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Maturation Period and Nitrogen Fixing Capacity of Some Cowpea (*Vigna unguiculata* L Walp) Varieties in Okigwe, Southeastern Nigeria

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ABSTRACT

The field experiment was carried out at Umulolo via National Horticultural Research Institute, Mbato, Okigwe Imo state, Nigeria in 2020 and 2021 to assess the maturation period and nitrogen-fixing capacities of some cowpea varieties in the rainforest ecology of southeastern Nigeria. The experiment was laid out in a randomized complete block design. The treatments were assigned in three replications. The treatments were seven cowpea varieties; IT98K-506-1, IT86D-719, IT89KD-391, IAR-48, IT90K-277-2, IT89KD-288 and Ife-brown. IT98K-506-1, IT98KD-391 and IT89KD-288 and attain early to 50% flowering between 42.23 - 44.71 days in 2020, and between 43.61 - 43.93 days in 2021. The most delayed to 50 % flowering, above 90 days in both cropping seasons, were recorded in Ife brown and IT86-D-719. The number of days to 50 % maturity as influenced by cowpea varieties differed significantly among the cowpea varieties, IT98-506-1 attained 50% maturation at 72.27 and 71.55 days in both cropping seasons followed by 88.92 and 91.33 days, respectively, recorded in IT89KD-391. Ife brown took the longest days to attain 50% maturity; 125.90 and 124.65 days in 2020 and 2021, respectively. IT89KD-391 had the significant grain yield of 1961.53kg/ha and 1904.17 kg/ha in both cropping seasons while the least grain yield; 963.41kg/ha and 965.72kg/ha was recorded from IT98K-506-1. IT90KD-288 had a significantly higher number of root nodules per plant; 85.01 and 86.34 in both cropping seasons, followed by 75.16 and 74.34 recorded in IT86KD-719. The least number of root nodules per plant; 37.33 and 39.60 was recorded in IT90K-277-2. IT90KD-288 had significant biomass accumulation of 1051.34 and 1047.11kg/ha in the 2020 and 2021 cropping seasons, respectively, followed by 1023.34 and 1030.13 kg/ha respectively, recorded in IT89KD-391. The least biomass; 550.45 and 562.91 kg/ha in both cropping seasons, respectively was recorded in IT90K-277-2.

INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp) is an annual self-pollinated plant. It has been ranked as the most economically important indigenous African legume crop (Moussa et al. 2011; Horn et al. 2022). is one of the most important versatile and nutritive legumes that is being consumed along with starchy food menus such as yam, processed maize products, sweet potato, etc., Production of this crop is so much cherished nowadays as FAO (2022) reported that the global production of primary crop commodities reached 9.5 billion tonnes in 2021, increasing by 54 percent since 2000 and 2 percent since 2020. Cowpeas of different varieties are cultivated all over agro-ecological zones of West Africa based on local preferences for yield, resistance to pests and diseases, maturation period, grain size, grain colour, storability and taste (MOFA, 2011; Ikeh et al. 2017). It contains 23-30% protein content, 50-67% carbohydrate, 1.9% fat, 6.35% fibre and a small percentage of the B vitamins such as folic acid, thiamine, riboflavin as well as some micronutrients (Iron, Phosphorus, Zinc and Calcium) which improve human nutrition, health status and income generation (Udoh and Ndon, 2016).

More than 7.4 million tons of dried cowpeas are produced worldwide, with Africa producing nearly 7.1 million. Nigeria, the largest producer and consumer, accounts for 48% of production in Africa and 46% worldwide (IITA, 2023). The grains contain 25% protein and several vitamins and minerals. The plant tolerates drought, performs well in a wide variety of soils, and being a legume replenishes low-fertility soils when the roots are left to decay. It is grown mainly by small-scale farmers in developing regions where it is often cultivated with other crops as it tolerates shade. It also grows and covers the ground quickly, preventing erosion (IITA, 2023). IITA scientists have developed high-yielding varieties that are early or medium maturing and have consumer-preferred traits such as large seeds, seed coat texture, and color. A number of the varieties have resistance to some of the major diseases, pests, nematodes, and parasitic weeds. They are also well-adapted to sole or intercropping (IITA, 2023).

According to Boukar et al (2018), cowpea is grown predominantly in the dry savannahs to the Sahel in the fringes of the Sahara Desert, where the annual rainfall is around 300 mm or less annually. It can grow under harsh environmental conditions where other major crops fail to grow (Pereira et al. 2020).

It provides an important source of food nutrients such as protein, carbohydrates fat/oils, minerals and vitamins for human beings and livestock. The distinctive feature of grain legumes such as cowpea is their ability to utilize atmospheric nitrogen as a nutrient source (Gogoi et al. 2018). Nitrogen is an essential element that plants require in large quantities for growth, development, and production. It is an abundant gas in the atmosphere but plants cannot utilize them as a form of nitrogen. Legumes must reduce atmospheric into ammonia, in a process called fixation (Gogoi et al. 2018). Nitrogen fixation is a biological process, performed by specific species of bacteria. Legume crops such as groundnut, cowpea and soybean do not need application of nitrogen fertilizer due to their ability to fix N in the soil. The grain legumes help in solubilizing insoluble phosphorus (P) in soil, improving the soil's chemical properties, and increasing soil microbial activity. Cowpeas and other legumes have a special significant effect in modern agriculture as the optimization of nitrogen fertilizer, Addition of organic matter to the soil, maintenance and restoration of soil organic carbon (SOC) and minimizing soil pollution through inorganic application of nitrogen fertilizer (Gogoi et al. 2018). For the sake of nitrogen-fixing ability, legumes like cowpeas can support their own growth, development and yield in soil with low fertility status. As legume like cowpea grows, they accumulate a high amount of foliage biomass through the biological process known as photosynthetic carbon (C) fixation. The accumulated biomass finally enriches the soil with carbon by net exudation. This helps in maintaining soil organic carbon.

Considering the numeral beneficial effect of cowpea legume, differences may exist within cowpea varieties in terms of yield and nitrogen fixative capacity. The significant importance of cowpea's ability to fix atmospheric nitrogen in marginal soils where farmers have no access to agricultural inputs such as fertilizers or manure (Bolarinwa et al. 2021) needs to be explored on a variety basis. Akinbile et al. (2021) suggested that N2 fixation will increase in high-yielding environments since the nitrogenase, located in the nodules, will adjust its activity to the demand of the legume (Akinbile et al. 2021). Also, for Nigeria and West African nations to achieve food security, sufficiency and poverty reduction among poor households and smallholder farmers, there is a need to envisage an in deep strategic research of cowpea, especially for the selection of promising cultivars that would thrive and produce an appreciable yield in high humid ecology of southern Nigeria. Considering that variations exist among cowpea varieties, which vary in terms of plant growing habit, seed type, and cropping system, the maturity period is extremely diverse from one agroecological zone to another. Therefore, this study was carried out to identify the promising cowpea varieties with high grain yield and to ascertain the cowpea variety with high nitrogen fixative capacity in the rainforest ecology of Nigeria.

MATERIALS AND METHOD

The study was conducted at Umulolo via the National Horticultural Research Institute, Okigwe Sub-Station during the late planting season of 2019 and 2020. Okigwe is located between latitudes 5°49' 45" N, and longitudes 7° 21' 2" E. It has a mean annual range of rainfall of 80 to 375 mm, mean relative humidity of 79%, and mean temperature of 22.7 to 34°C. The area lies within Nigeria's humid tropical rainforest zone and has two seasons. The seasons are wet and dry season. The wet season starts between March and April and lasts till October, with a brief break in August traditionally referred to as the "August Break." The dry season begins in November and extends to February and late March.

The experiment was carried out on a continuously cultivated land by subsistence farmers and prior to the experiment, egusi melon, okra, and maize were harvested on the experimental plot in July 2019 while cassava, maize, and okra were harvested from the plot used in the second trial.

The experiment was laid out in a Randomized Complete Block Design (RCBD). The treatments were assigned to three replicates. The treatments were eight cowpea varieties; IT81D-95, IT86D-719, IT89KD-391, IAR-48, IT89KD-288, IT90K-277-2, IT98K-506-1 and Ife-Brown. Planting was done in the first week of September 2020 and 2021. Three seeds were planted per plot on a spacing of 75 cm x 30 cm and later thinned down to two stands two weeks after planting (WAP). Hoe weeding was carried out at 3 WAP with the aid of weeding hoes while hand pulling was carried out at 7 WAP.

The following data were assessed from ten tagged plants; emergence percentage was taken at 6 days after planting by counting all the emerged stands of cowpeas in a plot and dividing by the total number of stands planted per plot and multiplying by 100. The number of leaves per plant was determined by counting all the functional leaves from the tagged cowpea plants in a net plot. Leaf area was determined on cowpea leaves using length, and width and multiplying by 2.325 a factor, (Osei et al. 1983). Plant height was determined by measuring the vine length from the base to the terminal bud with measuring tape. The number of days to 50 % flowering was determined when half of the cowpea plants in the plot flowered. The number of days to 50 % podding was determined when half of the cowpea plants in the plot were podded.

The number of days to 50 % maturity was determined when half of the green cowpea pods in the plot dried and turned light yellow or brown. The number of pods per plant was counted according to the treatments. Number of seeds per pods was obtained by counting the number of seeds in each pod. Plant biomass was determined by uprooting the entire plant after harvesting and weighing it on a treatment basis. After harvesting, the plants were uprooted and the number of nodules per cowpea plant was determined by counting the number of nodules formed with the roots of cowpea plant per stand.

After de-hulling, 100 seeds were counted and weighed with the aid of an electronic weighing balance. All the 100 seeds were weighed on varietal bases. Seed yield was determined with the aid of weighing balance in grams (g) and then converted to kilogram per hectare. All the growth and yield data collected were subjected to analysis of variance. Means that showed significant differences were compared using the least significant difference (LSD) at a 5% probability level.

RESULTS

The emergence percentage of cowpea was not significantly different among the cowpea cultivars, irrespective of any cropping season (Table 1). The range of emergence percentage was 95-100 % in 2020 and 99- 100% in the 2021 cropping season. The length of the vine as influenced by cowpea cultivars differed significantly ($p<0.05$) in the 2020 and 2021 cropping seasons (Table 1). At 9 weeks after sowing (WAS), IT89KD-391 had a significantly longer vine of 138.71 and 140.60 cm in the 2020 and 2021 cropping seasons, respectively. This was followed by 129.25 and 133.01 cm, respectively, recorded in Ife brown. Among the cowpea cultivars, the shortest vine at 9WAS; was 70.34 73.14 cm in 2020 and 2021, respectively.

Table 1: Emergence Percentage and Vine Length (cm) of Cowpea as Influenced by Varieties

Cowpea Cultivars	2020				2021			
	Emergence (%)	Weeks after Sowing			Emergence (%)	Weeks after Sowing		
		3	6	9		3	6	9
Ife Brown	100.00	51.34	100.34	129.25	100.00	54.91	107.88	133.01
IT86D-719	95.00	33.56	81.25	113.40	100.00	35.03	87.66	101.41
IT89KD-391	100.00	60.32	116.33	138.71	100.00	60.06	123.31	140.60
IAR 48	99.00	28.22	55.45	73.40	100.00	28.63	58.65	95.66
IT90KD-288	98.50	37.11	55.11	75.33	99.00	39.14	53.70	81.40
IT90K-277-2	99.00	23.92	40.45	70.34	100.00	25.33	42.09	73.14
IT98K-506-1	100.00	44.30	95.77	120.11	100.00	43.55	100.46	119.21
LSD(p<0.05)	**NS**	**3.36**	**6.41**	**7.69**	**NS**	**2.91**	**5.44**	**6.12**

The number of leaves per plant as affected by cowpea varieties was significantly different ($p<0.05$) at 3, 6, and 9 WAS in both cropping seasons (Table 2). In 2020, IT89KD-391 had a significantly higher number of leaves per plant; 18.33, 62.14 and 167.83 at 3, 6 and 9 WAS, respectively while in 2021, the vine length recorded in IT89KD-391 was 17.97, 85.45 and 155.19 at 3, 6 and 9 WAS, respectively. Ife brown had 12.50, 84.22 and 150.40 leaves per plant in 2020 while the corresponding number of leaves per plant; 14.12, 99.25 and 155.14 was recorded in the 2021 cropping season. The least number of leaves per plant; 8.03, 29.33 and 79.68 in 2020 was recorded in IT90K-277-2. In 2021, the least number of leaves per plant; 9.67, 39.81 and 99.78 at 3, 6 and 9 WAS, respectively was recorded in IT90K-277-2.

Table 2. Number of leaves per plant as Influenced by Cowpea Varieties

Cowpea Varieties	2020			2021		
	Weeks after Sowing			Weeks after Sowing		
	3	6	9	3	6	9
Ife Brown	12.50	84.22	150.40	14.12	99.25	155.14
IT86D-719	11.33	48.13	107.20	10.11	57.18	100.34
IT89KD-391	18.33	62.14	167.83	17.97	85.45	155.19
IAR 48	12.55	89.45	109.22	10.14	90.18	115.77
IT90KD-288	10.61	39.33	90.18	10.78	56.40	100.16
IT90K-277-2	8.03	39.33	79.68	10.67	39.81	99.78
IT98K-506-1	11.45	71.11	101.45	10.69	44.87	101.50
LSD(p<0.05)	**2.49**	**3.73**	**6.69**	**2.81**	**5.72**	**7.30**

Significant differences (p<0.05) were observed among the cowpeas for leaf area (Table 3). At 6 WAS, IT90KD-288 had a significantly larger leaf area in both cropping seasons; 129.87 and 131.40 cm2 in 2020 and 2021, respectively. This was followed by 125.81 and 126.59 cm2 recorded in IT89KD-391. Among the cowpea varieties, the least leaf area at 9 WAS; cropping season. At 6 WAS, IT90K-288 had 3-40% and 4-38% significantly larger leaf areas in both cropping seasons, compared to the other varieties.

The number of branches per plant as influenced by cowpea cultivars differed significantly in both cropping seasons (Table 3). IT89KD-288 had a significantly higher number of branches per plant at 6 WAS; 14.33 and 14.69 in 2020 and 2021, respectively. The IT89KD-391 cultivar had 10.59 and 11.18 branches per plant at 6WAS. The least number of branches per plant; 6.18 and 7.50 respectively were recorded in IT86D-719. IT90KD-288 had 26-50% and 24-49% significantly higher number of branches in 2020 and 2021 compared to the other cultivars.

Table 3: Leaf Area (cm^2) of Cowpea and Number of Branches per Plant as Influenced by Cowpea Varieties

Cowpea Varieties	2020		2021	
	Leaf Area (cm) at 6 WAS	Number of Branches per Plant	Leaf Area (cm) at 6 WAS	Number of Branches per Plant
Ife Brown	104.78	10.44	105.33	10.51
IT86D-719	98.90	7.18	100.10	7.50
IT89KD-391	125.81	10.59	126.59	11.18
IAR 48	88.63	8.59	92.75	8.11
IT90KD-288	129.87	14.33	131.40	14.69
IT90K-277-2	89.99	10.15	101.30	10.20
IT98K-506-1	78.14	10.44	81.51	10.25
LSD(p<0.05)	**5.77**	**2.29**	**5.62**	**2.26**

*WAS= Weeks after sowing.
NS= Not Significant

The cowpea cultivars assessed had significant variations in phenological characteristics (Table 4). The number of 50 % flowering, podding, and maturity differs in both cropping seasons (Table 4). IT98K-506-1, IT98KD-391 and IT89KD-288 attain early to 50 % flowering at 42.23, 42.91 and 44.71 days, respectively in the 2020 cropping season. These three cowpea varieties were at 50% at 43.61, 43.73, and 43.93 days, respectively in the 2021 cropping season. The most delayed to 50% flowering were Ife brown and IT86-D-719. Ife brown attained 50% flowering at 90.33 and 90.39 days in the 2020 and 2021 cropping seasons. The IT86D-719 had 50% flowering at 90.30 and 90.31 days in the 2020 and 2021 cropping seasons, respectively. IT98K-506-1 attained early to 50% podding at 56.68 and 55.45 days in 2020 and 2021 cropping seasons, respectively while IT89KD-391 attained 50% podding at 62.24 and 61.45 days in 2020 and 2021 cropping seasons, respectively. The cultivar with the highest number of days to 50% podding; 110.75 and 109.31 in both cropping seasons were recorded in IT86D-719.

The number of days to 50 % maturity as influenced by cowpea cultivars varied significantly differences in both cropping seasons (Table 4). IT98-506-1 matured earlier than other varieties in both cropping seasons. IT98-506-1 attained 50% maturation at 79.22 and 80.45 days in both cropping seasons, followed by 88.92 and 91.33 days, respectively, recorded in IT89KD-391. Ife brown took the longest days to attain 50% maturity; 125.90 and 124.65 days in 2020 and 2021, respectively.

Significant differences (p<0.05) were observed in the number of pods per plant (Table 5). IT89KD-391 had the highest number of pods per plant; 33.40 and 31.51 in both cropping seasons. IT89KD-288 produced 30.31 and 29.23 in the 2020 and 2021 cropping seasons, respectively. The least number of pods per; 10.45 and 10.91 was recorded in IT98K-506-1. IT89KD-391 which produced a significantly higher number of pods per plant, had 9-66% and 7-65% number of pods per plant compared to the other cultivars.

A number of seeds per pod as influenced by cultivars varied significantly different ($p<0.05$) in both cropping seasons (Table 5). IT89KD-391 had the highest number of seeds per plant, 10.11 in 2020 and 10.40 in 2021. The least number of seeds per pod, 6.41 in 2020 and 6.63 in 2021 was recorded in IT98-506-1. The weight of 100 seeds of cowpea as influenced by cultivars showed no statistically significant difference ($p>0.05$) among the cowpea cultivars, irrespective of cropping seasons. The weight of 100 seeds of the cowpea cultivars ranges from 17.33-17.87 g and 17. 38-17.81g in 2020 and 2021, respectively.

Table 4: Number of Days to 50% Flowering, Podding, and Maturation as Affected by Cowpea Varieties

Cowpea Cultivars	2020			2021		
	Number of Days to 50% Flowering	Number of Days to 50% Podding	Number of Days to 50% Maturity	Number of Days to 50% Flowering	Number of Days to 50% Podding	Number of Days to 50% Maturity
Ife Brown	90.33	108.32	125.90	91.39	106.40	124.65
IT86D-719	90.30	110.75	122.33	90.31	109.31	124.10
IT89KD-391	42.91	62.24	79.22	43.73	61.45	80.45
IAR 48	60.33	81.70	103.59	61.04	83.33	101.07
IT90KD-288	44.71	66.55	88.92	43.93	64.77	91.33
IT90K-277-2	54.33	82.18	123.45	55.80	80.03	124.41
IT98K-506-1	42.23	56.68	72.37	43.61	55.45	71.55
LSD(p<0.05)	**3.18**	**4.20**	**4.53**	**3.22**	**4.11**	**4.45**

Table 5: Yield and yield components of Cowpea as Affected by Varieties

Cowpea Varieties	2020					2021				
	Number of Root Nodules per Plant	**Number of Pod per Plant**	**Number of Seed per Pod**	**Weight of 100 Seeds (g)**	**Seed Yield (t/ha)**	**Number of Root Nodules per Plant**	**Number of Pod per Plant**	**Number of Seed per Pod**	**Weight of 100 Seeds (g)**	**Seed Yield (t/ha)**
Ife Brown	39.76	20.23	6.90	17.61	1678.01	38.81	20.16	6.77	17.60	1677.65
IT86D-719	45.16	21.14	8.12	17.67	1560.90	44.34	23.11	8.14	17.63	1566.52
IT89KD-391	25.19	33.40	10.11	17.81	1961.53	26.14	31.51	10.40	17.81	1904.17
IAR 48	27.67	28.23	7.39	17.46	1713.69	28.04	26.70	7.55	17.76	1710.00
IT90KD-288	51.01	30.31	10.07	17.87	1790.81	56.34	29.23	10.09	17.57	1770.50
IT90K-277-2	17.33	18.33	7.11	17.33	1088.80	15.23	19.60	7.17	17.38	1090.61
IT98K-506-1	26.41	10.45	6.41	17.56	963.41	26.33	10.91	6.63	17.70	965.72
LSD(p<0.05)	**4.23**	**3.31**	**2.32**	**NS**	**17.18**	**4.40**	**3.40**	**2.25**	**NS**	**18.05**

Cowpea seed yield as influenced by cultivars differed significantly ($p<0.05$) in both cropping seasons (Table 5). IT89KD-391 had a significant grain yield of 1961.53kg/ha and 1904.17 kg/ha in both cropping seasons. IT90KD-288 had 1790.81 and 1770.50 kg/ha in both cropping seasons. The least cowpea grain yield 963.41 kg/ha and 965.72 kg/ha was recorded from IT98K-506-1. The experimental result showed that IT89KD-391 produced 17-49 % and 19-50% grain yield compared to the other cowpea varieties in 2020 and 2021, respectively.

The number of root nodules per plant as affected by cowpea cultivars varied significantly in both cropping seasons (Table 6). IT90KD-288 had significantly higher number of root nodules per plant; 85.01 and 86.34 in both cropping seasons. This was followed by 75.16 and 74.34 recorded in IT86KD-719. The least number of root nodules per plant; 37.33 and 39.60 in both cropping seasons, was recorded in IT90K-277-2. The result revealed that IT90KD-288 had 12-54% and 13-59% significantly higher number of root nodules per plant in 2020 and 2021 compared to the other cowpea varieties assessed.

The biomass accumulation as influenced by cowpea varieties is shown in Table 6. The result of biomass accumulation varied by significant difference (p<0.05) in both cropping seasons. IT90KD-288 had significant biomass accumulation of 1051.34 and 1047.11kg/ha in the 2020 and 2021 cropping seasons, respectively. This was followed by 1023.34 and 1030.13 kg/ha respectively, recorded in IT89KD-391. The least plant biomass; 550.45 and 562.91 kg/ha in both cropping seasons, respectively was recorded in IT90K-277-2.

Table 6: Number of Root Nodules per Plant, Biomass, and Weight as Influenced by Cowpea Varieties

Cowpea Varieties	Root Nodules per plant		Biomass Weight (Kg/ha)	
	2020	2021	2020	2021
Ife Brown	69.76	68.81	1005.34	1010.09
IT86D-719	75.16	74.34	7113.45	716.45
IT89KD-391	55.19	56.14	1023.34	1030.13
IAR 48	57.67	58.04	856.13	852.44
IT90KD-288	85.01	86.34	1051.34	1047.11
IT90K-277-2	37.33	35.23	550.45	562.91
IT98K-506-1	56.41	56.33	871.55	884.33
LSD(p<0.05)	**4.23**	**4.40**	51.01	53.53

DISCUSSION

The result of the study showed no significant difference (P<0.05) in emergence percentage. This observation indicated that all the cowpea cultivars assessed had a high germination percentage. The cowpea cultivars used for the study varied on showed significant variations in vegetation traits, such as the number of leaves per plant, leaf area, and plant height. The significant differences observed in the growth and yield of cowpeas could be attributed to varietal differences in relation to the different genetic constitutions of each cultivar. The differences observed showed that different cowpea cultivars had different morphological characteristics. This observation agreed with Ikeh et al. (2013) who reported that the growth habit of cowpea varieties differs. The differences that exist among cowpea varieties were attributed to their inherent characteristics due to the different genetic makeup of each cultivar. The result showed significant differences in the number of days to 50% flowering, podding, and maturation. The differences in phenological characteristics of cowpea could be attributed to inherent differences between different cowpea varieties. Udonnah (2017) reported significant differences in the number of days to 50% flowering of cowpeas grown in the highly humid zone of southeastern Nigeria.

The differences in the yield and yield components assessed could be due to the higher number of pods per plant, the number of seeds per pod, and the weight of 100 seeds. This observation agrees with Futuless and Bake (2013), that the yield evaluation of cowpea cultivars usually involves the consideration of other characters and is therefore influenced by a number of traits acting singly or interacting with each other, earliness to the number of days to flowering, pod filling period, number of days to physiological maturity, number of branches per plant, pod length, number of seeds per pod, weight of 100 seeds and necessary agronomic practices contributed to seed yield.

In this study, nodule numbers varied among the cowpea varieties, some were low while some had a higher number of nodules per plant. The significant variation in the number of root nodules per plant could be a result of genetic differences existing among the cowpea varieties, this observation was in consonance with the report of Akinbile et al. (2021), that varietal differences account for nodule differences since the pattern of nodulation, most often, reflects the physical distribution of the root system in the soil. Hansen (1994) stated that nodulation capacity is known to vary between and within legume species. Agyeman et al. (2014) reported that cowpea varieties producing more nodules possess the capacity to fix nitrogen into the soil.

CONCLUSION

The result of the study revealed that variation exists among cowpea varieties in terms of vegetative traits, plant biomass, and nodulation capacity as well as grain yield. IT89 KD-391 produced appreciable grain yield in the study area. Farmers in the study were advised to adopt IT89 KD-391 for high grain yield. For soil improvement, IT89KD-391, IT89KD-288 and Ife-brown which produced significant root nodules per plant and larger plant biomass may have high nitrogen-fixing capacities compared to the other varieties. IT89KD-391, IT89-KD-288 and IT98K-506-1, matured early while Ife-brown matured late compared to the other varieties used for the study.

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