FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 6 No. 3, June, 2022, pp 56 - 61
DOI: https://doi.org/10.33003/fjs-2022-0603-982

SEASONAL RESPONSES OF FLOWERING AND POD SETTING IN COWPEA (*Vigna unguiculata* L. Walp)

*** Ukpene, A. O. and Isibor, C. N.**

Department of Biological Sciences, University of Delta, Agbor, Nigeria

*Corresponding authors' email: **anthony.ukpene@unidel.edu.ng**

ABSTRACT

Seven varieties of cowpea, *Vigna unguiculata* L. Walp were studied in two field trials (the wet and dry seasons) in the 2021 cropping season in Agbor, South-South geopolitical zone of Nigeria, were laid out in a complete randomized block design (CRBD) with seven replications for seasonal responses of flowering and pod setting. The dry season crops were manually watered twice daily while the wet season crops were rain-fed. The study recorded that most of the cowpea genotypes grown in the wet season showed photoperiod sensitivity, flowering between 46.36 and 56.43 DAP with mean of 54.97 $\pm$ 6.98. Pod setting was similar across genotypes but the number (9.64 $\pm$ 8.29), while length of pods varied (14.66 $\pm$ 2.83) as noted from field observations. Furthermore, Seeds per pod was not significant among varieties of the wet season but they were significant and among those of the dry season (9.37 $\pm$ 5.17). Genotypes which flowered earlier produced higher number of pods per plant and gave better yield such as IT06K-149-1, IT98K-128-3, IT95K1072-57 and IT98K-506-1 with grain filling of 205.58, 186.3, 183.53 and 775.99 mean seeds respectively were consequently recommended for hybridization in cowpea breeding programmes in south-south Nigeria.

Keywords: Flowering in cowpea, photoperiod, pod setting, pod filling

INTRODUCTION

Cowpea, (L.Walp) is a major source of plant protein for both humans and livestock and is principally grown for forage, green pods, and grains. According to Boukar *et al.* (2018) the bulk of cowpea production in West Africa comes from the drier regions of northern Nigeria with an estimated cultivated acreage of 5 million ha and an annual mean yield of 2.3 million tons. According to Carsky *et al.* (2001) the drier zones of northern Nigeria and Niger harbour the largest area of cowpea production in the world. This means that cowpea is fundamentally adapted to arid agro-climates. Being an annual herbaceous plant, it could be categorised as wild, weedy and land races (which includes the cultivated forms).

Morphologically, the growth habit of cowpea ranges from small and erect, determinate, non-branching types to vigorous spreading viny, prostrate or trailing indeterminate, profusely branching forms (Olorunmaiye, 2010). Cowpea stems are cylindrical but slightly ribbed, twisting, sometimes hollow and glabrous with scattered minute spinnerets. Pigmentation on the stem varies from none or localized purple at the nodes to solid purple. Each node bears two opposite leaves which are usually large, hairy, dark green, heart shaped and subtended by inconspicuous stipels. Flowers develop from apical buds and sometimes from axillary buds (Davies *et al*. 2010).

The inflorescence is an unbranched axillary raceme which bears several flowers at the terminal end of branches. Flowers in cowpea may be white, purple or pale-yellow. In wild cowpeas, flowers are almost sessile, conspicuously large with solid mauve (pale purple) pigmentation all over the standard and wing petals. Othman *et al*. (2006), showed that anthocyanin and melanin-like substances were responsible for colour in cowpea and the expression of any pigment on the plant is the result of the interaction between several pigment genes and a general colour factor.

Mukhtar and Singh (2006) observed that in West and Central Africa, photoperiod is the most important environmental variable affecting time of flowering and that most cowpea varieties put into cultivation were photoperiod sensitive. Lush and Evans (1980) had reported that in wild cowpeas flowers are larger and are produced much later than in the cultivated varieties. Rawal (1975) however added that once flowering is initiated in the wild cowpea it is continued throughout the year provided that adequate moisture was available. Flowers of the weedy cowpea are non-aromatic. They are usually of the same size and pigmentation as the wild forms but occasionally mutants carrying no floral pigmentation are observed. Flowers of the cultivated variety could be solid mauve, or white, and are usually smaller in size than those of their wild counterparts (Cook 2008).

Manggoel and Uguru (2012) documented that time of flowering is particularly important in cowpea (*Vigna unguiculata* (L.) Walp) as it is an indicator of the level of adaptation to a particular environment, while Ishaku *et al*. (2005), reported that it also serves as a determinant of pod setting and crop yield. Uarrota (2010) documented that flowering depends on the interaction of many complex processes which are influenced by both genetic and environmental factors. Similarly Muktar and Singh (2006), as cited by Manggoel and Uguru (2012), noted that in West and Central Africa, photoperiod was the most important environmental variable affecting time of flowering and noted that most cowpea varieties cultivated are photosensitive. Singh (1993) ascribed that those varieties whose days to first flowering were greater than 45 were photoperiod sensitive while those that flower in less than 45 days were photoperiod insensitive or day neutral. Pasquet (1998) summed it up that photo-sensitive accessions flowered later, when day length decreased. For pollination to occur in cowpea plants the flowers must open appropriately. Lush (1979) also reported that the flowers of all cowpea lines open only once, before dawn, and shut by midmorning. However, Rawal (1975) observed that in certain wild forms the flowers could remain open for a longer period.

The pods of cowpea vary from 5 to 10 cm long or sometimes longer. They are linear, coiled or curved. Davies *et al. (*2010), cited that immature pods are usually green in colour but change to black, brown or straw colour upon maturity. They also reported that the wild cowpea pods dehisce along the sutures with a spiral twisting of the valves. On the other hand pods of cultivated cowpea are indehiscent, and range from

green to partial or complete mauve pigmentation along the tips, sutures or valves.

Problems of the study: The edible cowpea varieties which are cultivated for their high protein contents thrive mainly in the savannah climates of Northern Nigeria. Efforts to domesticate the crop in South-South Nigeria using its variability in genetic and biochemical compositions in different accessions of the crop plant to improve both their nutritional qualities as well as their economic yield potentials has often been faced with ravages of pest and diseases as well as unpredictable climatic conditions.

The study intends to investigate the seasonal responses of flowering and pod setting in cowpea varieties grown in South-South Nigeria in order to generate new opportunities for the local farmers to upscale biodiversity of crops grown for local consumption.

Objectives of the Study: The overall aim of the study was to determine the seasonal responses of flowering and pod setting in cowpea varieties grown in South-South Nigeria and determine suitable genotypes for selection in cowpea breeding programmes.

METHODOLOGY

Field experiments: There were two field experiments (the wet season and dry season experiments respectively) which comprised of seven cowpea varieties of *Vigna unguiculata (L.) Walp* namely: Ife Brown, IT98K-128-3, IT98K-506-1, IT93K-452-1 and IT95K-1072-57, IT06K-149-1, and IT06K-136 that were laid out in a complete randomized block design (CRBD) with seven replications. The rain-fed wet season experiment was planted in the month of April while the dry season experiment was planted in October, 2021, respectively, in a 30.5 x 24.4 meters vegetable garden in Agbor, Delta State, South-South Nigeria.

The seven cowpea varieties were randomly assigned to the plots in each replicate by the lottery technique. The plot measured 2x2 meters per replicate, per variety. Cowpea was planted at intra-row layout of 0.5 meters and amid rows of 2 meters per replicate at a planting depth of 2-5 cm. 3 seeds were planted per hole for possible thinning to two after emergence.

Data collection: The study collected data on the mean number days to flowering, pods per peduncle, pods length, days to first ripe pod, seeds per pod, and seeds per plant.

Number of days to flowering: This parameter was determined by the difference between the date of planting and the date of first flower pod opening per plant.

Number of pods per peduncle: Five mature plants were randomly selected and the number of mature pods on each peduncle just before harvest were counted and recorded.

Pod length: The lengths of pods (cm) were determined by measuring and recording selected pods on each plant with a ruler.

Number of days from planting to first ripe pod: This parameter was obtained from the difference between the date of planting to the date the mature pods were ripe, dry and ready for harvest. A ripe pod showed colour change from green or purple to light / straw yellow, with reduced moisture content

Number of seeds per pod: Five pods were randomly selected from each replicate and the pods were opened and the number of seeds per pod counted and expressed as a mean.

RESULTS

Days to flowering

Flowers were produced between 45.00 to 56.43 days after planting (DAP) among the genotypes of the wet season (Table 1), and between 48.43 to 64.71 DAP among the dry season genotypes (Table 2) . Seasonal mean number of days to flowering for wet season plants was 50.03 $\pm$ 4.19 as against 59.16 $\pm$ 5.91 for dry season plants (Table 10). Days to flowering was not significant across cowpea genotypes in the wet season ($p>0.05$) (Table 1 and 8) but the cowpea genotypes grown in the dry season showed significant differences ($p<0.05$) (Table 2). IT06K-136 (45.00 DAP) was the earliest cowpea genotype to flower among the wet season crops, as compared to Ife Brown (46.43 DAP) that produced the earliest flower among the dry season crops. Some dry season genotypes flowered very late as was recorded in IT98K-128-3 (64.71 DAP), IT06K-149-1 (64.71 DAP) and IT06K-136 (62.43 DAP) respectively. The number of days to 50% flowering was in agreement with Biskwa, *et al.,* (2014). According to Uarrota (2010), flowering serves as a determinant of pod setting and crop yield. Furthermore, Manggoel and Uguru (2012) noted that the time of flowering is particularly important in cowpea, *Vigna unguiculata* (L.) Walp as it serves as an indicator of the level of adaptation to a particular environment. Based on the above, the dry season was not suitable for the cowpea genotypes grown showed low level adaptation for growth in South-South agro-ecological zone of Nigeria.

Pods per peduncle

The mean number of pods per peduncle for the wet season cowpea genotypes varied from 3.07 to 3.21 (Table 1), while the mean number of pods per peduncle for the dry season cowpea genotypes ranged from 3.00 to 3.14 (Table 2). Seasonal means for the wet season plants was 3.16 $\pm$ 11.63, while the mean number of pods per peduncle for dry season plants was 3.04 $\pm$ 1.16 (Table 10). Pods per peduncle was not significant across genotypes and seasons ($p>0.05$) (Tables 4 and 9). Highest mean number of pods per peduncle of 3.21 each was recorded in IT98K-506-1, IT98K-128-3, IT06K-136 and IT06K-149-1 among the wet season genotypes. However, Ife Brown (2.14) and IT98K-128-3 (2.14) recorded the highest mean number of pods per peduncle among the dry season cowpea genotypes. The mean number of pods per peduncle recorded in this study was similar to the results of Edeh and Igberi, (2012) and Ukpene (2022).

Number of pods per plant

The mean values of number of pods per plants for the wet seasons ranged from 13.50 to 17.79 (Table 1), while those of the dry season varied from 3.14 to 4.86 (Table 2). Seasonal means were 15.50 $\pm$ 1.67 (wet season) and 3.78 $\pm$ 1.89 (dry season) respectively (Table 10). Pods per plant were not significant among the wet season among cowpea genotypes ($p>0.05$) (Table 1 and Table 4) whereas significant differences were recorded among crops of the dry season ($p<0.05$) (Table 2). The highest number of pods was recorded for IT06K-149-1 (17.79), and IT98K-128-3 (17.29), followed by IT93K-452-1 (16.36), and IT95K-1072-57 (15.00), (wet season). On the other hand, Ife Brown (4.86) recorded the highest number of pods per plant in the dry season, followed by IT93K-452-1 (3.86) and IT95K1072-57 (3.86) and IT98K-128-3 (3.71) respectively. The study noted that the cowpea genotype, IT06K-149-1 which recorded the highest number of branches (5.29) in the wet season also produced the highest number of pods (17.79). Cowpea plants with good growth rate, shoot and root elongation and higher number of branches produced more pods than those with less branches. This was in agreement with Fawole (1986), who reported that higher number of branches are produced by the branching varieties

of cowpea which consequently produce higher number of pods per plant than the non-branching varieties.

Pod length (cm)

The mean values of the pod length are represented in Tables 1 and 2 respectively .They varied from 15.57 to 17.86 cm (wet season crops, Table 1) and also ranged from 11.84 to 13.73 cm (dry season, Table 2). Seasonal mean was higher for the wet season plants (16.66 ± 1.33 cm) compared with 12.66 ± 0.69 cm recorded by the dry season plants (Table 10). Longest pods in the wet season were recorded in IT06K-149-1 (17.86 cm) and IT95K-1072-57 (17.00cm) respectively. Among the dry season genotypes, pods were longest in IT95K-1072-57 (13.73 cm) and IT98K-128-3 (13.33 cm) respectively. Pod length was not significant across the cowpea genotypes as well as in the seasons ($p>0.05$). Pod length is an important determinant of seeds per plant and grain yield. However pod length may fail to correlate with number of seeds per pod, as a longer pod may not necessarily mean more seeds. In this study the cowpea genotypes with the longest pod (IT06K-149-1, 17.86 cm) did not have the highest number of seeds.

Table 1: Growth parameters of seven cowpea genotype grown in the wet season

Genotypes	Branches per plant	Days to 1st flowering	Pod per peduncle	Pod per plant	Pod length
Ife Brown	4.50	56.43	3.14	13.86	16.67
IT93K-452-1	4.50	46.36	3.07	16.36	15.57
IT98K-506-1	4.71	46.64	3.21	14.71	16.96
IT95K-1072-57	4.07	50.57	3.07	15	17
IT98K-128-3	4.86	52.71	3.21	17.29	15.99
IT06K-136	4.50	45.00	3.21	13.5	16.58
IT06K-149-1	5.29	52.50	3.21	17.79	17.86
Decision	NS	NS	NS	NS	NS

Values are expressed as mean ± SD

Table 2: Growth parameters of seven cowpea genotype grown in the dry season

Genotypes	Branches per plant	Days to 1st flowering	Pods per peduncle	Pods per plant	Pod length
Ife Brown	4.57	48.43^{d}	3.14	4.86^{a}	11.84
IT93K-452-1	4.57	57.00^{bc}	3.00	3.86^{b}	12.98
IT98K-506-1	4.71	61.29^{abc}	3.00	3.14^{b}	12.43
IT95K-1072-57	3.71	55.57^{c}	3.00	3.86^{b}	13.73
IT98K-128-3	3.14	64.71^{a}	3.14	3.71^{b}	13.33
IT06K-136	3.14	62.43^{ab}	3.00	3.43^{b}	12.18
IT06K-149-1	4.14	64.71^{a}	3.00	3.57^{b}	12.14
Decision	NS	S	NS	S	NS

Values are expressed as mean ± SD

Table 3: Analysis of variance on means for branches per plant, days to flowering in seven cowpea genotypes grown in the wet season

Sources of Variation	df	Branches per plant			Days to flowering		
		MSS	F ratio	Sig	MSS	F ratio	Sig
Replicate	6	1.939	1.359	240	44.544	.417	.866
Variety	6	1.986	1.393	.227*	223.830	2.094	.062*
Error	85	1.426			106.875		
Total	98			*NS			*NS

P<0.05

Table 4: Analysis of variance on means for pods per peduncle, pods per plant and seeds per pod in seven cowpea genotypes grown in the wet season

Sources of Variation	Df	Pods per peduncle			Pods per plant			Seeds per pod		
		MSS	F ratio	Sig	MSS	F ratio	Sig	MSS	F ratio	Sig
Replicate	6	.279	2.093	2.848	.531	.783	.062	23.452	.582	.774
Variety	6	.065	.484	10.446	1.949	.082	.818	38.667	.959	.458
Error	85	.133		5.360				40.303		
Total	98			NNS			NS			NS

P<0.05

Seeds per pod

The mean values of the seeds per pod for wet season cowpea genotypes ranged from 11.95 to 13.89 cm (Table 5), while those of the dry season ranged 3.79 to 9.42 cm (Table 6). The seasonal means for the cowpea genotypes were 11.11 ± 0.86 cm (wet season,) and 5.71 ± 1.30 cm (dry season), (Table 10).The highest mean value of seeds per pod in the wet season was recorded in the pods of IT98K-506-1 (13.89cm),

followed by IT06K-149-1 (13.85 cm). Among the dry season genotypes, higher number of seeds per pod were recorded in IT06K-149-1 (9.42cm) and IT98K-128-3 (6.45cm) respectively. Seeds per pod was comparatively low among other dry season genotypes such as IT93K-452-1 (3.79cm), IT98K-506-1 (4.97cm) and IT95K-1072-57 (4.46cm) respectively (Table 6).

The wet season cowpea genotypes were not significant ($p>0.05$) for seeds per plant (Table 7), whereas there were significant differences among the dry season genotypes ($p<0.05$) (Table 6). This result was in agreement with Dugje. *et al.*, Kamara, & Ajeigbe (2009) who asserted that time of planting could greatly influence pod filling.

Table 5: Grain filling in the cowpea genotypes studied in the wet season

Genotypes	Seeds per pod	Seeds per plant
Ife Brown	12.14	136.68
IT93K-452-1	11.95	154.53
IT98K-506-1	13.89	775.99
IT95K-1072-57	13.8	183.53
IT98K-128-3	13.49	186.3
IT06K-136	12.49	135.23
IT06K-149-1	13.85	205.58
Decision	NS	NS

Values are expressed as mean ± SD

Table 6: Grain filling in the cowpea genotypes studied in the dry season

Genotypes	Seeds per pod	Seeds per plant
Ife Brown	5.36 ^{bc}	17.33^{b}
IT93K-452-1	3.79^{d}	8.87^{d}
IT98K-506-1	4.97^{c}	9.61^{d}
IT95K-1072-57	4.46^{cd}	10.93 ^{cd}
IT98K-128-3	6.45 ^{b}	15.91 ^{bc}
IT06K-136	5.54 ^{bc}	12.18 ^{bcd}
IT06K-149-1	9.42 ^{a}	22.85^{a}
Decision	S	S

Means followed by the same alphabets are not significantly different at 5% level of probability by the Duncan Multiple Range Test.

Table 7: Analysis of variance on means for seeds per plant in seven cowpea genotypes grown in the wet season

Sources of Variation	Df	Seeds per plant		
		MSS	F ratio	Sig
Replication	6	691068.678	.929	.479
Variety	6	751651.265	1.010	.424
Error	85	744068.039		
Total	98			*NS

P<0.05

Table 8: Analysis of variance on means for branches per plant and days to flowering in seven cowpea genotypes grown in the dry season

Sources of Variation	Df	Branches per plant			Days to flowering		
		MSS	F ratio	Sig	MSS	F ratio	Sig
Replicate	6	1.939	1.359	.240	44.544	.417	.866
Variety	6	1.986	1.393	.227	223.830	2.094	.062
Error	85	1.426			106.875		
Total	98			*NS			NS

P<0.05

Table 9: Analysis of variance on means for pods per peduncle, pods per plant and seeds per pod in seven cowpea genotypes grown in the dry season

Sources of Variation	Df	Pods per peduncle			Pods per plant			Seeds per pod		
		MSS	F ratio	Sig	MSS	F ratio	Sig	MSS	F ratio	Sig
Replicate	26	.034	.811	.568	.565	.816	.564	.976	1.002	.439
Variety	6	.034	.811	.568	2.041	2.951	.019 ^{xx}	23.651	24.281	.000^{xx}
Error	85	.042			.692			.974		
Total	98			NS			^{xx} S			^{xx}S

P<0.05

Table 10: Seasonal influence on some growth parameters studied

	Wet Season		Dry Season		Total	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Branches per plant	4.63	1.099	3.99	0.68	3.81	0.25
Days to flowering	50.03	4.19	59.16	5.91	54.97	6.98
Pods per peduncle	3.16	11.63	3.04	1.16	3.10	0.08
Pods per plant	15.50	1.67	3.78	1.89	9.64	8.29
Pod length (cm)	16.66	1.33	12.66	0.69	14.66	2.83
Seeds per pod	11.11	0.86	5.71	1.30	9.37	5.17
Seeds per plant	253.97	12.60	13.95	5.02	133.96	169.72

Values are expressed as mean $\pm$ SD

DISCUSSION

Days to flowering showed significant seasonal differences among varieties. The wet season plants flowered as early as 45 days after planting (DAP), while some of the dry season plants spent as much as 64 DAP before flowering. The cowpea genotypes showed photoperiod sensitivity in agreement with Singh (1993) that genotypes whose days to first flowering are greater than 45 are photoperiod sensitive while those that flower in less than 45 days are photoperiod insensitive or day neutral. All the cowpea genotypes grown in the wet season except IT06K-136 (45.00) showed photoperiod sensitivity. They flowered between 46.36 DAP in IT93K-452-1 and 56.43 DAP in Ife Brown. In the dry season however, all the genotypes showed photoperiod sensitivity, with days to flowering ranging from 62.43 to 64.71 DAP. Manggoel and Uguru (2012) had noted that the time of flowering is particularly important in cowpea, *Vigna unguiculata* (L.) Walp as it served as an indicator of the level of adaptation to a particular environment.

Pod per peduncle was similar across genotypes but the number and length of pods varied, as noted from field observations. The highest mean number of pods was recorded on IT06K-149-1(17.79) and IT98K-128-3 (17.29), IT93K-452-1(16.36) and IT95K-1072-57 (15.00) among the wet season plants. These genotypes also produced flowers between 46.64 to 52.71 DAP, suggesting that early flowering in cowpea under good agronomic conditions could enhance pod development in agreement with Ishaku *et al*. (2005). On the other hand, Ife Brown (4.86), IT93K-452-1 (3.86) and IT95K-1072-57 (3.86) recorded the highest number of pods among the dry season plants. Variable pod length was observed among the genotypes. While IT95K-1072-57 and IT06K-149-1 had pods as long as 17.00 cm and above, the rest cowpea genotypes had pods ranging from 15.57 to 16.96 cm among the wet season varieties. Furthermore, the pods from the dry season cowpea genotypes also showed variability, ranging from 11.84 to 13.73 cm. Pod length correlated positively with the number of seeds per pod. This showed that cowpea genotypes with longer pods were likely to produce higher number of seeds per plant and better grain yield. Variability in pod length between cowpea genotypes grown in the wet season and those planted in the dry season implied that this trait was influenced by time of planting, in agreement with Ojomo and Raji, (1976) who cited that adequate availability of water to the crop throughout the growing period maintains an unimpaired growth.

Also evaluated in the study were seeds per pod and seeds per plant. Seeds per pod was not significant among varieties of the wet season ($p>0.05$) but there were significant differences among those of the dry season ($p<0.05$). IT98K-506-1 (13.89) recorded the highest value followed by T06K149-1(13.85), and IT95K-1072-57 (13.80), while the least number of seeds per pod was recorded in IT93K-452-1(11.95) among the wet season plants. Lesser values were reported for the dry season plants across the various genotypes. For instance, seeds per pod was highest in IT06K-149-1 (9.42), followed by IT98K-128-3 (6.45) and IT06K-136 (5.54) respectively while the values for the other genotypes ranged from 3.79 to 4.97. Pod filling was highly affected by seasons. Pod filling was more efficient among the wet season plants with an average of 11.11 seeds per pod than the dry season plant where an average of 5.71 seeds per pod was recorded. Similarly, field observations revealed that overall seeds per plant were highest among genotypes grown in the wet season although variations among the genotypes were not significantly different ($p>0.05$).

CONCLUSION

The study noted that flowering was initiated earlier in crops grown in the wet season than those cultivated in the dry season. Better productivity was further recorded among crops grown in the wet season in other parameters such as plant height, number of pods per plant, seeds per pod and seeds per plant. Conclusively, the dry season was not suitable for the cowpea genotypes grown as they showed low level adaptation for growth in South-South agro-ecological zone of Nigeria. Early flowering and higher number of pods per plant were recorded among IT06K-149-1(17.79), IT98K-128-3 (17.29), IT93K-452-1 (16.36), IT95K-1072-57 (15.00), in the wet season while Ife Brown (4.86) recorded the highest number of pods per plant in the dry season. Furthermore, longest pods were recorded in IT06K-149-1(17.86 cm) and IT95K-1072-57 (17.00 cm) for wet season plants, and in IT95K-1072-57 (13.73cm) and IT98K-128-3 (13.33 cm) for the dry season plants respectively. It is therefore concluded that seasonal variation in agro-climatic conditions was a major determinant of flowering and pod setting in cowpea, *Vigna unguiculata* L. Walp.

RECOMMENDATIONS

The study recommended the following cowpea genotypes for inclusion in cowpea hybridization programmes in South-South agro-ecological zone of Nigeria.

i. IT06K-149-1 recorded high variability in branches per plant, pod length, seeds per pod, and seeds per plant. It equally recorded higher grain yield than other genotypes in the wet season.
ii. IT98K-506-1, IT95K-1072-57 and IT98K-128-3 recorded high variability in morphological and agronomic characters studied. They also recorded high number of seeds per plant among the dry season plants. It is consequently recommended due to its ability to produce better than the other cowpea genotypes under low rainfall conditions.

REFERENCES

Bisikwa, J., Kawooya, R., Ssebuliba, S.P., Ddungu, M., Biruma, M. and Okello, D.K. (2014). Effect of plant density

on the performance of local and elite cowpea (Vigna unguiculata) L. Walp) varieties in Eastern Uganda. *African Journal of Applied Agricultural Science and Technologies* [online], 1(1): 28-41.

Boukar, O., Belko, N. & Chamarthi, S., Togola, A. *et.al*., (2018). Cowpea (*Vigna unguiculata*): Genetics, Genomics and Breeding. Plant Breeding, 138 (4): 415-424

Carsky, R.J., Singh, B.B and Oyewole, B. (2001). Contribution of early season Cowpea to late season maize in the savanna zone of West Africa. Biol Agric Hortic 18: 303-315.

Cook, B. (2008). Cowpea. Factsheet-cowpea. Retrieved on 11/9/2012 from *http://www.pasturepicker.comau/html/cowpea.htm*

Davies, D.W., Oelke, E. A., Oplinger, E.S., Doll, J.D., Hanson, C.V. and Putnam, D.H. (2010). Cowpea. Alternative Field Crops Manual. University of Wisconsin and Minnesota: Centre for Plant and Animal products.

Dugje, I.Y., Omoigui, L.O., Ekeleme, F., Kamara, A.Y. and Ajeigbe, H. (2009).Farmers' guide to cowpea production in West Africa. IITA, Ibadan, Nigeria. 20 p.

Edeh, H.O. and Igberi, C.O. (2012). Assessment of vegetable cowpea production among small holder farmers in Ebonyi State, Nigeria. *APRN Journal of Agricultural and Biological Science* **7** (3) 215-222.

Fawole, I. (1986). Selection for morphological traits in cowpea. *Tropical Grain Legume Bull.* **32**: 31-33.

Ishaku, M.F., Singh, B.B and Craufurd, P.Q. 2005). Inheritance of time of flowering in Cowpea (*Vigna unguiculata* (L.) walp.). *Euphytica* 142: 291-300.

Lush, M.W. (1979). Floral morphology of wild and cultivated cowpea. *Economic Botany* 33(4): 442-447.

Lush, M.W. and Evans, L.T. (1980). Photoperiodic regulation of flowering of cowpea, (*Vigna unguiculata* (L.) Walp.). *Annals of Botany*, 46: 719-725.

Manggoel, W. and Uguru, M.I. (2012). Evidence of maternal effect on the inheritance of flowering time in cowpea (*Vigna unguiculata* (L.) Walp.). *International Journal of Plant Breeding and Genetics.* 6: 1-16.

Muktar, F.B. and Singh, B.B. (2006). Influence of photoperiod and gibberellic acid (GA_3) on the growth and flowering of cowpea (*Vigna unguiculata* (L.) Walp.). *J. Food Agric Environ*, 4: 201-203.

Olorunmaiye, K.S. (2010). Reproductive performance of two cowpea *(Vigna unguiculata* (L.) Walp) varieties, Ife Brown and TVx3236 as influenced by imidazolinone and Dinitroaniline herbicides. *Australian Journal of Agricultural Engineering* 1(3): 101- 105.

Othman, S.A., Singh, B.B. and Mukhtar, F.B. (2006). Studies on the inheritance pattern of joints, pods and flower pigmentation in cowpea (*Vigna unguiculata* (L.) Walp).*African Journal of Biotechnology* 5 (23): 2371-2376.

Pasquet, R.S. (1998). Morphological study of cultivated cowpea, *Vigna unguiculata* (L.) Walp.) Importance of ovule number and definition of cv gr Melanophthalmus. *Agronomie*, (18): 61-70.

Rawal, K.M. (1975). Natural Hybridization among wild, weedy and cultivated *Vigna unguiculata* (L.) Walp. *Euphytica.* 24:699-707.

Singh, B.B. (1993). Cowpea breeding. Archival Report, Part 1 (1988-1992), IITA Publication, IITA Crop Improvement Division, Ibadan, Nigeria. pp 1-65.

Uarrota, V.G. (2010). Response of cowpea (*Vigna unguiculata* (L.) Walp.) to water stressand phosphorus fertilization. *J. Agron;* **9**: 87-91.