IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 9, Issue 9 Ver. II (Sep - Oct. 2016), PP 48-55
www.iosrjournals.org

Assessment of Advanced Lines of Cowpea for Nodulation, Dry Matter Accumulation And Grain Yield

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Abstract: *In an experiment conducted at University of Agriculture, Abeokuta Teaching and Reaserch farm (Alabata), twenty one cultivars of cowpea Vignaungiuculata (L) Walp were evaluated for their nodulation, dry matter accumulation and grain yield.The varieties were laid out in a randomized complete block design and replicated three times.Two categories of varieties were observed in the study. The first category consist of Danila, IT 96D -651, IT96K-113-6, IT97K-508-2, IT96D-648 which produced high nodule count (50-81 per plant) and biomass (0.777t/ha to 1.733t/ha) thus having potential in a crop/livestock system for fodder production.The second category of varieties IT95K-366-1, IT93K-452-1, IT95K-1090-12, IT97K-1034-14, IT97K-508-2, IT95K-1091-3, IT86D-719,Ife brown produced high biomass (1.040t/ha to 1.733t/ha) and good grain yield (1257kg/ha to 2991kg/ha). This group can therefore be cultivated as dual purpose varieties.Other agronomic traits of the varieties were synchronous maturity date of 65DAP and 77DAP giving the producer and advantageof harvesting in one or two harvesting operations.*

Keywords: *Nodulation, Dry Matter, DAP, Yield, Biomass*

I. Introduction

Cowpea (*Vignaunguiculata*(L) Walp) belongs to the family *Fabacene*.Cultigroup*unguiculata*is the most diverse of the cultivated subspecies. It is the most important grain legume crop throughout the tropical belt of Africa and America. Cowpea is a key staple food for the poor in the tropical and sub-tropical Africa because of the protein that it provides for the urban and rural population. It is relatively cheap and readily available to the poor. (Aghali, 1991) The chemical composition of cowpea compares well with that of most edible legumes with composition as follows; 25 – 30% protein, 7% crude fibre, 49% Ash (Singh, 1993). Cowpea protein contains relatively high lysine content of (55 -60%) thus making cowpea an excellent protein supplement to cereal based diet. In Nigeria, cowpea is boiled and eaten in form of dry seeds, green pods, green seed and tender green leaves, as well as fried bean cake and moin-moin. It can be used for baking by adding wheat flour to it. Green beans or cut green pods used as vegetable is of secondary importance for making soup. Cowpea has the ability to fix atmospheric nitrogen efficiently up to 240kg nitrogen per hectare it thus provides a high proportion of its own nitrogen requirements besides leaving a fixed nitrogen deposit in the soil of up to 60 – 70kg per hectare for succeeding crop (Miller *et al*., 1986)

Cowpea plays a vital role for soil fertility restoration, which results from its nitrogen fixing root nodules. Nitrogen fixation is achieved through the symbiotic association between the rhizobia bacteria and the root legume. This infects the root of cowpea plant, forming nodules. These rhizobia reduce atmospheric nitrogen (N_2) into compounds assimilable by the host plant. Nitrogenous substances accumulate in the leaves during vegetative growth and they are then transported to the seed during grain filling and subsequently resulting in good grain yield. Cowpea fits very well as a rotation/alternate crop during the dry season, as it requires a moderate amount of water and matures within 60 – 80 days of planting. Despite the popularity of cowpea as a food item, production is not popular among farmers in the humid tropics. Most of the cowpea consumed in the humid south-western Nigeria is produced from the drier savannah of the north.Production of the crop is not very popular among the farmers in the humid southwest because of insect pest particularly Maruca and disease problems which cause low yield (Singh, 1993). The crop is susceptible to insect pest at virtually all stages of development. Such pests include *Leaf thrips, aphids,* maruca, and bruchids. Several cowpea varieties have been developed at International Institute of Tropical Agriculture (IITA), which combines resistance to viruses, thrips, nematodes, aphids, bruchids and striga with high yield. (Singh *et al*, 1997) Cowpea improvement involves developing progeny lines through many generations up to F_6.By the 5^{th} generation of crossing, the resulting lines are regarded as advanced lines. Such lines need to be evaluated in different agroecologies while promising lines are advanced to multi-locational yield trials before their eventual release.

Objectives Of The Study

The objectives of this study were:

1. To assess the contribution of nodulation to grain yield and dry matter production.
2. To determine the varieties that have potentials for high biomass and grain yield.
3. To recommend the high yielding varieties to farmers.

II. Materials And Methods

Study Area

The experiment was conducted on the teaching and research farm of University of Agriculture, Alabata, Abeokuta, Nigeria (Latitude $7° 20'N$ and Longitude$3° 23'E$) to evaluate 21 lines of cowpea for productivity. A preplanting operation was carried out which involved a general view of the farm sites to identify the weed types, vegetation and topography.

Experimental Design, Treatments And Plot Sizes

The field was laid out using a 3, 4, 5 Pythagoras procedure. The varieties were evaluated in a randomized complete block design in three replications during the late cropping season. Each plot that consisted of five rows had a gross size of 5m× 4m and each replicate comprised of 21 plots giving a total of 63 plots. The net size of the plot was 3m× 2m.The cowpea lines were supplied by International Institute of Tropical Agriculture (IITA).

Cultural Practices

Two seeds of cowpea were planted in hills spaced at 20cm in 1m width row. Planting was done by dibbling. Weeds were controlled by hoe at 3 and 6 weeks after planting using West African hoes. Insect pests were controlled by the application of Sherpa plus (formulated mixture cypermethrin+ dimethoate) at the rate of 20mL/10L of water. Spraying against insect pests commenced five weeks after planting (WAP) and was repeated at ten days interval until three sprayings were done and when the pods had started maturing.

Data Collection

Nodule Count

This commenced 2 weeks after planting (WAP) and continued weekly until flowering stage (35 DAP). Four plants from two stands were randomly uprooted along the border rows. Roots of the uprooted seedlings were detached and the nodules counted. The nodules counted were enveloped and dried in an oven at 70℃ for 24 hours. Four samplings were done.

Dry Matter Production

The shoots of the four randomly uprooted plants used for nodule count were bagged and weighed before and after drying in the oven at 70℃ for 48 hours. This was done repeatedly at weekly intervals until flowering stage (35 DAP).The shoot sampling commenced 2 weeks after planting (WAP).

Number Of Days To 50 Percent Flowering

This was taken as the number of days from planting till when 50 percent of the stands on the entire plot had flowered.

Number Of Days To 90 Percent Maturity

Days to 90 percent maturity was taken as the number of days from planting to the time when 90 percent of the total pods had reached physiological maturity that the pods were fully filled and were already turning brown in colour.

Number Of Peduncles Per Plant

Four plants harvested from the border row were used for this. The peduncles from these plants were counted and the average per plant calculated.

Pods Per Peduncle

Pods of each peduncle of the four plants harvested were counted and average of pods per peduncle calculated.

Pods Per Plant

Number of pods per plant were obtained as an average of pods of four plants from the border row.

Pods Yield

The total pods harvested from the net plot was weighed to obtain the pod yield.

Pod Length

Pod length was obtained per variety. Length of the pods obtained from the four harvested plants from the border rows were measured at harvest.

Grain Filling

Grain filling was obtained by estimating the difference in number of days to 50 percent flowering and number of days to 90 percent maturity.

Number Of Seeds Per Pod

Number of seeds per pod was obtained as an average number of seeds of five pods.

One Hundred Seed Weight

100 seed weight was obtained by counting 100 seeds from each plot yield and weighing using the top loading mettler balance.

Grain Yield

The grain yield was obtained by threshing the pods after harvesting, winnowing and weighing of total grains obtained from the net plot.

Cowpea Fodder Yield

An average of 10 plants were cut at above ground level, dried and weighed to determine the cowpea fodder. This was done after harvesting the grain.

Statistical Analysis

The data obtained were subjected to analysis of variance (ANOVA) and means separated by standard error of means. Correlation Co-efficient and regression were also done to determine the relationship among characters or parameters.

III. Results

Number Of Nodules And Dry Weight

The result of the number of nodules and dry weight are shown in Table 1.

Significant differences exist among the cultivars for number of nodules at the seedling (14 DAP) and vegetative stages (21 – 35 DAP) of development. However, only the nodule weight of cowpea at 28 DAP differed significantly among the varieties.

The peak nodulation period was at 14 DAP and nodulation declined until 35 DAP for some varieties like IT96D-651, IT97K-608-4, and Ife brown as shown in Table 1.

Table 1: *Analysis of Variance on nodule number and dry weight.*

VARIETIES	NNP 14 DAP	NNP 21 DAP	NNP 28 DAP	NNP 35 DAP	NDWP 14 DAP	NDWP 21 DAP	NDWP 28 DAP	NDWP 35 DAP
IT95K-366-1	6kl	6fg	5h	7efg	0.010	0.040	0.037ghi	0.033
IT93K-452-1	10fgh	14c	3i	5gh	0.017	0.050	0.010k	0.027
IT95K-1090-12	8ij	8e	7gh	6fg	0.017	0.033	0.050ef	0.043
IT96D-651	13cd	11d	15c	9d	0.023	0.040	0.037b	0.037
IT96K-113-6	11fg	19b	14d	13b	0.017	0.037	0.050ef	0.067
IT93K-686-2	9ghi	11d	9f	6efg	0.017	0.027	0.040fgh	0.040
IT97K-608-14	16ab	13c	5h	3i	0.047	0.033	0.013k	0.010
IT97K-837-8	5lm	6efg	3i	2i	0.010	0.027	0.013k	0.027
DANILA	16a	21a	26a	18a	0.027	0.067	0.117a	0.090
IT97K-1034-14	11ef	14c	7fg	8de	0.020	0.040	0.030hij	0.030
IT97K-508-2	13de	21a	9f	13b	0.023	0.047	0.040fgh	0.057
IT95K-1091-3	4m	3h	6gh	4hi	0.010	0.010	0.057de	0.023
IT97K-499-8	9ghi	5g	6gh	7def	0.017	0.017	0.027ij	0.053
IT97K-899-180	3m	2h	3i	3i	0.013	0.010	0.020jk	0.020
IT94K-437-1	6jk	8e	9f	6fg	0.017	0.033	0.037ghi	0.053
IT97K-403-2	8i	7ef	6gh	4hi	0.010	0.020	0.043fg	0.053
IT97K-499-39	4m	7ef	2i	4hi	0.010	0.037	0.010k	0.027
IT96D-648	10fgh	17b	11e	18a	0.023	0.060	0.047cfg	0.087
IT97K-497-2	9hi	7ef	11e	6fg	0.020	0.023	0.083b	0.043
IT86D-719	9ghi	11d	12e	9d	0.020	0.043	0.067cd	0.063
IFE BROWN	15bc	11d	21b	11c	0.043	0.040	0.077bc	0.050
$SE \pm$	**3.78**	**4.05**	**4.39**	**4.82**	**0.00**	**0.00**	**0.00**	**0.00**

Nodulation increased significantly between 14 DAP and 21 DAP for such varieties as IT93K-452-1, IT96K-113-6, IT93K-686-2, DANILA, IT97K-1034-14, IT97K-508-2, and IT96D-648. The highest nodulating cultivar is DANILA which produced consistently high nodules up to 28 DAP. Even at 35 DAP DANILA ranked among the varieties with highest number of nodules. For some others,nodulation increased significantly between 14DAP and 21DAP.This was noted for varieties IT93k-452-1,IT96k-113-6,IT93k-680-2,Danila,IT97k-1034-14,IT97k-508-2,and IT96D-648.The highest nodulation cultivar is Danila which produced consistently high nodules up to 28DAP.Even at 35 DAP,DANILA ranked among the varieties with highest no of nodules.

Agronomic Traits Of Cowpea Lines

Significant differences were observed among the varieties for number of days to attainment of 50% flowering, 90% maturity, as well as pod yield and grain yield The varieties attained 50 % flowering between 45 DAP and 50 DAP. The earliest to attain 50 % flowering were IT93K-452-1, IT97K-837-8, IT97K-1034-94, IT97K-403-2 (45 DAP) while IT95K-1091-3 attained 50% flowering at 50 DAP. Days to 90% maturity varied from 69 DAP to 77 DAP for IT960-651 and Ife brown respectively. Consequently, grain filling periods for the varieties were close. This varied from 22 days for IT94K-437-1 and 29 days for Ife Brown as shown in Table 2.

Table 2: *Analysis of Variance on the Agronomic Traits of Cowpea Lines*

Varieties	Days to 50% flowering	Days to 90% maturity	Grain filling
IT95K-366-1	47de	71ef	25bc
IT93K-452-1	45gh	71ef	25bc
IT95K-1090-12	48cd	72dc	24bc
IT96D-651	46fg	69h	23bc
IT96K-113-6	46f	71ef	25bc
IT93-686-2	47de	72e	24bc
IT97K-608-14	49b	73cd	23bc
IT97K-837-8	45gh	71ef	25bc
DANILA	47de	73cd	25bc
IT97K-1034-94	45h	71ef	27ab
IT97K-508-2	49b	73cd	24bc
IT95K-1091-3	50a	74b	24bc
1T97K-499-8	46fg	71ef	25bc
IT97K-819-180	49b	73c	24bc
IT94K-437-1	48c	71ef	22c
IT97K-403-2	45gh	72de	27ab
IT97-499-39	48cd	72de	24bc
IT960-648	46fg	70g	24bc
IT97K-497-2	47de	71ef	24bc
IT86D-719	46fg	70g	24bc
IFE BROWN	48cd	77a	29a
SE±	0.65	0.75	0.89

Means with same alphabets along the column are not statistically significantly different from one another according to Duncan's Multiple Range Test (DMRT) at 0.05 level of probability.

Yield and yield components of cowpea lines

Number of peduncle per plant varied between 9 for, IT96K-113-6 and 19 for IT97K-819-180. Ife brown recorded the highest number (3) of pods per peduncle and pods per plant, which varied between 24 for Ife brown and 8 for IT96K-113-6 and IT97K-499-8. Weight of 100 seeds from variety were significantly different from one another, IT93K-452 is significantly different in weight of 100 seeds (22.063g) from other varieties like Ife brown, IT860-719, IT95K-1090-12 among others. Number of seeds/pod ranged between 7 for IT96K-113-6, IT960-648 and 12 for IT95K-1091-3. Length of pod varied between (16.47cm) for IT97K-1034_94 and (11.02cm) for DANILLA. Cowpea fodder weight ranged between 1.733t for IT860-719 and 0.25t for IT97K-403-2. 15 varieties gave yield comparable to the Ife brown (local check while six others were not better than the check variety in terms of grain yield. Highest pod yield was recorded by Ife brown as compared to IT97K-499-8 that yield 1864kg/ha as shown in Table 3.

TABLE 3: *Analysis of Variance on yield and yield components of cowpea lines.*

Varieties	Pod yield kg/ha	Total seed yield kg/ha	Cowpea fodder t/ha	Length of pod (cm)	Seed pod	Peduncles plant	Pod per peduncle	Pod/ plant	100 seed weight
IT95K-366-1	2745bc	1257b	1.143	13.97de	10f	13f	2b	11g	12.420k
IT93K-452-1	3129bc	1975ab	1.040	12.27h	8g	12g	2b	11g	22.063a
IT95K-1090-12	3505bc	2151ab	1.283	13.77e	10ef	14ef	2b	12ef	15.980h
IT96D-651	4268abc	2475ab	0.963	13.90de	8h	11g	2b	14c	16.870g
IT96K-113-6	5332ab	2392ab	0.777	13.17fg	7i	9h	2b	8i	20.587b
IT93-686-2	4491abc	1831ab	0.600	13.53efg	9fg	14dcf	2b	10gh	18.290ef
IT97K608-14	3746abc	1929ab	0.993	12.23h	10de	16b	2b	15bc	19.313cd
IT97K-837-8	2831bc	1644ab	0.637	12.97g	8h	11g	2b	10gh	19.633c
DANILA	1913c	1105b	1.080	11.20i	10de	15cde	2b	12def	18.867de
IT97K-1034-94	1865c	1330b	1.247	16.47a	8hi	12g	2b	9h	16.670g
IT97K-508-2	2109c	1443ab	1.060	16.13a	10cd	15cd	2b	13cde	19.107cd
IT95K-1091-3	3504bc	1702ab	1.1110	14.40cd	12a	15cd	2b	16b	16.693g
IT97K-499-8	1864c	978bb	0.517	13.67ef	8ij	10gh	2b	8i	19.097cd
IT97K-819-180	2881bc	1317b	0.947	11.70hi	9g	19a	2b	12ef	17.950f
IT94K-437-1	3233bc	1776ab	0.753	13.17fg	11b	11g	2b	9h	15.730hi
IT97K-403-2	2869bc	1487ab	0.250	13.93de	11c	19a	2b	16b	15.947h
IT97-499-39	4181abc	2301ab	0.980	14.77c	10cd	13f	2b	14c	17.937f
IT960-648	4262abc	2397ab	0.643	14.63cd	7j	15bc	2b	13cd	18.860de
IT97K-497-2	4057abc	1912ab	0.927	15.33b	10c	14ef	2b	15bc	17.283g
IT86D-719	2988bc	1697ab	1.733	11.87b	9fg	12g	2b	9h	15.330i
IFE BROWN	6550a	2991a	0.677	12.03h	11c	16b	3a	24a	14.713j
SE±	47322728	146338.05	0.07	0.48	0.41	2.44	0.01	2.67	0.58

The variance attained 50% flowering between 45 Dap and 50 DAP. The earliest to attain 50% flowering were IT93K-452-1, IT97K-837-8, IT97K-1034-94, IT97K-403-2 (45 DAP) while IT95K-1091-3 attained 50% flowering at 50 DAP. Days to 90% maturity varied from 69 DAP to 77 DAP for IT960-651 and Ife brown respectively. Consequently grain filling periods for the varieties were close. This varied from 22 days for T94K-437-1 and 29 days for Ife brown as shown in table 2. Number of peduncle per plant varied between 9 for IT96K-113-6 and 19 for IT97K-819-180. Ife brown recorded the highest number (3) of pods per peduncle and pods per plant, which varied between 24 for Ife brown and 8 for IT96K-113-6 and IT97K499-8. Weight of 100 seeds from varieties were significantly different from one another, IT93K-452 is significantly different in weight of 100 seeds (22.063g) from other varieties like Ife brown, IT860-719, IT95k-1090-12 among others. Number of seeds/pod ranged between 7 for IT96K-113-6, IT96D-648 and 12 for IT95K-1091-3. Length of pod varied between (16.47cm) for IT97K-1034-94 and (11.20cm) for DANILA.Cowpea fodder weight ranged between 1.733t for IT860-719 and 0.25t for IT97K-403-2. 15 varieties gave yield comparable to the Ife Brown (local check while six others were not better than the check variety in terms of grain yield).Highest pod yield was also recorded by Ife Brown as compared to IT97K-499-8 that yield 1864 kg/ha as shown in table 3.

Relationship Among Various Agronomic Traits In Cowpea

Cowpea seed yield was positively correlated with number and weight of nodules; total dry matter production; number of pods per plant; pods per peduncle, number of days to 50% flowering and 90% maturity as well as pod yield as shown in table 4.

Table 4: *Correlation coefficient showing relation among various agronomic traits in cowpea.*

	100SW	*NOD NO.*	*NDW*	*TDM*	*PED/PT*	*POD/PT*	*POD PED*	*50%F*	*90%M*	*PY*	*SY*
100SW	1.00										
NOD NO.	0.14	1.00									
NDW	0.04	0.80*	1.00								
TDM	0.09	0.61*	0.71*	1.00							
PED/PT	0.20	0.41*	0.41*	0.38*	1.00						
POD/PT	0.02	0.32*	0.37*	0.39*	0.28*	1.00					
POD PED	-0.25	0.30*	0.39*	0.38*	0.27*	0.28*	1.00				
50%F	0.01	0.20	0.39*	0.32*	0.40*	0.41*	0.05	1.00			
90%M	0.01	0.37*	0.45*	0.56*	0.51*	0.54*	0.16	0.72*	1.00		
PY	0.04	0.20	0.28*	0.35*	0.15	0.36*	0.34*	0.36*	0.14-*	1.00	
SY	0.14	0.27*	0.29*	0.37*	0.15	0.30*	0.34*	0.36*	0.36*	0.88*	1.00

Key:

100SW-	One hundred seed weight		*POD/PED*	-	Pod per peduncle
NOD NO-	Nodule number		*50%F*	-	Days to 50% flowering
NDW -	Nodule Dry Weight		*90%M*	-	Days to 90% maturity
TDM -	Total Dry Weight		*PY*	-	Pod yield
PED/PT-	Peduncle per plant		*SY*	-	Seed yield
POD/PT-	Pod per plant				

Cowpea seed yield was positively correlated with number and weight of nodules; total dry matter production; number of pods per plant; pods per peduncle; number of days to 50% flowering and 90% maturity as well as pod yield (table 4).Regression analysis which was done with total nodulation against time and total dry matter against time had a linear relationship. While the number of nodules slightly decreased with age of plant, the dry weight of nodules and dry matter accumulation increased with the age of plants. (Figure 1, 2 and 3 respectively).

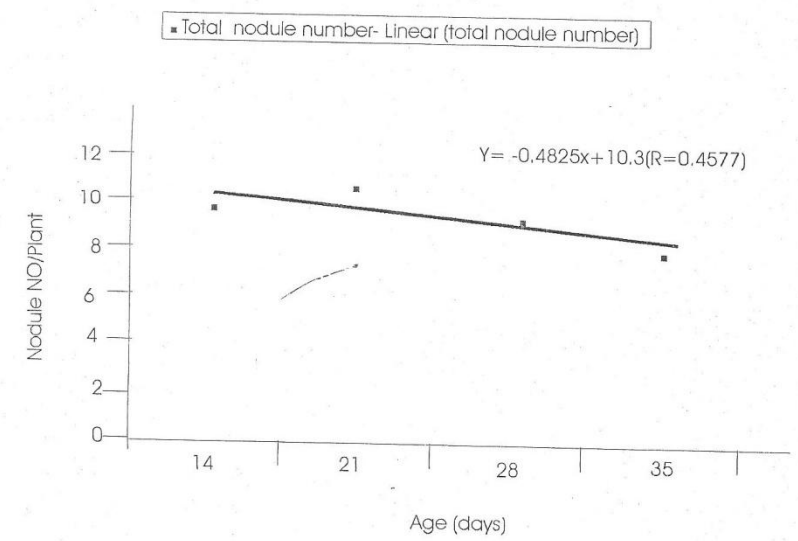

Figure 1: Regression Analysis of Total Nodule against Time

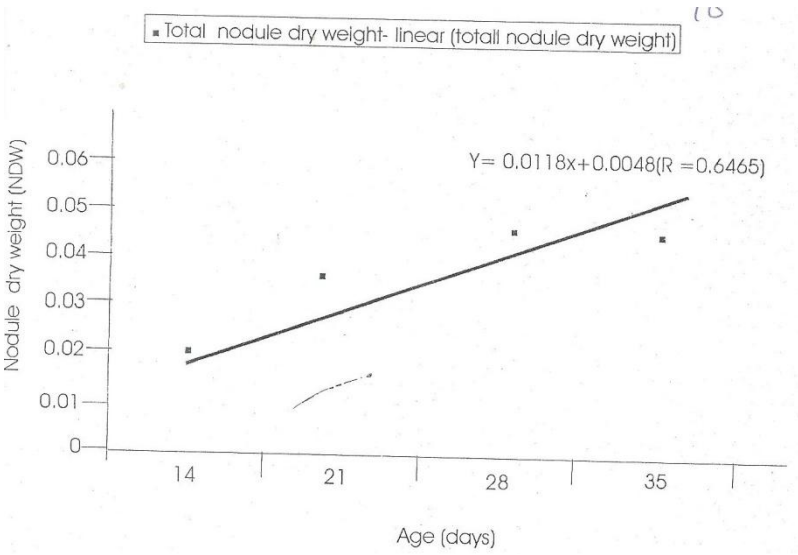

Figure II: Regression Analysis of Nodule Dry Weight Against Time.

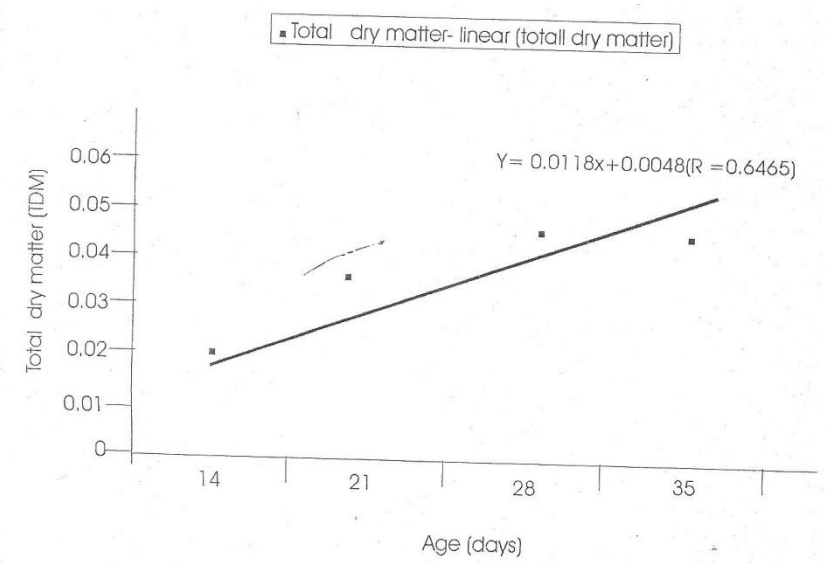

Figure III: Regression Analysis of Total Dry Matter Accumulation against Time

IV. Discussion

One of the economic importance of legumes is the ability to utilize atmospheric nitrogen through the nitrogen fixing ability of the rhizobium in the root. Generally, when rhizobia traps atmospheric nitrogen and convert it to nitrate, it becomes useful for vegetative growth of the crop. The cowpea varieties studied exhibited varying amount of nodulation. DANILA was the highest nodulation variety with 81 nodules per plant while, IT97K-819-180 was the least nodulating varieties with 21 nodules per plant. The increase in nodule weight with time observe for the varieties suggest that while number of nodules may decrease with time, nitrogen fixation and accumulation of fixed nitrate may increase and this could be reflected in higher nodule weight as observed in this study.Attainment of 50% flowering by the varieties were very similar hence they attained 50% flowering at about the same time between 47-49 DAP. Hence there is synchronous flowering of cultivars in this study. This is reflected in grain filling period and attain of maturity. On the average, varieties that flowered early had a short maturity period, IT96D-651 flowered at 46DAP and matured 69DAP while the varieties that flowered late had a long maturity period. This observation is similar to that for variety Ife brown which flowered at 48DAP and matured 77DAP. IT95k-1091-3 flowered at 50 DAP and matured at 74 DAP. Varieties that flowered early had a long grain filling period. Varieties such as IT97k-1034-94, IT97k-403-2, IT93k-452-1, IT97k-837-8 flowered at 45 DAP and had a long grain filling period of 27 DAP. The result confirm earlier finding of Wein and Ackah (1988), Alofe and Amusan (1992) who observed that cowpea varietythat flowered early will have a longer grain filling period. Generally, the maturity period of cultivars were similar. This is advantageous in that harvesting operation can be done once or twice thereby reducing labour and time. The differences in earliness to flowing were not reflected in the number of pods per plant produced. This is in agreement with the observation of Alofe and Amusan (1980).This study showed significant differences among the varieties evaluated as in length pod, seeds per pod and peduncles per plant. This indicates significant varietal difference among the varieties. Similar observations were noted by Singh and Mehndirrate (1989). Among the varieties studied, Ife brown had the highest number of pods/plant, likewise the highest grain yield. This confirms the report of Afolabi (1990) that the most important variable to seed yield is the numbers of pods per plant.

Correlation coefficient among the agronomic traits and yield components showed that seed yield has a significant positive correlation with pods per plant, pod per peduncle, days to 50% flowering, days to 90% percent maturity. This suggest that grain yield could be improved by selecting for these characters. This agree with a similar observation made by Okeleye*et al* (1999). The relationship between peduncle per plant and pods per plant is also worthy of note. Plants with many peduncles tended to bear more pods and consequently higher seed yield. This implies that an increase or decrease in the values of these traits will cause corresponding change in yield of the varieties. This result confirms the result of Veenupshappa*et al* (1990) which showed significant correlation between pods per plant and yield. There was no significant correlation between 100 seed weight and yield. This agrees with the report of Leleji (1981) and Aolabi (1980). This result suggest that out of the three yield components measured, two (pod per plant and pod per peduncle) had a significant positive correlation with yield. Nodulation had a significant positive correlation with yield. This implies that the role of nodules is the supply of nutrients to the cowpea plant has an enormous contribution to seed yield. During nodulation, NO_3-(nitrate) is produced from the symbiotic association between rhizobium and the plant root. The NO_3-N-fixed are utilized by the plant for their vegetative growth and yield. About 15 of the varieties compared favorably with the local check (Ife brown) for grain yield. Although the grain yield of DANILA is significantly lower than most of the improved varieties evaluated, its nodulation is the highest.The implication of these result is that the varieties can be growth for different purposes like highly nodulating and dual purpose varieties. Highly nodulation varieties are expected to contribute to soil nitrogen. So varieties. Like DANILA, Ife brown, IT96k-113-6 that were the best three in nodulation would be useful for improving soil nitrogen particularly under intensive land use when the biomass is removed. For fodder production, varieties with high biomass yield would be suitable. Such can be used in crop/livestock integrated system. DANILA with about 1.080 t/ha biomass yield compared with seven others. These were also good in terms of grain yield producing above one tonne per hectare. These varieties IT95k-366-1, IT93k-452-1 IT95k-1090-12, IT97k-1034-94, IT97k-508-2, IT95k-1091-3, and IT86D-719 are recommended as dual purpose varieties, however, since this study is just one year, it might need to be repeated.

V. Conclusion And Recommendation

This study showed that nodule number and nodule dry weight are both positively correlated with biomass production and grain yield. The varieties that were observed to have high nodule production are recommended for intensive cropping system. Other varieties with high biomass and grain yield are classified as dual purpose varieties and can be used for integrated livestock cropping system.

The synchronous flowering and maturity date of these varieties may be an advantage to farmers in that harvest operations can be done once. This has implication for time and labour utilization to the farmers.

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