Available online at www.pelagiaresearchlibrary.com

Pelagia Research Library

Advances in Applied Science Research, 2011, 2 (6):155-160

ISSN: 0976-8610
CODEN (USA): AASRFC

Trait Response to Early- Generation Selection using a common parent in two crosses of Cowpea (V*igna unguiculata)* for humid environment performance

Aremu, C.O

Department of Agronomy, Ladoke Akintola University of Technology, Ogbomoso

---

ABSTRACT

Attempts have been made to improve the effectiveness of generation selection in Cowpea Vigna unguiculata. This study compared the response to direct and indirect generation selection for yield and yield traits using two crosses of cowpea with a common parent- Ife Brown (IFB) to give IFB X Danilla and IFB X IAR 48w, the mean differences between selected high and low groups at the F2 were greater than those derived from F3 and F4 family selections. Realized heritability (RH) estimates were high for number of branch per plant, Length of peduncle, number of pods, and seeds per plant when selection is made at the F3 with response in the F4. Genetic advance (GA) was very high for number of branch per plant, Length of peduncle and seed yield. The high values for these traits using RH and GA estimates justify the effectiveness of making reliable selection for these indirect and direct yield traits in the early generation of F2 and F3. The use of RH and GA demonstrated the complementary use of these two parameters in best describing trait genetic performance in highly variable planting environment.

Key words: early generation selection, common parent, cowpea crosses, realized heritability, genetic advance, environment.

INTRODUCTION

Low yield of Cowpea in Guinea Savanna agro-ecology remained a major concern to plant breeders. Selection for yield and yield components in early generations has produced varying results. Plant characters bearing desirable gene combinations are easily identified and selected for at the early generations preferably at theF_1 before reaching homozygosity in the late generations [Cristina and Hall 1995]. Contrarily, Falcinelli et al., [1983] [2], Alexandra et. al [1984] [3] reported effective selection of grain weight and plant height at F_3 and F_4 generations in wheat. Also, MCvetty and Evans [1980] [4], reported that selection of such desirable characters can be delayed until plants reach near homozygosis at a later generation. Araujo and Coulman [2002] [5], Sing and Singh [1997] [6], reported plant height and kernel weight as

showing effective selection in the early generation of F_2 while harvest index, grain yield and dry matter weight were ineffective when selection is made at the early generation in bread wheat. Rasmussen [1987] reported that delaying selection to a later generation of F_4 could lead to loss of such desirable gene combinations.

In the analysis of response to early generation selection, the use of Realized heritability estimates have proved useful and reliable. Using Realized heritability and Genetic advance estimates, this study considers the effectiveness of yield and yield component selection at the early or later generations using two crosses of cowpea with a common parent developed for adaptation to guinea savanna agro-ecology specific environment

MATEREIALS AND METHODS

Two crosses of cowpea were developed using Ife-brown (IFB) a popularly accepted local cultivar as common parent to each of Danilla and IAR48w to give IFB x Danilla and IFB x IAR48w.

Ife-brown is a high yielding variety in the derived savanna and humid savanna agro-ecology. While Danilla and IAR48w cultivated in the dry savanna agro-ecology are moderate yielding. Ife-brown apart from the high yielding trait has long peduncles above the plant canopy and matures earlier than Danilla and IAR48W. Whereas, Danilla has short peduncle with pods spread under the moderate canopy but IAR48W has the longest peduncle with plant canopy spreading over the pods. Both Danilla and IAR48W mature later than IFB. IAR48W has largest seed weight (Table I).

Experiments were carried out at the Teaching and Research farm of Ladoke Akintola University of Technology during the planting seasons of 2004, 2005 and 2006.The crosses of IFB X Danilla (F_1) and IFB X IAR48W (F_1) were grown in 2004 to produce FI having 140 plant stands in each of the two crosses during the planting season of 2004. Using a plot size of 6m x 3m, a Randomized Complete Block Design (RCBD) was used. The spacing was 60cm between rows and 45cm within rows to give 14 plant stands per row.

Using a divergent selection method of Falcinelli *et al.,[*1983] [2], plants from the F_2 were selected if the yield character was higher than its adjacent row plant. The selected F_2 seeds from each of the two crosses were grown to produce the F_3 plants during the planting season of 2004 in a Randomised Complete Block Design (RCBD) using a single row plot of 4m long with 3 replications. Each plot had a 60cm and 40cm inter and intra row spacing to give a total of 22 plant stands per row plot. The selected seeds from the F_3 plants were sown in the 2005 sowing season to produce the F_4 plants using plot size and design as in F_3

Data collection and analysis

Selections were made on higher and lower yield traits and data collected from the following traits:

Days to flowering, Number of branch per plant, Length of peduncle, Number of pods per plant, Days to 95% maturity, Number of seeds per pod, 100- seed weight and Seed yield (g) per plant

Two systems of response to selection were used as follows:
(1) Selection in F_2 plants with response in the F_3
(2) Selection in F_3 with response in F_4.

From the data a Realized Heritability estimate was calculated for each trait in each generation following the method of Sneep [1997] [8] and Falconer [1989] [9]

Where Realized Heritability (RH) is given as

$$RH = \frac{[(H_{t+I} - L_t/H_t)]/ H_{t+I}}{[(H_{t+I} - L_t/Ht)]}$$

and
H = mean value of the selected high group for a trait
L = mean value of the selected Low group for a trait
t= the generation in which selection occurred
Ht = subsequent generation in which the response was measured

Mean character performance was generated following Analysis of Variance technique (ANOVA)

RESULTS AND DISCUSSION

The differences between selected high and Low groups at the F2 were greater than those derived from F3 and F4 for length of Peduncle, number of pods per plant and days to maturity in both crosses (Table 2). The other traits showed higher value between the high and low groups when selection is made at the F3. The persistence of large differences between selected high and low groups in the first two filial generations (F2 and F3) is indicative of the effectiveness of selection before the F4 generations.

Table 1: Mean Character performance of the 3 cowpea genotypes used in the crosses

Genotype	Number of days to 50% flower	Number of branch/plant	Length of peduncle	Number of pods per plant	Days to 95% maturity	Number of seeds/plant	100 seed weight (g)	Seed Yield
Ife-brown	37	5	31.1	26	62	9	12	24.00
DANILLA	45	5	25.13	20	78	5	15	19.71
IAR48W	49	3	17.18	22	71	6	19	18.33
S.E.	0.17	0.23	0.19	0.08	0.20	0.43	0.15	0.17

The family realized heritability estimates for the two crosses of Ife-brown X Danilla and Ife-brown X IAR48w is as shown in Table 3. The high realized heritability recorded for the seed traits when selections are made at the F3 with response in the F4 is suggestive of the reliability in selection at F3 for these traits. That days to maturity recorded higher realized heritability estimate derived at the F_2 family with response at F_3 (54.7), 70.4) in the two crosses, is a confirmation that indirect selection for maturity period even at the F_2 generation can be

effective and compensatory to selecting trait for earliness, to flowering in the F_3 family. According to Rasmussen (1987), indirect selection based upon one or more yield traits is more effective than direct selection for seed yield itself. The highest magnitude of RH of 73.0 and 70.4 from selection in F_3, with response in F_4 , for number of pods per plant and 64.2and 68.1 for length of peduncle per plant and 68.1 and 59.7 for number of branch per plant in the two crosses of IFB x Danilla and IFB X IAR48W respectively, demonstrated that selection of these traits is more effective than selection for days to maturity, number of seeds per pod and seed yield with moderate lower RH magnitude of 50.2 and 59.6, 56.2 and 61.9, 51.1 and 46.2 respectively. Estimate of Genetic advance in the two crosses were very high for number of branch per plant (60.6; 59.8), length of peduncle (61.4; 57.1) and seed yield (60.1;56.7) for the two crosses when selection is made at F_3 with response in F_4 (**Table 4**). Falcinelli et al [1983] [2], suggested moderate and high GA for branch number and days to maturity as having minimal environmental effect on wheat performance. The high Genetic Advance as well as high Rh for number of branch, length of peduncle and number of seeds per plant at the F_3 with response in F_4 reveals the complementary use of these two parameters in best describing trait genetic performance in highly sensitive and variable planting environment

Table 2: Mean of selected family groups of F_2, F_3, and F_4 in the two crosses of cowpea used

Trait	Family Response	IFB x Dan.(% high to low)	IFB x IAR. (%High to low)
Days to 50% flowering	F_2	48.2	43.1
	F_3	23.7	63.0
	F_4	*35.6*	39.1
Number of branch/plt	F_2	40.6	46.3
	F_3	45.0	65.0
	F_4	35.1	32.4
Length of peduncle	F_2	54.9	51.4
(cm)	F_3	21.2	47.3
	F_4	35.1	40.1
Number of pods /plt	F_2	56.2	54.0
	F_3	31.7	33.3
	F_4	40.0	35.0
Days to *95%* maturity	F_2	41.7	49.1
	F_3	28.2	47.4
	F_4	33.1	41.2
Number of seeds/pod	F_2	40.2	25.1
	F_3	36.3	48.2
	F_4	22.78	28.3
100-seed wt. (g)	F_2	36.1	33.2
	F_3	60.9	50.8
	F_4	54.3	40.3
Seed yield/plt (g)	F_2	60.1	52..1
	F_3	31.6	55.3
	F_4	25.3	30.2

Foot note: plt = plant; cm =unit of measurement, in centimeter; g = gramme

Table 3: Family Realised heritability traits estimates for the two crosses of cowpea used

Traits	Family Response	IFB x Danilla	IFB x IAR48W
Number of days to 50% Flower	$F_2 - F_3$	48.2	44.3
	$F_3 - F_4$	68.1	59.7
No of branch/pt	$F_2 - F_3$	50.2	50.2
	$F_3 - F_4$	68.1	59.7
Length of peduncle (cm)	$F_2 - F_3$	43.1	58.3
	$F_3 - F_4$	64.2	68.1
Number of pods/plt	$F_2 - F_3$	54.7	64.2
	$F_3 - F_4$	73.0	70.4
Days to 95% maturity	$F_2 - F_3$	54.7	70.4
	$F_3 - F_4$	50.2	59.6
Number of seeds/pod	$F_2 - F_3$	40.9	48.1
	$F_3 - F_4$	56.2	61.9
10 seed wt (g)	$F_2 - F_3$	40.5	36.5
	$F_3 - F_4$	26.9	39.2
See yield (g/plt.)	$F_2 - F_3$	38.2	66.4
	$F_3 - F_4$	51.1	46.2

Table 4: Trait Genetic advance estimates in the two crosses of cowpea used

Traits	Family Response	IFB x Danilla	IFB x IAR48W
Number of days to 50% Flower	$F_2 - F_3$	41.3	36.2
	$F_3 - F_4$	40.4	30.5
No of branch/pt	$F_2 - F_3$	48.2	47.2
	$F_3 - F_4$	60.6	59.8
Length of peduncle (cm)	$F_2 - F_3$	61.4	57.12 57.1
	$F_3 - F_4$	61.4	
Number of pods/plt	$F_2 - F_3$	42.1 65.2	54.3 68.4
	$F_3 - F_4$		
Days to 95% maturity	$F_2 - F_3$	45.3	40.2
	$F_3 - F_4$	50.2	61.4
Number of seeds/pod	$F_2 - F_3$	54.1	50.9
	$F_3 - F_4$	69.2	58. 2
10 seed wt (g)	$F_2 - F_3$	58.2	49.7
	$F_3 - F_4$	21.6	33.4
See yield (g/plt.)	$F_2 - F_3$	48.1	20.2
	$F_3 - F_4$	60.1	56.7

Furthermore where breeding for specific environment adaptation is the focus, these traits are equally identified as important and effective yield components which can be exploited. Length of peduncle can be exploited in developing lines adaptable to very humid environment where the pods can be carried above plant canopy to avoid attack by diseases associated with humid environments. The significant inter-family correlation coefficients (**Table 5**) for number of branch, length of peduncle and number of pods per plant in both family responses in F_3 and F_4 respectively is indicative of seed yield improvement via these traits even when selection is made at F_2 and F_3. Hence, increase in number of branches means increase in number of pod and as such increase in seed yield. Singh and Singh [1997] [6], Saadella [1994] [10], reported significant correlation of number of kernels per spike, plant height and grain yield in wheat.

That branch number, Length of peduncle, number of seeds per plant and maturity period recorded high Rh and GA in addition to significant inter-family correlations, have displayed the

effective and complementary use of Rh and GA even though few discrepancies existed in individual trait selection. This fall out notwithstanding, the use of these three selection indices have been informative in enhancing genetic breeding research programme.

Table 5: Inter-family correlation coefficient for yield and yield characters in the family generations for the two crosses of cowpea used

Trait	Family response	IFB X Dan	IAB X IARW
Number of branch/plant	F_2-F_3	0.46**	0.61**
	F_3-F_4	0.51**	0.54 **
Length of Peduncle (cm)	F_2-F_3	0.42*	0.37*
	F_3-F_4	0.71 **	0.58**
Number of pods/plant	F_2-F_3	0.73**	0.60**
	F_3-F_4	0.34	0.50**
Days to 95% maturity	F_2-F_3	0.24	-0.38
	F_3-F_4	0.41*	0.18
Number of seeds/pod	F_2-F_3	-0.31	-0.41*
	F_3-F_4	-0.17	0.22
100-seed weight (g)	F_2-F_3	-0.22	0.20
	F_3-F_4	-0.27	0.20

Foot note: plt = plant; cm =unit of measurement, in centimeter; g = gramme

REFERENCES

[1] Cristina A, Hall E, *Crop Sci*,. **1995**, 35,3, 673- 678.
[2] Falcinelli M, Brigand G, Damini F, *Amalidella Facolatadi Agrarian*, **1983**,37, 331-341.
[3] Alexander M, Smith E, Dhanasobhan C, *Euphytica*, **1984,** 33, 953-961.
[4] Mcvettv P, Evans L, *Crop Sci*, **1980**, 20, 583-586.
[5] Araujo M, Coulman B, *Plant. Breed*, **2002** 121, 427-434.
[6] Singh K, Singh T, *Indian J. Genet*, **1997**, 57, 411-414.
[7] Rasmussen D, C*rop Sci.* **1987**, 27, 1140-1146.
[8] Sneep J, *Euphytica*, **1997**, 26, 27-36.
[9] Falconer D, Introduction to quantitative Genetics. 3rd Ed. Longman inc. New York **1989**, 438pp.
[10] Saudalla M, *Research. Comm.* **1994**, 22, 187-193.