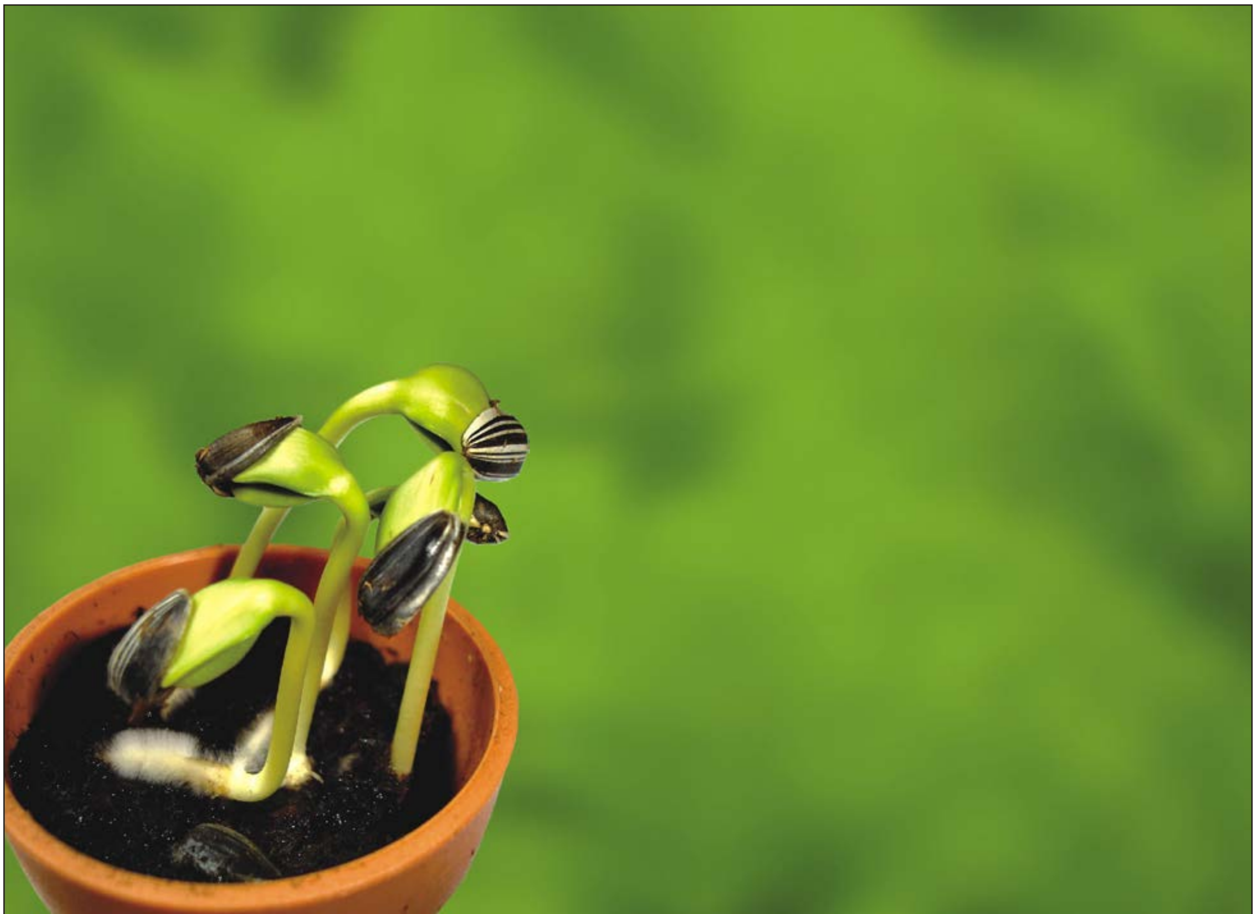

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Genetic Study of Earliness in Cowpea (*Vigna unguiculata* L. Walp) Under Screen House Condition

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Abstract: Genetic effects for earliness were determined from a cowpea cross under screen house condition using generation mean analysis from six populations (P_1, P_2, F_1, F_2, BC_1 and BC_2). The result from this study suggests that earliness is under polygenic control. Generation mean analysis did not fit an Additive dominance model. The Additive and dominance effects were low with the dominance component not significantly different from zero. The Additive x Additive (I) and Dominance (h) effects were negative with diminishing effects suggesting an enhancing effect on earliness while the Additive x Dominance (j) effect was high and positive suggesting an enhancing effect for late maturity. The narrow sense heritability was high 90.87%. Genetic advance assuming 10% selection intensity of the earliest or latest flowering plants was selected for further propagation is expected to be ±17 days. The Additive (d), Additive x Additive (I), Additive x Dominance (j) and Dominance x dominance (l) interaction were the most important gene actions conditioning earliness.

Key words: Generation mean analysis, gene action, earliness, days to first flower

INTRODUCTION

Knowledge of the type of gene action involved in the expression of a trait is helpful in deciding the appropriate breeding procedures to be used for the improvement of the trait. Whereas dominance gene action would tend to favor production of hybrids, additive gene action signifies that standard breeding procedures would be effective in bringing advantageous changes in the trait. Earliness in cowpea (*Vigna unguiculata* (L.) Walp.) is an important agronomic trait. It is an important component of adaptation of crops to any agro-climatological zone especially in the semi-arid tropics, where it is associated with some stress factors that occur late in the growing season (Singh, 1986). Typical, it is measured by such criteria, as days to first flower with corolla visible, days to 50% flowering and days to maturity. Early maturing cowpea varieties are important in opening the possibility of successful sole cropping in areas with short rainy season, double/triple cropping in rice and/or wheat based systems, relay cropping in areas with relatively longer rainfall after millet, sorghum, or maize as well as parallel multiple cropping with cassava, yam and cotton.

Ojomo (1971) and Mak and Yap (1980) reported dominant effects in the direction of early maturity in cowpea. However, Capinpin and Irabagon (1950) concluded that at least two genes condition early flowering. Trehan *et al*. (1970) and Tikka *et al*. (1977) observed that high heritability estimates for earliness are associated with low genetic advance suggesting that earliness is conditioned by effects other than additive gene action.

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Additional information concerning the nature of gene action for earliness would be a valuable tool for breeding better cultivars.

The objective of this study is to elucidate the nature of gene action involved in the inheritance of earliness in a cross of two photo-insensitive cowpea varieties SAMPEA 7 and IT 90K-76.

MATERIALS AND METHODS

The screen house experiment was conducted in August 2000 at the Institute for Agricultural Research, Samaru, Zaria. Nigeria (07°38'E, 11°11'N, 686 m ASL). Two genotypes were used in this study. IT90K-76 (Early maturity 60 days) and SAMPEA 7 (Late maturity 80 days). Hand crossing was used to develop the F_1 hybrid. To achieve synchronization of flowering periods, SAMPEA 7 was planted one week earlier than IT90K-76. The initial crosses as well as the derived F_2 and backcross populations were generated in the screen house. The parents, F_1 and F_2 and backcross populations were evaluated in a completely randomized design with three repetitions. Each repetition had 12 plastic pots.

A total of 36 plastic pots (Each 228 mm in diameter, 8.6 L in volume) were used. Six seeds of each population were planted in the plastic pots filled with fresh topsoil (composition: Soil: Sand mixture). The seedlings were thinned to three plants per plot at 2 Weeks After Planting (WAP) to maintain a population of nine plants for the three pots per population. This constituted a repetition. Prior to sowing, 1.0 g of compound fertilizer (15:15:15 NPK) at the rate of 100 kg ha^{-1} were incorporated into each pot. The potted plants were watered daily to field capacity using watering tank throughout the growth period of the plant. A mixture of karate 25EC and Mycotrin 80WP at the rate of 37.5 g a.i. ha^{-1} and 62.5 g to 10 L of water respectively was sprayed at 7 days interval to control flowering and post-flowering insect pests. Weeds were controlled by hand pulling as and when necessary throughout the growing period of the crop. Days taken from sowing to first open flower, (corolla visible) was recorded on per plant basis for each population.

Analysis of variance was used to test the significance of differences between family means. The data was tested for the adequacy of the additive-dominance model using the joint scaling test (Cavalli, 1952) using the weighted least square procedure of (Hayman, 1960) in order to determine the presence or absence of non allelic gene interactions. A generation mean analysis was performed on the data according to the procedure outlined by Jinks and Jones (1958). Six parameter model suggested by Jinks and Jones (1958) were used for the estimation of various genetic components, assuming the absence of linkage, multiple alleles, lethal genes and full viability of gametes and zygotes.

RESULTS AND DISCUSSION

Results from this study revealed genetic differences among the generations studied and the wide range of variability suggesting the possibility for genetic improvement of earliness. The results showed that IT 90K-76 flowered earlier than SAMPEA 7 with a mean and variance of 30 days and 3.6 days, respectively. Mean and variance of SAMPEA 7 were 38 and 54 days, respectively (Table 1). This result showed a narrow range of days to first flower between parents of 8 days. However there was transgressive segregation for both early and late flowering in the F_2 population with plants

Table 1: Mean, range, standard error and variance of day taken from sowing to first flower for parents, F_1, F_2 and backcrosses of the cross involving SAMPEA 7 and IT90K-76 evaluated in the screen house

Generations	Mean	Range	Standard error	Variance
P_1	30	28-47	±1.83	53.6
P_2	38	29-48	±0.55	3.6
F_1	37	26-45	±2.64	55.6
F_2	47	21-75	±0.93	118.3
BC_1	35	21-47	±1.60	58.9
BC_2	51	24-63	±1.28	70.2

flowering earlier (21 days) than the early parent and plants flowering later than the late parent (75 days). These results are in accordance with the findings of Ishiyaku *et al*. (2005). The backcross to the early parent (IT90K-76) gave rise to plants flowering later than the early parent while the backcross to the later flowering parent SAMPEA 7 produced more plants flowering earlier than the late flowering parent SAMPEA 7. This suggests that genetic variance is composed of more than dominance and additive effects.

Results of the different genetic analyses suggested polygenic control of earliness. The joint scaling test of Cavalli (1952) was significantly larger than zero (Table 2) suggesting the presence of epistatic gene action in the control of earliness. A test of goodness of fit to the additive dominance model was not significant ($p>0.1$ for χ^2 of 183.05) (Table 3) which further indicates the importance of epistasis. This was confirmed by the result of the scaling test of Jinks and Jones (1958) in Table 2. Thus in addition to the significance ($p<0.01$) of the additive gene effect (d), the epistatic component, Additive x Additive (I), Additive x Dominance (j) and Dominance x Dominance (l) effects were also significant suggesting the involvement of more than one gene in the control of earliness. The Dominance gene effect was not significantly different from zero. The additive effect was of minor importance compared to the epistatic effects. Nevertheless a sufficient among of additive variation appears to be present for selection to be successful. The Additive x Additive (I) and Dominance x Dominance (l) epistatic effects were negative suggesting a diminishing effect towards earliness due to these types of gene effect. Additive x Dominance (j) gene effect was positive suggesting an enhancing effect in favor of late maturity. These findings are in accordance with Ojomo (1971) who reported duplicate dominant epistasis between two major genes in the presence of some modifying genes are responsible for the inheritance of days to first flower.

Genetic advance, suggested gain in selection of 17 days. The mean of the F_2 population was 47 days; hence the mean days to flower of the F_3 progeny of selected individuals assuming 10% of the

Table 2: Estimates of genetic parameters, heritability and genetic advance for earliness using different models for the cross involving SAMPEA 7and IT90K-76

Model	Estimates
Cavalli (1952)	
m = Mean	35.59±12.32**
d = Additive effect	-1.61±7.74**
h = Dominance effect	19.17±14.47**
Jinks and Jones (1958)	
m = Mean	45.78±5.58**
d = Additive effect	4.0±0.96**
h = Dominance effect	3.26±14.78
I = Additive x Additive effect	-14.98±5.49**
j = Additive x Dominance effect	24.22±4.48**
l = Dominance x Dominance effect	-25.24±10.54**
Narrow sense heritability	
Estimated from F_2 and Backcross data	90.87%
Genetic advance assuming 10% selection intensity	±17 days

*Significant at 5%; **Significant at 10%

Table 3: Test of goodness of fit to the additive dominance model of Cavalli (1952) of the Generation mean for the cross SAMPEA 7 X IT90K-76

Generation	Observed	Expected	χ^2
P_1 (IT90-76)	30.0	34.20	14.73
P_2 (SAMPEA 7)	38.0	30.98	58.79
F_1 (SAMPEA 7) x IT90K-76)	37.0	51.76	31.37
F_1 x SAMPEA 7	35.0	41.37	27.07
F_1 x IT90K-76	51.0	42.98	26.01
F_1	47.0	42.17	25.08
Total			183.05
Significance			p<0.1

earliest or latest flowering plants were selected for further propagation is expected to be ±17 days, respectively. Heritability in the narrow sense was high (90.87%). Similar high narrow sense heritability has been reported for earliness by Ramachandran *et al*. (1982). However, Trehan *et al*. (1970) and Tikka *et al*. (1977) and observed that high heritability estimates for earliness are associated with low genetic advance. This negative association they pointed out suggests that earliness is controlled by effects other than additive gene action.

CONCLUSIONS

The results from this study indicate that earliness is under polygenic control with the Additive x additive (I), Additive x Dominance (j), Dominance x dominance (l), effects of more importance than additive effect therefore conventional selection for earliness should be delayed to later generation for more tangible advance.

REFERENCES

Capinpin, J.M. and T.A. Irabagon, 1950. A genetic study of pod and seed characters in vigna. Philippine Agriculturist, 33: 263-277.

Cavalli, L.L., 1952. An Analysis of Linkage in Quantitative Genetics. In: Quantitative Inheritance. HSMO, Rieve, C.R. and C.H. Waddington (Eds.). London, pp: 135-144.

Hayman, B.I., 1960. Maximum likelihood estimation of genetic components of variation. Biometrics, 16: 369-381.

Ishiyaku, M.F., B.B. Singh and P.Q. Craufurd, 2005. Inheritance of time to flowering in cowpea (*Vigna unquiculata* (L.) walp). Euphytica, 142: 242-291.

Jinks, J.L. and R.M. Jones, 1958. Estimation of components of heterosis, Genetics, 43: 223-234.

Mak, C. and T.C. Yap, 1980. Inheritance of seed protein content and other agronomic characters in long bean (*Vigna sesquipedalis* fouw). Theor. Applied Genet., 56: 233-239.

Ojomo, O.A, 1971. Inheritance of flowering date in cowpea (*Vigna unquiculata* (L.) Walp). Trop. Agric. (Trinidad), 48: 277-282.

Ramachandran, C., K.U. Peter and P.K. Gupalahrishnan, 1982. Variability in selected varieties of cowpea *Vigna unquiculata* (L.) walp). Agric. Res. Kersale, 18: 94-97.

Singh, B.B., 1986. Potentials for intensive cropping in the tropics by using 60 day cowpea varieties. Agron. Abst., pp: 44.

Tikka, S.B.S., S.N. Jaimini, B.M. Asawa and J.R. Mathus, 1977. Genetic Variability, interrelationships and discriminant function analysis in cowpea (*V. unquiculata* (L.) Walp). Indian J. Heredity, 9: 1-9.

Trehan, K.B., L.R. Bagrecha and V.K. Sylvastava, 1970. Genetic variability and correlations in cowpea (*Vigna smensis* (L.) savi) under rain fed conditions. Indian J. Heredity, 2: 39-43.