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AGRONOMIC POTENTIALS OF COWPEA, V*igna unguiculata* L. (WALP) GROWN IN THE RAINFOREST ZONE OF SOUTHERN NIGERIA

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Abstract
Seven varieties of cowpea (Vigna unguiculata), Ife Brown, IT98K-128-3, IT98K-506-1, IT93K-452-1 and IT95K-1072-57, IT06K-149-1, and IT06K-136 were obtained from the International Institute of Tropical Agriculture, Ibadan (IITA) and evaluated at the Biological Garden of the University of Delta, Agbor, to determine the development of agronomic characteristics under the influence of the rainforest climatic conditions for possible selection of germplasm for domestication. The study recorded that there were no significant differences among the cowpea varieties but noted higher number of pods per plant for IT06K-149-1(15.79), IT98K-128-3 (15.29), IT93K-452-1 (14.36), IT95K-1072-57 (14.00) while longer pods were recorded in IT06K-149-1(15.86 cm) and IT95K-1072-57 (15.00 cm). These agronomic characteristics are positive indicators of high yield in cowpea and the paper recommended that they could be domesticated for cultivation by farmers.

Key words: Agronomic characters

Cowpea, V*igna unguiculata* (L.) Walp is an important pulse found in the tropical as well as subtropical countries covering about 65 countries in Asia and Oceania, the Middle East, Southern Europe, Africa, Southern USA and Central and South America (Singh, Cambliss and Sharma, 1997). Cowpea belongs to the family *Fabaceae* (*Leguminosae*), sub-family *Papilionoideae* and genus, *Vigna* with about one hundred and seventy species.

Boukar, *et al*., (2018) noted that 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 Brasil (about 1.9 million ha and 0.7 tons) respectively. This important tropical and subtropical legume is grown for forage, green pods, and grains. It is an excellent source of protein for both humans and livestock. White seeded varieties and black-eyed types are commonly grown for grain and table use. While viny varieties that mature late are preferred for forage cowpea and can be grown on wide range of soil types and under a diversity of climatic and cultural condition. Highest yields of forage are obtained in sandy loam soils supplemented with irrigation. However for seed production, cowpea reasonably performs well on soil with low fertility. High rates of nitrogen and excessive moisture are detrimental and can result in excessive vegetative growth, delayed maturity and pod shattering (Ali, Aslam, Hussain and Shakur, 2004).

Cowpea is grown for both grain and fodder. It is of major importance to the nutrition and livelihood of millions of people. It is equally important as nutritious fodder for livestock (Sheela and Gopalan 2006). It is rich in proteins and mineral elements (Mullen 2005). It's dry edible seed or pulse contains about 23 percent protein, 17 percent water, 56.8 percent carbohydrate, 1.3 percent fat, 3.9 percent fibre and 3.6 percent ash (Bressani, 1985). Cowpea cultivation is constrained by the vagaries of ecological stress. Climate variability has made the onset and termination of rains unpredictable resulting in a shift to the cultivation of early maturing varieties by farmers. The concept of early maturity in cowpea is a combination of early flower initiation and short grain filling period (Owusu, *et al.*2018).

Problem of the Study

Cowpea performs well in agro ecological zones where the rainfall range is between 500 and 1200 mm/year and poorly under heavy rainfall regimes. However, with the development of extra-early maturing cowpea varieties, the crop can thrive in the Sahel where the rainfall is less than 500mm/year. Delta State with an annual average rainfall of 2000mm, a mean annual temperature of 27ºC, lies on latitude 6º00'N to 6º25'N and longitude 6º05'E and 6º25'E. The soil profile consists mostly of red and yellow earth and loose poorly sorted sands intermixed with clay deposits in some places. The soil suffer excessive internal drainage, erosion and intensive leaching. The lowland has soil waterlogged, muddy and saturated with salt water with mangrove forests. The upland has well drained soil that support the rain forest.

The rich soil of Delta State supports the growth of tree crops such as timber, rubber, oil palm as well as food crops such as maize, yams, cassava and plantain. The conventional cowpea varieties which are cultivated for their high protein content in the savannahs of Northern Nigeria do not thrive well here. Only some mottled land race varieties which are highly susceptible to pests, with less appeal to consumers is cultivated in intercrops as companion crops with cereals, yams and cassava.

Objective of the Study

The overall aim of the study is to determine cowpea varieties that will adapt to the ecological conditions of Agbor, in the rainforest zone of Delta State.

1.1.4 Specific Objectives of the Study.

The specific objectives of this research include:-

i. Determine cowpea varieties that will adapt to the rainforest agro-ecological conditions of Agbor, Delta State, through the evaluation of variation in their morphological and agronomic characteristics.

The Field Experiments.

The experimental crops were planted at the biological garden of College of Education, Agbor in the planting season of 2021. The experiments 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 seven treatments were randomly assigned to the plots in each replicate by the lottery technique. The plot measured 2x2 meters per

replicate, per variety. Weeds and insect pests were controlled manually as well as through the use of pesticides, respectively.

Data Collection

The following data were collected.

a). Quantitative characters

The morphological development of the seven varieties of cowpea was examined for the following characteristics: Numbers of days to emergence, Number of emergent plants, plant height at second, fourth, sixth and eight weeks respectively, number of days to first flowering, number of branches per plant, number of pods per peduncle, and number of days from planting to first ripe pod.

Evaluation of Agronomic Characters

Seven cowpea genotypes were studied during the 2021 cropping season in Agbor, Delta State (May to August). The results of 9 agronomic characters studied were presented in Tables 1, and 2 respectively. The agronomic characters are days to emergence, percentage emergence, plant heights, branches per plant, days to flowering, nodules per plant, pods per peduncle, pods per plant, and pod length. Analysis of variance indicated no significant differences for most morphological, and agronomic components (appendix 1a-b).

Days to Emergence

Tables 1 shows the pattern of emergence among the cowpea genotypes. The mean value of days to emergence varied from 3.43 to 3.71 across genotypes. This showed that although differences were observed in the days to emergence across the seven cowpea genotypes, the differences were not significant ($p>0.05$). The seedlings received adequate moisture at the time of planting hence environment did not confer any stress on the emergence of seedlings. Dugje *et al.,* (2009) noted that adequate supply of moisture was needed for cowpea seeds to emerge after planting.

Percentage Emergence

The percentage emergence of the cowpea seedlings ranged from 46.23 to 72.64 percent (Table 1). The seasonal mean emergence was 58.94. There was no significant difference among the genotypes ($p>0.05$) however, Ife Brown (72.64 %) recorded the highest percentage emergence. The high percentage emergence could have been influenced by the time of cultivation which was around August for the wet season plants, in agreement with the suggestion of Dugje *et al.,* (2009).

Plant Height (cm)

The mean height of the cowpea genotypes varied from 27.84 to 62.95 cm (Table 1). Ife Brown (62.95) was the tallest plant among the genotypes at 8 WAP, followed by IT06K-136 (52.61) and IT98K-506-1(47.84) while the least value was recorded in IT93K-452-1 (27.84) (Table 1). Plant height among the genotypes were significant ($p<0.05$) (Table 1). This result was 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.

Table 1: Emergence and growth of seven cowpea genotypes at 8 WAP

Genotypes	Days to emergence	Percentage emergence	Height at 2 weeks	Height at 4 weeks	Height at 6 weeks	Height at 8 weeks
Ife Brown	3.64	72.64	8.77	12.87	32.99	62.95[a]
IT93K-452-1	3.64	66.78	8.61	12.84	20.19	27.84 [c]
IT98K-506-1	3.50	50.04	7.91	10.64	28.76	47.84 [ab]
IT95K-1072-57	3.71	46.23	7.76	10.79	26.86	45.15 [abc]
IT98K-128-3	3.43	54.94	7.87	13.14	26.93	41.94 [bc]
IT06K-136	3.57	59.30	8.28	12.74	31.16	52.61 [ab]
IT06K-149-1	3.36	62.67	7.34	11.04	20.91	40.83 [bc]
Decision	NS	NS	NS	NS	NS	S

Days to Flowering

Flowers were produced between 44.00 to 55.43 days after planting (DAP). Days to flowering was not significant across cowpea genotypes ($p>0.05$) (Appendix 1a). 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 cowpea genotypes grown showed potential adaptability to the rainforest agro-ecological climate of Delta State based on the time of planting.

Nodules Per Plant

The number of nodules per plant varied from 5.71 to 8.21 across genotypes (Table 2). Nodulation was not significant ($p>0.05$) among the cowpea varieties (Appendix 1a). Nodules were more pronounced in IT98K-128-3 with 8.21. The least number of nodules were recorded in Ife Brown (5.79) and IT06K-149-1 (5.71). Nodules are important for nitrogen fixation. According to Danso (1992), nitrogen is a key element required for plant growth and stressed that the symptoms of its deficiency in soils range from poor yields to crop failures.

Pods Per Peduncle

The mean number of pods per peduncle for the cowpea genotypes varied from 2.07 to 2.21 (Table 2). Pods per peduncle was not significant across genotypes ($p>0.05$) (Appendix 1b). Highest mean number of pods per peduncle of 2.21 each was recorded in IT98K-506-1, IT98K-128-3, IT06K-136 and IT06K-149-1. The mean number of pods per peduncle recorded in this

study was in agreement with Edeh and Igberi, (2012) who noted that the peduncles of cowpeas carry just one or two pods and sometimes none.

Number of Pods Per Plant

The mean values of number of pods per plants ranged from 11.50 to 15.79 (Table 2). Pods per plant were not significant among the genotypes ($p>0.05$) (Appendix 1b). The highest number of pods was recorded for IT06K-149-1 (15.79), and IT98K-128-3 (15.29), followed by IT93K-452-1 (14.36), IT95K-1072-57 (14.00), (Table 2). The study noted that the cowpea genotype, IT06K-149-1 which recorded the highest number of branches (4.29) also produced the highest number of pods (15.79). 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.

Days to Flowering

Flowers were produced between 44.00 to 55.43 days after planting (DAP). Days to flowering was not significant across cowpea genotypes ($p>0.05$) (Appendix 1a). 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 cowpea genotypes grown showed potential adaptability to the rainforest agro-ecological zone of Delta State based on the time of planting.

Nodules Per Plant

The number of nodules per plant varied from 5.71 to 8.21 across genotypes (Table 2). Nodulation was not significant ($p>0.05$) among the cowpea varieties (Appendix 1a). Nodules were more pronounced in IT98K-128-3 with 8.21. The least number of nodules were recorded in Ife Brown (5.79) and IT06K-149-1 (5.71). Nodules are important for nitrogen fixation. According to Danso (1992), nitrogen is a key element required for plant growth and stressed that the symptoms of its deficiency in soils range from poor yields to crop failures.

Pods Per Peduncle

The mean number of pods per peduncle for the cowpea genotypes varied from 2.07 to 2.21 (Table 2). Pods per peduncle was not significant across genotypes ($p>0.05$) (Appendix 1b). Highest mean number of pods per peduncle of 2.21 each was recorded in IT98K-506-1, IT98K-128-3, IT06K-136 and IT06K-149-1. The mean number of pods per peduncle recorded in this study was in agreement with Edeh and Igberi, (2012) who noted that the peduncles of cowpeas carry just one or two pods and sometimes none.

Table 2: Agronomic characteristics of seven cowpea genotype

Genotypes	Branches per plant	Days to 1st flowering	Nodules per plant	Pod per peduncle	Pod per plant	Pod length
Ife Brown	3.50	55.43	5.79	2.14	11.86	14.67
IT93K-452-1	3.50	45.36	7.71	2.07	14.36	13.57
IT98K-506-1	3.71	45.64	7.93	2.21	12.71	14.96
IT95K-1072-57	3.07	49.57	7.21	2.07	14	15
IT98K-128-3	3.86	50.71	8.21	2.21	15.29	13.99
IT06K-136	3.50	44.00	7.21	2.21	11.5	14.58
IT06K-149-1	4.29	50.50	5.71	2.21	15.79	15.86
Decision	NS	NS	NS	NS	NS	NS

Number of Pods Per Plant

The mean values of number of pods per plants ranged from 11.50 to 15.79 (Table 2). Pods per plant were not significant among the genotypes ($p>0.05$) (Appendix 1b). The highest number of pods was recorded for IT06K-149-1 (15.79), and IT98K-128-3 (15.29), followed by IT93K-452-1 (14.36), IT95K-1072-57 (14.00), (Table 2). The study noted that the cowpea genotype, IT06K-149-1 which recorded the highest number of branches (4.29) also produced the highest number of pods (15.79). 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 2 .They vary from 13.99 to 15.86 cm (Table 2). Longest pods were recorded in IT06K-149-1 (15.86 cm) and IT95K-1072-57 (15.00cm) respectively. Pod length was not significant across the cowpea genotypes. 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.

Discussion

The variation on days to emergence, percentage emergence, plant height, nodules per plant, pod per peduncle, pod per plant and pod length were evaluated in the planting season of 2021 . The seven cowpea genotypes emerged within three to four days, with not less than 45 percent emergence, which indicated that all the varieties were viable.

The mean height of cowpea plants grown was comparable and showed no significant difference ($p> 0.05$) at the early stages of growth (from week two to six) after emergence (Tables 1). However, there was a significant difference ($p< 0.05$) in mean plant height at week

eight among the plants. Ife Brown recorded the highest value in mean height (62.95 cm), followed by IT06K-136 (52.61cm) while the least was noted on IT93K-452-1 (27.84 cm). Adequate growth and development are determinants of good yield outcomes in cowpea, *Vigna unguiculata* as documented by Noggle and Fritz (2006).

Branching among the cowpea varieties was not significantly different ($p>0.05$). This was in agreement with the report of Nehru and Suvarna (2009). Days to flowering showed significant differences among the varieties. On the average, some plants flowered as early as 48 days after planting (DAP), while some spent as much as 55 DAP before flowering. The cowpea genotypes showed photoperiod sensitivity in agreement with the assertion of 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 except IT06K-136 (44.00) showed photoperiod sensitivity. They flowered between 45.36 DAP in IT93K-452-1 and 55.43 DAP in Ife Brown. 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. The result showed that cowpea, *Vigna unguiculata* could adapt favourably to the rain forest zone if planting is well timed.

Nodulation in the cowpea genotypes did not show any significant difference, however nodule production was prolific among genotypes. Fernandez and Miller (1985), had shown that the number of nodules per plant was heritable and may be used as criteria for selection in improvement programs. 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(15.79) and IT98K-128-3 (15.29), IT93K-452-1(14.36) and IT95K-1072-57 (14.00). Variable pod length was observed among the genotypes. While IT95K-1072-57 and IT06K-149-1 had pods as long as 15.00 cm and above, the rest cowpea genotypes had pods ranging from 13.57 to 14.96 cm. Cowpea genotypes with longer pods often produce higher number of seeds per plant and give better grain yield.

Conclusion

The study recorded that there was no significant difference in agronomic characters such as plant height except at 8 WAP. Also, there was no significant difference in the number of branches per plant. Furthermore, agronomic characters such as nodules per plant, pods per plant, pods per peduncle, and pod length did not show significant differences among the cowpea varieties.

Recommendations

From the study, high number of pods per plant were recorded among IT06K-149-1(15.79), IT98K-128-3 (15.29), IT93K-452-1 (14.36), IT95K-1072-57 (14.00). Furthermore, longest pods were recorded in IT06K-149-1(15.86 cm) and IT95K-1072-57 (15.00 cm). These agronomic characteristics are positive indicators of high yield in cowpea and the above cowpea lines are therefore recommended for cultivation by potential cowpea breeders in thr rainforest agro-ecological zones of Nigeria.

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Appendices:

Appendix 1a: Analysis of variance on means for branches per plant, days to flowering and nodules per plant in seven cowpea genotypes

Sources of Variation	df	Branches per plant MSS	F ratio	Sig	Days to flowering MSS	F ratio	Sig	Nodules per plant MSS	F ratio	Sig
Replicate	6	1.939	1.359	.240	44.544	.417	.866	8.235	.730	.627
Variety	6	1.986	1.393	.227*	223.830	2.094	.062*	13.949	1.237	.296*
Error	85	1.426			106.875			11.278		
Total	98			*NS			*NS			*NS

P<0.05

Appendix 1b: Analysis of variance on means for pods per peduncle, pods per plant and seeds per pod in seven cowpea genotypes

Sources of Variation	df	Pods per peduncle MSS	F ratio	Sig	Pods per plant MSS	F ratio	Sig
Replicate	2 6		2.093	.062	23.452	.582	..774

		.279					
Variety	66	.065	.484	.818	38.667	.959	.458
Error	85	.133			40.303		
Total	98			NS			NS

P<0.05