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# Phenotypic variability and association of component characters for seed yield in Cowpea (*Vigna unguiculata* (L) Walp)

**[1*]Adavbiele, V.J., [2]Mensah J.K. & [1]Onolemhemhen P.O .**

**[1]Department of Crop Science, Ambrose Alli University, Ekpoma, Edo State, Nigeria**

**[2]Department of Botany, Ambrose Alli University, Ekpoma, Edo State, Nigeria**

***Corresponding Author- adavbiele_victor@yahoo.com ±2348100960916**

## ABSTRACT

Phenotypic variability and association of component characters for seed yield in cowpea (*Vigna unguiculata* .L.Walp.) was carried out in Teaching and Research Farm, Ambrose Alli University, Ekpoma. Five varieties of cowpea (Kano-white, Ife brown, TVX3236, IT82KD-374-57 and IT84-224) were evaluated in the early and late cropping seasons of 20012/2013 for growth and yield characters as well as the association of yield component characters. The experimental was Randomized complete Block Design (RCB) with three replicates. Differences in growth and yield parameters were estimated. Significant differences except for plant height were recorded for all growth and yield parameters. The phenotypic coefficient of variations values ranged from 0.59 for weight of pod to 4854.17cm$^2$ for total leaf area/plant and from 0.51 for weight of pod to 23844.5cm$^2$ for total leaf area/plant for late and early seasons respectively. Pod length had high significant positive correlation with pods/plant (r = 0.681 and r = 0.687), seeds/pod (r = 0.928 and r = 0.973) and seeds/plant (r = 0.689 and r = 0.977) during the two cropping seasons at the phenotypic level and thus revealed that an improvement in one of these characters would invariably lead to improvement in other characters.

## INTRODUCTION

The increasing demand throughout the world for high protein and energy crops has stimulated considerable interest in the development of leguminous crops. Among different members of grain legume in Nigeria is cowpea (*Vigna unguiculata* (L) Walp), an important crop that supplies good quality protein and ditetary nutrients at reasonable cost.

Cowpea is a member of the genus *Vigna*, which belongs to the tribe Phaseoleae. It is currently cultivated in all tropical areas and in some temperate areas like Mediterranean basin and the southern states of the United State of America (Pasquet, 2000). World cowpea hectarage is estimated to exceed 12.5 millions and annual production is over 3 million tones worldwide (Singh *et al*., 1997). Cowpea, which is a warm-weather annual crop, does well in the semi-arid tropics and can tolerate less rainfall than cereal crops. An annual rainfall of 750mm to 1500mm evenly distributed is adequate for cowpea production (IITA, 2002).

Cowpea is one of the main grain legume crops in the world and is the principal grain legume throughout much of its savanna zone (Pasquet, 2000). It is valued for high protein content and is consumed as dry seeds, green pods or leaves (Menedez et al., 1997). In addition to its` use as a pulse crop, it is cultivated as a fodder crop although the latter is currently disappearing.

Throughout Nigeria, cowpea is commonly grown. Nigeria is presently the world`s leading producer of the crop accounting for over 80 percent of the total world production (IITA, 2002). Other major producers are

Uganda, Burkina Faso and United State of America. The prevalent crop varieties of cowpea in southern Nigeria, especially in Edo state are low yielding, hence selection for high yielding line is desirable. However, there are needs to establish characters which would serve as selection tool for the improvement of cowpea in terms of seed yield.

## MATERIALS AND METHODS

This study was conducted at the Teaching and Research Farm of the Faculty of Agriculture, Ambrose Alli University, Ekpoma (Lat. $6^042^1$N, Long. $6^068^1$E). Five varieties of cowpea (Kano White, Ife brown TVX3236, IT89KD-374-5 7 and IT84-224) obtained from Federal Department of Agriculture (FDA), Ubiaja were evaluated using a Randomized Complete Block Design (RCBD) and replicated three times during the early and the late cropping seasons of 2012 and 2013, respectively.

The late cropping season (October-December, 2012) consisted of five-row plots with a plot size of 4 x 1 m (4 $m^2$). The early cropping season (February to April, 2013) also consisted of five- row plots with a plot size of 1m x 50cm (0.5 $m^2$). Plants were spaced at 100x 30 cm within and between rows with three seeds planted per hole. These were later thinned to two plants per stand seven days after planting. Each row of the late cropping season consisted of 12 plants, giving a total of 60 plants per plot while that of early cropping season consisted 6 plants per row and 30 plants per plot both corresponding to 120,000 plants per hectare.

The morphological development of the five varieties of cowpea was examined for the following characters:

**Pant height:** At 6 weeks after planting (WAP), a measuring tape was used to measure five randomly selected plants in each plot from the soil surface to the plant apex expressed in cm.

**Number of leaves/pant:** Five randomly selected plant leaves/plot were counted and the average value recorded.

**Leaf area:** This was determined by using graph-tracing method. Fully expanded leaves were placed on graph papers, traced and then the number of squares/traced area recorded as the leaf area in $cm^2$.

**Number of branches/plant:** Branches/ plant from five randomly selected plants at 6 WAP were counted and the mean value recorded.

**Days to 50% flowering**: Days from the date of sowing to the opening of the first floral bud for 50% of the population for each variety was recorded.

**Days to pod maturity**: Days from the date of sowing to the day pods became fully matured were recorded.

**Pod length**: Five randomly selected pods/plant harvested were measured and the average length taken; where the pods were curved, a string was used to traced their outline before taken measurement.

**Number of pods/plant**: The number of pods/plant was determined by counting.

**Number of seeds/pod**: Seeds/pod was determined by counting.

**Number of seeds/plant:** Five plant stands/plot were randomly selected, seeds counted and average value recorded.

**Weight of pod**: Ten matured pods were randomly selected from each plot and weighed.

**100 seeds weight**: 100seeds/variety were randomly selected and weighed.

**Data Analysis:** Data collected were analyzed using analysis of variance (ANOVA) at 5% level of probability and the means separated using Least Significant Differences (LSD).

**Coefficient of Variation (CV)**: The coefficient of variation for treatment means were calculated using the formula by Steele and Torrie, (1980).

$$\partial^2/\mu \times 100$$

Where $\mu$ = Mean

$\partial^2$ = Standard deviation

## RESULTS AND DISCUSSION

**Table 1: The growth characters of five varieties of cowpea during late and early cropping seasons**.

| Varieties | Seasons | Plant height (cm) | Leaves/Plant | Total leaf area ($cm^2$) | Branches/plant | Flower initiation | Days to pod maturity |
|---|---|---|---|---|---|---|---|
| Kano-white | L | $40.33^{a} \pm 0.56$ | $33.6^{a} \pm 1.48$ | $89.47^{b} \pm 2.07$ | $4.62^{a} \pm 0.41$ | $43.30^{a} \pm 0.01$ | $72.00^{c} \pm 1.15$ |
| | E | $57.75^{a} \pm 0.87$ | $50.00^{a} \pm 2.14$ | $187.67^{b} \pm 14.79$ | $8.33^{b} \pm 0.88$ | $45.17^{c} \pm 0.17$ | $76.67^{d} \pm 1.76$ |
| Ife-brown | L | $43.98^{b} \pm 1.44$ | $36.82^{a} \pm 0.01$ | $168.37^{c} \pm 160$ | $6.02^{b} \pm 0.13$ | $43.00^{a} \pm 0.001$ | $67.00^{b} \pm 0.58$ |
| | E | $63.94^{ab} \pm 2.43$ | $52.33^{a} \pm 0.88$ | $355.6^{c} \pm 16.96$ | $10.00^{c} \pm 0.58$ | $45.00^{c} \pm 0.50$ | $72.33^{d} \pm 0.033$ |
| TVX3236 | L | $39.58^{a} \pm 1.49$ | $35.00^{a} \pm 1.25$ | $69.79^{a} \pm 1.74$ | $5.12^{a} \pm 0.32$ | $45.00^{ab} \pm 0.58$ | $60.00^{a} \pm 0.58$ |
| | E | $57.80^{a} \pm 1.45$ | $50.00^{a} \pm 1.53$ | $123.00^{a} \pm 4.58$ | $6.00^{a} \pm 0.58$ | $43.50^{b} \pm 0.50$ | $71.07^{c} \pm 0.88$ |
| IT89KD-374-57 | L | $46.49^{ab} \pm 1.14$ | $37.5^{a} \pm 1.75$ | $76.32^{a} \pm 1.08$ | $4.95^{a} \pm 0.53$ | $45.70^{a} \pm 1.20$ | $71.70^{d} \pm 1.43$ |
| | E | $63.25^{b} \pm 1.23$ | $52.00^{a} \pm 1.53$ | $166.00^{a} \pm 23.07$ | $6.33^{a} \pm 0.33$ | $40.50^{b} \pm 1.52$ | $64.67^{b} \pm 0.33$ |
| IT84-224 | L | $38.04^{a} \pm 1.89$ | $36.4^{a} \pm 1.74$ | $84.51^{ab} \pm 1.05$ | $5.12^{a} \pm 0.29$ | $40.80^{b} \pm 0.01$ | $59.50^{a} \pm 0.58$ |
| | E | $56.87^{a} \pm 0.79$ | $59.67^{b} \pm 0.88$ | $176.67^{ab} \pm 10.14$ | $7.00^{a} \pm 0.58$ | $38.17^{a} \pm 0.44$ | $61.00^{a} \pm 0.58$ |
| Mean | L | 41.64 | 35.86 | 97.67 | 6.17 | 43.56 | 67.24 |
| | E | 59.87 | 52.00 | 201.6 | 7.53 | 40.70 | 71.87 |
| L.S.D | L | 1.12 | 3.17 | 8.22 | 2.23 | 0.73 | 2.46 |
| | E | 5.03 | 3.09 | 54.3 | 1.90 | 1.83 | 1.98 |

*All figures within a column with the same alphabet are not significantly different at 5% level of probability.
L.S.D. = Least Significant Difference
L = Late cropping season
E = Early cropping season.

**Table 2: The yield parameter of five varieties of cowpea during late and early cropping seasons**

| Varieties | Seasons | Plant height (cm) | Leaves/Plant | Total leaf area ($cm^2$) | Branches/plant | Flower initiation | Days to pod maturity |
|---|---|---|---|---|---|---|---|
| Kano-white | L | 8.1 $^{a}$ ± 0.12 | 10.08$^{d}$ ± 0.87 | 11.08 $^{d}$ ± 0.26 | 89.10 $^{a}$ ± 0.23 | 3.30 $^{c}$ ± 0.08 | 24.60 $^{d}$ ± 0.34 |
| | E | 9.8 $^{a}$ ± 0.52 | 11.68 $^{a}$ ± 0.20 | 10.70 $^{a}$ ± 0.19 | 106.82 $^{a}$ ± 0.63 | 3.50 $^{c}$ ± 0.08 | 25.40 $^{d}$ ± 0.57 |
| Ife-brown | L | 7.4 $^{a}$ ± 0.30 | 12.47 $^{c}$ ± 0.19 | 11.67$^{b}$ ± 0.21 | 86.36 $^{a}$ ± 0.57 | 2.77 $^{b}$ ± 0.06 | 24.40 $^{d}$ ± 0.57 |
| | E | 8.2 $^{a}$ ± 0.52 | 12.49$^{ab}$ ± 0.19 | 11.77 $^{a}$ ± 0.15 | 96.51 $^{a}$ ± 0.51 | 3.20 $^{b}$ ± 0.05 | 25.0 $^{d}$ ± 0.51 |
| TVX3236 | L | 8.4 $^{a}$ ± 0.30 | 12.81 $^{c}$ ± 0.38 | 14.67$^{b}$ ± 0.31 | 123.23$^{ab}$ ± 0.81 | 3.00$^{bc}$ ± 0.05 | 17.83$^{a}$ ± 0.32 |
| | E | 10.2 $^{c}$ ± 0.80 | 12.93 $^{b}$ ± 0.41 | 13.67 $^{b}$ ± 0.26 | 139.43 $^{c}$ ± 0.78 | 3.40$^{bc}$ ± 0.10 | 18.91$^{a}$ ± 0.52 |
| IT89KD-374-57 | L | 8.7 $^{a}$ ± 0.32 | 15.00 $^{d}$ ± 0.09 | 17.00 $^{c}$ ± 1.02 | 147.90 $^{b}$ ± 0.79 | 2.54 $^{b}$ ± 0.06 | 20.77 $^{c}$ ± 0.26 |
| | E | 9.8 $^{c}$ ± 0.83 | 15.40 $^{c}$ ± 1.01 | 17.02 $^{c}$ ± 1.81 | 166.80 $^{c}$ ± 0.88 | 2.81 $^{b}$ ± 0.06 | 21.50 $^{c}$ ± 0.05 |
| IT84-224 | L | 6.9 $^{a}$ ± 0.23 | 7.35 $^{a}$ ± 0.21 | 9.33 $^{a}$ ± 0.75 | 64.38 $^{a}$ ± 0.40 | 2.14 $^{a}$ ± 0.03 | 15.53 $^{a}$ ± 0.25 |
| | E | 7.6 $^{a}$ ± 0.29 | 11.47 $^{b}$ ± 0.08 | 10.00 $^{a}$ ± 0.25 | 76.00 $^{a}$ ± 0.52 | 2.52 $^{b}$ ± 0.03 | 16.89 $^{a}$ ± 0.54 |
| Mean | L | 7.90 | 11.54 | 12.73 | 101.53 | 2.75 | 20.63 |
| | E | 9.11 | 12.79 | 12.67 | 117.11 | 3.09 | 21.54 |
| L.S.D | L | 0.64 | 1.19 | 1.30 | 3.07 | 0.40 | 2.46 |
| | E | 0.87 | 1.29 | 1.58 | 4.68 | 0.36 | 2.72 |

*All figures within a column with the same alphabet are not significantly different at 5% level of probability.
L.S.D. = Least Significant Difference
L = Late cropping season
E = Early cropping season.

**Table 3: Correlation (r) matrix for different phenotyphic characters of cowpea during the late cropping season**

| Phenotypic | Plant height | Leaves/ plant | Total leaf area($cm^2$) | Branches/ plant | Days to pod maturity | Pod length (cm) | Pods/ plant | Seeds/ pod | Seeds/ plant | Weight of pod (g) | 100 seed weight (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Flower initiation | 0.539* | -0.3800** | 0.2720 | 0.1540 | 0.5150* | 0.6740* | 0.7180* | 0.9920* | 0.2730 | 0.4010** | 0.1770 |
| Plant Height | | 0.1680 | 0.5710* | -0.1090 | 0.7740* | 0.7690* | 0.4720* | 0.6290* | 0.6530* | 0.2260 | 0.2800 |
| Leaves/plant | | | 0.3440** | 0.7460* | -0.015 | -0.2790 | -0.8490* | -0.3900** | -0.1610 | -0.8150* | -0.6550* |
| Total leaf area | | | | 0.1200 | 0.2930 | 0.0140 | 0.1210 | -0.1750 | -0.1680 | 0.1840 | 0.2560 |
| Branches/plant | | | | | -0.7180* | -0.5180* | 0.4060** | -0.5520* | 0.2610 | 0.2130 | 0.9080* |
| Days to pod maturity | | | | | | 0.5990* | 0.6130* | 0.5870* | 0.4860* | 0.22610 | 0.7000* |
| Pod length | | | | | | | 0.6870* | 0.9730* | 0.9770* | 0.3410** | 0.3930** |
| Pods/plant | | | | | | | | -0.7270* | 0.5780* | 0.8880* | 0.7150* |
| Seeds/pod | | | | | | | | | 0.9710* | 0.4030** | 0.3100** |
| Seeds/pod | | | | | | | | | | 0.2270 | 0.1890 |
| Weight of pod | | | | | | | | | | | 0.6590* |

* Significant at 5% level of probability
** Significant at 1% level of probability

**Table 4: Correlation (r) matrix for different phenotypic characters of cowpea during the early cropping season**

| Phenotypic | Plant height | Leaves/ plant | Total leaf area ($cm^2$) | Branches/ plant | Days to pod maturity | Pod length (cm) | Pods/ plant | Seeds/ pod | Seeds/ plant | Weight of pod (g) | 100 seed weight (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Flower initiation | 0.4040** | -0.6820* | 0.6360* | 0.7740* | -0.1110 | -0.1230 | -0.6400** | -0.4220** | -0.6470* | 0.7660* | 0.9610* |
| Plant Height | | -0.2500 | 0.6390* | 0.4070** | 0.2300 | 0.6430* | -0.045 | 0.3480** | -0.0340 | 0.0800 | 0.5270* |
| Leaves/plant | | | 0.0031 | -0.0690 | -0.6660* | -0.3520** | -0.076 | -0.2130 | -0.0680 | -0.8920 | -0.6300* |
| Total leaf area | | | | 0.9280* | 0.5720* | 0.1770 | -0.723* | -0.7160* | -0.4750* | -0.0100 | 0.0340 |
| Branches/plant | | | | | 0.7480* | -0.4130** | -0.9100* | -0.7100* | -0.9100* | 0.2360 | 0.7350* |
| Days to pod maturity | | | | | | -0.2770 | -0.6620 | -0.5260* | -0.6700* | 0.8100* | 0.8560* |
| Pod length | | | | | | | 0.6810* | 0.9280* | 0.6890* | -0.0980 | 0.0480 |
| Pods/plant | | | | | | | | 0.9010* | 0.9950* | -0.2440 | -0.6100* |
| Seeds/pod | | | | | | | | | 0.9090* | -0.2110 | -0.2980 |
| Seeds/pod | | | | | | | | | | -0.2580 | -0.6150* |
| Weight of pod | | | | | | | | | | | 0.6890* |

* Significant at 5% level of probability
** Significant at 1% level of probability

During the early cropping season in February, higher values for plant height, leaves/plant and branches/plant were recorded due to higher rainfall. TVX3236 and IT89KD-374-57 were the only varieties that differed significantly during the early planting season from others. Ezedinma, (1975) reported similar observation that heavy rainfall favour vegetative growth in cowpea during early cropping season in southern Nigeria. Significance differences with respect to plant height, leaves/plant and branches/plant were recorded among the varieties. Thus seasonal variations have effect on these characters. There were significant variations in the numbers of days to 50% flowering during the two cropping season in all the varieties. The number of days to 50% flowering was highly significant ($P<0.05$). However, plant grown during early cropping season had delayed flowering when compared with late cropping season and this was due to heavy rainfall, which led to enhance vegetative growth. Thus, flowering exhibited distinct seasonal pattern as reported by Okeleye (1999), Coulibaly, *et al*. (2000) and Echekwu, (2001).

Early cropping season recorded higher number of pods/plant (10.2+0.80) when compared to late cropping season (9.8$\pm$52). Seasonal variation also affected the number of pods/plant. Wien and Ackah (1978) and Ndubisi (1982) reported similar observation that seasonal variations have effect on the number of pods/plants. The number of pods/plants was influenced by number of days to flowering and this confirms the earlier report by Okeleye *et al.* (1999) that number of days to flowering has effect on pod/plant There were significant differences ($P<0.05$) between varieties for the number of pods/plant. High significant and positive relationships were observed among some phenotypic characters such as pod length and pod/plant, seeds/pod and seeds/plant.

## CONCLUSION

Seasonal variations were observed for growth and yield parameters such as plant height, leaves/plant, branches/plant, leaf area, number of days to pod maturity, seeds/pod, seeds/plant, weight of pod and 100 seed weight. There were high significant and positive relationship among some phenotypic characters such as pod length and pod/plant, seeds/pod and seeds/plant. Thus, indicating that improving on one of the characters would lead to an improvement in the other characters positively correlated.

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