28	21.69	
S.E.D[1] cultivar		ns			
S.E.D spacing		ns			
S.E.D interaction		ns			
2003					
Akidiani	27.92	12.71	26.67	31.72	24.75
Akidienu	26.69	29.01	30.70	15.74	25.54
IT86F-2014-1	14.41	22.56	23.40	14.82	18.80
IT81D-128-14	27.29	19.50	14.62	10.73	18.03
Mean	24.08	20.94	23.85	18.25	
S.E.D[1] cultivar		ns			
S.E.D spacing		ns			
S.E.D interaction		4.66			

[1]S.E.D = Standard error of the difference between two means

Table 2: Effect of vegetable cowpea cultivars and intra-row spacing on pod length (cm) in 2002 and 2003

Cultivar	Intra-row spacing (cm) 10	20	30	40	Mean
2002					
Akidiani	16.43	17.45	17.24	15.98	16.78
Akidienu	20.04	22.70	22.07	22.79	21.91
IT86F-2014-1	14.84	15.21	13.11	15.34	14.63
IT81D-128-14	24.21	24.75	24.08	23.06	23.53
Mean	18.81	19.54	19.18	19.29	
S.E.D[1] cultivar		0.57			
S.E.D spacing		ns			
S.E.D interaction		ns			
2003					
Akidiani	17.51	16.85	15.97	15.71	16.51
Akidienu	16.71	17.67	17.41	17.82	17.40
IT86F-2014-1	14.28	11.66	12.18	13.19	12.83
IT81D-128-14	22.53	21.01	22.86	22.77	22.29
Mean	17.76	16.80	17.11	17.37	
S.E.D[1] cultivar		0.40			
S.E.D spacing		ns			
S.E.D interaction		ns			

[1]S.E.D = Standard error of the difference between two means

Table 3: Effect of vegetable cowpea cultivars and intra-row spacing on pod width (cm) in 2002 and 2003

Cultivar	Intra-row spacing (cm)				
	10	20	30	40	Mean
2002					
Akidiani	2.58	2.49	2.53	2.37	2.49
Akidienu	2.65	2.69	2.77	2.70	2.70
IT86F-2014-1	2.81	2.87	2.77	2.93	2.85
IT81D-128-14	3.17	3.09	3.14	3.10	3.13
Mean	2.80	2.79	2.80	2.78	
S.E.D[1] cultivar		0.07			
S.E.D spacing		ns			
S.E.D interaction		ns			
2003					
Akidiani	1.75	1.78	1.77	1.83	1.78
Akidienu	2.02	1.90	1.91	1.96	1.95
IT86F-2014-1	1.97	1.99	2.03	2.01	2.00
IT81D-128-14	2.32	2.03	2.17	2.37	2.22
Mean	2.01	1.92	1.97	2.05	
S.E.D[1] cultivar		0.04			
S.E.D spacing		ns			
S.E.D interaction		ns			

The semi-bushy cultivar (IT81D-128-14) had the longest, widest pods in both years (Tables 2 and 3). This cultivar also had the heaviest pods (Table 4). Intra-row spacing did not influence pod length, width and weight. There was also no significant interaction between cultivar and intra-row spacing showing that the observed results on these attributes may be genetically determined. These results differ from the earlier report of Remison *et al.* (1980).

The effect of vegetable cowpea cultivar and intra-row spacing on number of seeds per pod and 100 seed weight (seed size) are shown in Tables 5 and 6. The result showed that the climbing cultivar (Akidienu) had the highest number of seeds per pod in both years [15 seeds/pod in 2002, and 17 seeds/pod in 2003] (Table 5) and this Differed significantly from the other cultivars in both years. The semi-bushy (IT81D-128-14) cultivar (IT81D-128-14) had large seeds [13 g^{-100} seeds in 2002, 11 g^{-100} seeds in 2003] (Table 6). It differed significantly from the other cultivars in 2002 but from prostrate cultivar only in 2003.

The erect cultivar had more pods m^{-2} in both years (190.8 in 2002, 209.25 in 2003) and differed significantly from the other cultivars in both years. The interaction between cultivar and row spacing was significant in 2003. The prostrate and erect cultivars [Akidiani and IT86F-2014-1] (Table 7) had the highest number of pods m^{-2} at 30 cm row spacing (108.0 and 298 pods m^{-2}) while the climbing and the semi-bushy cultivars had the highest number of pods m^{-2} at 10 cm row spacing (138 and 146 pods m^{-2}).

Table 4: Effect of vegetable cowpea cultivars and intra-row spacing on pod weight (g pod^{-1}) in 2003

Cultivar	Intra-row spacing (cm)				
	10	20	30	40	Mean
2003					
Akidiani	3.31	3.53	3.86	3.55	3.56
Akidienu	5.09	4.02	4.63	4.63	4.59
IT86F-2014-1	3.31	3.22	3.33	3.61	3.37
IT81D-128-14	8.19	7.87	7.97	7.08	7.78
Mean	4.97	4.66	4.95	4.72	
S.E.D[1] cultivar		0.25			
S.E.D spacing		ns			
S.E.D interaction		ns			

[1]S.E.D = Standard error of the difference between two means

Table 5: Effect of vegetable cowpea cultivars and intra-row spacing on number of seeds per pod in 2002 and 2003

Cultivar	Intra-row spacing (cm)				
	10	20	30	40	Mean
2002					
Akidiani	13.53	12.91	13.41	13.90	13.44
Akidienu	14.03	14.73	15.07	14.81	14.66
IT86F-2014-1	9.60	11.28	10.38	12.23	10.87
IT81D-128-14	11.73	12.47	11.82	10.52	11.64
Mean	12.22	12.85	12.67	12.87	
S.E.D[1] cultivar		0.36			
S.E.D spacing		ns			
S.E.D interaction		ns			
2003					
Akidiani	14.08	13.03	14.36	13.73	13.80
Akidienu	16.29	16.58	16.91	16.34	16.53
IT86F-2014-1	9.19	11.67	10.07	10.01	10.24
IT81D-128-14	14.60	12.13	12.15	12.47	12.84
Mean	13.54	13.35	13.37	13.14	
S.E.D[1] cultivar		0.39			
S.E.D spacing		ns			
S.E.D interaction		ns			

[1]S.E.D = Standard error of the difference between two means

Table 6: Effect of vegetable cowpea cultivars and intra-row spacing on seed weight (g 100 seeds^{-1}) in 2002 and 2003

	Intra-row spacing (cm)				
Cultivar	10	20	30	40	Mean
2002					
Akidiani	8.03	8.29	9.00	7.99	8.33
Akidienu	11.29	10.98	11.58	13.74	11.90
IT86F-2014-1	12.07	11.45	11.56	12.23	11.83
IT81D-128-14	12.87	12.68	13.27	13.24	13.02
Mean	11.07	10.85	11.36	11.80	
S.E.D[1] cultivar		0.24			
S.E.D spacing		ns			
S.E.D interaction		ns			
2003					
Akidiani	7.00	7.13	8.37	7.53	7.51
Akidienu	10.13	10.57	10.53	10.67	10.48
IT86F-2014-1	10.70	9.73	10.47	10.67	10.39
IT81D-128-14	11.20	11.37	10.83	11.53	11.23
Mean	9.76	9.70	10.85	10.10	
S.E.D[1] cultivar		0.29			
S.E.D spacing		ns			
S.E.D interaction		ns			

[1]S.E.D = Standard error of the difference between two means

The erect and semi-bushy cultivars had similar fresh pod yield in 2002 and 2003 (Table 8), which differed from the other two cultivars in 2002 but in 2003 differed only from the prostrate cultivar. The interaction between cultivar and row spacing was significant in 2003. The prostate and erect cultivars had the highest yield at 30 cm row spacing (4.22 t ha^{-1} and 9 t ha^{-1}) while the climbing and semi-bushy cultivar had the highest yield at 10 cm row spacing (7 t ha^{-1} and 9.18 t ha^{-1}).

This result showed that the vegetable cowpea cultivars responded differently to increasing plant population which may be due to their growth habit and morphology. The climbing and semi-bushy cultivars had higher yields at high population whereas the prostrate and erect cultivars had high yield at 30 cm row spacing. Similar result has been reported by Jaaffar and Garner (1988) in groundnut.

The results suggest that Akidienu and IT86F-2014-1 are more suitable than the other varieties in the humid forest ecology especially as sole crop and should be plant at 50 cm inter-row and 30 cm intra-row spacing.

Table 7: Effect of vegetable cowpea cultivars and intra-row spacing on number of pods per m^2 in 2002 and 2003

	Intra-row spacing (cm)				
Cultivar	10	20	30	40	Mean
2002					
Akidiani	64.00	53.00	54.00	70.67	60.42
Akidienu	93.67	76.67	99.00	88.00	89.33
IT86F-2014-1	130.00	211.00	222.67	196.67	190.08
IT81D-128-14	64.00	82.00	65.67	97.67	77.33
Mean	87.92	105.67	110.33	113.25	
S.E.D[1] cultivar		14.56			
S.E.D spacing		ns			
S.E.D interaction		ns			
2003					
Akidiani	102.67	37.33	107.67	62.00	77.42
Akidienu	138.33	93.67	129.67	120.67	120.58
IT86F-2014-1	95.33	248.33	298.33	195.00	209.25
IT81D-128-14	146.33	115.67	74.33	74.00	102.58
Mean	120.67	123.75	152.50	112.90	
S.E.D[1] cultivar		16.00			
S.E.D spacing		ns			
S.E.D interaction		32.12			

[1]S.E.D = Standard error of the difference between two means

Table 8: Effect of vegetable cowpea cultivars and intra-row spacing on pod yield (t ha^{-1}) in 2002 and 2003

	Intra-row spacing (cm)				
Cultivar	10	20	30	40	Mean
2002					
Akidiani	1.49	1.02	1.16	1.96	1.41
Akidienu	4.26	3.45	3.96	3.64	3.83
IT86F-2014-1	4.61	7.04	7.06	7.22	6.48
IT81D-128-14	4.49	5.87	5.97	6.99	5.83
Mean	3.71	4.34	4.54	4.95	
S.E.D[1] cultivar		0.71			
S.E.D spacing		ns			
S.E.D interaction		ns			
2003					
Akidi-ani	3.21	1.15	4.22	2.65	2.81
Akidi-enu	6.68	3.17	5.85	5.88	5.39
IT86F-2014-1	2.98	6.83	8.75	6.59	6.29
IT81D-128-14	9.18	6.08	4.44	6.26	6.49
Mean	5.51	4.31	5.81	5.35	
S.E.D[1] cultivar		0.66			
S.E.D spacing		ns			
S.E.D interaction		1.31			

[1]S.E.D = Standard error of the difference between two mean

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