

LIST OF SYMBOLS AND ABBREVIATIONS

%	:	Per cent
σ	:	Standard deviation
ANOVA	:	Analysis of variance
CD	:	Critical difference
cm	:	Centimeter
Cov.	:	Covariance
CV	:	Coefficient of variation
df	:	Degrees of freedom
F ₂	:	Second filial generation
F ₃	:	Third filial generation
g	:	Gram
GA	:	Expected genetic advance
GAM	:	Genetic advance as per cent of mean
GCV	:	Genotypic coefficient of variation
H	:	Heritability in broad sense
m	:	Meter
MSL	:	Mean sea level
MSS	:	Mean sum of squares
mt	:	Million tones
NMR	:	Nuclear magnetic resonance
No.	:	Number
PCV	:	Phenotypic coefficient of variation
r	:	Correlation coefficient
RBD	:	Randomised Block Design
S.Ed	:	Standard error of the difference
SQRT	:	Square root
t ha ⁻¹	:	Tonnes / hectare
viz.,	:	Namely

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(R.V.S.V. SRIDHAR)

ABSTRACT

Name of the Author : **R.V.S.V. SRIDHAR**

Title of the Thesis : **CHARACTER ASSOCIATION AND PATH COEFFICIENT ANALYSIS IN F₂ AND F₃ GENERATIONS OF SESAME (*Sesamum indicum* L.)**

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The present investigation was carried out during *rabi* 2003-04, at Agricultural College Farm, Bapatla to study the genetic variability, heritability, expected genetic advance, extent of character association and path coefficient analysis in F₂ and F₃ segregating generations of eleven crosses of sesamum. The characters evaluated in present investigation include plant height, days to 50% flowering, days to maturity, number of primaries, number of capsules per plant, number of seeds per capsule, 1000-seed weight, oil content and seed yield per plant.

Analysis of variance revealed significant differences among the genotypes for all characters studied, indicating a high degree of variability in the material.

The characters like number of primaries, number of capsules per plant in both the generations and 1000-seed weight in F_2 generation registered high heritability coupled with high expected genetic advance as per cent of mean suggesting that these characters will respond well to simple selection and rapid gain could be obtained in the desirable direction.

Correlation studies revealed that, the seed yield per plant had significant positive association with plant height, number of primaries, number of capsules per plant and number of seeds per capsule and negative non-significant association with days to 50% flowering and days to maturity in both the generations.

Path coefficient analysis in F_2 and F_3 generations revealed that the characters *viz.*, number of primaries and number of capsules per plant had significant positive association as well as a positive direct effect with seed yield per plant in both the generations, and thus may aid yield improvement, through selection.

The present investigation revealed that the characters *viz.*, number of capsules per plant, plant height, number of primaries, 1000-seed weight and number of seeds per capsule should be considered as selection criteria for improvement in seed yield. The study suggests that oil yield can also be improved through biparental mating, which provides chances for finding superior recombinants in advanced generations by breaking linkages.

CHAPTER I

INTRODUCTION

Sesame (*Sesamum indicum* L.) a member of the order Tubiflorae, family Pedaliaceae is perhaps the oldest oil seed known and used by human-beings (Weiss, 1983). The crop is now grown in a wide range of environments, extending from the semi arid tropics and sub tropics to the temperate regions. Sesamum is mainly distributed in between 25°S and 25°N latitude.

Sesamum is aptly described as the “Queen of oil seeds” because of its high oil content (38-54%), protein (18-25%) and the excellent qualities of the seed oil and meal (Prasad, 2002). Sesamum oil is very stable because of antioxidant system comprising of sesamel and sesamolinal. Apart from its culinary usage, sesamum oil is known to reduce stress, tension, prevents nervous disorders, relieves fatigue and promotes strength and vitality, besides having anti-cancer properties.

India has lower levels of sesame production (0.62 mt) and productivity (0.35 t ha⁻¹), compared to World production (2.89 mt) and productivity (0.41 t ha⁻¹) (Oil World Monthly, 2004). This indicates the need to enhance the productivity potential of this crop

by evolving high yielding genotypes, which depends on the availability of variability for yield and its component traits in the populations. Many attempts are being made to widen the variability through hybridization. Economic characters mostly polygenically controlled and having complex inheritance are often influenced by environment. Hence, progress in breeding is determined by the magnitude and nature of the genotypic variability and the extent of heritability in the desirable traits. Segregating populations with a wide range of desirable and undesirable segregants serve as a base for effective selection (Backiyarani *et. al.*, 1997b). Further, the magnitude of variation for component characters and the difference in character association from generation to generation are important from the point of handling the segregating populations.

Path analysis provides an effective means of finding out the direct and indirect effects of association between variables (Wright, 1921). Thus the information on the direct and indirect effect of each character on yield will be an added advantage for the improvement of any crop.

Study of variability, magnitude of association among yield and yield attributing traits in segregating population forms a basis for selecting and intermating of segregants. Taking all these aspects into consideration, the present investigation was carried out

in F_2 and F_3 populations of eleven different crosses in sesame with the following objectives.

1. To study the genetic variability, heritability and genetic advance in the segregating generations of F_2 and F_3 .
2. To estimate the extent of character association among yield and yield attributes.
3. To study the direct and indirect effects of yield components on seed yield.

CHAPTER - II

REVIEW OF LITERATURE

A review of work done in sesamum and other crops relevant to the present investigation is furnished under the following headings.

2.1 Genetic variability, heritability and genetic advance.

2.2 Character association (correlations)

2.3 Path coefficient analysis

2.1 GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE

Yield being a complex character, is influenced by a number of other traits, which are polygenically inherited and such characters are influenced by several environmental factors. The heritable variation is often masked by non-heritable variation, which creates difficulty in selection. Therefore, it is necessary to partition the overall variability into heritable and non-heritable components, which enable the breeder to adopt suitable breeding procedures. It can be done with the help of genetic parameters like genotypic and phenotypic coefficients of variation. Genetic advance under selection quantifies the possible genetic gain by

selection. Thus these factors help in crop improvement programme.

Lush (1949) proposed that the heritability in narrow sense, as the ratio of additive variance to the total variance.

Hanson *et. al.* (1956) proposed heritability in broad sense as the ratio of genotypic variance to total variance.

Expected genetic advance was suggested as the product of heritability, phenotypic standard deviation and selection differential by Burton and Dewane (1953).

Shadakshari (1984) observed high genotypic and phenotypic coefficients of variability for number of capsules, number of branches and seed yield per plant. High heritability coupled with high genetic advance was noticed for seed yield per plant, number of capsules and number of branches.

High heritability and expected genetic advance for branch number, capsule number per branch, seed number per capsule and yield was reported by Kandaswamy (1985).

High phenotypic and genotypic coefficients of variability for height to first capsule and number of branches per plant were observed (Bakheit and Mahdy, 1988).

Li (1988) reported high heritability for 1000-seed weight and seeds per capsule and low heritability for plant height, high genotypic variation and expected genetic advance for number of

capsules per plant and yield per plant and low for plant height, number of branches and 1000-seed weight.

Govindarasu *et. al.* (1990) recorded high GCV value, heritability estimate and genetic advance with seed yield, capsules on primaries, capsules on secondaries and number of secondaries.

Kandaswamy *et. al.* (1990) observed high heritability with high genetic advance in yield per plant, high heritability and low genetic advance in 50% flowering, and low heritability and low genetic advance in number of capsules on main stem, number of capsules on branches and total number of capsules per plant.

Janardhanam *et. al.* (1981) revealed significant differences among the 15 genotypes studied and also reported that the yield per plant showed high heritability and high genetic advance with high degree of disparity of phenotypic and genotypic coefficients of variance indicating the environmental influence.

Wide range of variation for plant height, days to maturity and number of capsules per plant and low variation for number of primary branches, 1000-seed weight and seed yield per plant was noticed by Raut *et. al.* (1991).

A significant variability for plant height, number of capsules per plant and seed yield per plant was observed by Shinde *et. al.* (1991).

Pathak and Dixit (1992) revealed wide range of variability for plant height, branches per plant, seed yield and capsules per plant, high heritability for protein and oil content, days to maturity, days to flower and high genetic advance for plant height, branches per plant, seed yield, days to flower, capsules per plant and protein content.

Shadakshari *et. al.* (1992) observed high PCV and GCV values for total number of branches, total number of capsules, seed yield per plant and node of first flowering. They also reported high heritability and genetic advance for seed yield per plant and number of capsules per axil.

In their study on segregating populations of sesame, Baruah and Goud (1993) reported that there was less difference between GCV and PCV among all characters they studied except for number of primary branches per plant and seed yield per plant. They noticed high heritability for seed yield per plant, 1000-seed weight, plant height and oil content.

John *et. al.* (1993) obtained highest phenotypic and genotypic coefficients of variation for number of capsules on branches followed by seed yield per plant and number of capsules on main stem. Oil content registered highest heritability

and number of capsules on main stem registered highest genetic advance in their studies.

High estimates of heritability for number of capsules per plant, number of seeds per capsule, 1000-seed weight were recorded by Fendel and Penso (1994).

High heritability for days to 50% flowering, plant height and number of branches per plant were reported by Chandramony and Nayar (1994).

Navadiya *et. al.* (1995) observed high GCV for days to 50% flowering, plant height, 1000-seed weight, oil content and days to maturity.

Lower heritability and genetic advance as per cent of mean for seed yield were noticed by Reddy and Dorairaj (1995), indicating that variation in this character was governed more by environment rather than the heritable genetic component.

Shadakshari *et. al.* (1995) recorded large values of PCV and GCV for number of capsules, number of branches and seed yield per plant and low values for days to 50% flowering, oil content and days to maturity. They also reported high values of heritability and genetic advance for seed yield per plant, total number of capsules and high heritability with low genetic advance for oil content.

In their study on sesamum genotypes, Mishra and Yadav (1996) observed higher variability for days to maturity, number of capsules per plant, number of seeds per capsule and 1000-seed weight.

Backiyarani *et. al.* (1997b) recorded high heritability estimates along with high genetic advance for plant height, primary branches, capsule number and single plant yield by their studies in F_2 and F_3 generations of sesame.

High heritability with high genetic advance for number of branches and high heritability with low genetic advance for days to 50% flowering and days to maturity were exhibited in studies on ten parental lines and 45 F_3 populations in sesame conducted by Jayalakshmi *et. al.* (1998).

High heritability for days to maturity, plant height, branches per plant, capsules per plant, seed per capsule and 1000-seed weight and moderate to low heritability for seed yield per plant were observed by Kamala (1999) in sesamum.

Higher estimates of heritability in intermating progenies of sesame compared to F_2 were revealed (Parameswari and Muralidharan, 1999). It was also suggested that selection of intermated progenies is desirable over F_3 due to their superior mean performance, higher GCV and heritability coupled with high genetic advance.

Saravanan *et. al.* (2000) recorded high heritability and moderate genetic advance as per cent of mean for plant height, number of capsules per plant and seed yield per plant in most of crosses under study.

Greater variability for single capsule descent breeding procedure across crosses for the characters *viz.*, seed yield per plant, total number of capsules, plant height and days to maturity was noticed by Srinivas *et. al.* (2000).

High GCV and PCV for seed yield per plant, total capsules per plant, plant height and oil yield per plant in sesamum genotypes were observed by Ashoka *et. al.* (2001).

High phenotypic and genotypic coefficients of variation for number of branches per plant, number of seeds per capsule, high variability for seed yield per plant, high heritability and genetic advance for number of capsules and seed yield per plant were revealed by Kumar *et. al.* (2002), with different crosses of sesame under their study.

2.2 CHARACTER ASSOCIATION

Improvement in the yield of a crop is the primary objective for any plant breeding programme. Yield is a complex character and the resultant of many yield attributes, which are simply inherited. Correlation coefficient analysis measures the mutual relationship between various plant characters and

determines the component characters on which selection can be based for improvement in yield. Unfavourable associations between the desired attributes under selection may limit genetic advance. Hence, a sound knowledge of associations between different yield components is essential for planning effective selection programme. The available literature in this regard is reviewed as follows.

2.2.1 Plant Height (cm)

Significant positive association of plant height with seed yield was revealed by Biswas and Akbar (1995), Patil and Sheriff (1996), Backiyarani *et. al.* (1997a), Siddiqui *et. al.* (1998), Backiyarani *et. al.* (1999) in F₂ generation of sesame, Alam *et. al.* (1999), Kumaresan and Nadarajan (2002), Ramireddy and Sundaram (2002), Yingzhong and Yishou (2002) and Deepasankar and Anandakumar (2003). Non-significant positive association of seed yield with plant height was noticed by Backiyarani *et. al.* (1999) in F₃ generation of sesame. Negative association of plant height with seed yield was observed by Shukla and Verma (1976).

2.2.2 Days to 50% Flowering

Kandaswamy *et. al.* (1990), Shadakshari *et. al.* (1992), Vadhavani *et. al.* (1992), Chauhan and Gurjar (1998), Manivannan (1998), Siddiqui *et. al.* (1998) and Alam *et. al.* (1999) revealed significant positive correlations of days to 50% flowering

with the seed yield. Trehan *et. al.* (1975), Kumaresan and Nadarajan (2002) and Ramireddy and Sundaram (2002) reported positive but non-significant association of this character with seed yield. Shukla (1983), Amaresha (1997) and Kavitha and Sethupathiramalingam (1999) in segregating populations of sesame, noticed negative association of days to 50% flowering with seed yield.

2.2.3 Days to Maturity

Significant positive correlation of seed yield with days to maturity was revealed by Ramakrishnan and Soundarapandian (1990), Shadakshari *et. al.* (1992), Ranganatha *et. al.* (1994) in F_3 and F_4 generations of sesame, Subramanian and Subramanian (1994), Biswas and Akbar (1995), Padmavathi and Thangavelu (1996), Patil and Sheriff (1996), Subbalakshmi (1996), Tak (1997) and Alam *et. al.* (1999). Significant negative association of days to maturity with seed yield was reported by Kandaswamy *et. al.* (1990).

2.2.4 Number of Primaries

Significant positive association of seed yield with number of primaries was reported by Ramakrishnan and Soundarapandian (1990), Ranganatha *et. al.* (1994) in F_3 and F_4 generations, Patil and Sheriff (1996), Backiyarani *et. al.* (1997a) among segregating generations, Manivannan (1998), Alam *et. al.* (1999), Kavitha and Sethupathiramalingam (1999) in segregating populations, Solanki

and Deepak (2000), Kumaresan and Nadarajan (2002), Ramireddy and Sundaram (2002) and Deepasankar and Anandakumar (2003). Negative correlation of number of branches per plant with seed yield was noticed by Reddy *et. al.* (1984).

2.2.5 Number of Capsules per Plant

Shadakshari *et. al.* (1992), Fendel and Penso (1994), Ranganatha *et. al.* (1994) in F_3 and F_4 generations, Biswas and Akbar (1995), Patil and Sheriff (1996), Govindarasu and Ramamoorthi (1998) in irradiated and non-irradiated segregating populations of sesame, Manivannan (1998), Alam *et. al.* (1999), Kumaresan and Nadarajan (2002), Ramireddy and Sundaram (2002), Yingzhong and Yishou (2002) and Deepasankar and Anandakumar (2003) noticed significant positive correlations of seed yield with number of capsules per plant. Vanisri *et. al.* (1994), Backiyarani *et. al.* (1999) in F_2 and F_3 generations, showed positive association of number of capsules with seed yield.

2.2.6 Number of Seeds per Capsule

Pathak and Dixit (1992), Babu and Sivasubramanian (1993), Chandrasekhara and Reddy (1993), Backiyarani *et. al.* (1997a) among segregating generations, Rai *et. al.* (1997), Backiyarani *et. al.* (1999) in F_2 generation, Solanki and Deepak (2000), Ramireddy and Sundaram (2002) reported that number of

seeds per capsule was significantly correlated with seed yield in a positive direction. Rong and Wu (1989) and Backiyarani *et. al.* (1999) in their F_3 generation studies recorded negative association of seed yield with number of seeds per capsule.

2.2.7 1000-Seed Weight (g)

Patil and Sheriff (1996), Backiyarani *et. al.* (1997a) among segregating generations, Backiyarani *et. al.* (1999) in both F_2 and F_3 generations, Solanki and Deepak (2000), Kumaresan and Nadarajan (2002), Yingzhong and Yishou (2002) and Deepasankar and Anandakumar (2003) reported positively significant correlations of 1000-seed weight with seed yield. Yingzhong and Yishou (2002) noticed negative and significant association of number of capsules per plant with 1000-seed weight. Chandrasekhara and Reddy (1993) noticed positive non-significant association of 1000-seed weight with seed yield. Shadakshari *et. al.* (1992), Biswas and Akbar (1995), and Thiagarajan and Ramanathan (1996) showed negatively significant association of seed yield with 1000-seed weight. Krishnadoss (1984), Manivannan (1998) and Ramakrishnan and Soundarapandian (1990) observed no association between 1000-seed weight and seed yield.

2.2.8 Oil Content (%)

Significant positive correlation of seed yield with oil content was reported by Pathak and Dixit (1992), Shadakshari *et. al.* (1992), Backiyarani *et. al.* (1997a) among segregating populations, Pawar *et. al.* (2002), Ramireddy and Sundaram (2002), Pathak and Dixit (1992) observed significant and positive genotypic correlations of days to 50% flowering, days to maturity, plant height and number of capsules per plant with oil content. Non-significant positive correlations of seed yield with oil content was observed by Ranganatha *et. al.* (1994) in F_3 and F_4 generations, Vanisri *et. al.* (1994), Babu (2000) and Kumaresan and Nadarajan (2002). Negatively significant correlation of oil content with seed yield was recorded by Vadhavani *et. al.* (1992) and Backiyarani *et. al.* (1999) in their studies on both F_2 and F_3 generations.

2.2.9 Seed Yield per Plant (g)

Seed yield per plant had significant positive correlations with other traits like plant height, number of primaries, capsules per plant, number of seeds per capsule as reported by Backiyarani *et. al.* (1997a), Alam *et. al.* (1999) and Ramireddy and Sundaram (2002). Positive correlations of seed yield with characters *viz.*, 1000-seed weight and oil content was showed by Backiyarani *et. al.* (1997a) and Kumaresan and Nadarajan (2002). Negative association of seed yield per plant with 1000-seed

weight was reported by Thiagarajan and Ramanathan (1996) and with oil content by Vadhavani *et. al.* (1992) and Backiyarani *et. al.* (1999).

2.3 PATH COEFFICIENT ANALYSIS

Selection based on the magnitude and direction of association between yield components and yield, will be useful in identifying important traits, which can be exploited profitably in a short time to achieve the desired level of improvement in yield. Path analysis provides an effective means of partitioning the correlations into direct and indirect effects of yield components. Hence correlation studies in combination with path coefficient analysis will give a better idea of the cause and effect relationship existing between pairs of characters.

The literature available regarding path coefficient analysis in sesame is reviewed here under.

2.3.1 Plant Height (cm)

Positive direct effect of plant height on seed yield was reported by Singh *et. al.* (1997), Siddiqui *et. al.* (1998), Veena (1998), Kavitha and Sethupathiramalingam (1999) in the segregating populations and Yingzhong and Yishou (2002). Direct effect of plant height was positive and higher in biparental progenies than F_3 bulk population as reported by Sudharani *et. al.* (1996).

Negative direct effect of plant height on seed yield was noticed by Janardhanam *et. al.* (1982), Shukla (1983), Gupta and Chopra (1984), Reddy *et. al.* (1984), Reddy and Haripriya (1991) in both parents and F₁ hybrids. Subbalakshmi (1996) also reported similar results for this character.

2.3.2 Days to 50% Flowering

Days to 50% flowering exerting direct positive effect on seed yield was observed by Pathak and Dixit (1986), Mishra *et. al.* (1995) and Siddiqui *et. al.* (1998). Indirect positive effect via days to maturity and plant height was observed by Pathak and Dixit (1986), through plant height, number of capsules per plant, 1000-seed weight and oil content was noticed by Thiyagarajan and Ramanathan (1996) through number of capsules per plant and days to maturity was recorded by Siddiqui *et. al.* (1998) via primary branches by Kavitha and Sethupathiramalingam (1999). Low indirect effect through number of capsules per plant with negligible direct effect was reported by Deepasankar and Anandakumar (2003).

Days to 50% flowering exerted direct effect in a negative direction as revealed by Thiyagarajan and Ramanathan (1996) and Kavitha and Sethupathiramalingam (1999). Negative indirect effect via number of capsules per plant, plant height and 1000-seed weight was reported in segregating populations of sesame by Kavitha and Sethupathiramalingam (1999).

2.3.3 Days to Maturity

Pathak and Dixit (1992), Siddiqui *et. al.* (1998), Alam *et. al.* (1999) reported positive direct effect on seed yield with days to maturity.

Sudharani *et. al.* (1996) observed a shift from positive direct effect of days to maturity in F_3 bulk population to a negative direction in biparental progenies.

Kaushal *et. al.* (1977) and Thangavelu and Rajesekharan (1983) revealed negative direct effect of days to maturity on seed yield.

2.3.4 Number of Primaries

Thangavelu and Rajesekharan (1983) reported that number of primaries had positive direct effect on seed yield per plant. Govindarasu and Ramamoorthi (1998) reported that number of primaries had high positive direct effect on seed yield per plant, in segregating populations of sesame.

A shift from positive direct effect of number of primary branches on seed yield in F_3 bulk population to negative direction in biparental progenies was observed by Sudharani *et. al.* (1996).

Backiyarani *et. al.* (1999) reported that number of primaries had high direct effect on seed yield in F_2 and low direct effect in F_3 generation.

Kavitha and Sethupathiramalingam (1999) reported negative direct effect of number of primary branches on seed yield per plant.

2.3.5 Number of Capsules per Plant

Vadhavani *et. al.* (1992), Vanisri *et. al.* (1994), Subbalakshmi (1996), Sudharani *et. al.* (1996), Govindarasu and Ramamoorthi (1998) in segregating populations, Manivannan (1998), Kavitha and Sethupathiramalingam (1999), Tomar *et. al.* (1999), Yingzhong and Yishou (2002) and Deepasankar and Anandakumar (2003) observed that number of capsules per plant had direct positive effect on seed yield per plant.

Pathak and Dixit (1992) and Thiagarajan and Ramanathan (1996) noticed that number of capsules per plant exerted negative direct effect on seed yield.

2.3.6 Number of Seeds per Capsule

Pathak and Dixit (1986), Bhele *et. al.* (1987), Vanisri *et. al.* (1994), Alam *et. al.* (1999), Tomar *et. al.* (1999) revealed number of seeds per capsule had positive direct effect on seed yield.

Rai *et. al.* (1997) reported that the number of seeds per capsule had negative direct effect on seed yield coupled with positive indirect effects via capsule number and days to 50%

flowering and negative indirect effects through primary branches and 1000-seed weight.

Manivannan (1998) noticed negative indirect effect on seed yield via capsules on branches.

2.3.7 1000-Seed Weight (g)

Positive direct effect of 1000-seed weight on seed yield was given by Sudharani *et. al.* (1996), Tak (1997), Tomar *et. al.* (1999) and Solanki and Deepak (2000). Positive indirect effect through number of primary branches was reported by Kavitha and Sethupathiramalingam (1999) in segregating populations of sesame. Tomar *et. al.* (1999) reported positive indirect effects via capsules per plant and seeds per capsule.

Negative direct effect of 1000-seed weight on seed yield was noticed by Vadhavani *et. al.* (1992), Rai *et. al.* (1997) and Kavitha and Sethupathiramalingam (1999). Backiyarani *et. al.* (1999) revealed that direct effect was low and negative in both F_2 and F_3 generations of sesame. Negative indirect effect through plant height, number of capsules per plant was recorded by Vadhavani *et. al.* (1992) and Kavitha and Sethupathiramalingam (1999).

2.3.8 Oil Content (%)

Direct effect of oil content on seed yield per plant was positive reported by Thiagarajan and Ramanathan (1996) and

Solanki and Deepak (2000). Positive indirect effect via plant height, 1000-seed weight was reported by Thiyagarajan and Ramanathan (1996). Oil content via days to maturity contribute high positive, indirect effect to seed yield was recorded by Pathak and Dixit (1992).

Negative direct effect of oil content on seed yield was reported by Kavitha and Sethupathiramalingam (1999).

Backiyarani *et. al.* (1999) reported that the direct effect of oil content on seed yield was negative and low both in F_2 and F_3 generations of sesame. Thiyagarajan and Ramanathan (1996) indicated negative indirect effect via days to 50% flowering.

CHAPTER - III

MATERIALS AND METHODS

The present investigation was carried out during *rabi* 2003-04, at the Agricultural College Farm, Bapatla, Andhra Pradesh, located at an altitude of 5.4 m MSL, 15°54' north latitude and 80°90' east longitude. The material used and the methods followed in the present investigation are described here under.

3.1 MATERIALS

The experimental material for this study consisted of segregating generations of eleven crosses. These crosses were selected from the line x tester analysis done by Ratnababu (2003) and F_2 and F_3 generations were developed by selfing. The information about the material used in this study is presented in Table 1.

3.2 METHODS

3.2.1 Experimental Technique

The detailed experimental technique for the present investigation is furnished in Table 2.

Table 1 : Material used in Character association and path coefficient analysis in F₂ and F₃ generations of sesame.

S.No.	Crosses
1	Madhavi x SO-12-2154
2	Madhavi x Vinayak
3	Madhavi x DCB-1855
4	Gowri x SO-12-2154
5	Gowri x Vinayak
6	Tanuku brown x SO-12-2154
7	Tanuku brown x Vinayak
8	Tanuku brown x DCB-1855
9	Rajeswari x SO-12-2154
10	Rajeswari x Vinayak
11	Rajeswari x DCB-1855

Table 2 : Experimental details

Experimental details	
Season	<i>Rabi</i> 2003-04
Design	Randomised Block Design
Replications	3 (three)
Number of entries	Experiment 1: F ₂ generation of eleven crosses Experiment 2: F ₃ generation of eleven crosses
Length of the row	2 m
Number of rows per treatment per replication	3
Number of plants per row	20
Spacing	30 cm x 10 cm
Fertilizer dose	40N + 40 P ₂ O ₅ + 20 K ₂ O (kg/ha)

3.2.2 Record of Observations

Thirty plants at random from each cross in each replication were chosen and labelled for recording observations and the mean was used for statistical analysis. The data on the following yield and yield component traits were recorded.

3.2.2.1 Plant height (cm)

The height of the fully matured plant from the base of the plant to the tip was measured in centimeters.

3.2.2.2 Days to 50% flowering

The number of days taken from sowing to the day when 50 per cent of the plants in a plot were seen flowering in the population.

3.2.2.3 Days to maturity

The total number of days taken from date of sowing to complete maturity was taken as days to maturity.

3.2.2.4 Number of primaries

The total number of branches arising from the main stem were counted at the time of maturity.

3.2.2.5 Number of capsules per plant

The number of matured capsules obtained both from main stem as well as branches were counted on each plant.

3.2.2.6 Number of seeds per capsule

Twenty random capsules from each plant were chosen to count the number of seeds per capsule. The mean of seeds from all capsules counted from the sample plants was expressed as the number of seeds per capsule.

3.2.2.7 1000-seed weight (g)

Random samples of 1000 healthy seeds were taken and their weight was recorded in grams with the help of digital electronic balance.

3.2.2.8 Oil content (%)

Oil content was recorded with NMR Spectrometer at National Seed Project, Rajendranagar for each entry at the rate of three samples per replication.

3.2.2.9 Seed yield per plant (g)

Thirty randomly selected plants from each plot were harvested and threshed and the cleaned seed were dried and weighed in grams and mean yield of thirty plants was taken as seed yield per plant.

3.2.3 Statistical Analysis

The data on various characters was subjected to the following statistical analysis.

3.2.3.1 Analysis of variance

The analysis of variance for each of the character was done by using the standard statistical procedure (Panse and Sukhatme, 1961), as follows.

$$Y_{ij} = \mu + t_i + b_j + e_{ij}$$

Where, Y_{ij} = performance of i^{th} genotype in j^{th} block.

μ = General mean

t_i = i^{th} genotypic effect

b_j = j^{th} block effect

e_{ij} = Random error.

The structure of analysis of variance was as follows:

ANOVA table for R.B.D.

Source	Degrees of freedom (df)	Sum of squares (SS)	Mean sum of squares (MSS)	"F" calculated value
Replications	(r-1)	SSr	Mr	Mr/Me
Treatments	(t-1)	SS _t	Mt	Mt/Me
Error	(r-1) (t-1)	SS _e	Me	

Where, r = Number of replications

t = Number of treatments

SSr = Sum of squares of replications

SS_t = Sum of squares of treatments

SS_e = Sum of squares of error

Mr = Mean sum of squares of replications

Mt = Mean sum of squares of treatments

Me = Mean sum of squares of error

The test of significance for variance was carried out referring to the “F” table value given in Snedecor and Cochran (1994). The significant differences for genotypes were tested at 0.05 and 0.01 probability levels.

3.2.3.2 Coefficient of variation

The genotypic and phenotypic coefficients of variation were calculated according to Burton (1952).

(i) Genotypic Coefficient of variation

$$GCV = \frac{\sigma_g}{\bar{X}} \times 100$$

(ii) Phenotypic coefficient of variation

$$PCV = \frac{\sigma_p}{\bar{X}} \times 100$$

Where, σ_g = Genotypic standard deviation

σ_p = Phenotypic standard deviation

$\bar{X}$ = General mean

Categorization of the range of variation was affected as proposed by Sivasubramanian and Madhava Menon (1973).

< 10% : Low

10-20% : Moderate

> 20% : High

3.2.3.3 Heritability (Broad sense) (H)

Heritability was calculated by the formula given by Lush (1940).

$$H = \frac{\sigma^2g}{\sigma^2p} \times 100$$

Where, H = Heritability in broad sense

σ^2g = Genotypic variance

σ^2p = Phenotypic variance

As suggested by Stansfield (1969) heritability in broad sense estimates were categorized as:

0 – 20% : Low

20 – 50% : Medium

50% and above: High

3.2.3.4 Expected genetic advance

Genetic advance was calculated based on formula given by Johnson *et. al.* (1955).

$$\text{Expected genetic advance (GA)} = \sigma_p \times h^2(b) \times K$$

Where, σ_p = Phenotypic standard deviation.

$h^2(b)$ = Heritability (Broad sense)

K = Selection differential at 5% selection intensity

(2.06).

$$\text{Genetic Advance as per cent of Mean} = \frac{\text{Genetic advance}}{\text{Grand mean}} \times 100$$

The range of genetic advance as per cent of mean was classified as suggested by Johnson *et. al.* (1955).

Less than 10% : Low

10 – 20% : Moderate

More than 20% : High

3.2.3.5 Correlations

Phenotypic and genotypic correlation coefficients between different variables were calculated by using covariance technique (Falconer, 1964).

The phenotypic and genotypic correlations among yield and other character were computed as :

$$r (x_i, x_j)_p = \text{Cov} (x_i, x_j)_p / [V (x_i)_p \times V (x_j)_p]^{1/2}$$

$$r (x_i, x_j)_g = \text{Cov} (x_i, x_j)_g / [V (x_i)_g \times V (x_j)_g]^{1/2}$$

Where, $r (x_i, x_j)$ = Correlation between i^{th} and j^{th} characters.

$\text{Cov} (x_i, x_j)$ = Covariance between i^{th} and j^{th} characters.

$V (x_i)$ and $V (x_j)$ = variance for i^{th} and j^{th} characters.

Significance of phenotypic and genotypic correlation coefficients were tested against Table value for r at $(n-2)$ degrees of freedom of Fisher and Yates (1963) Table where “ n ” is the number of genotypes tested.

3.2.3.6 Path coefficient analysis

Path Coefficients were obtained by solving the following simultaneous equations as suggested by Dewey and Lu (1959).

$$r_{1y} = P_{1y} + r_{12} P_{2y} + r_{13} P_{3y} + \dots + r_{1k} P_{ky}$$

Where,

r_{1y} = Simple correlation coefficient between x_1 and y , the dependent character.

P_{1y} = Direct effect of x_1 on y , the dependent character.

$r_{12}P_{2y}$ = Indirect effect of x_1 on y through x_2 .

r_{12} = Correlation coefficient between x_1 and x_2 .

$r_{1k}P_{ky}$ = Indirect effect of x_1 only through k^{th} variable.

In the same way equations for r_{2y} , r_{3y} , r_{4y} upto r_{ky} were obtained. The direct and indirect effects were calculated by solving the simultaneous equations. Besides the direct and indirect effects, the residual effect was computed by using the formula.

$$R = [1 - (P_{1y}r_{1y} + P_{2y}r_{2y} + P_{3y}r_{3y} + \dots\dots\dots)]^{1/2}$$

Where, R = Residual effect.

P_{1y} = Direct effect of x_1 on y .

r_{1y} = Correlation coefficient of x_1 and y .

P_{2y} = Direct effect of x_2 on y .

r_{2y} = Correlation coefficient of x_2 and y .

P_{3y} = Direct effect of x_3 on y .

r_{3y} = Correlation coefficient of x_3 and y .

CHAPTER - IV

RESULTS

The present investigation was carried out during *rabi* 2003-04 at Agricultural College Farm, Bapatla. The data on plant height, days to 50% flowering, days to maturity, number of primaries, number of capsules per plant, number of seeds per capsule, 1000-seed weight, oil content and seed yield per plant from F_2 and F_3 generation of eleven crosses of sesame was subjected to statistical analysis. The results obtained are described here under.

4.1 VARIABILILTY, HERITABILITY, GENETIC ADVANCE AND GENETIC ADVANCE AS PER CENT OF MEAN

4.1.1 F_2 Generation

The analysis of variance revealed significant differences among the genotypes for all characters studied, indicating a high degree of variability in the material (Table 3).

The mean performance of eleven crosses of sesame for nine characters, in F_2 generation is presented in Table 4. The estimates of genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (h^2), genetic advance (GA)

and genetic advance as per cent of mean (GAM) for different characters are presented in Table 5 and described character wise here under.

4.1.1.1 Plant height (cm)

The plant height ranged from 79.56 cm to 103.13 cm with a mean of 91.65 cm. The GCV and PCV were 8.75 and 8.86, respectively. The heritability recorded for this character was 97.3 per cent. Genetic advance recorded was 16.30 and GA as per cent of mean was 17.78 per cent.

4.1.1.2 Days to 50% flowering

The observed variation for this character ranged from 40.33 to 45.00 with a mean of 42.63. The GCV was 3.61 and PCV was 3.93. the heritability was 84.4 per cent with genetic advance 2.91 and genetic advance as per cent of mean 6.84 per cent.

4.1.1.3 Days to maturity

The number of days to maturity ranged from 81.33 to 86.00 with a mean of 83.45. The GCV and PCV were 1.78 and 1.94 per cent respectively. The heritability recorded was 84.7 per cent with genetic advance 2.82 and genetic advance as per cent of mean 3.39 per cent.

4.1.1.4 Number of primaries

A range of 2.06 to 4.03 was observed for this trait, with a mean value of 2.80. The GCV and PCV recorded were 22.93 and 23.39 per cent respectively. The heritability was 96 per cent, genetic advance 1.29 and genetic advance as per cent of mean 46.29 per cent were registered.

4.1.1.5 Number of capsules per plant

The number of capsules per plant varied from 49.96 to 72.03 with a mean of 61.66, GCV 11.68 per cent and PCV 11.98 per cent. This character recorded 95 per cent heritability with a genetic advance of 14.46 and genetic advance as per cent of mean 23.45 per cent.

4.1.1.6 Number of seeds per capsule

The range of number of seeds per capsule was 50.16 to 71.66 and its mean was 59.13. The estimates of GCV and PCV were 9.23 and 9.90 respectively. The heritability observed was 86.9 per cent, with 10.49 genetic advance and 17.74 per cent genetic advance as per cent of mean.

4.1.1.7 1000-seed weight (g)

The observed range of variation for this trait was 2.26 to 3.09 with a mean of 2.70. The genotypic coefficient of variation was 10.45. The heritability recorded was 96.4 per cent. The genetic advance was 0.56 and genetic advance as per cent of mean was 20.77 per cent.

4.1.1.8 Oil content (%)

The percentage of oil content ranges from 45.02 to 54.00 with a mean of 49.59. The GCV and PCV estimates were 5.14 and 5.22 respectively. The heritability recorded was 96.7 per cent. The genetic advance was 5.16 and genetic advance as per cent of mean was 10.42 per cent.

4.1.1.9 Seed yield per plant (g)

A range of 4.45 to 11.19, with a mean of 8.05 was observed for this trait. The GCV and PCV were 28.68 and 29.25 respectively. The character was having 96.1 per cent heritability, 4.66 genetic advance and 57.93 per cent genetic advance as per cent of mean.

4.1.2 F₃ Generation

The analysis of variance revealed significant differences among the genotypes for all characters studied, indicating a high degree of variability in the material (Table 6).

The mean values of the nine characters for eleven crosses of sesame in F₃ generation are presented in Table 7. The comparison of mean performances of eleven crosses for nine characters in F₂ and F₃ generations were depicted in Fig. 1 and Fig. 2. Genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (h^2), genetic advance (GA) and genetic advance as per cent of mean (GAM) were also estimated and the data for different characters was presented in Table 8 and described character wise here under.

4.1.2.1 Plant height (cm)

The observed variation for this character was ranged from 67.70 to 88.03 with a mean of 79.36. The GCV was 8.16 and PCV was 8.71. The heritability was 87.8 per cent with genetic advance 12.51 and genetic advance as per cent of mean 15.76 per cent.

4.1.2.2 Days to 50% flowering

A range of 42.00 to 47.33 was observed for this trait, with a mean value of 44.63. The GCV and PCV recorded were 3.80 and

4.03 per cent respectively. 88.9 per cent of heritability with a genetic advance of 3.30 and genetic advance as per cent of mean 7.40 per cent was registered.

4.1.2.3 Days to maturity

The number of days to maturity ranged from 83.00 to 88.33 with a mean of 85.18. The GCV and PCV were 1.88 and 2.04 per cent respectively. The heritability recorded was 85.1 per cent with genetic advance 3.05 and genetic advance as per cent of mean 3.59 per cent.

4.1.2.4 Number of Primaries

The range of 2.06 to 3.50 with a mean of 2.64 was observed for this trait. The GCV and PCV were 15.02 and 17.97 respectively. The character was having 69.8 per cent heritability, 0.68 genetic advance and 25.87 per cent genetic advance as per cent of mean.

4.1.2.5 Number of capsules per plant

The range of number of capsules per plant was 45.53 to 66.20 and its mean was 56.00. The estimates of GCV and PCV were 10.47 and 11.72 respectively. The heritability observed was 79.7 per cent, with 10.78 genetic advance and 19.26 per cent genetic advance as per cent of mean.

4.1.2.6 Number of seeds per capsule

The number of seeds per capsule varied from 33.93 to 53.61 with a mean of 40.43, GCV 12.81 per cent and PCV 13.85 per cent. This particular character recorded 85.5 per cent heritability with a genetic advance of 9.87 and genetic advance as per cent of mean of 24.42 per cent.

4.1.2.7 1000-seed weight (g)

This trait ranged from 2.20 to 2.94 with a mean of 2.57. The GCV and PCV were 9.61 and 11.34, respectively. The heritability recorded for this character was 71.8 per cent. Genetic advance recorded was 0.43 and GA as Per cent of mean was 16.79 per cent.

4.1.2.8 Oil content (%)

The percentage of oil content ranges from 42.73 to 53.40 with a mean of 47.87. The GCV and PCV estimates were 6.29 and 6.38 respectively. The heritability recorded was 97.3 per cent. The genetic advance was 6.12 and genetic advance as per cent of mean was 12.80 per cent.

4.1.2.9 Seed yield per plant (g)

The observed range of variation for this trait was 3.42 to 10.78 with a mean of 7.28. The genotypic coefficient of variation was 34.23 and phenotypic coefficient of variation was 34.64. The heritability recorded was 97.6 per cent. The genetic advance was 5.07 and genetic advance as per cent of mean was 69.67 per cent.

4.2 CHARACTER ASSOCIATION

Correlation studies indicate association between yield and yield attributing characters. Plant height, days to 50% flowering, days to maturity, number of primaries, number of capsules per plant, number of seeds per capsule, 1000-seed weight and oil content were the seed yield attributing characters in the present study. The results are presented in Tables 9 and 10 for F_2 and F_3 respectively.

4.2.1 F_2 Generation

The genotypic correlation coefficients were higher than phenotypic correlation coefficients for maximum number of characters in F_2 generation. The phenotypic correlations are described below.

4.2.1.1 Plant height (cm)

This character recorded non-significant positive association with oil content (0.5076) and days to maturity (0.0809) and significant positive correlations with number of primaries (0.9410), number of capsules per plant (0.9392), 1000-seed weight (0.8918) and seed yield per plant (0.9065) and non-significant negative association with days to 50% flowering (-0.2324).

4.2.1.2 Days to 50% flowering

Days to 50% flowering recorded significant positive association with days to maturity (0.6306) and non-significant negative correlations with number of primaries (-0.1077), number of capsules per plant (-0.2640), number of seeds per capsule (-0.2393), 1000-seed weight (-0.4848), oil content (-0.2513) and seed yield per plant (-0.2711).

4.2.1.3 Days to maturity

This trait possessed non-significant positive association with number of primaries (0.2228) and non-significant negative correlations with number of capsules per plant (-0.0159), number of seeds per capsule (-0.0908), 1000-seed weight (-0.1085), oil content (-0.2460) and seed yield per plant (-0.0422).

4.2.1.4 Number of primaries

Number of primaries showed highly significant positive correlations with number of capsules per plant (0.9137), number of seeds per capsule (0.7433), 1000-seed weight (0.8294) and seed yield per plant (0.9004). It had a non-significant positive association with oil content (0.4769).

4.2.1.5 Number of capsules per plant

This character possessed highly significant positive association with number of seeds per capsule (0.7278), 1000-seed weight (0.8294) and seed yield per plant (0.9474) and non-significant positive correlation with oil content (0.4564).

4.2.1.6 Number of seeds per capsule

This character recorded non-significant positive correlation with oil content (0.4384), significant positive associations with 1000-seed weight (0.6680) and seed yield per plant (0.7032).

4.2.1.7 1000-seed weight

1000-seed weight possessed significant positive association with oil content (0.6357) and highly significant positive correlation with seed yield per plant (0.8508).

4.2.1.8 Oil content (%)

Oil content showed non-significant positive association with seed yield per plant (0.4437).

4.2.1.9 Seed yield per plant (g)

This trait exhibited highly significant positive association with plant height (0.9065), number of primaries (0.9004) and number of capsules per plant (0.9474) and significant positive association with number of seeds per capsule (0.7032). It showed non-significant negative correlations with days to 50% flowering (-0.2711) and days to maturity (-0.0422).

4.2.2 F₃ Generation

It was observed that the genotypic correlation coefficients were higher than phenotypic correlation coefficients for most of the characters in F₃ generation. The phenotypic correlations are described below.

4.2.2.1 Plant height

Plant height recorded significant positive associations with number of primaries (0.8195), number of capsules per plant (0.8422), seed yield per plant (0.9208) and number of seeds per capsule (0.7626) and non-significant positive association with

1000-seed weight (0.1636) and non-significant negative correlation with days to 50% flowering (-0.4391), days to maturity (-0.3593) and oil content (-0.1533).

4.2.2.2 Days to 50% flowering

This character showed non-significant positive association with days to maturity (0.4299), non-significant negative correlation with number of primaries (-0.3105), number of capsules per plant (-0.4699), number of seeds per capsule (-0.3464), 1000-seed weight (-0.4371), oil content (-0.2284) and seed yield per plant (-0.3997).

4.2.2.3 Days to maturity

This trait possessed non-significant negative correlation with number of primaries (-0.0768), number of capsules per plant (-0.2105), number of seeds per capsule (-0.0391), 1000-seed weight (-0.2575), oil content (-0.2881) and seed yield per plant (-0.2372).

4.2.2.4 Number of primaries

Number of primaries recorded significant positive association with number of capsules per plant (0.7797), number of seeds per capsule (0.8175) and seed yield per plant (0.8275) and non-significant positive correlation with 1000-seed weight (0.1023). It has non-significant negative correlation with oil content (-0.1535).

4.2.2.5 Number of capsules per plant

This character had highly significant positive association with number of seeds per capsule (0.7802) and seed yield per plant (0.8682), non-significant positive correlation with 1000-seed weight (0.0622) and non-significant negative association with oil content (-0.1318).

4.2.2.6 Number of seeds per capsule

This trait possessed highly significant positive correlation with seed yield per plant (0.8205), non-significant positive association with 1000-seed weight (0.0199) and non-significant negative correlation with oil content (-0.0945).

4.2.2.7 1000-seed weight (g)

It has recorded non-significant positive correlation with oil content (0.3218) and seed yield per plant (0.1550).

4.2.2.8 Oil content (%)

This character showed non-significant negative association with seed yield per plant (-0.2160). This trait possessed non-significant negative association with all the other characters except for 1000-seed weight (0.3218).

4.2.2.9 Seed Yield per Plant

This complex trait exhibited highly significant positive correlation with plant height (0.9208), number of primaries (0.8275), number of capsules per plant (0.8682) and number of seeds per capsule (0.8205) and non-significant positive association with 1000-seed weight (0.1550). It has recorded non-significant negative association with days to 50% flowering (-0.3997) and days to maturity (-0.2372).

4.3 PATH COEFFICIENT ANALYSIS

Path coefficient analysis was carried out for partitioning the correlation coefficients of yield and yield contributing characters into direct and indirect effects. The results of path coefficient analysis of yield and yield components are presented in the Table 11 and 12 for F_2 and F_3 respectively. Path diagrams showing the cause and effect relationships were presented in Fig. 3 and Fig. 4, for F_2 and F_3 respectively.

4.3.1 F_2 Generation

4.3.1.1 Plant height (cm)

This character had a negative direct effect on seed yield per plant (-0.0741). It had indirect effects on seed yield in negative direction through days to 50% flowering (-0.0193), days to maturity

(-0.0159), number of seeds per capsule (-0.0408) and oil content (-0.0601) and indirect effects in positive direction via number of primaries (0.4464), number of capsules per plant (0.4798) and 1000-seed weight (0.1905). This trait had a positive association with the seed yield per plant (0.9065).

4.3.1.2 Days to 50% flowering

The direct contribution of this character on seed yield per plant was positive (0.0831). It exerted its indirect effects via plant height (0.0172), number of seeds per capsule (0.0126) and oil content (0.0298) in a positive direction and days to maturity (-0.1241), number of primaries (-0.0511), number of capsules per plant (-0.1349) and 1000-seed weight (-0.1036) in a negative direction. This character had a non-significant negative correlation with seed yield per plant.

4.3.1.3 Days to maturity

This trait had a negative direct effect on seed yield per plant (-0.1968). The indirect effects were in positive direction via days to 50% flowering (0.0524), number of primaries (0.1057), number of seeds per capsule (0.0048) and oil content (0.0291). The indirect effects through plant height (-0.0060), number of capsules per plant (-0.0081) and 1000-seed weight (-0.0232) were in negative

direction. Days to maturity showed non-significant negative correlation with the seed yield per plant (-0.0422).

4.3.1.4 Number of primaries

The direct contribution of number of primaries to seed yield per plant was positive (0.4744). It exerted indirect positive effects via number of capsules per plant (0.4668), 1000-seed weight (0.1772) and indirect negative effects through plant height (-0.0697), days to 50% flowering (-0.0089), days to maturity (-0.0439), number of seeds per capsule (-0.0390) and oil content (-0.0565). It had highly significant positive phenotypic correlation with seed yield per plant (0.9004).

4.3.1.5 Number of capsules per plant

The character had a positive direct effect on seed yield per plant (0.5109). The indirect effects on seed yield per plant through days to maturity (0.0031), number of primaries (0.4335) and 1000-seed weight (0.1836) were observed positive. The indirect effects via plant height (-0.0696), days to 50% flowering (-0.0219), number of seeds per capsule (-0.0382) and oil content (-0.0540) were negative. This trait had a highly significant positive association with seed yield per plant (0.9474).

4.3.1.6 Number of seeds per capsule

The direct contribution of this character on seed yield per plant was negative (-0.0524). It exerted its positive indirect effects via days to maturity (0.0179), number of primaries (0.3526), number of capsules per plant (0.3718) and 1000-seed weight (0.1427). Its indirect effects via plant height (-0.0576), days to 50% flowering (-0.0199) and oil content (-0.0519) were negative. This trait had a positive correlation with seed yield per plant (0.7032).

4.3.1.7 1000-seed weight (g)

This character recorded positive direct effect on seed yield per plant (0.2136). The indirect effects via days to maturity (0.0214), number of primaries (0.3934) and number of capsules per plant (0.4390) were positive. The indirect effect on seed yield per plant via plant height (-0.0661), days to 50% flowering (-0.0403), number of seeds per capsule (-0.0350) and oil content (-0.0753) were negative. The character had a significant positive correlation with seed yield per plant (0.8508).

4.3.1.8 Oil content (%)

The direct contribution of this character on seed yield per plant was positive (0.1358). This trait exerted positive indirect effects via days to maturity (0.0484), number of primaries (0.2262)

and number of capsules per plant (0.2332) and negative indirect effects through plant height (-0.0376), days to 50% flowering (-0.0209), number of seeds per capsule (-0.0230) and 1000-seed weight (-0.1184). This character had a positive but non-significant phenotypic correlation with seed yield per plant (0.4437).

4.3.2 F₃ Generation

4.3.2.1 Plant height (cm)

The direct contribution of this character on seed yield per plant was positive (0.4891). Plant height exerted its indirect positive effects via days to maturity (0.0092), number of primaries (0.0197), number of capsules per plant (0.2124), number of seeds per capsule (0.1804), 1000-seed weight (0.0172) and oil content (0.0169) and indirect negative effect through days to 50% flowering (-0.0239). This trait possessed highly significant positive correlation with seed yield per plant (0.9208).

4.3.2.2 Days to 50% flowering

This character had a positive direct effect with seed yield per plant (0.0545). The indirect effects were in negative direction through plant height (-0.2147), days to maturity (-0.0110), number of primaries (-0.0075), number of capsules per plant (-0.1185), number of seeds per capsule (-0.0819) and 1000-seed weight (-0.0459) and

in positive direction via oil content (0.0252). It had negative non-significant correlation with seed yield per plant (-0.3997).

4.3.2.3 Days to maturity

This character recorded negative direct effect on seed yield per plant (-0.0255). The indirect effects through plant height (-0.1757), number of primaries (-0.0018), number of capsules per plant (-0.0531), number of seeds per capsule (-0.0092) and 1000-seed weight (-0.0270) were negative. The indirect effects via days to 50% flowering (0.0234) and oil content (0.0318) were positive. Days to maturity showed non-significant negative correlation with seed yield per plant (-0.2372).

4.3.2.4 Number of primaries

This trait exerted positive direct effect on seed yield per plant (0.0241). This character possessed indirect positive effects via plant height (0.4008), days to maturity (0.0020), number of capsules per plant (0.1966), number of seeds per capsule (0.1934), 1000-seed weight (0.0107) and oil content (0.0170) and negative indirect effect through days to 50% flowering (-0.0169). Number of primaries recorded highly significant positive correlation with seed yield per plant (0.8275).

4.3.2.5 Number of capsules per plant

This character had a positive direct effect on seed yield per plant (0.2522). The indirect effects on seed yield per plant via plant height (0.4119), days to maturity (0.0054), number of primaries (0.0188), number of seeds per capsule (0.1845), 1000-seed weight (0.0065) and oil content (0.0146) were positive. The indirect effect via days to 50% flowering (-0.0256) was negative. The character had highly significant positive correlation with seed yield per plant (0.8682).

4.3.2.6 Number of seeds per capsule

The direct contribution of this character on seed yield per plant was positive (0.2365). It exerted its indirect effects to seed yield per plant via plant height (0.3729), days to maturity (0.0010), number of primaries (0.0197), number of capsules per plant (0.1967), 1000-seed weight (0.0021) and oil content (0.0104) in a negative direction and days to 50% flowering (-0.0189) in a positive direction. The character had highly significant positive correlation with seed yield per plant (0.8205).

4.3.2.7 1000-seed weight (g)

The direct contribution of 1000-seed weight on seed yield per plant was positive (0.1049). It exerted its negative effects via

days to 50% flowering (-0.0238) and oil content (-0.0355) and its positive effects through plant height (0.0800), days to maturity (0.0066), number of primaries (0.0025), number of capsules per plant (0.0157) and number of seeds per capsule (0.0047). The trait had positive and non-significant correlation with seed yield per plant (0.1550).

4.3.2.8 Oil Content (%)

The character had a negative direct effect on seed yield per plant (-0.1104). The indirect effects on seed yield per plant via plant height (-0.0749), days to 50% flowering (-0.0124), number of primaries (-0.0037), number of capsules per plant (-0.0332), number of seeds per capsule (-0.0224) were negative. The indirect effects on seed yield per plant through days to maturity (0.0073) and 1000-seed weight (0.0338) were positive. The character had negative non-significant correlation with seed yield per plant (-0.2160).

Table 3 : Analysis of variance for yield and yield component characters in F₂ generation of sesame.

Source	Mean sum of squares									
	Degrees of freedom	Plant height (cm)	Days to 50% flowering	Days to maturity	No. of primaries	No. of capsules per plant	No. of seeds per capsule	1000 seed weight (g)	Oil content (%)	Seed yield per plant (g)
Replications	2	0.96	0.63	0.64	0.004	3.81	3.16	0.010	1.26	5.38
Treatments	10	194.74**	7.56**	7.08**	1.256**	158.41**	94.02**	0.233**	19.72**	16.24**
Error	20	1.76	0.43	0.40	0.016	2.73	4.48	0.002	0.21	0.21

* Significant at 5% level

** Significant at 1% level

Table 4 : Mean performance of eleven crosses of sesame for nine characters in F₂ generation.

S. No.	Crosses	Plant height (cm)	Days to 50% flowering	Days to maturity	No. of primaries	No. of capsules per plant	No. of seeds per capsule	1000 seed weight (g)	Oil content (%)	Seed yield per plant (g)
1	Madhavi x SO-12-2154	94.93	40.33	83.00	3.00	63.33	61.06	2.83	49.28	8.07
2	Madhavi x Vinayak	100.41	42.33	84.33	3.20	67.20	61.23	2.96	48.48	10.03
3	Madhavi x DCB-1855	79.56	45.00	86.00	2.06	49.96	50.16	2.26	48.53	4.58
4	Gowri x SO-12-2154	84.30	41.66	82.33	2.16	54.23	59.96	2.55	48.47	5.82
5	Gowri x Vinayak	86.86	42.66	83.33	2.56	61.53	56.26	2.49	45.02	8.64
6	Tanuku brownxSO-12-2154	86.73	42.00	81.33	2.30	60.26	54.00	2.56	48.89	7.23
7	Tanuku brown x Vinayak	103.13	43.33	85.66	4.03	72.03	62.83	3.09	51.11	11.19
8	Tanuku brownx DCB-1855	95.43	44.33	83.00	3.13	64.83	60.50	2.72	52.10	9.45
9	Rajeswari x SO-12-2154	91.18	40.33	81.33	2.63	61.60	57.40	2.98	54.00	8.39
10	Rajeswari x Vinayak	83.73	44.66	84.33	2.13	52.06	55.40	2.32	47.28	4.45
11	Rajeswari x DCB-1855	101.91	42.33	83.33	3.60	71.20	71.66	2.91	52.29	10.76
	Mean	91.65	42.63	83.45	2.80	61.66	59.13	2.70	49.59	8.05
	CV	1.45	1.54	0.76	4.64	2.68	3.58	1.96	0.93	5.76
	S.Ed	1.08	0.53	0.51	0.10	1.34	1.72	0.04	0.37	0.37
	CD .5%	2.26	1.12	1.08	0.22	2.81	3.60	0.09	0.79	0.79

Table 5 : Mean, variability, heritability, genetic advance and genetic advance as per cent of mean for yield and yield components in F₂ generation of sesame.

S. No.	Character	Range		Mean	GCV (%)	PCV (%)	Heritability (%)	Genetic advance	Genetic advance as % of mean
		Min.	Max.						
1	Plant height (cm)	79.56	103.13	91.65	8.75	8.86	97.3	16.30	17.78
2	Days to 50% flowering	40.33	45.00	42.63	3.61	3.93	84.4	2.91	6.84
3	Days to maturity	81.33	86.00	83.45	1.78	1.94	84.7	2.82	3.39
4	Number of primaries	2.06	4.03	2.80	22.93	23.39	96.0	1.29	46.29
5	Number of capsules per plant	49.96	72.03	61.66	11.68	11.98	95.0	14.46	23.45
6	Number of seeds per capsule	50.16	71.66	59.13	9.23	9.90	86.9	10.49	17.74
7	1000 seed weight (g)	2.26	3.09	2.70	10.27	10.45	96.4	0.56	20.77
8	Oil content (%)	45.02	54.00	49.59	5.14	5.22	96.7	5.16	10.42
9	Seed yield per plant (g)	4.45	11.19	8.05	28.68	29.25	96.1	4.66	57.93

Table 9 : Phenotypic and genotypic correlation coefficients among yield and yield components in F₂ generation of eleven crosses of sesame.

S. No.	Character	Plant height (cm)	Days to 50% flowering	Days to maturity	No. of primaries	No. of capsules per plant	No. of seeds per capsule	1000 seed weight (g)	Oil content (%)	Seed yield per plant (g)
1	Plant height (cm)		-0.2324 (-0.2643)	0.0809 (0.0957)	0.9410** (0.9754)	0.9392** (0.9718)	0.7777** (0.8528)	0.8918** (0.9133)	0.5076 (0.5195)	0.9065** (0.9426)
2	Days to 50% flowering			0.6306* (0.7165)	-0.1077 (-0.1184)	-0.2640 (-0.3214)	-0.2393 (-0.3306)	-0.4848 (-0.5584)	-0.2513 (-0.2578)	-0.2711 (-0.2922)
3	Days to maturity				0.2228 (0.2581)	-0.0159 (-0.0234)	-0.0908 (-0.0411)	-0.1085 (-0.1398)	-0.2460 (-0.2468)	-0.0422 (-0.0140)
4	Number of primaries					0.9137** (0.9616)	0.7433** (0.8037)	0.8294** (0.8551)	0.4769 (0.4917)	0.9004** (0.9316)
5	Number of capsules per plant						0.7278* (0.8164)	0.8593** (0.8923)	0.4564 (0.4722)	0.9474** (1.0000)
6	Number of seeds per capsule							0.6680* (0.7239)	0.4384 (0.4744)	0.7032* (0.7589)
7	1000 seed weight (g)								0.6357* (0.6616)	0.8508** (0.8809)
8	Oil content (%)									0.4437 (0.4637)
9	Seed yield per plant (g)									

* Significant at 5% level ** Significant at 1% level. Figures in parentheses indicate genotypic correlations

Table 11 : Path coefficients of yield and yield components in eleven crosses of sesame in F₂ generation.

S. No.	Character	Plant height (cm)	Days to 50% flowering	Days to maturity	No. of primaries	No. of capsules per plant	No. of seeds per capsule	1000 seed weight (g)	Oil content (%)	Correlation coefficient with yield
1	Plant height (cm)	-0.0741	-0.0193	-0.0159	0.4464	0.4798	-0.0408	0.1905	-0.0601	0.9065**
2	Days to 50% flowering	0.0172	0.0831	-0.1241	-0.0511	-0.1349	0.0126	-0.1036	0.0298	-0.2711
3	Days to maturity	-0.0060	0.0524	-0.1968	0.1057	-0.0081	0.0048	-0.0232	0.0291	-0.0422
4	Number of primaries	-0.0697	-0.0089	-0.0439	0.4744	0.4668	-0.0390	0.1772	-0.0565	0.9004**
5	Number of capsules per plant	-0.0696	-0.0219	0.0031	0.4335	0.5109	-0.0382	0.1836	-0.0540	0.9474**
6	Number of seeds per capsule	-0.0576	-0.0199	0.0179	0.3526	0.3718	-0.0524	0.1427	-0.0519	0.7032**
7	1000 seed weight (g)	-0.0661	-0.0403	0.0214	0.3934	0.4390	-0.0350	0.2136	-0.0753	0.8508**
8	Oil content (%)	-0.0376	-0.0209	0.0484	0.2262	0.2322	-0.0230	-0.1184	0.1358	0.4437

* Significant at 5% level

Residual effect = SQRT (1-1.0349).

** Significant at 1% level

Values in bold face type are direct effects.

Table 6 : Analysis of variance for yield and yield component characters in F₃ generation of sesame.

Source	Mean sum of squares									
	Degrees of freedom	Plant height (cm)	Days to 50% flowering	Days to maturity	No. of primaries	No. of capsules per plant	No. of seeds per capsule	1000 seed weight (g)	Oil content (%)	Seed yield per plant (g)
Replications	2	4.12	0.08	2.82	0.01	1.28	5.73	0.108	0.13	0.21
Treatments	10	131.76**	9.02**	8.22**	0.54**	111.93**	85.09**	0.207**	27.52**	18.80**
Error	20	5.80	0.35	0.45	0.06	8.75	4.53	0.024	0.24	0.15

* Significant at 5% level

** Significant at 1% level

Table 7 : Mean performance of eleven crosses of sesame for nine characters in F₃ generation.

S. No.	Crosses	Plant height (cm)	Days to 50% flowering	Days to maturity	No. of primaries	No. of capsules per plant	No. of seeds per capsules	1000 seed weight (g)	Oil content (%)	Seed yield per plant (g)
1	Madhavi x SO-12-2154	80.73	42.00	84.66	2.66	57.00	40.82	2.97	53.40	7.04
2	Madhavi x Vinayak	84.26	44.00	86.00	2.90	60.00	42.23	2.71	42.73	9.48
3	Madhavi x DCB-1855	67.70	47.33	88.33	2.06	45.53	33.93	2.28	49.41	3.97
4	Gowri x SO-12-2154	75.96	44.66	84.00	2.26	51.90	36.60	2.33	49.19	4.52
5	Gowri x Vinayak	83.40	43.33	85.00	2.83	58.33	40.93	2.20	43.86	8.52
6	Tanuku brown x SO-12-2154	77.16	45.66	83.00	2.33	53.16	36.39	2.53	48.91	6.32
7	Tanuku brown x Vinayak	88.03	44.00	86.00	3.50	66.20	53.61	2.40	48.41	10.78
8	Tanuku brown x DCB-1855	82.38	46.66	84.66	2.70	57.13	41.58	2.48	47.16	8.71
9	Rajeswari x SO-12-2154	78.33	42.33	83.00	2.50	55.03	38.85	2.94	50.37	7.31
10	Rajeswari x Vinayak	68.80	46.33	87.33	2.23	48.46	36.13	2.64	45.35	3.42
11	Rajeswari x DCB-1855	86.26	44.66	85.00	3.10	63.30	43.70	2.79	47.83	10.02
	Mean	79.36	44.63	85.18	2.64	56.00	40.43	2.57	47.87	7.28
	CV	3.03	1.34	0.78	9.86	5.28	1.73	6.01	1.03	5.32
	S.Ed	1.96	0.48	0.54	0.21	2.41	5.26	0.12	0.40	0.31
	CD .5%	4.10	1.01	1.14	0.44	5.03	3.62	0.26	0.84	0.66

Table 8 : Mean, variability, heritability, genetic advance and genetic advance as per cent of mean for yield and yield components in F₃ generation of sesame.

S. No.	Character	Range		Mean	GCV (%)	PCV (%)	Herita- bility (%)	Genetic advance	Genetic advance as % of mean
		Min.	Max.						
1	Plant height (cm)	67.70	88.03	79.36	8.16	8.71	87.8	12.51	15.76
2	Days to 50% flowering	42.00	47.33	44.63	3.80	4.03	88.9	3.30	7.40
3	Days to maturity	83.00	88.33	85.18	1.88	2.04	85.1	3.05	3.59
4	Number of primaries	2.06	3.50	2.64	15.02	17.97	69.8	0.68	25.87
5	Number of capsules per plant	45.53	66.20	56.00	10.47	11.72	79.7	10.78	19.26
6	Number of seeds per capsule	33.93	53.61	40.43	12.81	13.85	85.5	9.87	24.42
7	1000 seed weight (g)	2.20	2.94	2.57	9.61	11.34	71.8	0.43	16.79
8	Oil content (%)	42.73	53.40	47.87	6.29	6.38	97.3	6.12	12.80
9	Seed yield per plant (g)	3.42	10.78	7.28	34.23	34.64	97.6	5.07	69.67

Table 10 : Phenotypic and genotypic correlation coefficients among yield and yield components in F₃ generation of eleven crosses of sesame.

S. No.	Character	Plant ht. (cm)	Days to 50% flowering	Days to maturity	No. of primaries	No. of capsules per plant	No. of seeds per capsule	1000 seed weight (g)	Oil content (%)	Seed yield per plant (g)
1	Plant height (cm)		-0.4391 (-0.5759)	-0.3593 (-0.3902)	0.8195** (0.9896)	0.8422** (1.0000)	0.7626** (0.8846)	0.1636 (0.1505)	-0.1533 (-0.1648)	0.9208** (0.9876)
2	Days to 50% flowering			0.4299 (0.5420)	-0.3105 (-0.5002)	-0.4699 (-0.5338)	-0.3464 (-0.3845)	-0.4371 (-0.5444)	-0.2284 (-0.2472)	-0.3997 (-0.4315)
3	Days to maturity				-0.0768 (-0.0706)	-0.2105 (-0.3059)	-0.0391 (-0.0158)	-0.2575 (-0.3401)	-0.2881 (-0.3167)	-0.2372 (-0.2487)
4	Number of primaries					0.7797** (0.9899)	0.8175** (0.9883)	0.1023 (0.1060)	-0.1535 (-0.2300)	0.8275** (0.9997)
5	Number of capsules per plant						0.7802** (0.9959)	0.0622 (0.2857)	-0.1318 (-0.1618)	0.8682** (0.9854)
6	Number of seeds per capsule							0.0199 (0.0708)	-0.0945 (-0.0951)	0.8205** (0.8721)
7	1000 seed weight (g)								0.3218 (0.3819)	0.1550 (0.1650)
8	Oil content (%)									-0.2160 (-0.2238)
9	Seed yield/plant(g)									

* Significant at 5% level ** significant at 1% level

Figures in parentheses indicate genotypic correlations

Table 12 : Path coefficients of yield and yield components in eleven crosses of sesame in F₃ generation.

S. No.	Character	Plant height (cm)	Days to 50% flowering	Days to maturity	No. of primaries	No. of capsules per plant	No. of seeds per capsule	1000 seed weight (g)	Oil content (%)	Correlation co-efficient with yield
1	Plant height (cm)	0.4891	-0.0239	0.0092	0.0197	0.2124	0.1804	0.0172	0.0169	0.9208**
2	Days to 50% flowering	-0.2147	0.0545	-0.0110	-0.0075	-0.1185	-0.0819	-0.0459	0.0252	-0.3997
3	Days to maturity	-0.1757	0.0234	-0.0255	-0.0018	-0.0531	-0.0092	-0.0270	0.0318	-0.2372
4	Number of primaries	0.4008	-0.0169	0.0020	0.0241	0.1966	0.1934	0.0107	0.0170	0.8275**
5	Number of capsules per plant	0.4119	-0.0256	0.0054	0.0188	0.2522	0.1845	0.0065	0.0146	0.8682**
6	Number of seeds per capsule	0.3729	-0.0189	0.0010	0.0197	0.1967	0.2365	0.0021	0.0104	0.8205**
7	1000 seed weight (g)	0.0800	-0.0238	0.0066	0.0025	0.0157	0.0047	0.1049	-0.0355	0.1550
8	Oil content (%)	-0.0749	-0.0124	0.0073	-0.0037	-0.0332	-0.0224	0.0338	-0.1104	-0.2160

* Significant at 5% level

Residual effect = 0.3043.

** Significant at 1% level

Values in bold face type are direct effects.

CHAPTER V

DISCUSSION

Study on “Character association and path coefficient analysis in F_2 and F_3 generations of sesame (*Sesamum indicum* L.)” was conducted at Agricultural College Farm, Bapatla during *rabi* 2003-04. The data collected on plant height, days to 50% flowering, days to maturity, number of primaries, number of capsules per plant, number of seeds per capsule, 1000-seed weight, oil content and seed yield per plant from F_2 and F_3 generations of eleven crosses were subjected to statistical analysis and the results obtained are discussed here under.

5.1 VARIABILITY, HERITABILITY AND GENETIC ADVANCE

Sesame (*Sesamum indicum* L.) is considered by Vavilov as a group of crop plants having a very great range of variation (Shadakshari *et. al.*, 1992). The variability available in the segregating material is an important prerequisite for the selection programme. Since, many characters of economic importance are highly influenced by environmental conditions, the improvement of the crop mainly depends upon the nature and magnitude of genetic variability present in the population.

The phenotypic expression of a trait is the resultant of interaction between the genotype and environment. Hence, the total variance needs to be partitioned into heritable and non-heritable components so as to assess true breeding value of that particular trait (Shadakshari *et. al.*, 1995). The comparison of coefficients of variation for nine characters of eleven crosses in F_2 and F_3 generations of sesame were represented in Fig. 5.

Estimates of heritability serve as an index of the relative contribution of genotype and environment to the phenotypic variance for the concerned trait in a population. Burton (1952) indicated that genetic variability together with heritability estimates would give a better idea on the amount of genetic advance expected out of selection.

The results obtained on variability, heritability and genetic advance as per cent of mean, for F_2 and F_3 generations of eleven crosses of sesame are discussed here under.

5.1.1 Plant Height (cm)

Plant height recorded low genotypic and phenotypic coefficients of variation indicating less variance among the genotypes studied in both F_2 and F_3 generations. Very little difference between GCV and PCV indicates greater role of genetic factors influencing expression of this trait offering ample scope for

improvement. Estimates of high heritability and moderate genetic advance as per cent of mean indicate the importance of both additive and non-additive gene actions and the desired results may not be obtained by simple selection and these results are in concurrence with those of Baruah and Goud (1993), Chandramony and Nayar (1994), Backiyarani *et. al.* (1997b), Kamala (1999) and Saravanan *et. al.* (2000). While Li (1988) reported low heritability, low GCV and low expected genetic advance, contrary to the present results.

5.1.2 Days to 50% Flowering

This trait recorded low genotypic and phenotypic coefficients of variation among genotypes studied in both the segregating generations, and the same was reported in sesamum genotypes by Shadakshari *et. al.* (1995). The narrow difference between genotypic and phenotypic coefficients of variation is in accordance with Baruah and Goud (1993). This character recorded high heritability with low genetic advance as per cent of mean indicating predominance of non-additive gene action. This result reveals that the trait may not be amenable to simple selection. Similar reports were given by Kandaswamy *et. al.* (1990) and Jayalakshmi *et. al.* (1998).

5.1.3 Days to Maturity

This trait possessed low GCV and PCV in both the generations, indicating less variation among the genotypes studied and it had a narrow difference between genotypic and phenotypic coefficients of variation, which indicate the lesser influence of environment on expression of this character. The results are in accordance with Shadakshari *et. al.* (1995). Days to maturity recorded high heritability with low genetic advance as per cent of mean and therefore unsuitable for improvement through direct selection. The same was reported by Kandaswamy *et. al.* (1990) and Jayalakshmi *et. al.* (1998).

5.1.4 Number of Primaries

This trait exhibited wide range of variability giving much scope to exert selection in improvement of this character, in F_2 generation. The GCV and PCV values for F_2 were high and the difference between GCV and PCV was low which indicates that the phenotypic variability is the direct measure of genetic variability. These results are in conformity with Bakheit and Mahdy (1988), Shadakshari *et. al.* (1995) and Kumar *et. al.* (2002). While in F_3 , moderate GCV and PCV were observed with a narrow difference between them. High heritability coupled with high genetic advance obtained in both the generations showed that genotypic variance for

these characters is probably due to high additive gene effect (Johnson *et. al.*, 1955). Hence response to selection could be anticipated in improving the trait. Similar results were reported by Shadakshari (1984), Backiyarani *et. al.* (1997b) and Jayalakshmi *et. al.* (1998).

5.1.5 Number of capsules per Plant

Moderate genotypic and phenotypic coefficients of variation were recorded for this trait indicating high variability among genotypes studied, thus giving scope to exert selection in improving the trait. Narrow difference was observed between GCV and PCV. The closer and parallel PCV and GCV estimates indicate that these characters are relatively less influenced by environment and comparatively stable. Similar results were reported by Baruah and Goud (1993) and Ashoka *et. al.* (2001). High heritability coupled with high genetic advance as per cent of mean in F_2 indicates predominant additive gene action and therefore selection is effective in improvement of this character to some extent. While in F_3 , high heritability with moderate genetic advance as per cent of mean indicates predominance of both additive and non-additive gene actions. Therefore desired results may not be obtained by simple selection. The results in F_2 are in agreement with Fendel and Penso (1994), Shadakshari *et. al.* (1995),

Backiyarani *et. al.* (1997b) and Kumar *et. al.* (2002) and the results in F_3 are in conformity with Saravanan *et. al.* (2000).

5.1.6 Number of Seeds per Capsule

Low to moderate genotypic and phenotypic coefficients of variation were observed in F_2 and F_3 generations indicating lesser variation among crosses studied. The difference between GCV and PCV was narrow and therefore indicates that phenotypic variability is the direct measure of genetic variability. These results are in accordance with Raut *et. al.* (1991).

High heritability coupled with moderate genetic advance as per cent of mean was observed in F_2 indicating the predominance of both additive and non-additive gene actions and therefore desired results may not be obtained with simple selection. While in F_3 high heritability was observed with high genetic advance as per cent of mean indicating additive gene action, which is important for inheritance of the trait. Hence, the trait can be improved by direct selection. Similar observations regarding heritability were reported by Li (1988), Fendel and Penso (1994) and Kamala (1999).

5.1.7 1000-Seed Weight (g)

1000-seed weight possessed moderate to low GCV and PCV indicating less variability among genotypes studied. Similar results were reported by Li (1988) and Raut *et. al.* (1991). High

heritability coupled with high genetic advance as per cent of mean in F_2 generation indicated that additive gene action is important for the inheritance of this trait. Similar results were reported by Baruah and Goud (1993), Fendel and Penso (1994) and Kamala (1999). In F_3 the same trait showed high heritability with moderate genetic advance as per cent of mean indicating importance of both additive and non-additive gene actions. Therefore desired results may not be obtained by direct selection, in F_3 generation.

5.1.8 Oil Content (%)

Oil content exhibited low values of genotypic and phenotypic coefficients of variation indicating less range of variability thereby less scope for selection in both the generations. Narrow difference between GCV and PCV indicated negligible influence of environment on the inheritance of this character. Similar reports were obtained from Baruah and Goud (1993) and Shadakshari *et. al.* (1995). High heritability with moderate genetic advance as per cent of mean was recorded for this trait in both the generations indicating predominance of additive and non-additive gene actions. Therefore, the character may not be suitable for desired improvement through direct selection. Similar reports were obtained with Pathak and Dixit (1992), Baruah and Goud (1993), John *et. al.* (1993) and Shadakshari *et. al.* (1995).

5.1.9 Seed Yield per Plant (g)

Seed yield per plant exhibited very high genotypic and phenotypic coefficients of variability, which indicate wide range of variability. Therefore, there exists a lot of scope for improvement through selection of this character. The difference between GCV and PCV was very narrow suggesting significant role of genetic factors influencing expression of this character offering much scope for improvement. Similar results were reported by Govindarasu *et. al.* (1990), Shadakshari *et. al.* (1992), John *et. al.* (1993), Shadakshari *et. al.* (1995) and Ashoka *et. al.* (2001).

The estimate of heritability was very high with high genetic advance as per cent of mean in both the generations which shows that genotypic variance for this character probably is a result of high additive gene effect. Hence this trait can be improved through selection. The results are in conformity with Janardhanam *et. al.* (1981), Govindarasu *et. al.* (1990), Kandaswamy *et. al.* (1990), Baruah and Goud (1993), Shadakshari *et. al.* (1995), Backiyarani *et. al.* (1997b) and Kumar *et. al.* (2002).

The comparison of seed yield per plant in F_2 and F_3 generations of eleven crosses in sesame was depicted in Fig. 6.

5.2 CHARACTER ASSOCIATION

All forms of plant improvement activities through breeding methods aim at an eventual boost in genetic potential for yield. Since yield is polygenically controlled and highly influenced by environment, selection based on yield alone is not effective. The breeder, hence, delves into proposition of selecting for yield indirectly through yield-associated and highly heritable characters, after eliminating environmental components of phenotypic variation (Mather, 1949).

Correlation studies test the strength of association of yield components with yield, which inturn helps the plant breeder during selection (Robinson *et. al.*, 1951).

The association between two traits can be ascertained by phenotypic correlations, which is determined from measurement of two characters on a number of individuals of the segregating population. The inherent association between two variables is known as genotypic correlation. This may be due to pleiotropy or linkage or more likely both. The main genetic cause of such correlation is pleiotropy, which refers to manifold effects of a gene (Falconer, 1989). If the association between two traits remains the same in the parental population as well as segregating populations, it means the association is due to pleiotropy. If it changes in the

segregating population, it is most likely due to linkage between two genes which has broken in the segregating population resulting in recombination between such genes (Singh and Narayanan, 2000).

Sharma and Asaw (1977) opined that the study of character association in segregating generation would be of special importance since more genotypes are available.

In the present investigation, phenotypic and genotypic correlation estimates were obtained from both F_2 and F_3 generations of eleven crosses of sesame for yield and yield attributing characters. The character-wise results of phenotypic correlations are discussed here under.

5.2.1 Plant Height (cm)

Plant height recorded significant positive association with seed yield per plant in both F_2 and F_3 generations and the same was reported by Patil and Sheriff (1996), Backiyarani *et. al.* (1999) in F_2 generation of sesame and Deepasankar and Anandakumar (2003). This character also showed significant positive association with number of primaries, number of capsules per plant, number of seeds per capsule and 1000-seed weight in both the generations. These results suggested that selection for any one of the above characters may result in improvement of plant height and in turn yield.

5.2.2 Days to 50% Flowering

Days to 50% flowering showed non-significant negative association with seed yield and the same was recorded by Shukla (1983) and Kavitha and Sethupathiramalingam (1999). This character had non-significant negative correlation with all other characters under study except for days to maturity in both the generations.

5.2.3 Days to Maturity

Days to maturity recorded non-significant negative correlation with seed yield per plant. The result was in accordance with Kandaswamy *et. al.* (1990). The trait had non-significant negative correlation with number of capsules per plant, number of seeds per capsule, 1000-seed weight and oil content. Therefore, days to maturity may not be one of the selection criteria in choosing better segregants, aimed at crop improvement with respect to seed yield per plant.

5.2.4 Number of Primaries

This character exhibited significant positive correlations with number of capsules per plant, number of seeds per capsule and seed yield per plant, in both F_2 and F_3 generations. The positive significant correlation with seed yield was also reported by Ranganatha *et. al.* (1994), Kavitha and Sethupathiramalingam

(1999), Kumaresan and Nadarajan (2002) and Deepasankar and Anandakumar (2003). Thus selection for any of the above characters will be effective in increasing seed yield per plant.

Number of primaries had positive association with oil content in F_2 generation, while in F_3 it had a negative association. Similarly significant level changed to non-significant level for number of primaries with 1000-seed weight. This level of shift in the correlation coefficients among the component characters, could be attributed to the differences in the gene complementation of the linkage blocks (Miller *et. al.*, 1958).

5.2.5 Number of Capsules per Plant

Number of capsules per plant showed significant positive correlation with seed yield per plant in both the generations. These results are in accordance with Fendel and Penso (1994), Ranganatha *et. al.* (1994), Govindarasu and Ramamoorthi (1998), Yingzhong and Yishou (2002) and Deepasankar and Anandakumar (2003). These results indicated that the improvement in seed yield can be achieved by selection for number of capsules per plant in both F_2 and F_3 generations. The change in level of significance was observed for association of 1000-seed weight with number of capsules per plant, shift in direction from positive to negative was observed for the correlation between number of capsules per plant

and oil content, from F_2 to F_3 . This sort of shift in associations may be attributed to the change in gene linkage constellations.

5.2.6 Number of Seeds per Capsule

Significant positive correlation in F_2 and highly significant positive association in F_3 was observed for number of seeds per capsule with seed yield per plant. Similar results were furnished by Pathak and Dixit (1992), Backiyarani *et. al.* (1999) in F_2 generation and Ramireddy and Sundaram (2002). This trait had significant positive correlations with plant height, number of primaries and number of capsules per plant. The results suggest that the strength of association remains unchanged over the generations for some characters, while it varies in a few other cases as the generations were advanced. The level of correlations may have increased due to higher degree of homozygosity in later generations (Knott and Kumar, 1975). Further, selection for any of the above traits may prove effective in improvement of seed yield per plant.

5.2.7 1000-Seed Weight (g)

Significant positive correlations were observed for 1000-seed weight with oil content and seed yield per plant in F_2 generation. Significant positive correlation of this trait with yield was observed by Patil and Sheriff (1996), Backiyarani *et. al.* (1999), Yingzhong and Yishou (2002) and Deepasankar and Anandakumar

(2003). Positive non-significant association was observed for 1000-seed weight with seed yield per plant in F_3 generation. The result was in accordance with Chandrasekhara and Reddy (1993).

5.2.8 Oil Content (%)

Oil content exhibited positive correlation with seed yield per plant in F_2 , while in F_3 it had a negative correlation. Non-significant positive correlation of seed yield with oil content was observed by Ranganatha *et. al.* (1994) and Kumaresan and Nadarajan (2002), while significant negative correlation of oil content with seed yield was reported by Backiyarani *et. al.* (1999), in both the generations. Oil content had positive correlation with 1000-seed weight indicating that both are inherited together and selection of any one of the two characters may cause corresponding improvement in other trait finally resulting in increased seed weight with good oil percentage. Similar results were reported by Pawar *et. al.* (2002).

5.3 PATH COEFFICIENT ANALYSIS

Seed yield in sesamum is a complex character influenced by a number of components, which present a complex situation for making selection. Thus direct selection based on correlations may not be effective. Therefore, it is necessary to split the total correlation coefficients into direct and indirect effects on the given

character. This can be achieved by path coefficient analysis, a standardized partial regression coefficient which splits the correlation coefficient into the measures of direct and indirect effects.

If the correlation coefficient is positive, but the direct effect is negative, the indirect effect may be the cause of correlation. Correlation coefficient may be negative but the direct effect is positive and high. Then a restricted simultaneous selection model is to be followed. The total correlation between yield and a component character may sometimes be misleading as it might be an over estimate or under estimate because of its interdependence with other characters which are also correlated with yield. Hence, direct selection based on correlated response may sometimes be unworthy when many characters are affecting a given character. Correlation in combination with path coefficient analysis gives a better understanding into cause and effect relationship between different pairs of characters (Singh and Chaudhary, 1999).

Path coefficient analysis was worked out for eight characters with seed yield in the segregating generations to get the information on direct and indirect contribution of yield contributing characters to yield and the character wise results are discussed here under.

5.3.1 Plant Height (cm)

Plant height possessed low negative direct effect and high significant positive correlation with the seed yield, in F_2 generation. This trait had high positive indirect effects via number of primaries, number of capsules per plant and low positive indirect effect via 1000-seed weight. These indirect positive effects may have nullified the negative effects. These results are in concurrence with Singh *et. al.* (1997), Siddiqui *et. al.* (1998) and Kavitha and Sethupathiramalingam (1999).

The same trait had high positive direct effect and highly significant correlation with seed yield in F_3 generation. This result suggested that selection for this trait in F_3 may improve seed yield directly. This is in agreement with Janardhanam *et. al.* (1982) and Subbalakshmi (1996).

5.3.2 Days to 50% Flowering

Days to 50% flowering recorded low positive direct effect and negative, non-significant correlation with the seed yield, in both the generations. Direct positive effect of days to 50% flowering on seed yield was also reported by Pathak and Dixit (1986), Siddiqui *et. al.* (1998). The results suggest that the restrictions are to be imposed to nullify the undesirable indirect effects in order to make use of the direct effects (Singh and Kakar, 1977).

5.3.3 Days to Maturity

Days to maturity exhibited low and negative direct effect with the seed yield per plant. It also had negative correlation with seed yield per plant in both the generations. The negative direct effect of days to maturity on seed yield revealed the possibility of selection of early segregants coupled with high yield. Similar results were reported by Kaushal *et. al.* (1977) and Sudharani *et. al.* (1996).

5.3.4 Number of Primaries

This trait recorded positive direct effect and significant positive correlation with seed yield in both the generations. These results are in accordance with Thangavelu and Rajesekharan (1983) and Govindarasu and Ramamoorthi (1998). Therefore selection for number of primaries could be effective in both the segregating populations in improving seed yield per plant.

5.3.5 Number of Capsules per Plant

Number of capsules per plant had a high positive direct effect with seed yield coupled with highly significant correlation in both the generations. Thus number of capsules per plant played a major role in improving seed yield as revealed by path and hence can be used as an important selection criterion in the generations of F_2 and F_3 in sesame. The results are in concurrence with

Vadhavani *et. al.* (1992), Sudharani *et. al.* (1996), Govindarasu and Ramamoorthi (1998) and Deepasankar and Anandakumar (2003).

5.3.6 Number of Seeds per Capsule

This trait possessed negative direct effect on seed yield per plant and it had positive correlation with seed yield per plant in F_2 generation. The trait had positive indirect effects via days to maturity, number of primaries, number of capsules per plant and 1000-seed weight, which may have cancelled the negative effects and resulted in positive correlation with seed yield. Negative direct effect of this trait on seed yield was reported earlier by Rai *et. al.* (1997). While in F_3 the same trait had a positive direct effect on seed yield per plant coupled with positive correlation. It had positive effects via plant height, days to maturity, number of primaries, number of capsules per plant and 1000-seed weight. These results can be interpreted that selection for number of seeds per capsule or any of these characters results in improvement of seed yield. Similar results were reported by Pathak and Dixit (1986), Alam *et. al.* (1999) and Tomar *et. al.* (1999).

5.3.7 1000-seed Weight (g)

1000-seed weight recorded direct positive effect on seed yield. It had a positive correlation with the seed yield in both the generations. These results were in accordance with

Sudharani *et. al.* (1996), Tak (1997) and Solanki and Deepak (2000). Positive indirect effect via number of primaries, number of capsules per plant and number of seeds per capsule for seed yield per plant indicated that the selection for 1000-seed weight or any of these traits would be rewarding for seed yield improvement. Similar results were reported by Kavitha and Sethupathiramalingam (1999) and Tomar *et. al.* (1999).

5.3.8 Oil Content (%)

Oil content exhibited direct effect on seed yield per plant coupled with positive correlation in F_2 generation. Also the positive correlation of this character with seed yield revealed the scope for further and coupled enhancement of seed and oil yield in F_2 through selection. Similar results were observed by Thiyagarajan and Ramanathan (1996) and Solanki and Deepak (2000). While in F_3 , a shift was observed in negative direction for both the direct effect and correlation of this trait with the seed yield. Similar results of negative direct effect of oil content on seed yield was reported by Kavitha and Sethupathiramalingam (1999). This may be due to neutralization of positive indirect effects via days to maturity and 1000-seed weight by the negative indirect effects of plant height, days to 50% flowering, number of primaries, number of capsules per plant and number of seeds per capsule. The negative correlation between seed yield and oil content and negative direct effect of oil

content on seed yield and vice versa indicated that a compromise must be made between oil content and seed yield, while making selection for these two characters simultaneously in F_3 . Similar report was furnished earlier by Pathak and Dixit (1992).

CONCLUSIONS

From the results and discussion on various aspects of present investigation entitled "Character association and path coefficient analysis in F_2 and F_3 generations of sesame (*Sesamum indicum* L.)", the following conclusions are drawn.

- ❖ The analysis of variance revealed significant differences among the genotypes for all characters studied, indicating a high degree of variability in the material.
- ❖ High heritability was exhibited by all the characters under study and majority of characters exhibited moderate to high genetic advance as per cent of mean.
- ❖ Correlation studies indicated that, traits *viz.*, plant height, number of primaries, number of capsules per plant, number of seeds per capsule and 1000-seed weight had significant positive association with seed yield per plant, in F_2 generation.
- ❖ Investigation on character association in F_3 generation revealed significant positive association of seed yield per plant

with the characters viz., plant height, number of primaries, number of capsules per plant and number of seeds per capsule.

- ❖ 1000-seed weight showed significant correlation with seed yield in F_2 generation and non-significant correlation with seed yield in F_3 generation.
- ❖ Character association studies revealed positive association of oil content with seed yield per plant in F_2 generation and negative association of oil content with seed yield per plant in F_3 generation.
- ❖ The traits viz., number of primaries, number of capsules per plant, 1000-seed weight and oil content had positive direct effect on seed yield per plant in F_2 generation.
- ❖ Plant height, number of primaries, number of capsules per plant, number of seeds per capsule and 1000-seed weight showed positive direct effect on seed yield per plant in F_3 generation.
- ❖ Studies on character association and path analysis in F_2 generation indicated that, direct selection for number of capsules per plant, number of primaries, 1000-seed weight and oil content will be effective in improving seed yield per plant.

- ❖ Investigation on correlations and path coefficient analysis in F_3 generation revealed that, characters *viz.*, plant height, number of capsules per plant, number of seeds per capsule, number of primaries and 1000-seed weight were important selection criteria for seed yield improvement.
- ❖ The results of path analysis revealed that the direct effect of plant height on seed yield was negative in F_2 generation and positive and high in F_3 generation.
- ❖ A negative direct effect of number of seeds per capsule on seed yield per plant in F_2 generation and positive direct effect on seed yield per plant in F_3 generation was also noticed.
- ❖ The residual effect in F_2 and F_3 generations was lower in magnitude, indicating that the characters included in this study were adequate and appropriate.

CHAPTER VI

SUMMARY

The present investigation was carried out during *rabi* 2003-04 at the Agricultural College Farm, Bapatla with two segregating generations of eleven crosses (F_2 generation of eleven crosses and F_3 generation of eleven crosses in two different experiments) of sesamum (*Sesamum indicum* L.).

The mean, variability, heritability, expected genetic advance, genetic advance as per cent of mean, character association and path coefficient analysis were studied for nine characters *viz.*, plant height, days to 50% flowering, days to maturity, number of primaries, number of capsules per plant, number of seeds per capsule, 1000-seed weight, oil content and seed yield per plant.

The analysis of variance in both the generations revealed significant differences among the genotypes for all the characters studied, indicating a high degree of variability in the material. This shows a scope for sufficient selection.

Estimates of heritability were high for all the characters in both the generations.

Genetic advance as per cent of mean was high for seed yield per plant and number of primaries in both the generations and for number of capsules per plant and 1000-seed weight in F_2 generation. High heritability coupled with high genetic advance as per cent of mean for these traits indicates additive gene action and hence response to selection could be anticipated in improving these characters.

Plant height and oil content in F_2 and F_3 and number of capsules per plant and 1000-seed weight in F_3 generation recorded moderate genetic advance as per cent of mean. High heritability coupled with moderate genetic advance as per cent of mean was observed for these traits revealing the predominance of additive and non-additive gene actions. Hence desired results in these traits may not be obtained through simple selection.

Low genetic advance as per cent of mean coupled with high heritability was observed for days to 50% flowering and days to maturity may be due to non-additive gene action. Hence, these characters are not amenable to direct selection.

Correlation studies in segregating generations revealed significant positive association of seed yield per plant with number of primaries, number of capsules per plant, number of seeds per capsule and plant height. These results indicate that the

improvement of seed yield can be obtained by exercising selection for any one of these traits. Significant level changed to non-significant level in the association of 1000-seed weight with seed yield from F_2 to F_3 generation. A change in the direction of association between the two segregating generations from positive to negative was also observed for oil content and seed yield per plant. These shifts in magnitude and direction of correlations may be attributed to breakage of linkages and release of higher level of recombinations.

Path coefficient analysis revealed positive direct effects for number of primaries, number of capsules per plant, number of seeds per capsule and 1000-seed weight on seed yield per plant, which were high in F_2 generation and were low in F_3 generation. Negative direct effect of plant height and number of seeds per capsule on seed yield per plant in F_2 generation and positive direct effect in F_3 generation were also noticed. Path analysis also revealed that direct effect of oil content on seed yield per plant was positive in F_2 generation and negative and low in F_3 generation. The residual effect in both the segregating generations was lower in magnitude indicating that the characters included in the study were adequate and appropriate.

Study of correlations and path coefficient analysis in F_2 generation suggests that, main emphasis should be laid on number of primaries, number of capsules per plant, 1000-seed weight and oil content, while selecting for higher seed yield.

Investigation on character association and path analysis in F_3 generation revealed that, selection for traits viz., plant height, number of capsules per plant, number of primaries, number of seeds per capsule and 1000-seed weight will be rewarding for seed yield improvement.

The study also suggests that the improvement in oil yield can be achieved through biparental mating, which provides chances of finding superior recombinants in advanced generations by breaking linkages. The recombinants with high yield and oil per cent may be selected for further use in breeding programme.

LITERATURE CITED

- Alam S, Biswas A K and Mandal A B 1999 Character association and path-coefficient analysis in sesame (*Sesamum indicum* L.). Environment and Ecology 17(2) : 283-287.
- Amaresha M 1997 Genetic studies in early generations of three crosses in sesame (*Sesamum indicum* L.). M.Sc (Ag) Thesis, University of Agricultural Sciences, Bangalore.
- Ashoka V R P, Reddy S M, Ranganath A R G and Dhanraj A 2001 Genetic variability and heritability for seed yield and its components in sesame (*Sesamum indicum* L.). Journal of Oilseeds Research 18(2) : 173-175.
- Babu C and Sivasubramanian V 1993 Studies on genetic divergence and association of characters in three maturity groups of sesame (*Sesamum indicum* L.). Plant Breeding Newsletter 2(2) : 1.
- Babu J S 2000 Studies on genetic variability and character association in a set of white seeded genotypes of sesame (*Sesamum indicum* L.). M.Sc(Ag) Thesis, Acharya N G Ranga Agricultural University, Hyderabad.

Backiyarani S, Subramanian M and Shanthi S 1997a Selection response as assessed through inter-generation correlation and regression in sesame. Madras Agricultural Journal 84(11-12) : 662-664.

Backiyarani S, Subramanian M and Shanthi S 1997b Variability studies in segregating populations of sesame (*Sesamum indicum* L.) crosses. Annals of Agricultural Research 18(4) : 556-558.

Backiyarani S, Subramanian M Shanthi S 1999 Character association and path coefficient analysis in segregating generations of sesame (*Sesamum indicum* L.). Crop Research, Hisar 18(2) : 251-255.

*Bakheit B R and Mahdy E E 1988 Genetic variability and correlations in a world collection of sesame. Assvit. Journal of Agricultural Sciences 19(3) : 228-240.

Baruah D P and Goud J V 1993 Variability studies in hybrid and segregating populations of sesame. Madras Agricultural Journal 80(4) : 210-214.

*Bhele O S, Khargade P W and Narkhede M N 1987 Estimation of genetic parameters, correlation coefficients and path analysis in sesamum (*Sesamum indicum* L.). Punjabrao Krishi Vidyapeeth Journal of Research 11 : 118-122.

*Biswas K P and Akbar M S 1995 Genetic variability, correlation and path co-efficient analysis in sesamum (*Sesamum indicum* L.). Bangladesh Journal of Agricultural Science 51 : 627-630.

*Burton G W 1952 Quantitative inheritance in grasses. Proceedings of the Sixth International Congress pp. 272-283.

Burton G W and Dewane E H 1953 Estimating heritability in tall fescue (*Festuca arundanaceae*) from replicated clonal material. Agronomy Journal 45 : 478-481.

Chandramony A and Nayar N K 1994 Genetic basis of yield attributes in sesame. Indian Journal of Agricultural Research 28 : 214-218.

Chandrasekhara B and Reddy C R 1993 Correlation and path coefficient analysis in sesame (*Sesamum indicum* L.). Annals of Agricultural Research 14(2) : 198-202.

Chauhan D V S and Gurjar B S 1998 Correlation study in sesamum (*Sesamum indicum* L.). Advances in Plant Sciences 11(2) : 303-304.

Deepasankar P and Anandakumar C R 2003 Character association and path coefficient analysis in sesame (*Sesamum indicum* L.). Agricultural Science Digest 23(1) : 17-19.

Dewey D R and Lu K H 1959 A correlation and path-coefficient analysis of components of crested wheatgrass seed production. *Agronomy Journal* 51(9) : 515-518.

Falconer D S 1964 An introduction to quantitative genetics. Second Edition. Oliver and Boyd Ltd., Edinburgh pp. 312-324.

Falconer D S 1989 Introduction to quantitative genetics. Longman Scientific and Technical, Edinburgh pp. 252.

Fendel A J E and Penso E J M 1994 Heritability estimates of six characteristics and their phenotypic correlation from a factorial design in sesamum (*Sesamum indicum* L.). *Agronomia Tropical Maracay* 44(3) : 529-540.

Fisher R A and Yates F 1963 Statistical tables for biological, agricultural and medical research. Oliver and Boyd, London pp. 44-63.

Govindarasu R and Ramamoorthi N 1998 Character association in irradiated and non-irradiated segregating populations of sesamum. *Crop Improvement* 25(1) : 83-87.

Govindarasu R, Rathinam M and Sivasubramanian P 1990 Genetic variability in sesame (*Sesamum indicum* L.). *Madras Agricultural Journal* 78(1-3) : 450-452.

Gupta B S and Chopra D P 1984 Genetic variability correlations and path coefficient analysis in sesamum. Indian Journal of Agricultural Sciences 54 : 1030-1033.

Hanson C H, Robinson H F and Comstock R E 1956 Biometrical studies of yield in segregating populations of korean lespedeza. Agronomy Journal 48 : 268-272.

Janardhanam V, Ratnakar B, Reddi N S, Satyanarayana G and Subramanyam D 1981 Genotypic, phenotypic, environmental variability, heritability estimates and genetic advance in sesame. The Andhra Agricultural Journal 28 : 105-108.

Janardhanam V, Ratnakar B, Reddi N S, Satyanarayana G and Subramanyam D 1982 Interrelationship and path analysis in sesame (*Sesamum indicum* L.). The Andhra Agricultural Journal 29 : 42-45.

Jayalakshmi V, Reddy C R and Reddy K H 1998 Variability studies in segregating populations of sesamum. Annals of Agricultural Research 19(3) : 237-240.

John S, Nair V G and John S 1993 Genetic variability, heritability and genetic advance in sesame. Journal of Tropical Agriculture 31(2) : 143-146.

Johnson H W, Robinson H F and Comstock R E 1955 Estimates of genetic and environmental variability in soybeans. Agronomy Journal 47 : 314-318.

Kamala T 1999 Gene action for seed yield and yield components in sesame (*Sesamum indicum* L.). Indian Journal of Agricultural Sciences 69(11) : 773-774.

Kandaswamy M 1985 Genetic variation and genotypic environment interaction in sesame (*Sesamum indicum* L.). Madras Agricultural Journal 72(3) : 156-161.

Kandaswamy M, Sundaram M K, Sridharan C S and Rangaswamy S R S 1990 Genetic variability in sesamum. Madras Agricultural Journal 77(9-12) : 395-398.

Kaushal P K, Shrivastava S R and Goswami G 1977 Correlation and path analysis of yield components in branched type of sesame. Jawaharlal Nehru Krishi Vidyalaya Research Journal 11 : 44-47.

Kavitha M and Sethupathiramalingam R 1999 Path analysis in segregating population of sesame. Madras Agricultural Journal 86(1-3) : 158-159.

Knott D R and Kumar J 1975 Comparison of early generation yield testing and single seed descent procedure in wheat breeding. Crop Science 15 : 295-299.

Krishnadoss D 1984 Studies on combining ability and heterosis in sesame (*Sesamum indicum* L.). M.Sc(Ag) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Kumar P S, Sundararajan R, Thangavel P, Karuppiah P and Ganeshan J 2002 Variability studies in the second generation of intervarietal crosses in sesame (*Sesamum indicum* L.). Sesame and Safflower Newsletter 17 : 36-39.

Kumaresan D and Nadarajan N 2002 Association of yield with some biometrical and physiological characters over different environments in sesame (*Sesamum indicum* L.). Sesamum and Safflower Newsletter 17 : 13-16.

*Li M Y 1988 A genetic analysis of the main characters in sesame (*Sesamum indicum* L.). Oil Crops of China 4 : 33-36.

Lush J L 1940 Intra-sire correlation and regression of off-spring on dams as a method of estimating heritability of characters. Proceedings of American Society of Animal Production 33 : 293-301.

*Lush J L 1949 Heritability of quantitative characters in farm animals. Proc. Eighth Congr. Genet. Hereditas 35 : 356-375.

Manivannan N 1998 Correlation and path analysis in back crosses in sesame. Madras Agricultural Journal 85(5-6) : 295-296.

Mather K 1949 Biometrical Genetics. Dover Publications, Inc. New York pp. 339.

- Miller P A, Williams J C, Robinson H F and Comstock R E 1958 Estimates of genotypic and environmental variances and covariances in upland cotton and their implications in selection. *Agronomy Journal* 50 : 126-131.
- Mishra A K and Yadav L N 1996 Combining ability and heterosis in sesame. *Journal of Oilseeds Research* 13(1) : 88-92
- Mishra A K, Yadav L N and Tiwari R L 1995 Association analysis for yield and its components in sesame (*Sesamum indicum* L.). *Agricultural Science Digest* 15(1) : 42.
- Navadiya L J, Godhani P R and Fougat R S 1995 Heterosis studies in sesamum (*Sesamum indicum* L.). *Gujarat Agricultural University Research Journal* 20 : 73-77.
- Oil World Monthly 2004 ISTA Mielke Gmbh. Germany 47(13) : 154-171.
- Padmavathi N and Thangavelu S 1996 Association of yield components in sesamum. *Sesame and Safflower Newsletter* 11 : 40-45.
- Panse V G and Sukhatme P V 1961 Statistical methods for agricultural workers. Indian Council of Agricultural Research, New Delhi pp. 381.
- Parameswari C and Muralidharan V 1999 Estimates of genetic variability in intermated progenies of sesame. *Journal of Oilseeds Research* 16(2) : 320-322.

- Pathak H C and Dixit S K 1986 Genetic variability, correlations and path coefficient analysis for components of seed yield in single stemmed sesame (*Sesamum indicum* L.). Gujarat Agricultural University Research journal 12(1) : 1-5.
- Pathak H C and Dixit S K 1992 Genetic variability and inter relationship studies in black seeded sesamum (*Sesamum indicum* L.). Madras Agricultural Journal 79(1) : 94-100.
- Patil R R and Sheriff R A 1996 Genetic variability, heritability and genetic advance studies in sesame. Current Research 25 : 23-27.
- Pawar K N, Chetti M B and Shamarao J 2002 Association between seed yield and yield attributing characters in sesamum (*Sesamum indicum* L.). Agricultural Science Digest 22(1) : 18-20.
- Prasad R 2002 Textbook of field crops production. Indian Council of Agricultural Research, New Delhi pp. 821.
- Rai C, Sah J N, Varshney S K, Mandal S S and Kumar P 1997 Character association and path analysis in sesame under irrigated ecosystems. Journal of Oilseeds Research 14 : 27-30.
- Ramakrishnan M and Soundarapandian G 1990 Association studies in sesame. Madras Agricultural Journal 77(9-12) : 580-581.

Ramireddy K A and Sundaram T 2002 Interrelationship among yield and yield components in sesame (*Sesamum indicum* L.). Journal of Research Acharya N G Ranga Agricultural University 30(2) : 42-44.

Ranganatha A R G , Srinivas T, Virupakshappa K, Mahishi D M and Shivashankar G 1994 Influence of segregating generations on character association in sesame. Indian Journal of Genetics 54(2) : 192-196.

Ratnababu D 2003 Line x Tester analysis in sesame (*Sesamum indicum* L.). M.Sc(Ag) Thesis, Acharya N G Ranga Agricultural University, Hyderabad.

Raut S K, Khorgade P W, Bolke M N and Ingle R W 1991 Studies on genetic variability in sesamum. Agricultural Science Digest 11(2) : 75-76.

Reddy C D R and Haripriya S 1991 Character association and path coefficient analysis in parental lines and their F₁ hybrids of sesame. Journal of Oilseeds Research 8 : 98-104.

Reddy M B, Reddy M V, Rana B S and Balakrishna R M 1984 Character association and path coefficient analysis in parents and F₁ hybrids of sesame (*Sesamum indicum* L.). Madras Agricultural Journal 71(3) : 147-151.

Reddy O U K and Dorairaj M S 1995 Heritability and correlation studies of various components of drymatter production in sesamum (*Sesamum indicum* L.). Madras Agricultural Journal 82(1) : 11-13.

Reddy P N 1984 Correlation and regression studies in sesame. The Andhra Agricultural Journal 31 : 230-233.

Robinson H F, Comstock R E and Harvey P H 1951 Genotypic and phenotypic correlations in corn and their implications in selections. Agronomy Journal 43 : 282-287.

*Rong X X and Wu W 1989 Correlation and path analysis of seed yield and some important agronomic characters in sesame (*Sesamum indicum* L.). Oil Crops of China 4 : 30-32.

Saravanan K, Manivannan N, Anbuselvan Y and Ganesan J 2000 Variability, heritability and genetic advance in sesame (*Sesamum indicum* L.). Madras Agricultural Journal 87(1-3) : 163 – 164.

Shadakshari Y G 1984 Genetic variability and path analysis in the germplasm collection of sesame (*Sesamum indicum* L.). M.Sc(Ag) Thesis, University of Agricultural Sciences, Bangalore.

Shadakshari Y G, Virupakshappa K and Shivashankar G 1992 Genetic variability and character association in sesamum. Mysore Journal of Agricultural Sciences 26 : 121-124.

- Shadakshari Y G, Virupakshappa K and Shivashankar G 1995 Genetic variability studies in the germplasm collections of sesamum (*Sesamum indicum* L.). Mysore Journal of Agricultural Sciences 29 : 133-137.
- Sharma H K and Asaw B N 1977 Path coefficient analysis and selection indices for segregating population of arhar. Mysore Journal of Agricultural Sciences 11 : 317-321.
- Shinde Y M, Badhe P C, Patel D M and Deokar A B 1991 Genetic evaluation of some lines in sesamum. Journal of Maharashtra Agricultural University 16 : 22-24.
- Shukla G P 1983 Path coefficient analysis in sesamum . Indian Journal of Agricultural Sciences 53 : 407-408.
- Shukla G P and Verma G 1976 Correlation and heritability in sesamum. Indian Journal of Agricultural Sciences 46 : 283-285.
- Siddiqui M A, Baig K S and Baig F M 1998 Character association and path co-efficient analysis in sesamum. Journal of Maharashtra Agricultural University 23(2) : 169-170.
- Singh P and Narayanan S S 2000 Biometrical techniques in plant breeding. Kalyani Publishers, Ludhiana pp. 249.
- Singh P K, Dixit R K and Yadava R K 1997 Estimates of genetic parameters, character association and path analysis in sesamum. Crop Research, Hisar 13(1) : 115-119.

Singh R K and Chaudhary B D 1999 Biometrical methods in quantitative genetic analysis. Kalyani Publishers, Ludhiana pp. 318.

*Singh R K and Kakar S N 1977 Control on individual trait means during index selection. Proceedings of Third Congress. SABRAO (Canberra) 3(d) : 22-25.

Sivasubramanian S and Menon P M 1973 Genotypic and phenotypic variability in rice. Madras Agricultural Journal 60 : 1093–1096.

Snedecor G W and Cochran W G 1994 Statistical methods. Eighth Edition, Iowa State University Press, Ames pp. 503.

Solanki T S and Deepak G 2000 Correlation and path analysis for oil yield in sesamum (*Sesamum indicum* L.). Journal of Oilseeds Research 17(1) : 51- 54.

Srinivas T, Ranganatha A R G and Suneetha Y 2000 Pattern of variability in bulk and single capsule descent breeding methods of sesame (*Sesamum indicum* L.). The Andhra Agricultural Journal 47(1-2) : 32-38.

Stansfield W D 1969 Theory and practices of genetics. Mc Graw Hill, New York pp. 461.

Subbalakshmi B 1996 Path analysis in sesamum. Madras Agricultural Journal 83 : 668-669.

- Subramanian S and Subramanian M 1994 Correlation studies and path coefficient analysis in sesamum (*Sesamum indicum* L.). Journal of Agronomy and Crop Science 173 : 241-248.
- Sudharani M, Reddy G L K, Reddy C R and Reddy K S 1996 Path coefficient analysis in biparental progenies and F₃ bulk population in sesame. Journal of Research Acharya N G Ranga Agricultural University 24(3) : 9-12.
- Tak G M 1997 Correlation and path coefficients in sesame. Agricultural Science Digest, Karnal 17(3) : 153-154.
- Thangavelu M S and Rajesekharan S 1983 Correlation and path-coefficient analysis in sesamum (*Sesamum indicum* L.). Madras Agricultural Journal 70(2) : 109-113.
- Thiyagarajan K and Ramanathan T 1996 Character association and path coefficient analysis of components of seed yield in sesame. Madras Agricultural Journal 83 : 683-687.
- Tomar H S, Srivastava G K, Twari O P and Tripathi R S 1999 Correlation and path coefficient analysis of various components on seed yield of summer sesame. Journal of Oilseeds Research 16(1) : 137-138.
- Trehan K B , Chand H , Metha S K , Baijal S K and Dhawan S 1975 Correlation and path coefficient analysis in sesame. Madras Agricultural Journal 62 : 7-10.

Vadhavani H K, Kukadia M V and Parmar V L 1992 Correlation and path analysis in sesame. Gujarat Agricultural University Research Journal 18 : 31-34.

Vanisri S, Raghunatham G, Ranganatha A R G and Sharma P S 1994 Studies on character association and path analysis on sesame (*Sesamum indicum* L.). Journal of Research. Andhra Pradesh Agricultural University 22 : 92-96.

Veena K N 1998 Character association and their interrelations among yield and its attributes in gingelly. M.Sc(Ag) Thesis, Acharya N G Ranga Agricultural University, Hyderabad.

Weiss E A 1983 Oilseed Crops. Longman, New York pp. 660.

Wright S 1921 Correlation and causation. Journal of Agricultural Research 20 : 557 –585.

Yingzhong Z and Yishou W 2002 Genotypic correlations and path coefficient analysis in sesame. Sesame and Safflower Newsletter 17 : 10-12.

* Original not seen

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