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AN EVALUATION OF SOME EARLY MATURING COWPEA GENOTYPES FOR YIELD AND YIELD COMPONENTS IN UMUDIKE, SOUTH EASTERN NIGERIA

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ABSTRACT

Nine early maturing cowpea genotypes were evaluated in 2001 and 2002 late cropping season to determine their grain yields and yield components. The experimental design was Randomized Complete Block in three replicates. Significant differences were recorded among the genotypes for yield in 2001 but not in 2002. Most of the yield components were significantly different from one another in both years. The genotypes flowered between 35 to 45 days after planting (DAP) and the maturity period did not exceed 65 days. Average grain yield ranged between 1607 kg/ha to 3013 kg/ha. Number of branches/plant, number of pods/plant and number of seeds/plant were significantly and positively correlated with yield at $P<0.01$.

INTRODUCTION

Legumes serve as alternatives or supplements to animal proteins, particularly in parts of the world where there is paucity of animal proteins due to socioeconomic constraints (Ojimelukwe, 2002). Cowpea (*Vigna unguiculata* (L). Walp) is a nutritious legume crop that is of considerable importance in Nigeria and other Sub-Sahelian countries. They constitute a significant proportion of the total dietary protein and energy intake of Nigerians (Davio *et al.*, 1976; and Ologhbo and Fetuga 1987). Two types of cowpea are cultivated in Nigeria. The grain cowpea grown for dry grains and extensively cultivated in the semi-arid belt and the vegetable cowpea grown for its fresh pods in the savanna and rainforest belts. Although the grain cowpea is predominantly a crop of drier areas, advances in the crop development have opened opportunities for its production in wetter agroecologies. Key areas of improvement that have enabled this expansion includes reduction in the severity of pests and diseases and more efficient manipulation of the crop duration.

Cowpea yield is low in Nigeria but more so in Southern Nigeria where incidence of pests and diseases originating from the forest vegetation are very pronounced (Ogumbodede, 1990; Okeleye *et al.*, 1999). One of the ways to circumvent these problems is through the use of early maturing cowpea genotypes which have been shown to yield as much as or more than the late maturing varieties (Okafor, 1986; Ofori and Djagbletey, 1995). These early maturing varieties which was recently released by International Institute of Tropical Agriculture, (IITA), Ibadan have

the added advantage of being suitable in areas with unreliable rainfall in terms of total amount, distribution and duration where crop failure is often attributed to early cessation of rains and thereby making it adaptive to different agroecological environments in Nigeria (Okeleye *et al.*, 1999).

Yield evaluation of some cowpea cultivars in Southern Nigeria have continued to generate interest among researchers such as Ogumbodede, (1989); Okeleye *et al.*, (1999) in Southwestern Nigeria and Ndon and Ndaeyo, (2001) in Southeastern Nigeria. These evaluations would indicate adaptable cultivars and expand the crops production area and provide more food and income for the populace (Ndon and Ndaeyo, 2001). Yield evaluation usually involve the consideration of other characters that determine the overall performance of the genotypes. This is necessary because yield is a quantitative character and therefore influenced by a number of traits acting singly or interacting with each other. Agronomic traits of cowpea that contribute to seed yield includes earliness (number of days to flowering, pod filling period and number of days to physiological maturity), number of branches per plant, number of pods per plant, pod length, number of seeds per pod and 100 seed weight (Babalola, 1989; Leleji, 1981; Ogunbodede, 1989; Okeleye *et al.*, 1999). Thus these traits and their inter-relationships are important factors to consider when the aim is to increase seed yield in cowpea.

This study examined seed yield and its components in some early maturing cowpea genotypes in Umudike, Southeastern Nigeria.

MATERIALS AND METHODS

Field experiments were conducted in September to December of 2001 and 2002 at Michael Okpara University of Agriculture Research farm, at Umudike (Longitude 07^0 33E, Latitude 05^0 2^N, Altitude 122m). The soil was classified as sandy loam ultisol (Agboola, 1979). Treatment comprised of nine early maturing cowpea genotypes which were in each year laid out in a randomized complete block design. Seven of the cowpea genotypes namely Ife-Brown, IT 97k-400-3, IT82E-16, IT84S-2246-4, IT90k-59, TVX-3236, IT90k-76 were obtained from the International Institute of Tropical Agriculture (IITA), Ibadan while the other two (Oraludi and Akidi-ani) are local genotypes obtained at Nsukka. In each plot measuring 3m X 3m, six rows of the appropriate genotype were planted 50 x 25cm. Two seeds were sown per hill and later thinned to one plant per hill at one week after seedling emergence giving a plant population of 80,000 plants /ha. Weeding was done twice (at 4 and 8 weeks after planting) while spraying against insect pests was done three times commencing at the onset of bud formation and repeated every two weeks. Cypermethrin at 75 ml per 10 litres of water was used.

Records were taken from 10 plants randomly chosen from the two central rows of each plot. Data collected were yield, plant height, number of leaves per plant, number of branches per plant, dry matter yield per plant, number of days to flowering, pod filling period, number of days to physiological maturity, number of pods per plant, pod length, number of seeds per pod, number of seeds per plant, and 100 seed weight. Data on shelling percentage was collected in 2002 experiment only. Analysis of variance of data was done using the procedure outlined by Gomez and Gomez, (1984) for a randomized complete block design. Significant differences among treatment means were evaluated using Duncan's Multiple Range Test (DMRT).

RESULT AND DISCUSSION

Table 1 shows the mean and standard error of growth parameters in some early maturing cowpea genotypes. Genotypic differences was significant ($P<0.001$) for all the parameters in 2001 but in 2002 it was significant for plant height and number of leaves per plant at $P<0.001$. Plant height ranged from 34cm to 238cm in 2001 and in 2002 it ranged from 25cm to 135cm. It is interesting to note that the local variety Akidi-ani was he tallest genotype in both years though it did not differ significantly from IT82E-16, Oraludi and Ife-Brown in 2001 and Oraludi and IT82E-16 in 2002. The genotypes that were short in both years are IT84S-2246-4 and IT97K-400-3. The number of leaves per plant followed similar trend with plant height. The tall genotypes had the highest number of leaves except TVX-3236 that was moderately tall and had a lot of leaves. The branching habit of the genotypes ranged from 3 to 6 per plant in both years, while the dry matter yield was more in 2001 than in 2002 (15.33 gm to 37.42gm/plant in 2001 as compared with 11.20gm to 24.19gm in 2002). Similar results have reported by Ogunbodede, 1988; Aiyelari, 1993; Ndaeyo *et al.*, 1995.

Table 2 shows the mean and standard error of number of days to flowering, pod filling period and the number of days to physiological maturity in some early maturing cowpea genotypes. These genotypes flowered between 38 days to 45 days in both years while the period between flowering and physiological maturity was between 16 to 23 days in both years. This short period between flowering and maturity implied that these genotypes must fill their seeds very fast and this is an important trait in areas where water availability is very low. It is also interesting that in both years the number of days to physiological maturity did not exceed 65days. Another interesting fact about this result is that the local genotypes all matured before 60 days therefore making them quite comparable with even the extra-early cultivars being promoted by the International Institute of Tropical Agriculture, Ibadan.

Table 3 and 4 shows the mean and standard errors of yield components in some early maturing cowpea genotypes in 2001 and 2002. Significant genotypic differences ($P<0.001$) was observed for all the genotypes in 2001 but in 2002, number of, pods per plant and shelling percentage was not significant while all the other components were significant at $P<0.001$. The results showed that number of pods per plant ranged from 12 to 36 pods in 2001 while in 2002 it ranged from 15 to 28 pods. Pod length ranged from 12.82cm in TVX-3236 to 18cm in IT82E-16 in 2001 and 13cm in TVX-3236 and 18cm in Oraludi in 2002. The number of seeds per pod was more in 2001 than in 2002 (11 to 16 seeds/pod in 2001 as compared with 7 to 13 seeds/pod in 2002). Seed size was lower in 2001 (7.4 gm to 14 gm) than in 2002 (9.3 gm to 19 gm). This result showed that in 2001 when there were more seeds per pod, that the seed size was reduced while in 2002 when there were fewer seeds per pod, the seed size was increased. This result agrees with the earlier reports of Singh and Mehndiratta, 1969; Okafor, 1986; Mosarwe, 1993; Ofori and Djagbletey, 1995; Nakawuka and Adipala, 1999; Okeleye *et al.*, 1999; and Ndon and Ndaeyo, 2001.

Table 1: Mean and standard error of growth parameters in some early maturity cowpea genotypes

Genotype	2001 Plant height (Cm)	2001 Number of leaves per Plant	2001 Number of branches per plant	2001 Dry matter yield/plant (gm)	2002 Plant height (Cm)	2002 Number of leaves per plant	2002 Number of branches per plant	2002 Dry matter yield/plant (gm)
Ife-Brown	166.27^{abc}± 25.49	63.42^{ab}±14.99	4.67^{bc}±0.36	27.47^{abc}±2.78	52.75^{bc}±9.10	31.85^{abcd}±5.51	4.30 ±0.44	19.43± 3.76
Oraludi	197.35^{ab}±25.03	40.08^{b}±3.36	3.92^{bc}±0.17	21.29^{abc} ±2.77	120.21^{a}±19.94	29.67^{abcd}±6.06	4.00 ±0.35	13.62± 3.06
Akidi-ani	237.78^{a} ± 50.73	92.83^{a}±23.04	4.58^{bc}±0.55	33.17^{ab}±10.50	134.74^{a}±6.04	43.92^{a}±3.58	4.17 ±0.22	13.96± 1.96
IT 97k-400-3	84.10^{defg} ±16.29	50.92^{b}±7.35	4.50^{bc}±0.38	23.41^{abc}± 2.04	25.08^{e}±2.99	25.13^{bcd}±6.76	4.22 ±0.69	18.90± 8.88
IT 82E-16	165.21^{abc}± 10.18	36.17^{b}±1.62	3.67^{c} ±0.22	19.72^{bc} ±2.76	107.51^{a}±11.79	36.50^{abc}±7.91	4.12 ± 0.25	24.19± 8.91
IT 84S-2246-4	33.88^{g} ±0.99	48.67^{b}±7.23	4.92^{ab}±0.36	24.90^{abc}±3.45	29.16^{bc}±2.55	23.40^{bcd}±3.22	4.08 ±0.65	11.34± 0.54
IT 90K-59	114.32^{cdef}±11.98	33.79^{b}±1.27	4.08^{bc}±0.58	18.30^{bc}±1.85	28.91^{bc}±1.40	28.63^{abcd}±3.37	4.35 ±0.24	11.20± 3.61
TVX-3236	150.14^{bc} ±7.05	96.92^{a}±24.63	5.92^{a} ±0.22	37.42^{a} ±5.26	61.37^{b}±10.12	39.67^{ab}±1.64	5.42 ±0.22	14.33± 1.74
IT 90K-76	47.08^{fg}±13.81	32.92^{b}±2.48	4.42^{bc}±0.08	15.33^{c}± 2.21	35.91^{bc}±5.73	18.10^{d}±2.79	3.73 ±0.37	13.04± 3.56

Values in the same column with different superscripts are significantly different (P<0.05, 0.01 and 0.001).

Table 2: Mean and standard error of number of days to flowering pod filling period and number of days to physiological maturing in some early maturity cowpea genotypes.

Genotype	2001 Number of days to flowering	2001 Pod filling period	2001 Number of days to physiological maturity	2002 Number of days to flowering	2002 Pod filling period	2002 Number of days to physiological maturity
Ife-Brown	44.33 ^{a}± 2.03	21.00^{ab}± 1.00	65.33^{a}±2.91	38.67^{b}± 0.33	20.00^{b}± 1.00	58.67^{bcd}± 0.88
Oraludi	41.00^{ab}±2.52	17.00^{c}± 0.00	58.00^{cd} ±2.52	40.67^{b}± 1.20	17.67^{bcd}± 0.88	58.33^{cd}± 0.67
Akidi-ani	41.33^{a} ±2.33	17.00^{c}±1.53	58.33^{bcd}±3.84	41.33^{b}± 0.67	16.33^{bcd}± 0.67	57.67^{d}± 0.67
IT 97k-400-3	42.33^{a}± 2.72	22.67^{a}±1.20	65.00^{a} ±1.73	39.00^{b}± 0.58	23.00^{a}± 0.58	62.00^{a}± 0.00
IT 82E-16	37.67^{b}± 2.40	18.67^{bc}±0.67	56.33^{d}±1.76	40.67^{b}± 0.33	19.00^{bc}± 0.58	59.67^{bcd}± 0.33
IT 82S-2246-4	42.00^{a}± 2.08	19.67^{abc}±0.33	61.67^{abc}±2.19	39.67^{b}± 0.33	19.67^{b}± 0.33	59.33^{bcd}± 0.33
IT 90K-59	42.00^{a}±2.31	20.67^{ab}±0.33	62.67^{ab}±2.03	40.00^{b}± 1.00	20.33^{b}± 1.20	60.33^{abc}± 0.88
TVX-3236	42.33^{a}±3.18	20.00^{abc}±1.15	62.33^{abc}± 2.03	44.67^{b}± 0.88	16.00^{d}± 0.58	60.67^{ab}± 0.67
IT 90K-76	42.00^{a}± 2.00	19.33^{abc} ±1.20	61.33 ^{abc} ± 0.88	41.00^{b}± 1.00	19.67^{b}± 1.45	60.67^{ab}± 0.67

Values in the same column with different superscripts are significantly different (P<0.05, 0.01 and 0.001).

Table 3: Mean and standard error of yield components in some early maturing cowpea genotypes in 2001.

Genotype	Number of pods per plant	Pod length (cm)	Number of seeds per pod	Number of seeds per plant	100 seed weight
Ife-Brown	12.50^{c}± 1.01	15.26^{b}± 0.58	12.23^{bc}± 0.94	153.52^{e}± 20.18	12.49^{ab}± 0.27
Oraludi	14.07^{c}± 3.89	16.80^{a}± 0.44	16.20^{a}± 0.23	228.09^{cde}± 58.19	10.71^{cd}± 1.00
Akidi-ani	19.67^{bc}± 4.34	15.39^{b}± 0.84	15.07^{a}± 0.34	297.30^{bcde}± 67.30	7.38^{e}± 0.59
IT 97k-400-3	32.75^{a}± 1.63	14.45^{b}± 0.37	10.93^{c}± 0.55	359.32^{abc}± 32.70	13.58^{a}± 0.25
IT 82E-16	11.83^{c}± 0.65	17.78^{a}± 0.15	16.13^{a}± 1.39	183.39^{de}± 15.69	12.22^{abc}± 0.21
IT 84S-2246-4	36.00^{a}± 4.73	15.35^{b}± 0.17	11.76^{bc}± 0.88	416.30^{ab}± 35.15	12.11^{abc}± 0.37
IT 90K-59	20.58^{bc}± 1.84	14.57^{b}± 0.29	12.63^{bc}± 0.48	261.36^{bcde}± 31.68	12.73^{ab}± 0.77
TVX-3236	35.33^{a}± 3.35	12.42^{c}± 0.07	14.03^{ab}± 0.27	496.07^{a}± 49.83	9.73^{d}± 0.39
IT 90K-76	28.25^{ab}± 5.86	14.62^{b}± 0.22	11.37^{c}± 0.59	323.04^{bcd}± 73.28	11.09^{bcd}± 0.39

Values in the same column with different superscripts are significantly different (P<0.05, 0.01 and 0.001).

The grain yield performance of the early maturing cowpea genotypes are shown in Table 5. Grain yield differed significantly among the genotypes ($P<0.05$) in 2001 but there was no significant difference among them in 2002. The best performing genotypes in 2001 were IT84S-2246-4 (4026.93kg/ha), IT97k-400-3 (3903.24 kg/ha), TVX-3236 (2752.27 kg /ha) and IT90 k- 76 (2821.01 kg/ha) while in 2002 it was in the following order: TVX-3236 (2466.89 kg/ha), IT 90k 59 (2191.11 kg/ha), IT84S-2246-4 (1999.56 kg/ha) and Ife-Brown (1999.78 kg/ha). The mean yield for the two years showed that the best performing genotypes were IT 84S-2246-4 (3013.25 kg/ha) IT 97k-400-3 (2875.90 kg/ha), TVX-3236 (2609.58 kg/ha), and IT 90k-76 (2157.17kg/ha. The difference in grain yields among the genotypes can be attributed to the observed growth parameters where there was a significant genotypic difference among the genotypes. Interestingly, the local varieties that were taller and had more leaves had low yield. This implies that they partitioned their assimilates to vegetative growth than to the production of grains.

Correlation analysis among the traits were similar, so only the 2002 analysis are shown in Table 6. Seed yield per plant was positively and significantly ($P<0.01$) correlated with number of branches per plant ($r = 0.610$), number of pods per plant ($r=0.768$) and number of seeds per plant ($r = 0.778$). It was also positively and significantly ($P<0.05$) correlated with number of leaves per plant while the other attributes except number of days to flowering was positively correlated to seed yield. This suggests that grain yield in these early maturing cowpea genotypes can be improved upon by selecting for these attributes. Similar results have been reported by Singh *et al.*, 1982; Ombakho and Tyagi, 1987; Ogunbodede, 1989; Ofori and Djagbletey, 1995; Nakawuka and Adipala, 1999; and Okeleye *et al.*, 1999. The number of seeds per plant was significantly and positively ($P<0.01$) correlated with number of leaves per plant ($r = 0.733$), number of branches per plant ($r = 0.617$) and number of pods per plant ($r = 0.799$). It was also positively and significantly ($P<0.05$) correlated with number of seeds per pod ($r = 0.436$). This implies that in selecting for more seeds per plant that these attributes should be taken in consideration. Number of pods per plant was positively and significantly ($P<0.01$) correlated with number of leaves/plant ($r = 0.633$) and number of branches per plant ($r = 0.793$). A negative correlation existed between 100 seed weight (seed size) and most of the traits. This can pose a major problem in selection for large seeds, as it will certainly lead to yield reduction. On the other hand, the developmental plasticity of yield components could facilitate the maintenance of a more stable yield level. Thus variation in one will tend to compensate for variation in another. A significant and positive ($P<0.01$) correlation was obtained between number of seeds per pod and pod length ($r = 0.557$). This indicates that with longer pods more space is provided for the seeds.

In conclusion, the result of this study indicated that early maturing cowpea can perform very well in Umudike when planted towards the end of the rains. The earliness character (days to flowering, pod filling and days to physiological maturity) enables them to flower, pod fill and mature early and thereby escape the dryness of late November. The yield of these genotypes were quite high and encouraging enough to enable the recommendation of some of the genotypes to farmers in this area after due consideration to seed color preference which is an important factor in cowpea acceptability by farmers. Correlation

Table 4: Mean and standard error of yield components in some early maturity cowpea genotypes in 2002

Genotype	Number of pods per plant	Pod length (cm)	Number of seeds per pod	Number of seeds per plant	Shelling Percentage	100 seed weight (Gm)
Ife-Brown	20.82± 4.54	15.18^{bc}± 1.00	10.26^{bc}± 1.24	224.56± 74.50	73.75± 3.89	13.30^{c}± 0.30
Oraludi	17.40± 2.96	17.71^{a}± 0.28	12.87^{a}± 1.12	218.06± 24.40	72.78± 3.86	12.77^{c}± 0.26
Akidi-ani	18.33± 2.14	14.34^{cd}± 0.18	12.29^{ab}± 0.67	226.58± 32.39	73.86± 8.18	9.30^{d}± 0.15
IT 97k-400-3	20.98± 4.18	14.82^{cd}± 0.63	7.45^{e}± 1.26	148.04± 16.47	78.27± 12.29	18.80^{a}± 0.75
IT 82E-16	15.93± 2.84	16.61^{ab}± 0.77	12.40^{ab}± 0.31	161.72± 74.99	69.84± 0.59	14.67^{bc}± 0.33
IT 84S-2246-4	18.55± 4.35	15.28^{bc}± 0.52	9.53^{cde}± 0.29	178.83± 46.85	77.49± 1.38	16.80^{ab}± 0.15
IT 90K-59	16.12± 1.97	14.59^{cd}± 0.17	11.23^{abc}± 0.84	181.41± 27.43	84.68± 2.69	18.10^{a}± 1.97
TVX-3236	27.75± 2.38	12.62^{e}± 0.12	10.00^{bcd}± 0.75	280.53± 41.57	77.61± 3.77	13.08^{c}± 0.42
IT 90K-76	14.82± 4.75	13.41^{de}± 0.20	7.71^{de}± 0.32	113.02± 33.70	76.12± 1.76	14.67^{bc}± 0.38

Values in the same column with different superscripts are significantly different ($P<0.05$, 0.01 and 0.001).

Table 5: Grain yields in some early maturity cowpea genotypes.

Genotype	2001	2002	Mean yield kg/ha
Ife-Brown	1536.39[b]± 210.79	1997.78± 685.02	1767.09
Oraludi	1926.93[b]± 438.76	1853.78±203.29	1890.36
Akidi-ani	1807.88[b]± 500.39	1406.44± 207.41	1607.16
IT 97k-400-3	3906.24[a]± 374.63	1845.56± 179.40	2875.90
IT 82E-16	1795.01[b]± 163.47	1932.92± 351.46	1863.97
IT 84S-2246-4	4026.93[a]± 342.76	1999.56± 517.23	3013.25
IT 90K-59	1610.41[b]± 641.13	2191.11± 378.23	1900.76
TVX-3236	2752.27[ab]± 121.50	2466.89± 430.08	2609.58
IT 90K-76	2821.01[ab]± 541.14	1493.33± 685.06	2157.17

Values in the same column with different superscripts are significantly different ($P<0.05, 0.01$ and 0.001).

analysis showed that the highest contributors to seed yield are number of branches per plant, number of pods per plant and number of seeds per plant. Although earlier research showed that seed size is a primary determinant of yield in cowpea (Imrie and Bray, 1983; Obisesan, 1985); this was not the case in this study. This discrepancy may have been due to the different genotypes used. Thus for yield improvement in early maturing cowpea genotypes branch, pod number and seeds per plant should be part of the selection indices.

Although, selecting for increase in the number of seeds for plant can lead to reduced seed size, the increase in the number of seeds can compensate for the loss.

Table 6: Correlation between the yield components of some early maturing cowpea genotypes in 2002.

	Plant Height 1	Number of leaves per plant 2	Number Of branches per plant 3	Number of pods per plant 4	Pod Length 5	Number of seeds per pod 6	Number of seeds per plant 7	100 seed weight 8	Dry matter yield per plant 9	Number of days to flowering 10	Pod filling period 11	Shelling percentage 12	Number of Days to physiological maturity 13	Yield per plant 14
1	-	0.564**	0.008	0.049	0.418*	0.658**	0.337	-0.709**	0.138	0.208	-0.525**	-0.389*	-0.539**	-0.20
2		-	0.626**	0.633**	0.087	0.403*	0.733**	-0.512**	0.420*	0.185	-0.415*	-0.402*	-0.400*	0.428*
3			-	0.793**	-0.141	-0.013	0.617**	-0.040	0.350	0.130	-0.077	-0.212	0.047	0.610**
4				-	-0.124	-0.067	0.799**	-0.111	0.223	0.092	-0.072	-0.238	0.007	0.768*
5					-	0.557**	0.173	0.044	0.171	-0.342	0.062	-0.125	-0.341	0.187
6						-	0.436*	-0.344	-0.124	0.199	-0564**	0.054	-0.610**	0.245
7							-	-0.300	0.037	0.194	-0.378	-0.063	-0.331	0.778*
8								-	-0.014	-0.397*	0.694**	0.336	0.556**	0.221
9									-	-0.241	0.291	-0.547**	0.139	0.058
10										-	-0.761**	0.161	0.108	-0.006
11											-	-0.010	0.563**	0.013
12												-	0.190	0.088
13													-	0.012
14														-

* P<0.05, ** P<0.01

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