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Determination gene action of five yield and yield related characters of selected castor accessions in a 5×5 diallel crosses

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KEYWORDS

Additive-dominance, Minor-genes, Partial-dominance, Over-dominance, Epitasis

A B S T R A C T

From a germplasm of castor accessions assembled for character evaluation in the University of Agriculture Makurdi Teaching and Research Farm, five selected castor accessions were crossed in all possible combinations excluding reciprocals. An evaluation trial experiment was laid out at Akwanga and Lafia in Nasarawa State and Makurdi in Benue State of Nigeria. The parents and the F_1s were evaluated in a randomized complete block design of three replications. The plots were made up of three rows of 1.5 m in length, spaced 1.0 m apart. The rows were sown to four hills of two seeds each, spaced 0.5 m and thinned to single stand per hill. The consistency t^2 test values for all the characters were non-significant. The regression coefficient b in all the characters has fulfilled the additive-dominance model except seed yield/hectare, which implicated epitasis gene action. The seed yield/hectare is controlled by predominantly recessive or minor-genes and is conditioned by over-dominance gene action,while the four traits are conditioned by partial-dominance gene action. Therefore, hybrid seed production could be used to explore the over-dominancy.

Introduction

Hayman (1954) listed six assumptions as the basis for the application of additive-dominance model. These assumptions were re-emphasized by Allard (1956), who further stated that if the assumptions are valid, the points on the covariance (w_r)/ variance (v_r) graph are expected to fall on a line of unit slope. Where the regression line is significantly different from unit slope epitasis is implicated (Manga and Sidhu, 1979; Srivastava *et al*., 1979).

The interceps of regression lines determine the levels of dominant gene action. Where the intercep is below the origin, at origin or above the origin, the gene actions is over-dominance, complete dominance and partial dominance, respectively (Hayman, 1954; Allard, 1956; Singh and Chaudhary, 1985).

The positions of the points of parental array in relation to the origin separate the parents into either dominant or recessive parents (Hayman, 1954; Allard, 1956; Singh and Chahal, 1974; Sirohi and Choudhury, 1983; Jolliffe and Arthur, 1993). However, the positions of the parental array in relation to the sides of the regression line are used to determine the additive and non-additive gene actions of the parents. Where the parent points lie above the regression line, they are said to possess additive gene action whereas those below are said to possess non-additive gene action (Manga and Sidhu, 1979; Kaw and Menson, 1983; Sirohi and Choudhury, 1983). Sirohi and Choudhury (1983) went further to add that those arrays below the regression line implicated both non-additive and epistatic gene actions. There is dearth of information in literature regarding covariance (w_r)/ variance (v_r) graphs and additive-dominance model in castor. In the light of the above, the current study is to highlight gene action using graphic method.

Materials and Methods

From a germplasm collected from Southern Guinea Savannah and characterized in the University of Agriculture Makurdi Teaching and Research Farm, five selected castor accessions were crossed in all possible combinations excluding reciprocals. An evaluation trial experiment was laid out at Akwanga and Lafia in NasarawaState and Makurdi in BenueState. The parents and the F_1s were evaluated in a randomized complete block design of three replications. The plots were made up three rows of 1.5 m in length spaced 1.0 m apart. The rows were sown to four hills of two seeds each, spaced 0.5 m and thinned to single stand per hill.

Observations were made on four plants of the middle row of each plot. Five characters viz: days to 50% flowering, days to 100% flowering, number of days to maturity,100-seed weight, seed yield/hectare and plant height. Hayman's (1954) method was adopted for covariance (Wr) and variance (Vr) estimates using the genotype means on MS Excel programme.

Results and Discussion

The covariance (Wr)/variance (Vr) graphical analyses are presented in Figures 1 to 5. The five yield and yield related characters have non-significant consistency t^2 values. The number of days to 50% flowering (D50F), number of days to 100% flowering (D100F), number of days to maturity (NDM) and 100-seed weight (SW100) have their regression coefficient b values fulfilling the unit slope, while that of seed yield/hectare (SYH) is more than a unit slope. The four characters : D50F, D100F, NDM and SW100 have their regression line intercepted the covariance (Wr)/variance (Vr) graphs above the origins as shown in Figs. 1, 2, 3 and 4, respectively, a partial gene action. The seed yield/hectare (Fig. 5) regression line intercepted the covariance (Wr)/Variance (Vr) graph below the origin, over-dominance gene action.

Fig. 1 and Fig.2 show accession 3 closer to the origin and rest of the accessions away from the origin, exhibited dominance and recessive gene actions, respectively. Accessions 10 and 34 are additive while accession 9 non-additive in nature. Similarly, accession 3 exhibited dominance gene action in Fig. 3 compare to the rest of the accessions. In the same vein, accessions 10 and 6 exhibited additive gene action while accession 9 non-additive gene action. Dominance gene action was displayed by accessions 6 and9 in Fig. 4 while accession 3 was recessive. The five accessions in Fig. 5, are all controlled by recessive genes and none is either additive nor non-additive.

Fig.1 Covariance (wr)/ variance (vr) graphs for days to 50% flowering of castor in southern guinea savanna of nigeria

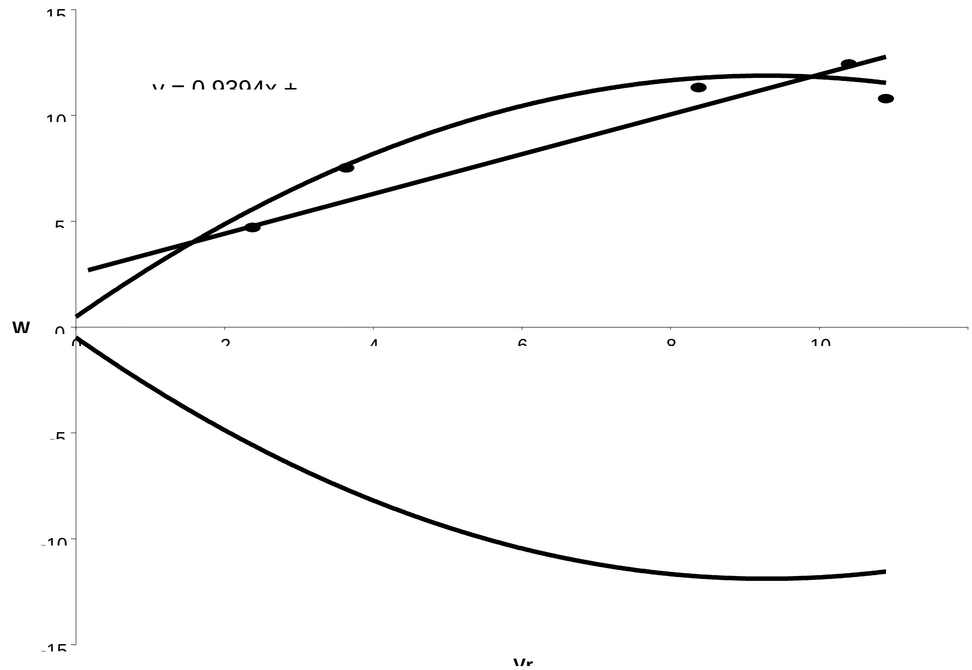


Fig.2 Covariance (wr)/ variance (vr) graphs for days to 100% flowering of castor in southern guinea savanna of Nigeria

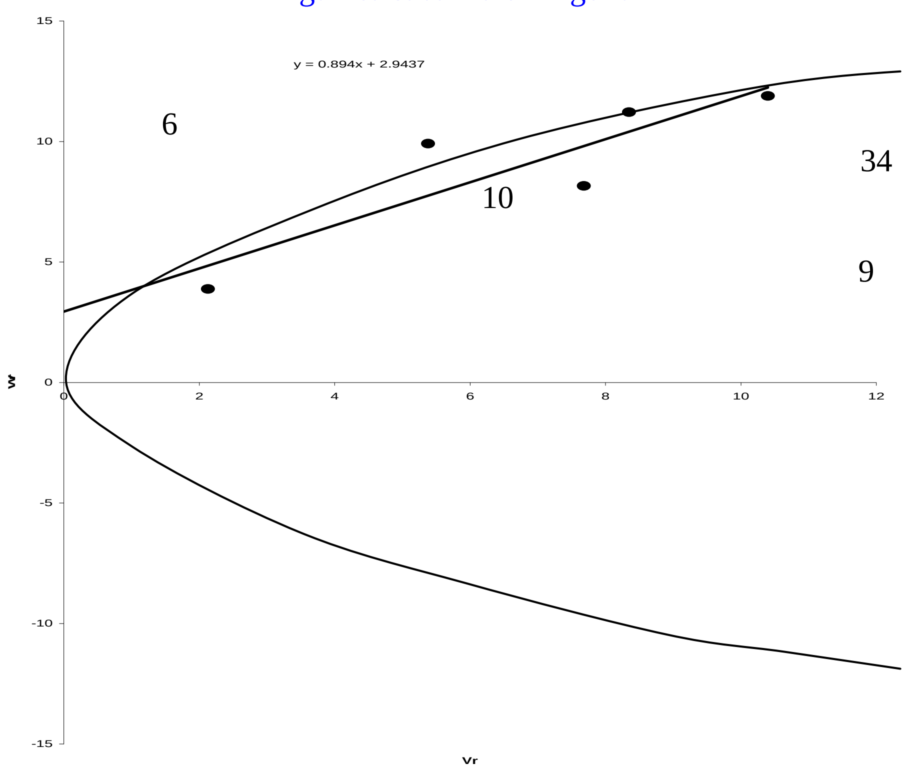


Fig.3 Covariance (wr)/ variance (vr) graphs for number of days to maturity of castor in southern guinea savanna of nigeria

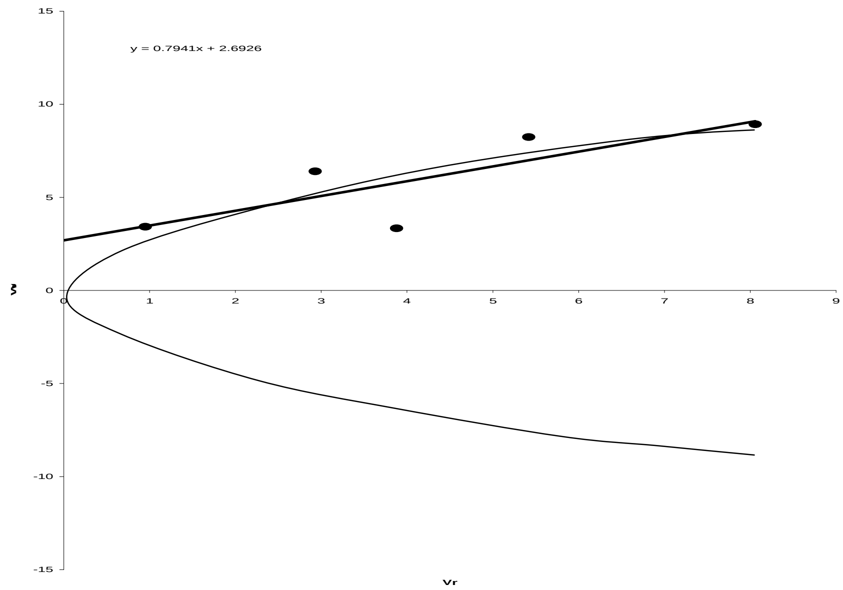


Fig.4 Covariance (wr)/ variance (vr) graphs for 100-seed weight (g) of castor in southern guinea savanna of Nigeria

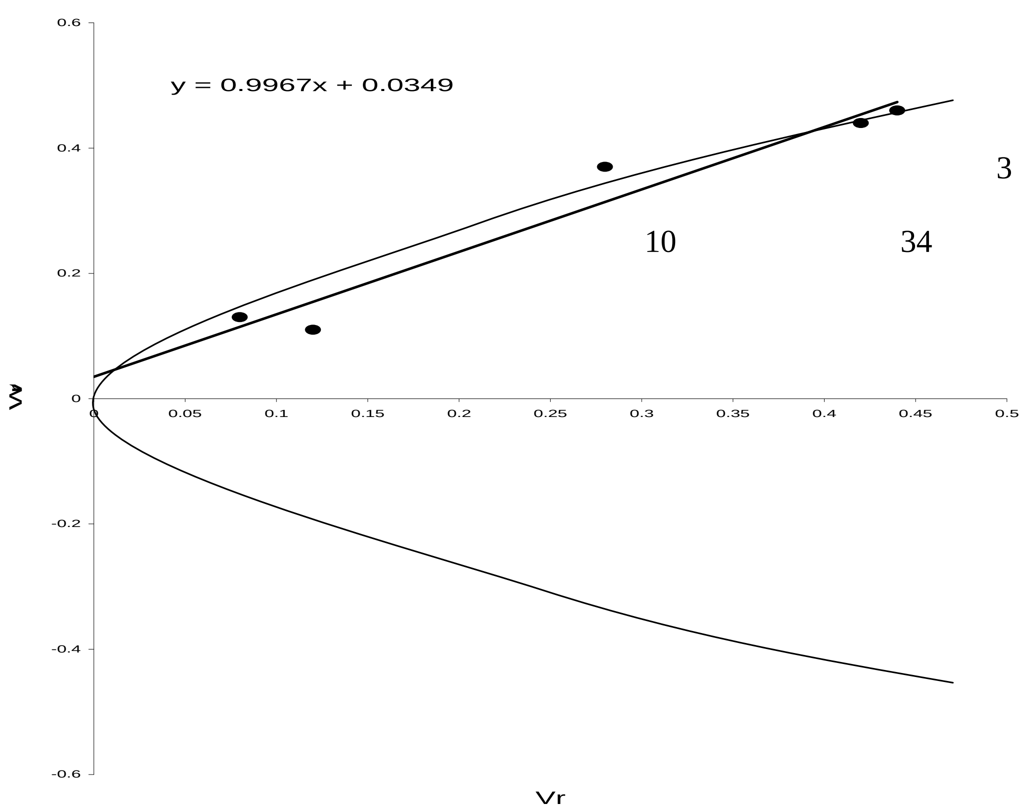
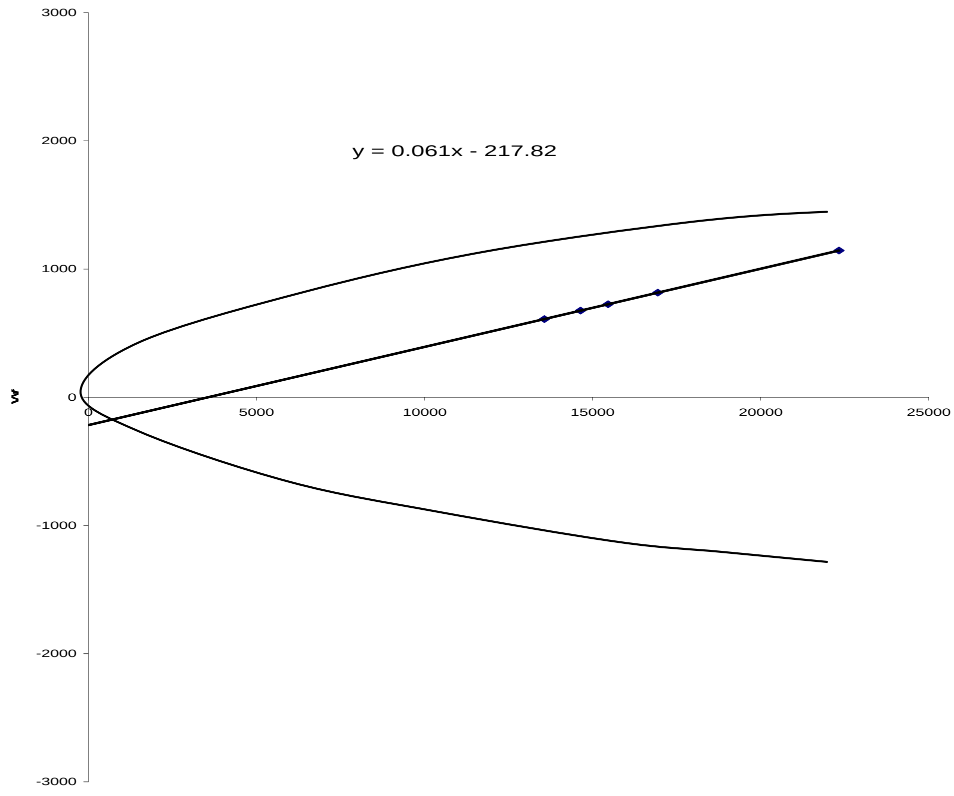


Fig.5 Covariance (wr)/ variance (vr) graphs for seed yield ha-1 (kg) of castor in southern guinea savanna of Nigeria



Literature citations were not available on covariance (W_r) and variance (V_r) graphical analysis in castor *per se*. However, from Hayman's (1954) assumptions, the consistency t^2 values for all the characters were non-significant. The regression coefficient b in all the characters has fulfilled the additive-dominance model except in seed yield ha^{-1}. Epitasis is implicatedin this character with regression coefficients b significantly different from unit slope (Manga and Sidhu, 1979; Srivastava et al., 1979). The covariance (W_r) /variance (V_r) graphic analyses have shown that seed yield/hectare exhibited over-dominance gene action as indicated by the regression lines intercepting the W_r coordinate below the origin, while partial dominance gene action was exhibited by the rest of the characters as the regression lines intercepted the Wr coordinates above the origins (Hayman, 1954; Allard, 1956; Singh and Chaudhary, 1985). The overdominance in this trait as deduced from the W_r/V_r graph,revealed that these character might be controlled by dominance or non-additive gene action. This agreed with the findings of Uguru and Abuka (1998) of overdominance reported in seed yield. Regarding the positions of the parental arrays on the graphs, Ac.3 tended to have predominantly dominant genes in the characters for earliness (number of days to maturity and number of days to 50 as well as 100% flowering) and characters related to earliness (number of nodes to primary panicle and height to primary panicle) by occurring towards origin of the covariance (W_r)/variance (V_r) graphs. This agreed with the assertion of Hayman (1954), supported by Allard (1956), Singh and Chahal (1974), Sirohi and Choudhury (1983), Singh and Chaudhary (1985) and Jolliffe and Arthur (1993) that the parents were either predominantly dominant or preponderantly recessive when they occur close to or far away from the origin, respectively. Accession three (Ac. 3) possessed mostly recessive genes for 100-seed weight. The genes controlling seed yield/hectare were mostly recessive genes, as parental points occurred far away from the origin of covariance (W_r)/variance (V_r) graph. This showed that the genes controlling seed yield/hectare were mostly recessive genes. This is an indication that the inheritance of seed yield/hectare was governed mostly by minor genes. In conclusion, hybrid seed production could be explored to capture dominant gene action existing in seed yield/hectare.

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