Cause and Effect Variations and Trait Selection Index for Indigenous Sesame (*Sesamum Indicum)* Genotypes

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Abstract

Fifteen indigenous sesame genotypes of diverse origin within Nigeria were evaluated for three years to provide insight to their growth and yield performance. Days to 50% flowering, number of capsules per plant, weight of capsule and number of seeds per capsule recorded significant differences in their respective performance across the three year study period. The genotypes performed differently with respect to all the traits except seed weight while genotype x year interaction was not significant for flowering date and seed weight only. Genotypic variance components were high for sesame number of capsules per plant and seed per capsule relative to other variance components. Simple linear correlation and determination coefficients were also high for these traits. Number of capsule per plant and seed per capsule contributed highest direct effect to seed yield of sesame. In improving indigenous sesame seed yield, there is reliability in selecting for number of capsule and seed per capsule as these traits recorded highest selection index using heritability and genetic advance parameters.

Key words: Variation, selection index, indigenous sesame, year effect, path analysis

Introduction

Sesame is a herbaceous plant grown mainly for its seed and vegetable yield in India, Asia, China and Africa (Anon., 2008). The seed contain 50% oil and 25% protein. According to Burden (2005), the oil contains a good amount of Linoleic acid for the control of blood cholesterol level. Also, the anti-oxidant nature of the vegetable oil makes for its stability and acceptance in the world market. The seed cake is valuable and highly nutritious when used as feed source for animals (Balasubramaniyan and Palaniappau 2001)

Nigeria produces an average sesame seed yield of 300kgha^{-1} compared to Sudan and Uganda with an average production of 425kgha^{-1} and 401kgha^{-1} respectively and therefore ranks the third lowest producer. China and India ranked the largest world producers of sesame seed yield (FAO 2005). Mehrotra *et al*. 1996, Ong'Ingo and Ayiecho 2009, noted that increase in sesame seed yield is dependent on efforts in identifying and improving morphological traits associated with yield. Thus, progress in crop improvement depends to a great extent on the ability of the breeder to select for traits that would produce high seed yield in a given environment. However, the fact that seed yield is polygenic makes direct selection misleading. Therefore traits that determine yield are the best indicators for specific genotype performance (Aremu *et al*.,

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(2007a). Burden (2005)) identified height at flowering and length of pod to strongly correlate with seed yield in cowpea. Moor-ul *et al.* (2001), reported days to flowering capsule weight and capsule number per plant to directly affect seed yield of hybrid sesame. Using accessions from germplasm collections, Adeyemo and Ojo (1993), reported that plant height and flowering traits are important in growth and yield evaluation of sesame and that the use of different planting environments recorded wide variations. Long neglect of research on indigenous food and vegetable crops in African Agriculture accounts for the sparse literature on indigenous sesame growth and seed yield performance. Indigenous crops have peculiarities in adaptation to both biotic and abiotic factors under the crop environment (Schippers 2000). Such factors include soil type, climatic condition, pest and disease susceptibility, etc. There is need therefore to evaluate the effect of environment on the performance of sesame so as to enhance meaningful breeding programme. The focus of this study is to determine the effect of year variations on sesame trait growth and identify traits with direct and indirect relationship with seed yield of indigenous sesame genotype.

Material and Methods

Fifteen indigenous sesame genotypes sourced from the National Cereal Research Institute (NCRI) Badeggi and Ladoke Akintola University of Technology (LAUTECH), Ogbomoso Nigeria, were evaluated in a field plot located at the Teaching and Research farm of LAUTECH,Ogbomoso in 2007, 2008 and2009 planting seasons. Using three replications in a randomized complete block design, each genotype was planted for each year in a four – row 3 x3m plot size. Sowing was by drilling and mixed with sand. At 21 days after planting, when the seedlings attained approximately 15cm height, thinning was carried out to leave a total of 16 plants per plot, with a spacing of 35m x 60m intra and inter row respectively. Weeding was done when necessary. At maturity when the pods turned from green to golden yellow, the capsules were harvested. Biometric data were collected on days to 50% flowering, plant height at flower (cm), capsule length (cm), number of capsules per plant, capsule weight per plant (g), number of seeds per capsule, 500 – seed weight (g) and seed yield (t/ha).

Using SAS, 2.0 package of 2001, data were subjected to combined analysis of variance and selection index of heritability and genetic advance calculated from the trait mean values across the years.

Estimates of heritability in broadsense (H_B), genetic advance (GA) and components of variance (σ_P; σ_g^2) were obtained following the statistics outlined by Falconer 1989 and given as:

$$h_b^2 = \delta g^2 / \delta p^2$$

Where $\delta p^2 = \delta g^2 + \delta e^2$

and

$$= \frac{(MS_G - Ms_e)}{r} + MS_e$$

h_b^2 = heritability at the broad sense
δg^2 = genotypic variance
δp^2= phenotypic variance

MS_G = Mean square for genotype in ANOVA
MSe = Mean square for error in ANOVA
From here, genetic gain (GA) was calculated as follows;

$$GA= H_b^2K\delta ph$$

and K = selection differential with a constant value 2.06
δph = phenotypic standard deviation of genotype means
Path coefficient analysis was carried out following the description of Dewey and Lu (1959)

Result

Combined analyses of variance of seed yield and related characters showed year effect to be significant for all traits except 500 seed weight (Table 1). The fifteen genotypes performed differently within the three-year study period as the traits recorded significant differences in their performance except capsule length and 500 seed weight that did not show significant effect in performance.

Genotype x year interaction affected seed yield via plant height, capsule length and seed number per capsule. Trait variance components mean performance and heritability estimates are detailed in Table 2. Genotypic variance estimates were high for plant height (50.2), number of capsule per plant (49.3) and number of seeds per capsule (28.2). Seed weight (5.35), flowering date (30.2), capsule length (39.9) and weight (29.7) per plant .were affected by the environment and therefore recorded higher phenotypic variance values than their respectively genotypic variance estimates. Selection parameters of Heritability and Genetic advance values were found to be equally high for plant height (71.2; 60.4; capsule number (58.1; 44.6); capsule weight (61.2; 49.7) and seed number per capsule (75.4; 50.2).

The coefficients of correlation of the seven sesame traits recorded capsule traits for length (0.71) and number (0.75), and number of seeds per capsule (0.60) to be highly significant (Table 3). Coefficient of determination was highest for capsule length (0.85) and capsule number (0.86).

Number of seeds per capsule was found to be the premium pathway to seed yield by recording a direct effect of 0.82 (Table 4). This was followed by number of capsule (0.78) and flowering date (0.59). Even though length of capsule gave a low but direct impact on sesame seed yield (0.40), its indirect but positive effect via capsule number (0.77) and number of seeds per capsule (0.70) was high. Number of capsule per plant impacted seed yield indirectly and positively via flowering date (0.63) and length of capsule (0.59). Increase in seed number was indirectly enabled through length of capsule (0.68).

Discussion

Significant differences in year, effect for flowering period, number of capsules per plant and number of seeds per capsule indicate that variable weather elements using year as the environment is important and that the traits studied were responsive to the environmental variations. That these traits also performed differently and significantly too in their respective variation sources of genotype and genotype x year interaction, suggest that the indigenous sesame are genetically different and that when grown in different year environment, the genotypes would respond differently. There is therefore achievable result when breeding programme aimed at improving sesame seed yield for specific year and agro-ecology adaptation exploit traits with such significant differences. Ariyo and Ayo-vaughan (2000) discovered year effect to significantly affect fruit and seed yield of okro. Genetic diversity is a measure of relative variability in a population and is measured to investigate the magnitude so as to make successful selection (Burden, 2005; Aremu *et al.,* 2007b). The high genotypic variance estimates for plant height, number of capsules per plant and seed number per capsule suggest existence of variability that can be exploited in selection for these traits.

The low genetic variation recorded by capsule length is compensated for by the higher genetic variation in seed number per capsule. This is at variance with the report of Ganesh and Sakila (1999), who recorded wide variation in capsule length to have contributed significantly to sesame yield. According to Adebisi (2005), selection for seed number per capsule is as important in sesame improvement programme as selection for capsule length. These two traits respectively provide significant contribution to seed yield and therefore can be interchangeably selected to improve sesame seed yield. Heritability estimate provide basis for selection (Borojevic 1990; Falconer 1989). However, estimates of heritability and index of selection (Genetic advance) help in understanding of gene action prevalent in trait expression and hence make selection worthwhile. Singh and Marayanan (1993), reported high values of genetic advance to indicate additive gene action. The high heritability and index of selection for sesame height, capsule and seed traits indicate the reliability in selecting for these traits. This report agrees with the work of Ong'Ingo and Ayiecho (2009) on sesame plants grown in Kenya, as well as that of Adebisi and Ajala, (2006), who predicted capsule length to significantly contribute to sesame seed yield when grown in rain-fed environment.

Coefficient of correlation is a measure of association between trait pairs (Falconer 1989; Ali *et al*, 2009). The significant and positive association of seed yield with sesame capsule length, number of capsule and seed traits, suggest that seed yield of sesame can be improved through simultaneous selection for these traits. Backiyarami *et al*. (1998); Bishwas and Akbar (1995), reported positive correlation of some yield components in sesame plants.

Path coefficient analysis reveals the magnitude of trait pathway on yield. Direct and indirect effects of traits further provide information on effectiveness of trait selection. Number of capsule and seed can be directly selected for in order to improve seed yield in sesame. Even though weight of capsule via seed number adversely affected seed yield, the moderate direct effect on seed yield makes for adequate compensation. Rao, *et al*. (1997), reported final plant height and parnicle per plant to have direct effect on seed yield of rice. That coefficient of correlation of flowering period is somewhat low, the high direct effect is indicative of success in breeding for reduced date to flowering for sesame even under environmental variations.

Conclusion

Seed yield in sesame was observed to be under the influence of plant height, number of capsule per plant and number of seed per capsule across the years under study. These traits were found to have significant direct causal effect and strong correlation with seed yield of sesame. When sesame breeding programme focuses on yield improvement especially for agro-ecology adaptation, the use of these traits as yield predictors would make for successful breeding. Further studies which include specific agro-ecology adaptation of indigenous sesame are ongoing.

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