

GENETIC ANALYSIS OF F₂ PROGENIES DERIVED FROM 8 x 8 DIALLEL CROSS OF SESAME (*Sesamum indicum* L.)

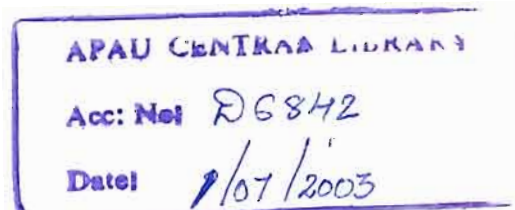
By
YERASI BHARATHI

B.sc. (Ag.)

**THESIS SUBMITTED TO THE
ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY
IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE OF
MASTER OF SCIENCE
IN THE FACULTY OF AGRICULTURE**

ANGRAU Central Library
Hyderabad

D6842



**DEPARTMENT OF GENETICS AND PLANT BREEDING
SRI VENKATESWARA AGRICULTURAL COLLEGE
ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY
TIRUPATI - 517 502**

JULY, 2002

CERTIFICATE

This is to certify that the thesis entitled "**GENETIC ANALYSIS OF F₂ PROGENIES DERIVED FROM 8 x 8 DIALLEL CROSS OF SESAME (*Sesamum indicum* L.)**" submitted in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE IN AGRICULTURE** of the **Acharya N.G.Ranga Agricultural University, Hyderabad** is a record of the bonafide research work carried out by **Miss. Y. BHARATHI** under our guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee.

No part of the thesis has been submitted for any other degree or diploma. The published part has been fully acknowledged. All assistance and help received during the course of investigations have been duly acknowledged by the author of the thesis.



(Dr. K. HARIPRASAD REDDY)
Chairman of the Advisory Committee

Thesis approved by the Student's Advisory Committee

Chairman : **Dr. K. HARIPRASAD REDDY**
Associate Professor
Department of Genetics and Plant Breeding
S.V.Agricultural College
Tirupati - 517 502



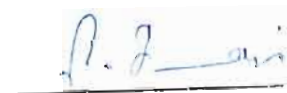
Member : **(Dr. G. LAKSHMI KANTHA REDDY)**
Professor & Head
Department of Genetics and Plant Breeding
S.V.Agricultural College
Tirupati - 517 502



Member : **(Dr. N.P. ESWARA REDDY)**
Associate Professor
Department of Plant Pathology
S.V.Agricultural College
Tirupati - 517 502



Member : **(Dr. ESMAIL)**
Associate Professor & Head
Department of Statistics & Mathematics
S.V.Agricultural College
Tirupati - 517 502



CERTIFICATE

Miss. Y. BHARATHI has satisfactorily prosecuted the course of research and that the thesis entitled "GENETIC ANALYSIS OF F₂ PROGENIES DERIVED FROM 8 x 8 DIALLEL CROSS OF SESAME (*Sesamum indicum* L.)" submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that the thesis or part there of has not been previously submitted by her for a degree of any University.

Major Advisor

Date : 17.9.02

Place : Tirupati



(Dr. K. HARIPRASAD REDDY)

LIST OF CONTENTS

Chapter No.	TITLE	Folio No.
I.	INTRODUCTION	1-4
II.	REVIEW OF LITERATURE	5-25
III.	MATERIAL AND METHODS	26-50
IV.	RESULTS	51-131
V.	DISCUSSION	132-168
VI.	SUMMARY	169-172
	LITERATURE CITED	173-185

LIST OF TABLES

Table No.	TITLE	Page No.
1.	Salient features of eight parental lines used in diallel of sesame	27
2	Analysis of variance of F_2 generation for fourteen characters in sesame	52
3	Mean performance of parents and F_2 progenies for fourteen characters in sesame	54-55
4	Mean, coefficient of variation, heritability (broad sense), genetic advance and genetic advance as percent of mean for fourteen characters in 8 parents of sesame	62
5	Mean, coefficient of variation, heritability (broad sense), genetic advance and genetic advance as per cent of mean for fourteen characters in 28 F_2 progenies of sesame	65
6	Analysis of variance for combining ability in a 8 x 8 diallel of sesame	69
7	General combining ability effects of 8 parents for fourteen characters of sesame	70
8	Specific combining ability effects of 28 F_2 crosses for fourteen characters in a 8 x 8 diallel of sesame	76-77
9	Segregation pattern in F_2 generation of sesame for number of capsules per plant	85-86
10	Segregation pattern in F_2 generation of sesame for seed yield per plant	101-102
11	Per cent of plants above the mean value of F_2 generation in individual crosses for number of capsules per plant and seed yield per plant	116
12	Segregation pattern in F_2 generation of sesame for total number of branches per plant in three crosses	118
13	Segregation pattern in F_2 generation of sesame for number of capsules per plant in three crosses	118

Table No.	TITLE	Page No.
14	Segregation pattern in F ₂ generation of sesame for 1000-seed weight in three crosses	122
15	Segregation pattern in F ₂ generation of sesame for seed yield per plant in three crosses	122
16	Percentage of total transgressive segregant (TTS) and significantly transgressive segregants (STS) in the F ₂ generation	127
17	List of to best parents, best F ₂ progenies (based on <i>per se</i> performance), best general combiners and best specific combiners identified for fourteen characters in a 8 x 8 diallel of sesame	163

LIST OF ILLUSTRATIONS

Fig. No.	TITLE	Page No.
1.	Segregation pattern in F ₂ generation of sesame for number of capsules per plant (%)	93-99
2.	Segregation pattern in F ₂ generation of sesame for seed yield per plant (%)	109-115
3.	Segregation pattern in F ₂ generation of sesame for total number of branches per plant in three crosses (%)	119
4.	Segregation pattern in F ₂ generation of sesame for number of capsules per plant (%)	121
5.	Segregation pattern in F ₂ generation of sesame for 1000-seed weight in three crosses (%)	124
6.	Segregation pattern in F ₂ generation of sesame for seed yield per plant in three crosses (%)	125
7.	Esterase zymogram of eight parents in sesame	130
8.	Mean performance of parents and F ₂ progenies for number of capsules per plant	140
9.	Mean performance of parents and F ₂ progenies for seed yield per plant	141

Acknowledgements

Gratitude one feels deep heart cannot be exactly expressed in words. Here, I found my self crippled in expressing my deep sense of indebtedness to one and all. It is by the grace and blessing of Lord Srivenkateswara that I have been able to complete successfully and present this humble piece of work for which I am eternally indebted.

I consider it my good for tune to express my profound gratitude and love to my beloved parents Y. Kesava Reddy and Y.Lakshmi devi, my only lovable brother Y. Venkatasubba Reddy for their heartfelt cooperation in every walk of my life and for their continuous encouragement and affection through out my academic career.

It gives me immense pleasure in expressing sincere gratitude to my esteemed teachers and all the distinguished people who have helped me in planning and presentation of this investigation.

First and foremost, I am pleased to humbly place my profound sense of gratitude, indebtedness and heartfelt thanks to my major advisor and chairman of my advisory committee Dr. K.Hariprasad Reddy, Associate Professor, Department of Genetics and Plant Breeding, S.V. Agricultural College, Tirupati for his meticulous guidance, constructive criticism, constant encouragement and ready help which enabled me over come several stumbling blocks during this period of investigation.

Ineffable is my gratitude to Dr.G. Lakshmikantha Reddy, Professor and Head, Department of Genetics and Plant Breeding, S.V. Agricultural College, Tirupati and member of Advisory committee for his valuable suggestions and keen interest taken in shaping the thesis.

*I place on record my sincere thanks to member of advisory committee **Dr.N.P.Eswara Reddy, Associate Professor, Department of Plant Pathology** for sparing his precious time to improve the thesis.*

*I am equally thankful to member of my advisory committee **Dr. Ismail, Department of Statistics and Mathematics, Associate Professor** for his help at various stages of data analysis for my research work.*

*I owe my respective regards to **Dr.K.Raja Reddy, Professor, Genetics and Plant Breeding**, for his constant motivation and co-operation throughout my postgraduate study.*

*I have infinite pleasure in expressing my heartfelt thanks to **Dr.M.Reddy Sekhar, Assistant Professor, Mr. M.Hemanth Kumar, Assistant Professor, Mr.K.Murali Krishna, Assistant Professor, Mrs. Shantipriya, Assistant Professor, Department of Genetics and Plant Breeding** for their ready help and carrer guidance for my further study.*

I acknowledge the help of non-teaching staff of the Department of Genetics and Plant Breeding during this investigation.

*I affectionately acknowledge the constant encouragement and whole hearted co-operation received from my seniors **Sobhan Babu, Sukumar, Venkateswarulu, Nagarjuna Sagar, Elongovan, Krishnaiah, Jayaprada, Srividhya, Nagaprasad, My colleagues Kathiresan, Vijayasekhar, Madhavalatha, my Junior Trivikrama Reddy, Sivasankar, Sreelakshmi, Radha.***

I am in dearth of words to express my deep feeling to my dear most amiable friends Sreekavitha, Neelima, Paramapavani, Usha, M.Kavitha, Praveena, Hemalatha, Indumathi, Parameswari, Rajyalakshmi, Vijayalakshmi, Sreedevi, Saritha, Swarna, Asha, Sreevani for their unparallel affection untiring help, which will go a long way throughout my life. An encompassing debt is owed to my beloved companions Rajylakshmi, Jyothsna, Padmalatha, Anitha, Jyothi, Sreedevi, Parvathi, Geetha, Madavilatha, Ashalatha, Mallika, Chaitanya, Umamaheswari, Aparna, Yamini, Uma, Sreevani, Venkataramanamma, Usharani, Suneetha, Haritha, Geetha.

I have infinite pleasure to express my whole hearted thanks to my friends Sreenu, Niyaz, Thangaswamy, Lakshminarayana for their endearment and sustained co-operation during my research work.

I acknowledge the professional excellence and pains taking attitude of Mr. J. Hemanth Reddy, Smart Centre, Tirupati in compiling and printing this manuscript.

I am thankful to the authorities of ANGRAU for providing financial assistance in the form of stipend and infrastructural facilities for smooth executions of research during my PG Studies.

Finally, I record my deep sincere thanks to all those who helped me directly and indirectly to bring out his work in the present form.

Place : Tirupathi

Date : 15/09/2002

Y. Bharathi
Y. BHARATHI ...

DECLARATION

I, Miss. Y. Bharathi, hereby declare that the thesis entitled "GENETIC ANALYSIS OF F_2 PROGENIES DERIVED FROM 8 x 8 DIALLEL CROSS OF SESAME (*Sesamum indicum* L.)" submitted to Acharya N.G. Ranga Agricultural University for the degree of **Master of Science in Agriculture** is the result of original work done by me. I also declare that the materials contained in this thesis has not been published earlier.

Date : 15/09/2002

Y. Bharathi
(Y. BHARATHI)

ABSTRACT

Author	:	Y. Bharathi
Title of the thesis	:	Genetic analysis of F₂ progenies derived from 8 x 8 diallel cross of sesame (<i>Sesamum indicum</i> L.)
Submitted for the award of degree	:	Master of Science
Faculty	:	Agriculture
Department	:	Genetics and Plant Breeding
Major Advisor	:	Dr.K.Hariprasad Reddy
University	:	Acharya N G Ranga Agricultural University
Year of Submission	:	2002

ABSTRACT

The present investigation was undertaken with the objective of identifying the superior parents and F₂ cross combinations and to conceptualize breeding strategy for yield improvement in sesame. The study was conducted by involving 8 parents and their 28 F₂ cross combinations, grown in a randomized block design with three replications at wet land farm of Sri Venkateswara Agricultural College, Tirupati during *Rabi* 2001 and the observations were recorded on seed yield and its fourteen component characters.

Analysis of variance revealed existence of significant genotypic differences for all the characters studied except for capsule length. Mean

performance of parental lines indicated that the genotype viz., Co-1, CIANNO, VRI-1 and DT 9-10-2-25 appeared to be promising donors for seed yield per plant and their component traits. High heritability and high genetic advance as per cent of mean was observed for seed yield per plant, plant height, number of capsules on primary branches, number of capsules per plant and number of secondary branches indicating the additive gene action and simple selection would be effective for improvement of these characters.

In combining ability analysis the variance due to GCA/SCA ratio revealed the presence of non-additive gene actions for all the characters except for plant height and number of capsules on main stem where additive gene action prevails. The study of direction and magnitude of GCA effects in parental lines revealed good GCA effects of the lines Co-1, ACV 2 and DT 9-10-2-25 for seed yield and their component traits. When *per se* and SCA effects were considered over all the characters including seed yield viz., Co-1 x AVT 26, Co-1 x DT 9-10-2-25 and Co-1 x TMV 6 were identified as best hybrids.

Isozyme analysis for esterase isoenzyme showed polymorphism for six alleles and Em values ranged from 0.375-0.79, which shows the genetic diversity among the genotypes.

ABBREVIATIONS & ACRONYMS

%	:	Per cent
CD	:	Critical Difference
Cm	:	Centimeter
Cv	:	Coefficient of variation
<i>et al</i>	:	and others,
Em	:	Electrophoretic mobility
Fig	:	Figure
g	:	gram
GA	:	Genetic Advance
GCA	:	General Combining Ability
GCV	:	Genotypic Coefficient of Variation
h^2 (b)	:	heritability in broad sense
ha	:	hectare
i.e.,	:	Which is to say in other words
Kg	:	Kilogram
Kg ha ⁻¹	:	Kilogram per hectare
m	:	Metre
m ha	:	million hectares
mt	:	million tonnes
MSL	:	Mean Sea Level
PCV	:	Phenotypic coefficient of variation
rpm	:	revolutions per minute
SCA	:	Specific combining ability
SEM	:	Standard Error between Means
STS	:	Significantly Transgressive Segregants
TTS	:	Total Transgressive Segregants
Viz.,	:	Namely.

Chapter I

Introduction

CHAPTER-I

INTRODUCTION

Sesame (*Sesamum indicum* L. $2n=26$) the oldest oilseed crop occupies an important place in the oilseed scenario of India after groundnut and rapeseed mustard. Its seed contains 48-55 per cent oil of which 80 per cent is composed of unsaturated fatty acids, consists mainly of oleic and linoleic acids and 20-28 per cent protein. Besides its use as edible oil, it also finds use in pharmacy, perfumery, cosmetics and soap industries. Because of all these desirable attributes there is an immediate need to increase the sesame productivity in India by 3-4 folds to meet the requirements of the domestic needs and the ever increasing demand in the international market.

Out of the total sesame cultivated area of the world (6.392 m ha) India ranks first in area (1.673m ha) but the productivity is very low (332 kg / ha) as compared with world (426 kg / ha) and Ethiopia (1143 kg /ha) average productivity (FAO Bulletin 2000). This may be due to lack of high yielding varieties suitable for cultivation and susceptibility of existing cultivars to pests and diseases.

In Andhra Pradesh its cultivation confines to 0.196 mha (ranking 3rd in area) producing about 0.053 mt (ranking 4th in production) and with an

average productivity of 290 kg/ ha which is far below when compared to world average productivity (Statistical Abstract India 1997).

However, the attempts made to achieve significant break through in improving the sesame productivity have not yielded fruitful results. One of the reasons may be inadequacy of directional selection in exploiting the range of useful genetic variability for seed yield and its component traits.

A knowledge of the gene pool of the cultivated species is a prerequisite for a programme of purposeful and effective crop improvement. The choice of suitable parents is of paramount importance for a planned hybridization programme. Hence, efforts are made to identify the best parents with wide genetic divergence from germplasm pool for characters of economic importance so as to utilize their efficiency in hybridization programme.

The breeding strategy to be adopted for improvement of a crop depends primarily on the nature and magnitude of gene action involved in the expression of quantitative traits of economic importance. Diallel analysis has been used as a popular experimental method to assess the combining ability of the parents and crosses for different characters and making further selections in the segregating populations. In addition, a thorough knowledge on genetic parameters like variability, heritability and genetic advance as per

cent of mean and gene action will provide a systematic breeding strategy to improve yield potential of genotypes. It is important to note that high genotypic coefficient of variability alone cannot be the best criterion for selection. Crop improvement also depends on the extent to which a character is heritable. Hence, one has to take into account the heritability value of a character. Further, success of selection in crop improvement programmes also depends on the choice of initial genetic variation, which may result in high expected genetic gain. Unless the amount of genetic gain is measured as per cent of mean and is substantial, the heritability alone can not depict the possible improvement of a character achievable through selection. Therefore estimates of genetic variability, heritability and genetic advance are of immense value in identifying the superior genotypes.

Moreover, analysis of isozymes forms an essential feature of the biochemical study of plant systems. The occurrence of multiple forms of an enzyme popularly called isozymes has been used as a tool to estimate genetic diversity and trueness to type of parental genotypes (Smith and Smith, 1992). A number of major biological problems such as evaluation of populations, transformation, regulation of gene expression and metabolic regulation in differentiated tissues are understood in the light of isozymes.

Keeping all the above in view, the present study was undertaken with the following objectives:

1. To estimate variability heritability and genetic advance for yield and yield components
2. To identify best parents based on GCA effects
3. To identify specific cross combinations based on SCA effects
4. To study the gene action involving important yield and yield contributing characters.
5. To study the segregation pattern of F_2 progenies in the population.
6. To study genetic variability among parents by isozyme analysis.

Chapter II

Review of Literature

CHAPTER - II

REVIEW OF LITERATURE

An attempt was made to critically review the literature of past research work done in relevance to the objectives of research programme in sesame (*Sesamum indicum* L.) under the following headings.

2.1 GENETIC PARAMETERS

2.2 COMBINING ABILITY AND GENE ACTION

2.3 ISOZYME ANALYSIS

2.1 GENETIC PARAMETERS

In any plant breeding programme the information on genetic parameter like genotypic co-efficient of variation (GCV), phenotypic co-efficient of variation (PCV), heritability and genetic advance has an immense value in identifying the superior genotypes. Presence of variability is the basic requirement for improving any crop. The total variation observed in a population could be partitioned into variance due to genotype and variance due to environment.

The degree of success in any selection programme depends on the magnitude of heritability. Heritability in broad sense may be defined as the ratio of total genotypic variance to phenotypic variance in the population.

Genetic advance is the expected genetic gain or improvement in the next generation by selecting the superior individuals under certain amount of selection pressure. Heritability estimates in conjunction with the estimates of genetic advance were more valid for selection than heritability estimates alone (Johnson *et al.* 1955). It was observed that if the heritability is chiefly due to additive gene action, a greater amount of genetic advance may be expected.

A brief review of studies on variability, heritability and genetic advance as per cent of mean in sesame is presented hereunder.

2.1.1 Variability

SLNo.	Character	Range	Reference
1.	Days to 50% flowering	Low	Shadakshari <i>et al.</i> (1995) Ashokavardhana Reddy (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
		High	Patil and Sheriff (1996) John Joel and Thangavelu (1997) Jayalakshmi <i>et al.</i> (1998)
2.	Days to maturity	Low	Baruah and Goud (1993) Mishra <i>et al.</i> (1995) Shadakshari <i>et al.</i> (1995) Patil and Sheriff (1996) John Joel and Thangavelu (1997) Anil Kumar (1999)
3.	Plant height	Low	Godawat and Gupta (1986) Kandaswami <i>et al.</i> (1990) Mishra <i>et al.</i> (1995)

Sl.No.	Character	Range	Reference
		Moderate	Janardhanam <i>et al.</i> (1981) Govindarasu <i>et al.</i> (1990) Chandrasekhara (1990) Baruah and Goud (1993) John Joel and Thangavelu (1997)
		High	Pathak and Dixit (1992) Ashokavardhana Reddy (1999) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
4.	Number of primary branches	Low	Mishra <i>et al.</i> (1995)
		Moderate	Chandrasekhara (1990) Baruah and Goud (1993) Ashokavardhana Reddy (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
		High	Govindarasu <i>et al.</i> (1990) Umesh Kumar Reddy and Stephen Dorairaju (1990) Pathak and Dixit (1992) John Joel and Thangavelu (1997)
5.	Number of secondary branches	High	Govindarasu <i>et al.</i> (1990) Chandrasekhara (1990) John Joel and Thangavelu (1997) Ashokavardhana Reddy (1999) Anil Kumar (1999)
6.	Capsules on main stem	Moderate	Govindarasu <i>et al.</i> (1990) Umeshkumar Reddy and Stephen Dorairaj (1990)
		High	Janardhanam <i>et al.</i> (1981) Thangavelu and Rajasekharan (1982) Gupta and Chopra (1984) Chandrasekhara (1990) John Joel and Thangavelu (1997) Ashokavardhana Reddy (1999) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)

Sl.No.	Character	Range	Reference
7.	Number of capsules on primary branches	High	Chandrasekhara (1990) Govindarasu <i>et al.</i> (1990) Umesh Kumar Reddy and Stephen Dorairaj (1990) Ashokavardhana Reddy (1999) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
8.	Number of capsules on secondary branches	High	Chandrasekhara (1990) Govindarasu <i>et al.</i> (1990) Anil Kumar (1999)
9.	Number of capsules per plant	Moderate	Baruah and Goud (1993)
		High	Kanaka Durga <i>et al.</i> (1993) Vanisri <i>et al.</i> (1994) John Joel and Thangavelu (1997) Ashokavardhana Reddy <i>et al.</i> (2001)
10.	Capsule length	Low	Govindarasu <i>et al.</i> (1990) Pathak and Dixit (1992) Mishra <i>et al.</i> (1995) Shadakshari <i>et al.</i> (1995) Patil and Sheriff (1996) John Joel and Thangavelu (1997) Solanki and Paliwal (1981) Baruah and Goud (1993)
		Moderate	Ashokavardhana Reddy (1999) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
11.	Number of seeds per capsule	Low	Janardhanam <i>et al.</i> (1981) Pathak and Dixit (1992) Mishra <i>et al.</i> (1995)

Sl.No.	Character	Range	Reference
		Moderate	Chandrasekhara (1990) Govindarasu <i>et al.</i> (1990) Baruah and Goud (1993) Shadakshari <i>et al.</i> (1995) John Joel and Thangavelu (1997) Ashokavardhana Reddy (1997) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
		High	Umesh Kumar Reddy and Stephen Dorairaj (1990) Patil and Sheriff (1996)
12.	1000-seed weight	Low	Solanki and Paliwal (1981) Janardhanam <i>et al.</i> (1981) Ashokavardhana Reddy (1999) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
		Moderate	Umesh Kumar Reddy and Stephen Dorairaj (1990) Baruah and Goud (1993) Patil and Sheriff (1996) John Joel and Thangavelu (1997)
13.	Seed yield per plant	Low	Mishra <i>et al.</i> (1995)
		High	Kandaswami <i>et al.</i> (1990) Baruah and Goud (1993) Shadakshari <i>et al.</i> (1995) Patil and Sheriff (1996) John Joel and Thangavelu (1997) Ashokavardhana Reddy (1999) Anil Kumar (1999)
		Moderate	Ashokavardhana Reddy (1999) Anil Kumar (1999)
14.	Harvest Index	Low	Umesh Kumar Reddy and Stephen Dorairaj (1990)
		Moderate	Ashokavardhana Reddy (1999) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
		High	Chandrasekhara (1990) Patil and Sheriff (1996)

2.1.2 Heritability

Sl.No.	Character	Range	Reference
1.	Days to 50% flowering	Low	Shadakshari <i>et al.</i> (1995)
		High	Patil and Sheriff (1996) John Joel and Thangavelu (1997) Jayalakshmi <i>et al.</i> (1998) Ashokavardhana Reddy (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
2.	Days to maturity	Moderate	Shadakshari <i>et al.</i> (1995)
		High	Chandrasekhara (1990) Govindarasu <i>et al.</i> (1990) Pathak and Dixit (1992) Baruah and Goud (1993) Mishra <i>et al.</i> (1995) Patil and Sheriff (1996) John Joel and Thangavelu (1997) Anil Kumar (1999)
3.	Plant height	Low	Janardhanam <i>et al.</i> (1991) Kandaswami <i>et al.</i> (1990)
		Moderate	Gupta and Chopra (1984) Kandaswamy (1985) Shadakshari <i>et al.</i> (1995) Patil and Sheriff (1996)
		High	Govindarasu <i>et al.</i> (1990) Mishra <i>et al.</i> (1995) John Joel and Thangavelu (1997) Ashokavardhana Reddy (1999) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
4.	Number of primary branches per plant	Low	Kandaswami <i>et al.</i> (1990) Mishra <i>et al.</i> (1995) Patil and Sheriff (1996)

Sl.No.	Character	Range	Reference
		Moderate	Solanki and Paliwal (1981) Chandrasekhara (1990) Baruah and Goud (1993) Pathak and Dixit (1997) Ashokavardhana Reddy (1999) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
		High	Govindarasu <i>et al.</i> (1990) Umesh Kumar Reddy and Stephen Dorairaj (1990) Pathak and Dixit (1992) John Joel and Thangavelu (1997)
5.	Number of secondary branches per plant	High	Govindarasu <i>et al.</i> (1990) Chandrasekhara (1990) John Joel and Thangavelu (1997) Ashokavardhana Reddy (1999) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
6.	Number of capsules on main stem	Low	Kandaswami <i>et al.</i> (1990)
		Moderate	Janardhanam <i>et al.</i> (1981) Gupta and Chopra (1984) Govindarasu <i>et al.</i> (1990) Umesh Kumar Reddy and Stephen Dorairaj (1990)
		High	Janardhanam <i>et al.</i> (1981) Thangavelu and Rajasekharan (1982) Kandaswamy (1985) Chandrasekhara (1990) John Joel and Thangavelu (1997) Ashokavardhana Reddy (1997) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
7.	Number of capsules on primary branches	Low	Kandaswami <i>et al.</i> (1990)

Sl.No.	Character	Range	Reference
		Moderate	Janardhanam <i>et al.</i> (1981)
		High	Chandrasekhara (1990) Govindarasu <i>et al.</i> (1990) Umesh Kumar Reddy and Stephen Dorairaju (1990) Ashokavardhana Reddy (1999) Anil Kumar (1999) Ashokvardhana Reddy <i>et al.</i> (2001)
8.	Number of capsules on secondary branches	High	Chandrasekhara (1990) Govindarasu <i>et al.</i> (1990) Anil Kumar (1999)
9.	Number of capsules per plant	High	Baruah and Goud (1993) Vanisri <i>et al.</i> (1994) John Joel and Thangavelu (1997) Ashokavardhana Reddy <i>et al.</i> (2001)
10.	Capsule length	Low	Govindarasu <i>et al.</i> (1990) Pathak and Dixit (1992) Mishra <i>et al.</i> (1995) Shadakshari <i>et al.</i> (1995) Patil and Sheriff (1996) John Joel and Thangavelu (1997)
		Moderate	Chandrasekhara (1990) Mishra <i>et al.</i> (1995) Shadakshari <i>et al.</i> (1995) Ashokavardhana Reddy (1999)
		High	Govindarasu <i>et al.</i> (1990) Baruah and Goud (1993) Patil and Sheriff (1996) John Joel and Thangavelu (1997) Anil Kumar (1999)
11.	Number of seeds per capsule	Low	Janardhanam <i>et al.</i> (1981) Pathak and Dixit (1992) Mishra <i>et al.</i> (1995)
		Moderate	Baruah and Goud (1993) Shadakshari <i>et al.</i> (1995)

Sl.No.	Character	Range	Reference
		High	Baruah and Goud (1993) Patil and Sheriff (1996) John Joel and Thangavelu (1997) Ashokavardhana Reddy (1999) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
12.	1000-seed weight	Low	Solanki and Paliwal (1981) Janardhanam <i>et al.</i> (1981)
		Moderate	Shadakshari <i>et al.</i> (1995) Patil and Sheriff (1996) John Joel and Thangavelu (1997) Ashokavardhana Reddy (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
		High	Chandrasekhara (1990) Govindarasu <i>et al.</i> (1990) Baruah and Goud (1993) John Joel and Thangavelu (1997) Anil Kumar (1999)
13.	Seed yield per plant	Low	Kandaswamy (1985) Mishra <i>et al.</i> (1995)
		Moderate	Janardhanam <i>et al.</i> (1981) Bhele <i>et al.</i> (1987) Kandaswami <i>et al.</i> (1990) Shadakshari <i>et al.</i> (1995)
		High	Kandaswami <i>et al.</i> (1990) Chandrasekhara (1990) Baruah and Goud (1993) Shadakshari <i>et al.</i> (1995) Patil and Sheriff (1996) John Joel and Thangavelu (1997) Ashokavardhana Reddy (1999) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
14.	Harvest Index	Low	Umesh Kumar Reddy and Stephen Dorairaj (1990)
		High	Chandrasekhara (1990) Patil and Sheriff (1996) Ashokavardhana Reddy (1999) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)

2.1.3 Genetic advance as per cent of mean

Sl.No.	Character	Range	Reference
1.	Days to 50% flowering	Low	Shadakshari <i>et al.</i> (1995) John Joel and Thangavelu (1997) Jayalakshmi <i>et al.</i> (1998) Ashokavardhana Reddy (1999)
		High	Patil and Sheriff (1996)
2.	Days to maturity	Low	Mishra <i>et al.</i> (1995) Shadakshari <i>et al.</i> (1995) John Joel and Thangavelu (1997) Anil Kumar (1999)
		Moderate	Chandrasekhara (1990) Govindarasu <i>et al.</i> (1990) Pathak and Dixit (1992) Baruah and Goud (1993) Patil and Sheriff (1996)
3.	Plant height	Low	Solanki and Paliwal (1981) Kandaswami <i>et al.</i> (1990)
		Moderate	Kandaswamy (1985) Godawat and Gupta (1986) Mishra <i>et al.</i> (1995) Shadakshari <i>et al.</i> (1995) Patil and Sheriff (1996)
4.	Number of primary branches per plant	Low	Kandaswami <i>et al.</i> (1990)
		Moderate	Baruah and Goud (1993) Patil and Sheriff (1996) Ashokavardhana Reddy (1999)
		High	Chandrasekhara (1990) Govindarasu <i>et al.</i> (1990) John Joel and Thangavelu (1997) Jayalakshmi <i>et al.</i> (1998) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)

Sl.No.	Character	Range	Reference
5.	Number of secondary branches per plant	High	Chandrasekhara (1990) Govindarasu <i>et al.</i> (1990) John Joel and Thangavelu (1997) Ashokavardhana Reddy (1999) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
6.	Number of capsules on main stem	Low	Gupta and Chopra (1984) Kandaswami <i>et al.</i> (1990)
		Moderate	Kandaswamy (1985)
		High	Thangavelu and Rajasekharan (1982) Chandrasekhara (1990) Govindarasu <i>et al.</i> (1990) John Joel and Thangavelu (1997) Ashokavardhana Reddy (1999) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
7.	Number of capsules on primary branches	Low	Kandaswami <i>et al.</i> (1990)
		High	Chandrasekhara (1990) Govindarasu <i>et al.</i> (1990) Ashokavardhana Reddy (1999) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
8.	Number of capsules on secondary branches	High	Chandrasekhara (1990) Govindarasu <i>et al.</i> (1990) Anil Kumar (1999)
9.	Number of capsules per plant	Moderate	Baruah and Goud (1993)
		High	Kanaka Durga <i>et al.</i> (1993) Vanisri <i>et al.</i> (1994) John Joel and Thangavelu (1997) Ashokavardhana Reddy <i>et al.</i> (2001)

Sl.No.	Character	Range	Reference
10.	Capsule length	Low	Pathak and Dixit (1992) Mishra <i>et al.</i> (1995)
		Moderate	Chandrasekhara (1990) Govindarasu (1990) Shadakshari <i>et al.</i> (1995) Patil and Sheriff (1996) John Joel and Thangavelu (1997) Ashokavardhana Reddy (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
		High	Solanki and Paliwal (1981) Kandaswamy (1985) Baruah and Goud (1993) Anil Kumar (1999)
11.	Number of seeds per capsule	Low	Bhele <i>et al.</i> (1987) Pathak and Dixit (1992)
		Moderate	Shadakshari <i>et al.</i> (1995) Ashokavardhana Reddy (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
		High	Chandrasekhara (1990) Baruah and Goud (1993) Mishra <i>et al.</i> (1995) Patil and Sheriff (1996) John Joel and Thangavelu (1997) Anil Kumar (1999)
12.	1000-seed weight	Low	Solanki and Paliwal (1981) Shadakshari <i>et al.</i> (1995) Ashokavardhana Reddy (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
		Moderate	Bhele <i>et al.</i> (1987) Anil Kumar (1999)
		High	Thangavelu and Rajasekharan (1982) Chandrasekhara (1990) Govindarasu <i>et al.</i> (1990) Baruah and Goud (1993) Patil and Sheriff (1996) John Joel and Thangavelu (1997)

Sl.No.	Character	Range	Reference
13.	Seed yield per plant	Moderate	Gupta and Chopra (1984) Kandaswamy (1985) Kandaswami <i>et al.</i> (1990)
		High	Chandrasekhara (1990) Govindarasu <i>et al.</i> (1990) Baruah and Goud (1993) Mishra <i>et al.</i> (1995) Shadakshari <i>et al.</i> (1995) Patil and Sheriff (1996) John Joel and Thangavelu (1997) Ashokavardhana Reddy (1999) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)
14.	Harvest Index	High	Chandrasekhara (1990) Patil and Sheriff (1996) Ashoka vardhana Reddy (1999) Anil Kumar (1999) Ashokavardhana Reddy <i>et al.</i> (2001)

2.2 COMBINING ABILITY AND GENE ACTION

Combining ability studies provide useful information for the selection of parents in terms of performance of hybrids and on the nature and magnitude of various types of gene actions involved in the expression of quantitative traits.

Combining ability is the ability of an inbred line to transmit desirable performance to its hybrid progenies. The concept of combining ability was put forward by Sprague and Tatum (1942) using single crosses in maize. They defined general combining ability (*GCA*) as the average performance of a parent in a series of hybrid combinations and is attributable to additive (fixable) gene action, while specific combining ability (*SCA*) refers to the deviation in the performance of crosses in certain combinations (worse or better than) that would be expected on the basis of the average performance of the lines involved in it and is attributed primarily to dominant and epistatic gene effects (non-additive).

Diallel cross technique which involves the crossing of group of lines in all possible combinations is an efficient method for the study of combining ability and the gene actions involved.

Review of literature on gene action for various characters in sesame

Sl. No.	Character	Additive	Non-Additive	Both Additive and Non-Additive
1.	Days to 50% flowering	Fatfeh <i>et al.</i> (1982) Sharma and Chauhan (1985) Anitha (1988) Pathak and Dixit (1988) Balsane <i>et al.</i> (1991) Sajjanar <i>et al.</i> (1995) Thiyagarajan and Ramanathan (1995) Fatfeh <i>et al.</i> (1995) Backiyarani <i>et al.</i> (1997) Mcharo <i>et al.</i> (2000)	Reddy <i>et al.</i> (1982) Goyal and Sudhir Kumar (1991) Shinde <i>et al.</i> (1993) Das and Gupta (1999) Jayalakshmi <i>et al.</i> (2000)	Reddy <i>et al.</i> (1984) Dora and Kamala (1986) Kadu <i>et al.</i> (1992) Das and Gupta (1999) Devasena <i>et al.</i> (2001)
2.	Days to maturity	Fatfeh <i>et al.</i> (1982) Sharma and Chauhan (1985) Krishnadoss <i>et al.</i> (1987) Anitha (1988) Pawar <i>et al.</i> (1990) Shinde <i>et al.</i> (1993) Fatfeh <i>et al.</i> (1995) Kamala (1999) Solanki and Gupta (2001)	Khorgade <i>et al.</i> (1989) Mishra and Yadav (1996) Jayalakshmi <i>et al.</i> (2000) Mishra and Sikarwar (2001)	Dora and Kamala (1986) Khorgade <i>et al.</i> (1988) Dikshit and Swain (2001)
3.	Plant height	Fatfeh <i>et al.</i> (1982) Krishna Doss <i>et al.</i> (1987) Anitha (1988) Khorgade <i>et al.</i> (1989) Dumbre <i>et al.</i> (1990) Pawar <i>et al.</i> (1990) Balsane <i>et al.</i> (1991) Narkhede and Sudhir Kumar (1991b) Shinde <i>et al.</i> (1993) Thiyagarajan and Ramanathan (1995) Backiyarani <i>et al.</i> (1997) Mansouri and Ahmadi (1998) Pathirana (1999) Solanki and Gupta (2001)	Ram (1995) Kamala (1999) Mishra and Sikarwar (2001)	Reddy <i>et al.</i> (1984) Dora and Kamala (1986) Fatfeh <i>et al.</i> (1995) Devasena <i>et al.</i> (2001)

Sl. No.	Character	Additive	Non-Additive	Both Additive and Non-Additive
4.	Number of primary branches	Gupta (1981) Krishnadoss <i>et al.</i> (1987) Khorgade <i>et al.</i> (1989) Dhumbre <i>et al.</i> (1990) Pawar <i>et al.</i> (1990) Backiyarani <i>et al.</i> (1997) Ramesh <i>et al.</i> (1998) Das and Gupta (1999)	Fatteh <i>et al.</i> (1982) Singh <i>et al.</i> (1983) Chaudhari <i>et al.</i> (1984) Khorgade <i>et al.</i> (1989) Narkhede and Sudhir Kumar (1991a) Narkhede and Sudhir Kumar (1992) Thiyagarajan and Ramanathan (1995) Ram (1995) Kamala (1999) Jayalakshmi <i>et al.</i> (2000)	Reddy <i>et al.</i> (1984) Padmavathi (1987) Khorgade <i>et al.</i> (1988) Kadu <i>et al.</i> (1992) Das and Choudhary (1998) Devasena <i>et al.</i> (2001)
5.	Number of secondary branches	Gupta (1981) Krishna doss <i>et al.</i> (1987) Khorgade <i>et al.</i> (1989) Dumbre <i>et al.</i> (1990) Pawar <i>et al.</i> (1990) Ramesh <i>et al.</i> (1998) Das and Gupta (1999)	Fatteh <i>et al.</i> (1982) Choudhari <i>et al.</i> (1984) Khorgade <i>et al.</i> (1989) Narkhede and Sudhir Kumar (1991a) Narkhede and Sudhir Kumar (1991b) Kamala (1999) Jayalakshmi <i>et al.</i> (2000)	Reddy <i>et al.</i> (1984) Padmavathi (1987) Khorgade <i>et al.</i> (1988) Kadu <i>et al.</i> (1992) Das and Choudhary (1998) Devasena <i>et al.</i> (2001)
6.	Number of capsules on main stem	Janardhanam <i>et al.</i> (1981) Krishna doss <i>et al.</i> (1987) Anitha (1988) Khorgade <i>et al.</i> (1989) Balsane <i>et al.</i> (1991) Dharmalingam and Ramanathan (1993) Sajjanar <i>et al.</i> (1995) Backiyarani <i>et al.</i> (1997) Ramesh <i>et al.</i> (1998) Mansouri and Ahmadi (1999) Das and Gupta (1999) Ashokavardhana Reddy <i>et al.</i> (2001)	Ramalingam <i>et al.</i> (1990) Narkhede and Sudhir Kumar (1991a) Narkhede and Sudhir Kumar (1991b) Shinde <i>et al.</i> (1991a) Ram (1995) Ananda Kumar and Sivaswamy (1995) Kamala (1999)	Reddy <i>et al.</i> (1984) Padmavathi (1987) Dora and Kamala (1986) Khorgade <i>et al.</i> (1988) Kadu <i>et al.</i> (1992) Dikshit and Swain (2001) Devasena <i>et al.</i> (2001)

Sl. No.	Character	Additive	Non-Additive	Both Additive and Non-Additive
7.	Number of capsules on primary branches	Janardhanam <i>et al.</i> (1981) Sharma and Chauhan (1985) Anitha (1988) Khorgade <i>et al.</i> (1989) Balsane <i>et al.</i> (1991) Dharmalingam and Ramanatham (1993) Sajjanar <i>et al.</i> (1995) Backiyarani <i>et al.</i> (1997) Mansouri and Ahmadi (1998) Ramesh <i>et al.</i> (1998) Das and Gupta (1999) Ashokavardhana Reddy <i>et al.</i> (2001)	Khorgade <i>et al.</i> (1989) Ramalingam <i>et al.</i> (1990) Narkhede and Sudhir Kumar (1991a) Narkhede and Sudhir Kumar (1991b) Shinde <i>et al.</i> (1991) Kamala (1999) Jayalakshmi <i>et al.</i> (2000)	Reddy <i>et al.</i> (1984) Dora and Kamala (1986) Khorgade <i>et al.</i> (1988) Kadu <i>et al.</i> (1992)
8.	Number of capsules on secondary branches	Janardhanam <i>et al.</i> (1981) Sharma and Chauhan (1985) Anitha (1988) Backiyarani <i>et al.</i> (1997) Mansouri and Ahmadi (1998) Ramesh <i>et al.</i> (1998) Balsane <i>et al.</i> (1999) Das and Gupta (1999)	Khorgade <i>et al.</i> (1989) Ramalingam <i>et al.</i> (1990) Narkhede and Sudhir Kumar (1991a) Narkhede and Kumar (1991b) Shinde <i>et al.</i> (1991) Kamala (1999) Jayalakshmi <i>et al.</i> (2000).	Reddy <i>et al.</i> (1984) Dora and Kamala (1986) Khorgade <i>et al.</i> (1988) Kadu <i>et al.</i> (1992)
9.	Number of capsules per plant	Das and Gupta (1999) Ashokavardhana Reddy <i>et al.</i> (2001)	Kadu <i>et al.</i> (1993) Manivannan and Ganesan (2000) Karuppaiyan <i>et al.</i> (2000) Mcharo <i>et al.</i> (2000) Mishra and Sikarwar (2001) Solanki and Gupta (2001)	Chavan <i>et al.</i> (1981) Dikshit and Swain (2001)
10.	Capsule length	Dumbre <i>et al.</i> (1990) Pawar <i>et al.</i> (1990) Ashokavardhana Reddy <i>et al.</i> (2001)	Chaudhari <i>et al.</i> (1984) Khorgade <i>et al.</i> (1989) Narkhede and Sudhir Kumar (1991a) Narkhede and Sudhir Kumar (1991b) Mcharo <i>et al.</i> (2000)	Fatteh <i>et al.</i> (1995) Dikshit and Swain (2001)

Sl. No.	Character	Additive	Non-Additive	Both Additive and Non-Additive
11.	Number of seeds per capsule	Padmavathi (1987) Anitha (1988) Dumbre <i>et al.</i> (1990) Pawar <i>et al.</i> (1990) Dharmalingam and Ramanathan (1993) Sajjanar <i>et al.</i> (1995) Ramesh <i>et al.</i> (1998)	Janardhanam <i>et al.</i> (1981) Goyal and Sudhir Kumar (1991) Narkhede and Sudhir Kumar (1991a) Narkhede and Sudhir Kumar (1991b) Shinde <i>et al.</i> (1991) Mishra and Yadav (1996) Kamala (1999) Mcharo <i>et al.</i> (2000) Mishra and Sikarwar (2001)	Dora and Kamala (1986) Kadu <i>et al.</i> (1992) Dikshit and Swain (2001)
12.	1000-seed weight	Fatfeh <i>et al.</i> (1982) Sharma and Chauhan (1985) Anitha (1988) Dumbre <i>et al.</i> (1990) Pawar <i>et al.</i> (1990) Balsane <i>et al.</i> (1991) Dharmalingam and Ramanathan (1993) Sajjanar <i>et al.</i> (1995) Mishra and Yadav (1996) Mcharo <i>et al.</i> (2000) Dikshit and Swain (2001)	Janardhanam (1981) Padmavathi (1987) Khorgade <i>et al.</i> (1989) Narkhede and Sudhir Kumar (1991a) Fatfeh <i>et al.</i> (1995) Thiyagarajan and Ramanathan (1995) Mansouri and Ahmadi (1998) Kamala (1999) Solanki and Gupta (2001)	Dora and Kamala (1986) Khorgade <i>et al.</i> (1988) Kadu <i>et al.</i> (1992) Das and Gupta (1999) Saravanan <i>et al.</i> (2000) Devasena <i>et al.</i> (2001)
13.	Seed yield per plant	Gupta (1981) Fatfeh <i>et al.</i> (1982) Krishna doss <i>et al.</i> (1987) Dora and Kamal (1987) Anitha (1988) Khorgade <i>et al.</i> (1989) Dhumbre <i>et al.</i> (1990) Pawar <i>et al.</i> (1990) Balsane <i>et al.</i> (1991) Dharmalingam and Ramanathan (1993) Backiyarani <i>et al.</i> (1997) Backiyarani <i>et al.</i> (1998) Mansour and Ahmadi (1998) Ramesh <i>et al.</i> (1998) Das and Gupta (1999) Ashokavardhana Reddy <i>et al.</i> (2001)	Narkhede and Sudhir Kumar (1991b) Ananda Kumar and SreeRangaswamy (1987) Krishnadoss <i>et al.</i> (1987) Ramalingam <i>et al.</i> (1990) Goyal and Sudhir Kumar (1991) Narkhede and Sudhir Kumar (1991) Shinde <i>et al.</i> (1991) Reddy <i>et al.</i> (1992) Shinde (1993) Ram (1995)	Reddy <i>et al.</i> (1984) Dora and Kamala (1986) Kadu <i>et al.</i> (1992) Manivannan (1997) Mcharo <i>et al.</i> (2000) Dikshit and Swain (2001) Devasena <i>et al.</i> (2001)

Sl. No.	Character	Additive	Non-Additive	Both Additive and Non-Additive
			Thiyagarajan and Ramanathan (1995) Fatteh <i>et al.</i> (1995) Mishra and Yadav 91996) Devaraj (1996) Das and Choudhary (1998) Kamala (1999) Pathirana (1999) Jayalakshmi <i>et al.</i> (2000) Saravanan <i>et al.</i> (2000) Mishra and Sikarwar (2001)	
14.	Harvest Index	Thiyagarajan and Ramanathan 91995) Ashokavardhana Reddy <i>et al.</i> (2001)	Narkhede and Sudhir Kumar (1991a)	Kadu <i>et al.</i> (1992) Dikshit and Swain (2001) Devasena <i>et al.</i> (2001)

2.3 ISOZYMES

Genetics, the study of resemblances between relatives has made a major contribution to improve agriculture. Despite the breeding progress already achieved, additional gains in agricultural productivity are demanded at an ever faster pace. For improvement of crops, a through understanding of molecular genetics of a crop is very much essential. In recent years, the fast emerging field of molecular biology has provided tools suitable for rapid and detailed analysis of different organism.

Parani *et al.* (1997) conducted isozyme analysis in *Sesamum indicum* and *Sesamum alatum* and its hybrids and found that four loci were differing for esterase and five loci for peroxidase enzymes. Polymorphism in esterase and peroxidase enzymes at different electrophoretic mobility values were found to be useful in hybrid identification in sesame.

Diaz and Layrise (2001) conducted isozyme studies in forty sesame accessions and classified, them into three groups. Twenty four isoenzymatic identical materials were included in group 'A' which represented 60% of the collection, the remaining 40% was distributed in two small groups B and C. The rare alleles in the collection was contributed by four accessions. The average distance between A-3, AR-4, Ch-2 and the 37 remaining accessions was more than the average distance, revealed the existence of genetic diversity among the sesame accessions.

The available literature on isozyme variability in sesame is very few, therefore in the present review, the related type of work in groundnut crop has been included.

Grieshammer and Wynne (1990) surveyed 61 US cultivars, one breeding line and 6 exotic lines of groundnut for 25 enzyme systems using horizontal starch gel electrophoresis. For catalase and Malic dehydrogenase (MDH), variation was present but not reproducibly within genotypes.

Laksh and Stalker (1993) evaluated 33 South American groundnut accessions from six countries for isozyme polymorphism for 18 isozymes. They reported polymorphism for same three enzymes as reported by Grieshammer and Wynne i.e., GOT, PHI and IDH. A specific PHI band was observed in all three hybrid lines with early leaf spot resistance. They assayed seed and flower tissue. IDH and MDH were variant in seeds but not in flowers and GOT was more polymorphic in flowers than seeds.

Stalker *et al.* (1994) assayed 113 accessions representing six of seven sections of genus *Arachis* and analyzed for 17 enzyme systems. They found that the variation was limited in cultivated species but diploid species were highly variable and they concluded that isozyme variation has potential use in future crossing and germplasm utilization programmes.

Chapter III

Materials and Methods

CHAPTER - III

MATERIAL AND METHODS

The present study on genetic analysis of certain quantitative characters in an 8 x 8 diallel set of sesame in F_2 generation was conducted during *Rabi* season of 2001 at Sri Venkateswara Agricultural College Farm, Tirupati, Andhra Pradesh which is located at an altitude of 189.2 m above MSL and geographically lies at a latitude of 13°N and a longitude of 79°E in Southern Agroclimatic Zone of Andhra Pradesh.

3.1 MATERIAL

The material consisted of 8 parental genotypes of sesame viz., Co-1, TNAU 20, CIANNO, TMV 6, VRI-1, ACV 2, DT9-10-2-25 and AVT 26 and their 28 F_2 combinations excluding reciprocals. The F_2 seed was made available by the courtesy of Dr. K. Hariprasad Reddy, Associate Professor, Department of Genetics and Plant Breeding, S.V. Agricultural College, Tirupati. The salient features of the parents are furnished in Table 1.

3.2 METHODS

3.2.1 Field trial

The experiment was laid out in a randomised block design with three replications and the eight parents and 28 F_2 crosses (36 entries) were sown on 30th December 2001. The entries were allotted at random to each plot.

Table 1 : Salient features of eight parental lines used in diallel of sesame

Genotype	Characteristic features
Co-1	Erect with branching and short internode, on the main stem, 4 loculed, closely set on the stem, matures in 85-90 days. Intense dark brown seed coat
TNAU 20	Erect with branching, 4 loculed early maturing (70-75 days) brown coloured seeds
CIANNO	Erect, short statured, multilocular, 8 loculed, early maturing (75-80 days), white coloured seeds, multiple capsules at each node
TMV 6	Erect, tall with moderate branching, 4 loculed, high yielder, brown coloured seeds.
VRI-1	Bushy with profuse branching, 4 loculed, high yielder, early maturing variety, brown coloured seeds.
ACV2	Bushy with profuse branching, stigma trifid, seeds shiny, black coloured, tetra loculed
DT9-10-2-25	Determinate, bushy with profuse branching, multiple capsules on tip of secondary branches, Anthers 6, seeds are brown
AVT26	Erect, short statured, 4 loculed, with short internodes on main stem, early maturing (70-75 days), white seeded variety

Each plot consisted of two rows of 4 m length. The entry allotted to the plot was grown in these two rows, each row consisting of 25 plants. A uniform spacing of 40 cm between the rows and 15 cm between plants within a row was provided. Seeds were sown by dibbling 5 seeds per hill and later thinned

out to a single seedling per hill. In parents ten plants and in F_2 s thirty plants were tagged randomly for recording observations.

3.2.2 Details of cross combinations studied in F_2 generation

- | | |
|----------------------------|---------------------------|
| 1. Co-1 x TNAU 20 | 15. CIANNO x VRI-1 |
| 2. Co-1 x CIANNO | 16. CIANNO x ACV 2 |
| 3. Co-1 x TMV 6 | 17. CIANNO x DT 9-10-2-25 |
| 4. Co-1 x VRI-1 | 18. CIANNO x AVT 26 |
| 5. Co-1 x ACV 2 | 19. TMV 6 x VRI-1 |
| 6. Co-1 x DT 9-10-25 | 20. TMV 6 x ACV 2 |
| 7. Co-1 x AVT26 | 21. TMV 6 x DT 9-10-2-25 |
| 8. TNAU 20 x CIANNO | 22. TMV 6 x AVT 26 |
| 9. TNAU 20 x TMV 6 | 23. VRI-1 x ACV 2 |
| 10. TNAU 20 x VRI-1 | 24. VRI-1 x DT 9-10-2-25 |
| 11. TNAU 20 x ACV 2 | 25. VRI-1 x AVT 26 |
| 12. TNAU 20 x DT 9-10-2-25 | 26. ACV 2 x DT 9-10-2-25 |
| 13. TNAU 20 x AVT 26 | 27. ACV 2 x AVT 26 |
| 14. CIANNO x TMV 6 | 28. DT 9-10-2-25 x AVT 26 |

3.2.3 Crop husbandry

Fertilizers which supply 20 kg N, 50 kg P_2O_5 and 40 kg K_2O per hectare were applied to the experimental plots as basal dressing. Weeding and intercultivation were done twice during crop growth period i.e at 20 and 40 days after sowing. Top dressing of 20 Kg N per hectare was done 20 days after sowing. Irrigations were given as and when found necessary. Plant protection measures were undertaken against pest and disease attack.

3.2.4 Data recording

Observations were recorded on 30 sampled plants from each genotype in each replication for fourteen characters. The details of the observations recorded are as described below.

3.2.4.1 Days to 50 per cent flowering

Number of days taken from sowing to the attainment of flowering by 50 per cent of the plants in each plot in each replication, was recorded.

3.2.4.2 Days to maturity

Number of days taken from sowing to the physiological maturity of capsules in each plot in each replication was recorded.

3.2.4.3 Plant height (cm)

The plant height was measured with metre scale from the base of the main stem to the tip of the plant at the time of maturity.

3.2.4.4 Number of primary branches per plant

The branches which arose from main stem of each plant were counted and recorded as number of primary branches per plant.

3.2.4.5 Number of secondary branches per plant

The branches that arose from the primary branches of each plant were counted.

3.2.4.6 Capsules on main stem

Capsules originating directly from the nodes of main stem were counted for each plant.

3.2.4.7 Capsules on primary branches

The capsules on all primary branches of the plant were counted as number of capsules on primary branches.

3.2.4.8 Capsules on secondary branches

The capsules on all secondary branches of the plant were counted as number of capsule on secondary branches.

3.2.4.9 Total number of capsules per plant

Computed as the number of matured capsules obtained both from the main stem as well as branches.

3.2.4.10 Capsule length (cm)

Five capsules were randomly selected from each plant at harvest and the length of capsules from base to tip was measured in centimeters with Vernier calliper. The mean length of the five capsules was recorded as the capsule length.

3.2.4.11 Number of seeds per capsule

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

3.2.4.12 1000-seed weight (g)

The weight of one thousand randomly selected seeds from each plant was recorded in grams with the help of digital electronic balance.

3.2.4.13 Seed yield per plant (g)

The seeds from each sample plant was dried and weighed in grams to obtain seed yield per plant.

3.2.4.14 Harvest Index (%)

Calculated by using the formula

$$= \frac{\text{Economic yield (seed yield)}}{\text{Biological yield}} \times 100$$

3.3. STATISTICAL ANALYSIS

Data obtained for each character was analysed for the following statistical parameters.

1. Analysis of variance
2. Estimation of genetic parameters
3. Estimation of gene action through combining ability and segregation pattern in F_2
4. Isozyme analysis

3.3.1 Analysis of variance

The analysis of variance was done for 36 entries with three replications. The partitioning of degrees of freedom from the different sources of variation was given as

Source of variation	Degrees of freedom	Sum of squares	Mean sum of square	'F' ratio
Replications	(r-1)	M_r	M'_r	M'_r / M'_e
Treatments	t-1	M_t	M'_t	M'_t / M'_e
Error	(r-1) (t-1)	M_e	M'_e	
Total	tr-1			

Where,

r = number of replications

t = number of treatments

The significant differences for treatment effects were tested at 0.05 and 0.01 probability levels.

3.3.2 Estimation of genetic parameters

3.3.2.1 Phenotypic and Genotypic variance

They were estimated according to the method suggested by Lush (1940).

$$\text{Genotypic variance } (\sigma_g^2) = \frac{M'_t - M'_e}{r}$$

$$\begin{aligned} \text{Phenotypic variance } (\sigma_p^2) &= \frac{M'_t - M'_e}{r} + \sigma_e^2 \\ &= \sigma_g^2 + \sigma_e^2 \end{aligned}$$

Where

M'_t = Mean sum of squares due to treatments

M'_e = Mean sum of squares due to error

σ_e^2 = Error variance

(i.e error MSS obtained from ANOVA Table)

r = Number of replications

3.3.2.2 Phenotypic and Genotypic Co-efficient of Variation

The genotypic (GCV) and phenotypic (PCV) Co-efficients of variation were computed according to the formula given by Burton (1952).

$$\text{PCV (\%)} = \frac{\text{Phenotypic standard deviation}}{\text{General mean}} \times 100$$

$$\text{GCV (\%)} = \frac{\text{Genotypic standard deviation}}{\text{General mean}} \times 100$$

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

< 10%	-	Low
10-20%	-	Moderate
>20%	-	High

3.3.2.3 Heritability (Broad sense)

Heritability in broad sense was estimated using the formula given by Hanson (1963).

$$h^2 \text{ (Broad sense)} = \left[\frac{\sigma_g^2}{\sigma_p^2} \right] \times 100$$

Where

σ_g^2 = Genotypic variance

σ_p^2 = Phenotypic variance

As suggested by Stansfield (1969) $h^2(b)$ estimates were categorized as

0-20%	-	low
20-50%	-	Medium
50% and above	-	High

3.3.2.4 Genetic advance

Genetic advance was worked out as per the formula proposed by Lush (1949) and Johnson *et al.* (1955a).

$$GA = K \cdot \sigma_p \cdot H$$

Where

GA = Expected Genetic advance under selection

K = Selection differential at 5 per cent selection intensity which accounts to a constant value 2.06 (Lush, 1949).

σ_p = Phenotypic standard deviation

H = Heritability co-efficient

Expected genetic advance as per cent of mean (GA as per cent of mean) was calculated as follows.

$$GA \text{ as per cent of mean} = (GA / \bar{x}) \times 100$$

Where

GA = Expected genetic advance under selection

$\bar{x}$ = General mean of the character

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

Less than 10%	:	Low
10-20%	:	Moderate
More than 20%	:	High

3.3.2.5 Estimation of combining ability

The combining ability analysis was carried out according to Model I and Method II of Griffings (1956). The fixed effect model (Model I) was considered to be more appropriate in the present investigation, since the study was restricted to the parents and direct crosses only. The mathematical model used is as follows :

$$Y_{ij} = \mu + g_i + g_j + S_{ij} + \frac{1}{bc} \sum_k \sum_l e_{ijkl}$$

$$i, j = 1, 2 \dots n$$

$$k = 1, 2 \dots b$$

$$l = 1, 2 \dots c$$

Where,

Y_{ij} is the mean i^{th} j^{th} genotype over k and l

μ is the population mean common to all parents.

g_i is the general combining ability (GCA) effect of i^{th} parents

g_j is the GCA effect of j^{th} parent

s_{ij} is the interaction i.e., specific combining ability

Effect of the cross between the i^{th} and j^{th} parent e_{ijkl} is the environmental effect associated with the $ijkl^{\text{th}}$ individual observation.

The restrictions $\sum_i g_i = 0$ and $\sum_j (S_{ij} + S_{ji}) = 0$ (for each i) are imposed on the combining ability elements.

For combining ability estimates, the degree of freedom for genotypes was further divided into GCA and SCA as indicated below.

Source	d.f	S.S.	M.S.	Expected M.S model (1)
General combining ability	$n-1$	S_g	M_g	$\sigma_e^2 + \frac{n+2}{n-1} \sum_i g_i^2$
Specific combining ability	$\frac{n(n-1)}{2}$	S_s	M_s	$\sigma_e^2 + \frac{2}{n(n-1)} \sum_i < \sum_j s_{ij}^2$
Error	M	S_e	M_e	σ_e^2

$$\text{S.S. due to GCA } S_g = \frac{1}{n+2} \left[\sum_i (y_i + y_{ii})^2 - 4/n Y^2.. \right]$$

$$\text{S.S. due to SCA } S_s = \sum_{i < j} x_{ij}^2 - \frac{1}{n+2} \sum_i (Y_i + Y_{ij})^2 + \frac{2}{(n+1)(n+2)} Y^2..$$

Keeping in view the expectations of the mean squares, the estimates of components are obtained as under

$$\text{Components due to GCA} = \frac{1}{n-1} \sum_i g_i^2 = \frac{(M_g - M'e)}{n+2}$$

Components
due to SCA =
$$\frac{2}{n(n+1)} \sum_{i < j} S_{ij}^2 = M_s - M'e$$

Now, the ratio of GCA variance to sca variance will be

$$\frac{1}{n-1} \sum_i g_i^2 / \frac{2}{n(n-1)} \sum_{i < j} s_{ij}^2$$

Effects

Variance

$$\mu = \frac{2}{n(n+1)} Y_{..} \quad \hat{\mu} = \frac{2}{n(n+1)} \sigma_e^2$$

Where,

n = Number of parents entering the diallel cross

Y_i = Female array total of the common parent

Y_j = Male array total of the common parent

$Y_{..}$ = Overall total of the diallel table

The error mean square $M'e = \sigma_e^2 / bc$

Where,

σ_e^2 = is the sampling error from the analysis of variance of the randomized block

bc = is the total number of observations for each treatment over all the blocks

Tests of significance were made using $M'e$ as the error estimate.

3.3.2.6 Estimation of general and specific combining ability

General combining ability effects of the parents (g_i) and the specific combining ability (S_{ij}) effects of the crosses were calculated as per the formulae.

$$\hat{\mu} = \frac{2}{n(n+1)} Y_{..}$$

$$g_i = \frac{1}{(n+2)} \left(Y_{i.} + Y_{.i} - \frac{2}{n} Y_{..} \right)$$

With the restriction $\Sigma g_i = 0$

$$\hat{S}_{ij} = Y_{ij} - \frac{Y_{i.} + Y_{.i} + Y_{..}}{n+2} + \frac{2}{n(n+2)} Y_{..}$$

With the restriction $\Sigma (S_{ij} + S_{ji}) = 0$ (for each i)

The variance of estimates and those of differences between effects were estimated as follows :

$$\text{Var}(\hat{\mu}) = \frac{2}{n(n+1)} \sigma_e^2$$

$$\text{Var}(\hat{g}_i) = \frac{(n-1)}{n(n+2)} \sigma_e^2$$

$$\text{Var}(\hat{S}_{ij}) = \frac{n(n-1)}{n(n+1)(n+2)} \sigma_e^2$$

$$\text{Var} (\hat{S}_{ij}) = \frac{n^2 + n + 2}{(n + 1) (n + 2)} \sigma_e^2 \quad (i \neq j)$$

$$\text{Var} (\hat{g}_i - \hat{g}_j) = \frac{2}{n + 2} \sigma_e^2 \quad (i \neq j)$$

$$\text{Var} (\hat{S}_{ij} - S_{ii}) = \frac{2 (n - 2)}{n + 2} \sigma_e^2 \quad (i \neq j)$$

$$\text{Var} (\hat{S}_{ij} - \hat{S}_{ik}) = \frac{2 (n - 1)}{n + 2} \sigma_e^2 \quad (i \neq j, \quad k; j \neq k)$$

$$\text{Var} (\hat{S}_{ij} - \hat{S}_{kl}) = \frac{2n}{n + 2} \sigma_e^2 \quad (i \neq j \neq k \neq l)$$

By taking square roots of the variances, the corresponding standard errors required for testing were obtained

3.3.4 Analysis of segregation pattern

The segregation pattern was represented in a graphic form. The total population for each cross combination for a particular character was classified into different frequency intervals according to the percentage of plants falling within a class.

$$\text{Var} (\hat{S}_{ij}) = \frac{n^2 + n + 2}{(n + 1) (n + 2)} \sigma_e^2 \quad (i \neq j)$$

$$\text{Var} (\hat{g}_i - \hat{g}_j) = \frac{2}{n + 2} \sigma_e^2 \quad (i \neq j)$$

$$\text{Var} (\hat{S}_{ij} - S_{ii}) = \frac{2 (n - 2)}{n + 2} \sigma_e^2 \quad (i \neq j)$$

$$\text{Var} (\hat{S}_{ij} - \hat{S}_{ik}) = \frac{2 (n - 1)}{n + 2} \sigma_e^2 \quad (i \neq j, k; j \neq k)$$

$$\text{Var} (\hat{S}_{ij} - \hat{S}_{kl}) = \frac{2n}{n + 2} \sigma_e^2 \quad (i \neq j \neq k \neq l)$$

By taking square roots of the variances, the corresponding standard errors required for testing were obtained

3.3.4 Analysis of segregation pattern

The segregation pattern was represented in a graphic form. The total population for each cross combination for a particular character was classified into different frequency intervals according to the percentage of plants falling within a class.

The graph was represented by taking different characters of the populations namely number of capsules per plant, seed yield per plant, number of branches per plant and 1000-seed weight. The F_2 segregants exceeding the average mean value of two parents were counted as total transgressive segregants (TTS). Among these total transgressive segregants, those which had considerably higher values than the better parental means were classified as significantly transgressive segregants (STS). Ninety plants were randomly selected from three replications and observations were recorded for the characters plant height, number of branches per plant, number of capsules per plant, 1000-seed weight and seed yield per plant.

3.4 ISOZYME STUDIES

The esterase isozyme pattern was analysed by using PAGE (Polyacrylamide gel electrophoresis). The parameters viz., gel concentration, sample concentration and staining procedures were standardized for this enzyme.

3.4.1 Collection of sample

The seeds from eight parents under the study were imbibed overnight in water at room temperature and they were used for the enzyme extraction.

3.4.2 Extraction buffer

0.5 M Tris-methylamine (pH 6.8) : 6 g tris was dissolved in 80 ml of distilled water and pH was adjusted to 6.8 with 0.1 N HCl and made upto 100 ml with distilled water

3.4.3 Sample extraction

100 mg seed samples were homogenized in 150 μ l of extraction buffer in ice using pre-chilled pestle and mortar. Sample homogenate was centrifuged at 12000 rpm at 4°C for 15 minutes. The supernatant was collected and used for the isozyme analysis.

3.4.4 Electrophoretic separation of isozyme materials

3.4.4.1 Stock acrylamide solution

Acrylamide : 29.2 g

N,N-Methyl-bisacrylamide : 0.8 g

Make upto the volume to 100 ml with distilled water.

3.4.4.2 Separation gel buffer / resolving gel buffer

(1.5 M Tris-HCl, pH 8.8)

18.15 g of tris base was dissolved in 80 ml of distilled water and pH was adjusted to 8.8 with 0.1 N HCl and made upto 100 ml with distilled water.

3.4.4.3 Stacking gel buffer (0.5 M Tris - HCl buffer, pH (6.8))

6.0 g tris was dissolved in 80 ml of distilled water and pH was adjusted to 6.8 with 0.1 N HCl and made upto 100 ml with distilled water.

3.4.4.4 Polymerising agents

Ammonium per sulphate (10%) Catalyst

(0.1g / ml distilled water, freshly prepared)

TEMED (Fresh from refrigerator) Chain initiator

N, N, N', N'-tetramethyl ethylene diamine (TEMED)

3.4.4.5 Electrode buffer

0.05 M Tris-HCl : 6 g

0.192 M Glycine : 14.4 g

and added distilled water to make up one litre

3.4.4.6 Sample buffer (5 x concentration)

0.5 M Tris-HCl (pH 6.8) : 5.0 ml

Sucrose : 5 gms

2-Mercaptoethanol : 0.25 ml

Bromophenol blue (0.05 % w/v) : 1 ml

Distilled water : 10.0 ml

The above solutions were mixed thoroughly and stored at room temperature diluted to 1 x concentration and was used.

3.4.5 Gel composition

Stock solution	7.5 % Resolving gel (30 ml)	5% Stacking gel (5 ml)
30% Acrylamide	8.0 ml	2.7 ml
Resolving gel buffer	6.0 ml	—
Stacking gel buffer	—	2.0 ml
Distilled water	16 ml	1.5 ml
10% APS*	200 μ l	200 μ l
TEMED	50 μ l	50 μ l

* Freshly prepared just before use

3.4.6 Preparation of gel

Vertical slab gel unit in the casting mould with one mm spacer was used. Resolving gel solution was prepared as given under gel composition table. The solution was poured into Sandwich to a level of 2 cm from the top. Distilled water was added gently along the wall of the Sandwich to form uniform gel surface and allowed for polymerization. After polymerization, the water on the resolving gel was poured off and dried with filter paper. Stacking gel was prepared and overlaid on the resolving gel. The comb was inserted into the stacking gel and allowed for polymerization.

3.4.7 Sample loading

Comb was gently removed from gel after polymerization. The lower and upper chambers were filled with 1x electrode buffer. The air bubbles, if any, were removed by rinsing the wells with distilled water. The electrophoresis unit was connected to the powerpack and the voltage was initially adjusted to 60 V to 100 V. The electrophoresis was stopped when the dye reached to the bottom of the gel.

3.4.8 Staining and Destaining

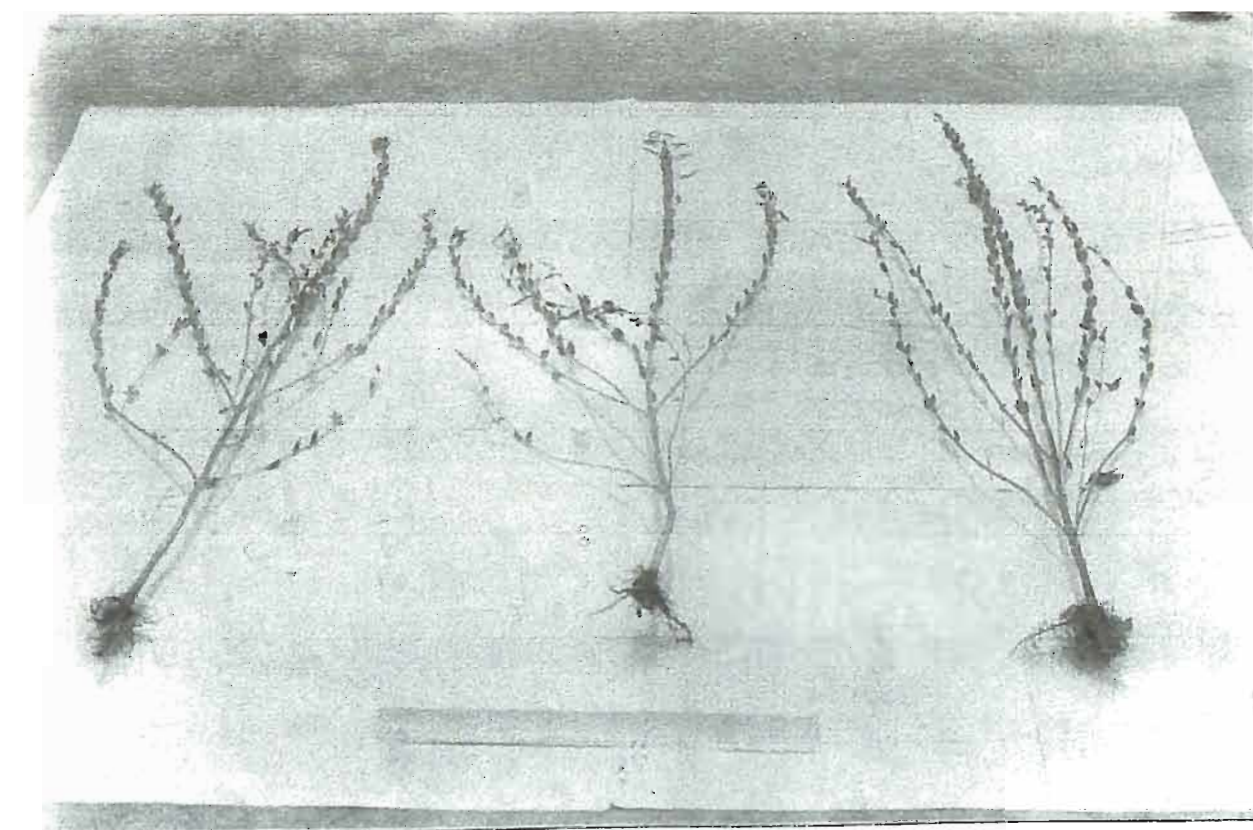
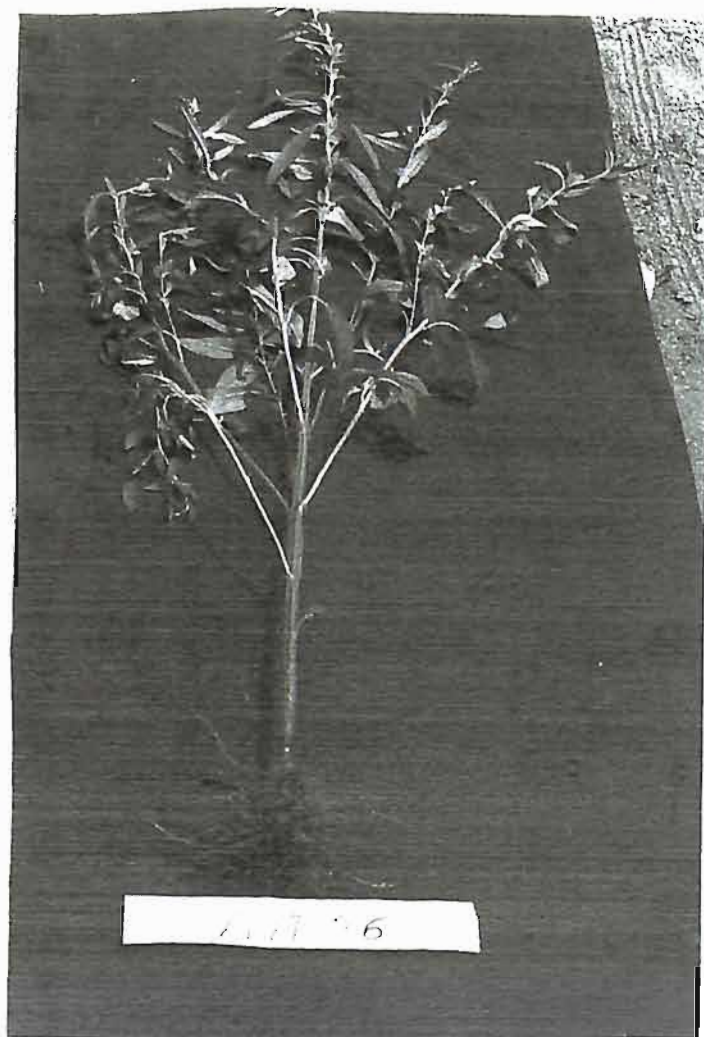
The composition of staining solution, duration of staining, fixer solutions for the enzyme esterase are given below (Vallejos, 1993).

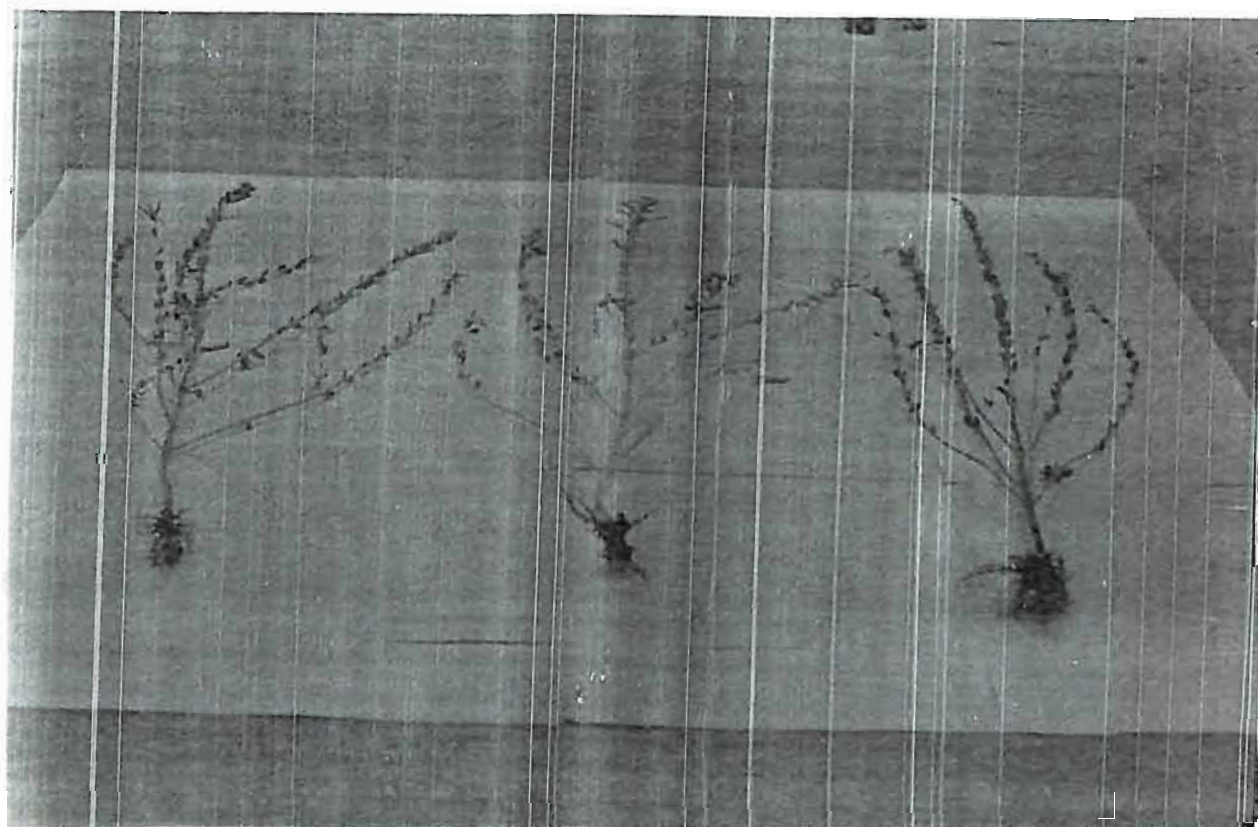
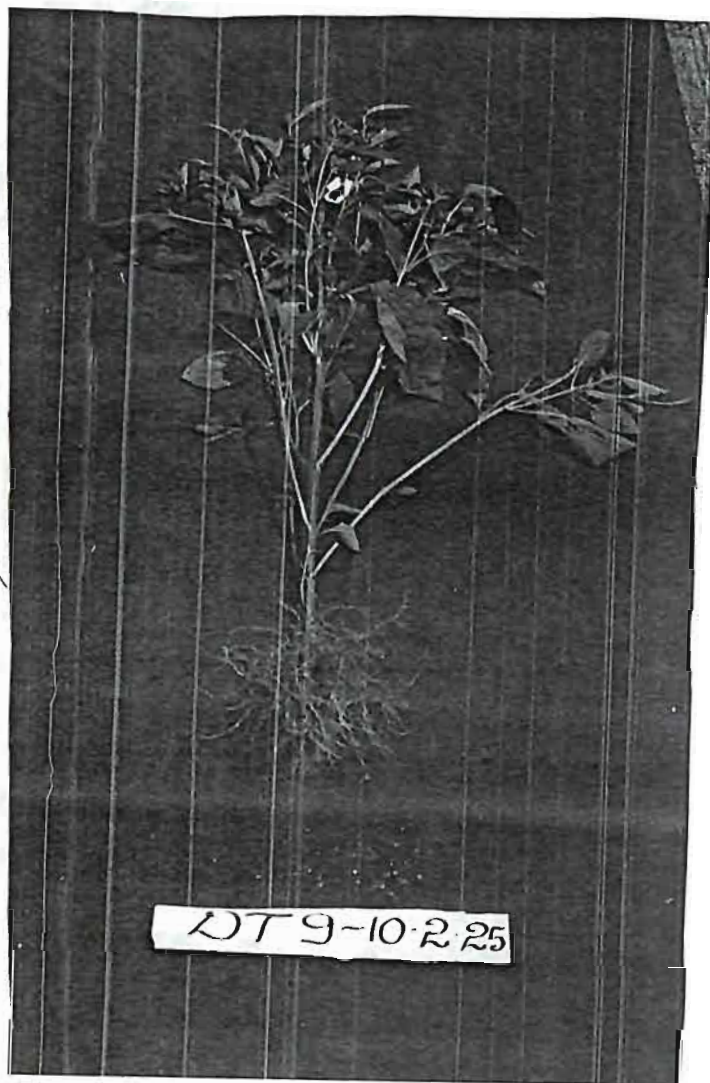
Staining solution

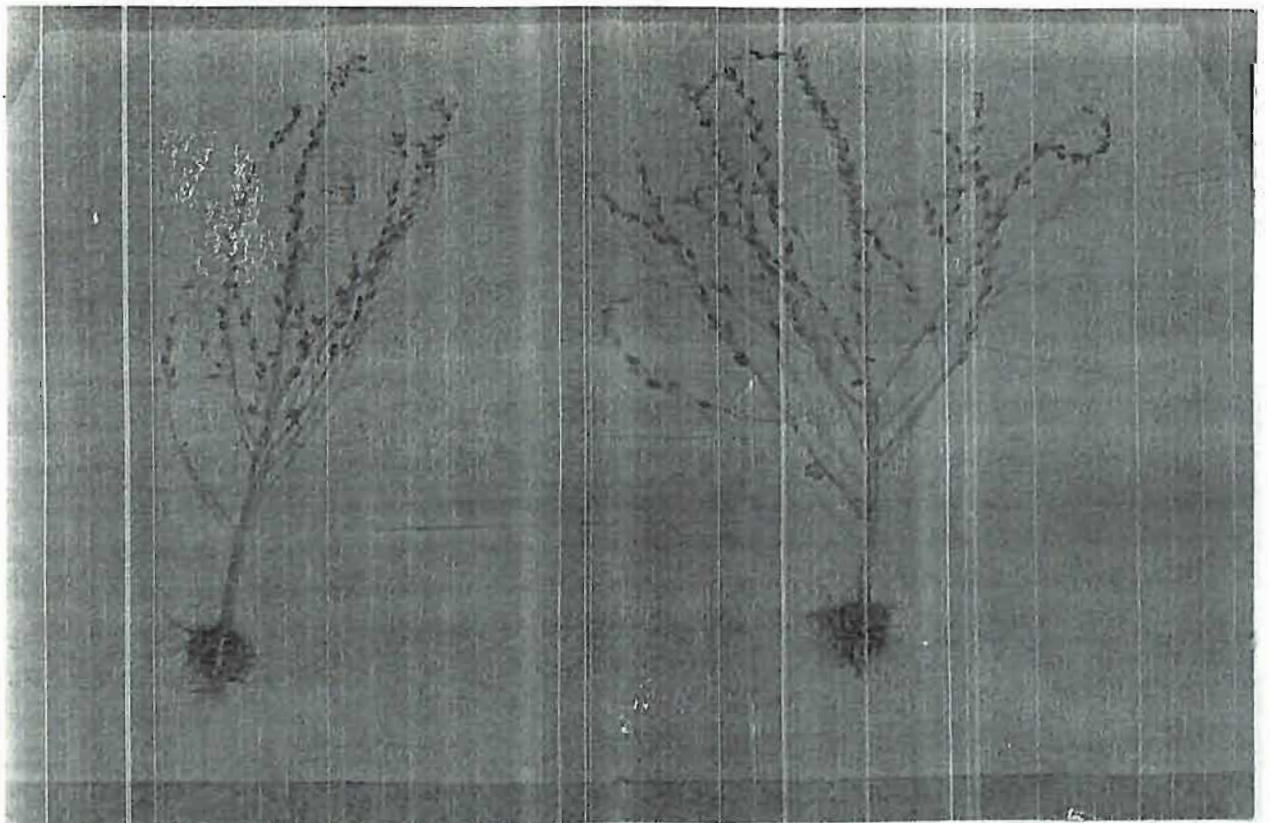
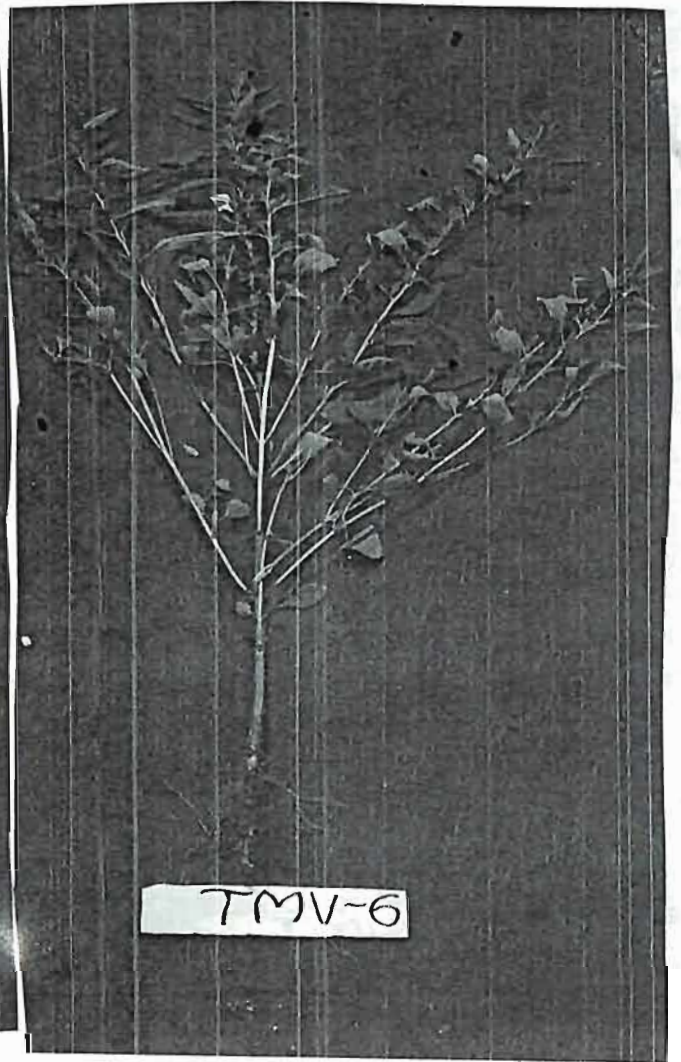
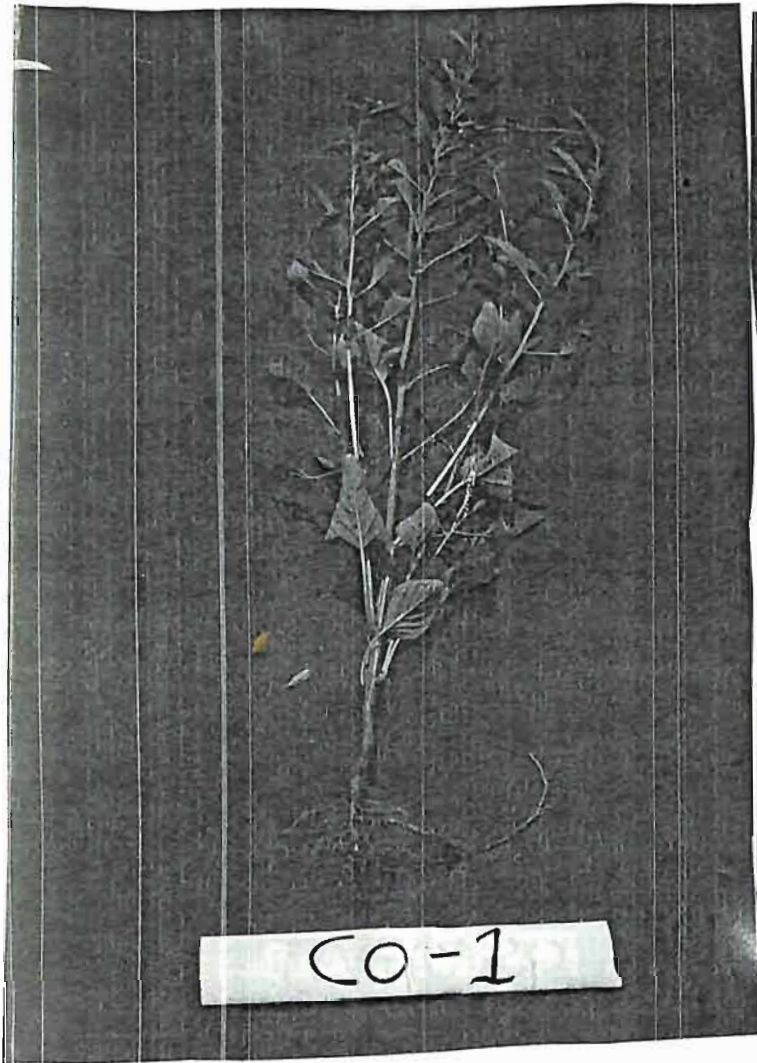
- | | | | |
|----|--|---|--------|
| a. | Sodium dihydrogen phosphate | : | 2.8 g |
| b. | Disodium hydrogen phosphate
dissolved in 200 ml distilled water | : | 1.1 g |
| c. | 1-naphthyl acetate | : | 0.05 g |
| d. | Fast blue RR salt | : | 0.2 g |

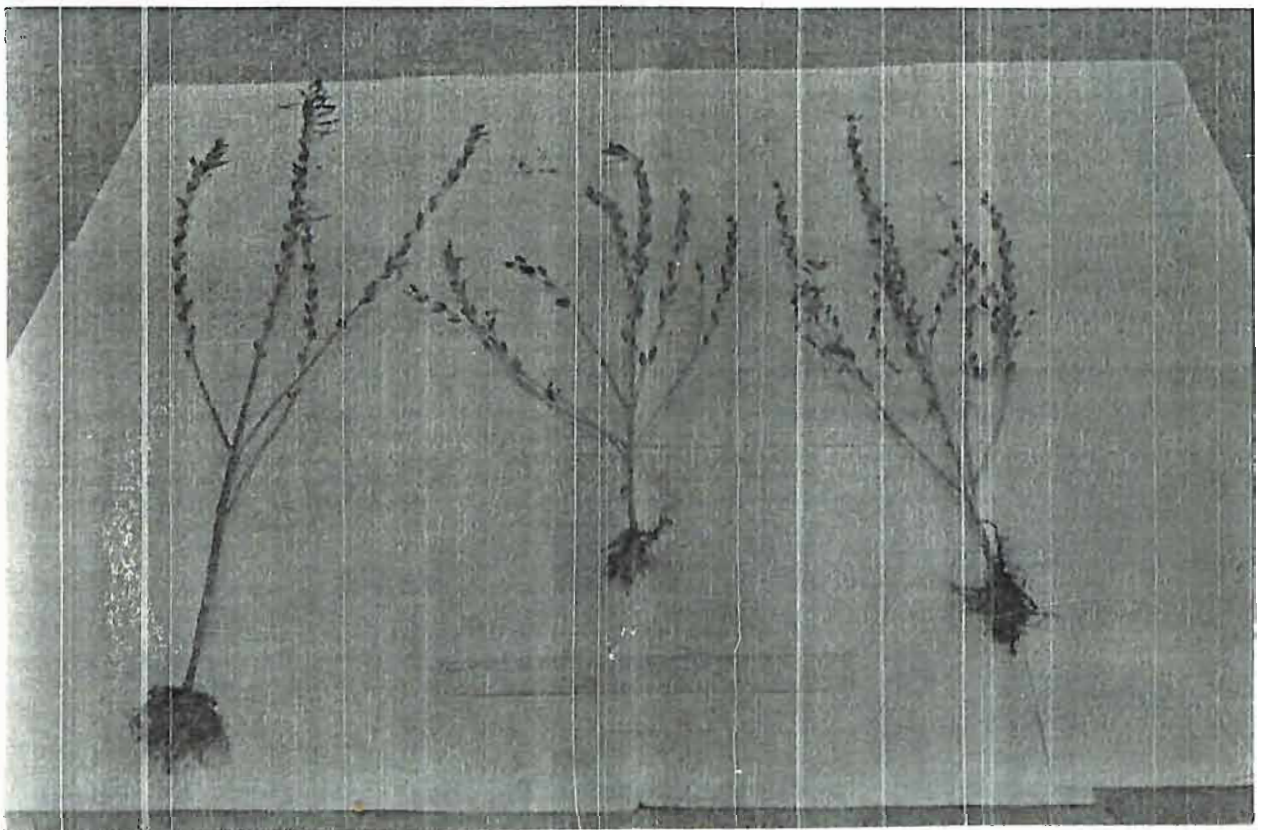
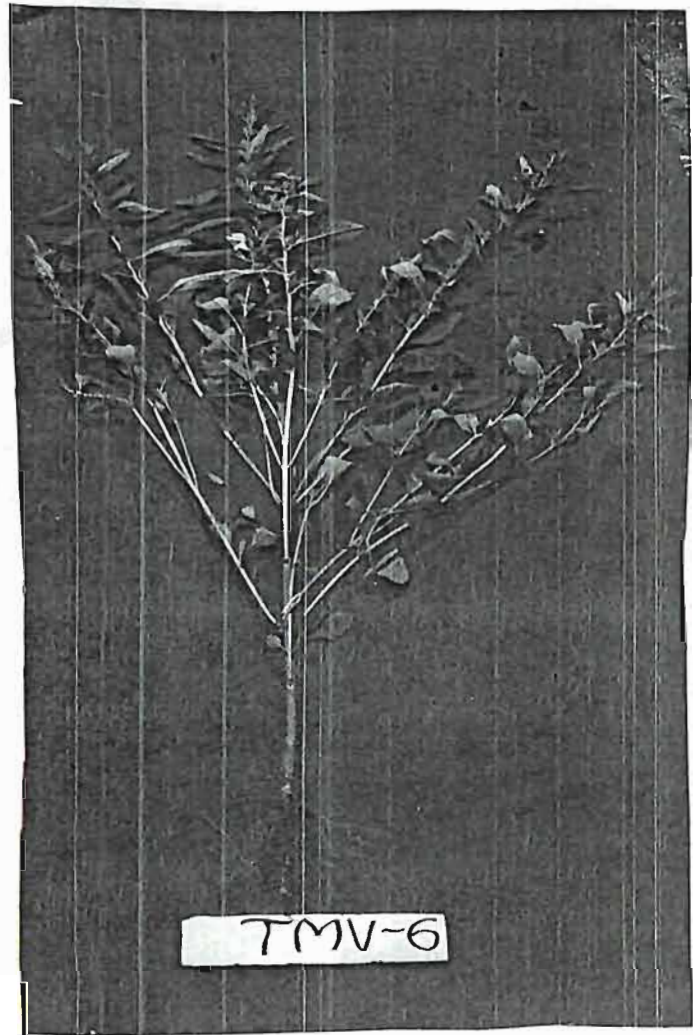
Chemicals (C) and (d) were dissolved in small quantity of acetone separately and added to the above solution with sodium salts first before incubation. The gel was incubated in dark for 30 minutes or till the appearance of brown bands.

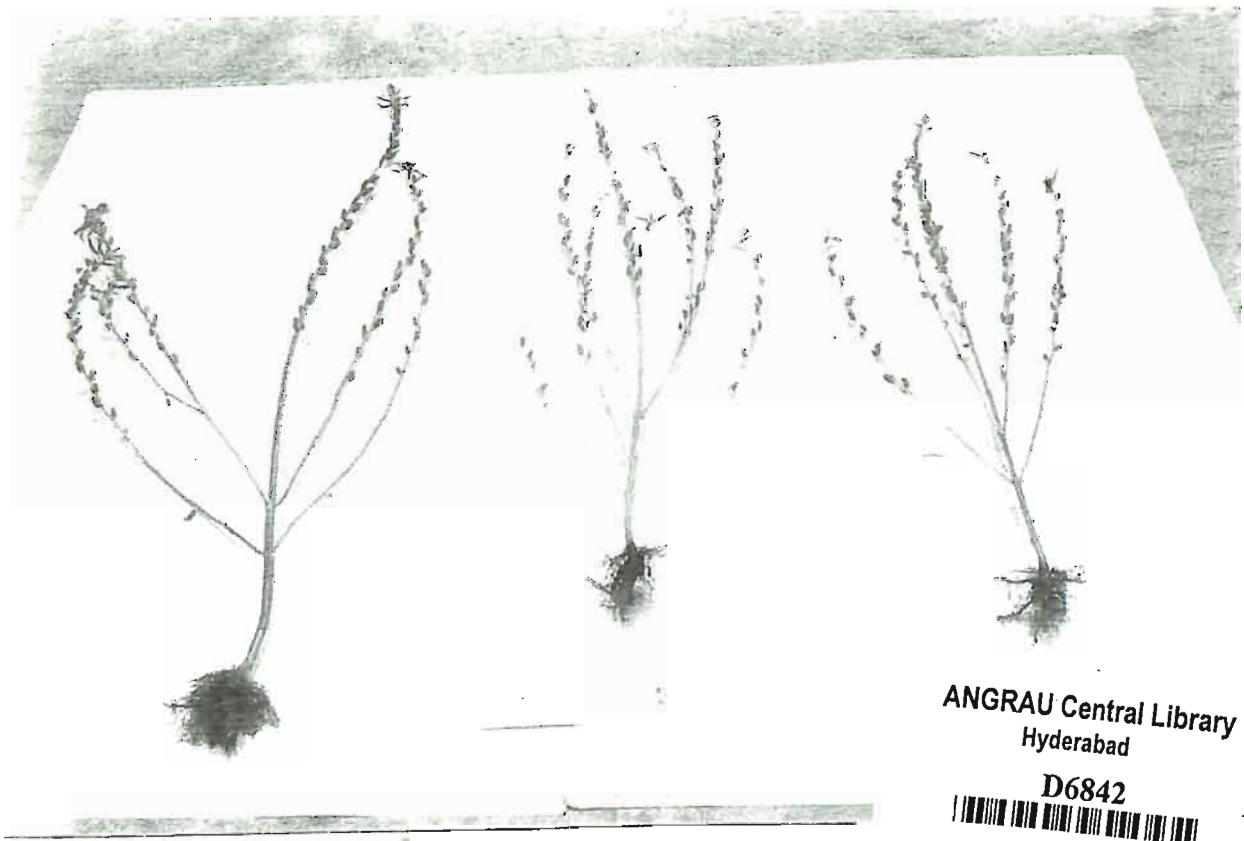
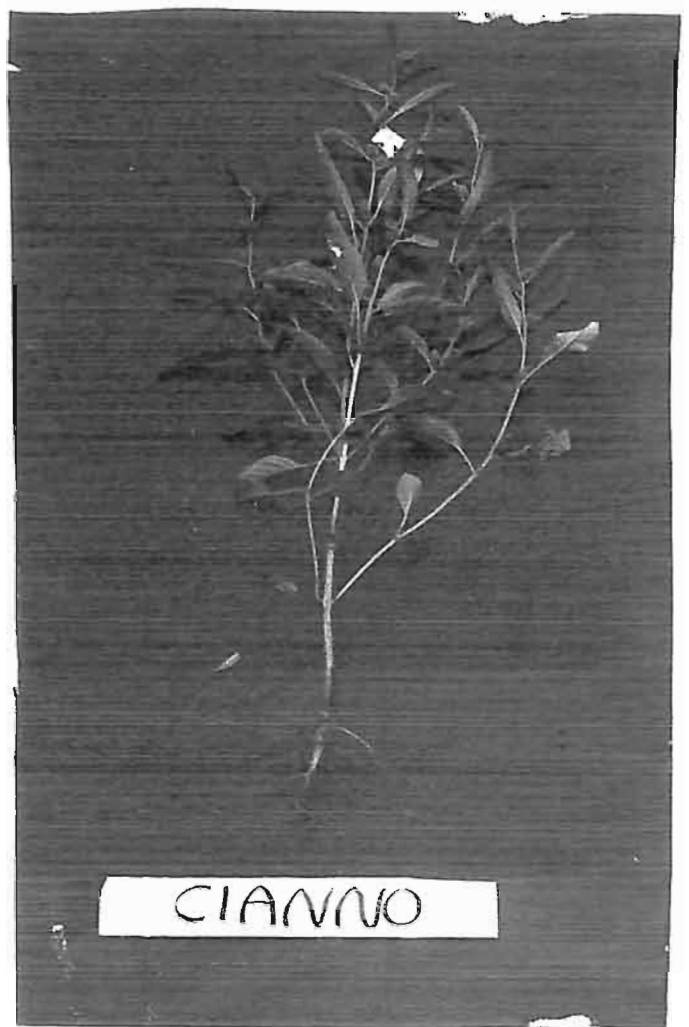
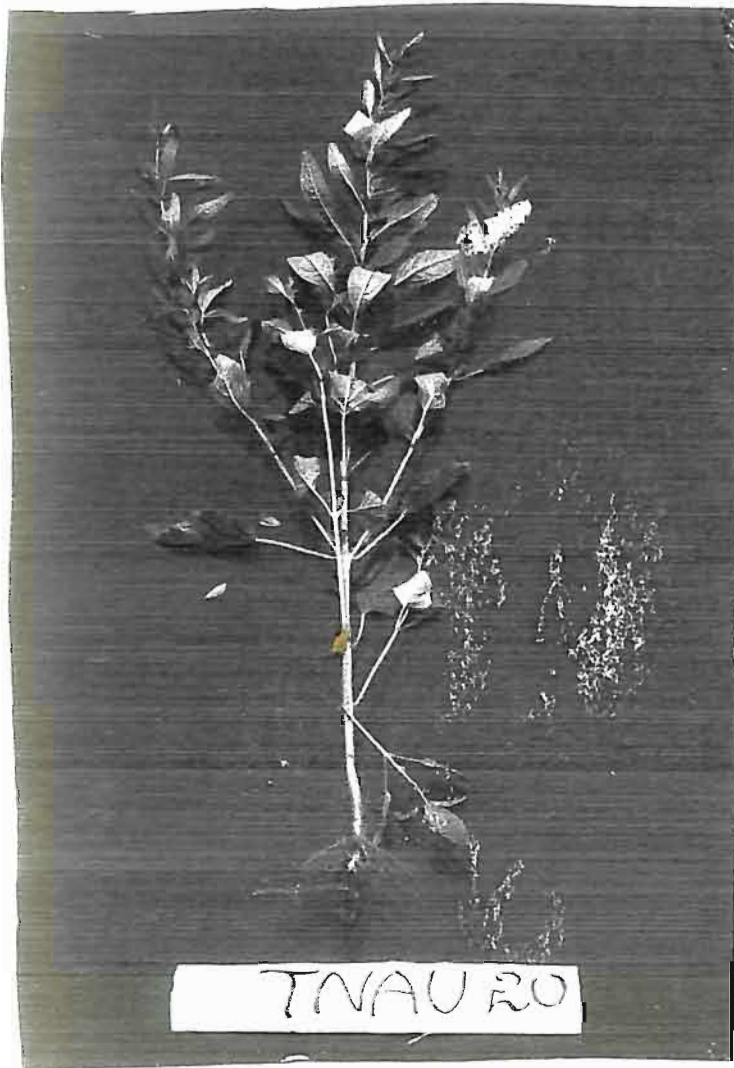
Destaining solution : Water : Methanol : Acetic acid : (15 : 4 : 1) for twenty minutes.











Chapter IV

Results

CHAPTER - IV

RESULTS

Eight parents and their 28 F_2 sesame progenies obtained from 8 x 8 diallel cross were evaluated for fourteen characters. The results obtained are presented under the following heads

4.1 ANOVA

4.2 MEAN PERFORMANCE OF PARENTS AND HYBRIDS

4.3 GENETIC PARAMETERS - VARIABILITY, HERITABILITY AND GENETIC ADVANCE

4.4 COMBINING ABILITY ANALYSIS

4.5 SEGREGATION PATTERN IN F_2

4.6 ELECTROPHORETIC ANALYSIS OF ISOZYME ESTERASE

4.1 ANOVA

The analysis of variance deciphered significant differences among the treatments for all the characters viz, days to 50 percent flowering, days to maturity, plant height, number of primary branches, number of secondary branches, capsules on mainstem, capsules per plant, on primary branches, capsules on secondary branches, total number of capsules, number of seeds per capsule, 1000-seed weight, seed yield per plant and harvest index except for capsule length (Table 2).

Table 2 : Analysis of variance of F_2 progenies for fourteen characters in sesame

Sl. No.	Character	Mean sum of squares		
		Replications df = 2	Treatments df = 35	Error df = 70
1.	Days to 50% flowering	3.86	8.05**	1.74
2.	Days to maturity	2.39	84.90**	1.32
3.	Plant height (cm)	46.77	964.33**	21.65
4.	Number of primary branches per plant	0.21	2.07**	0.15
5.	Number of secondary branches per plant	0.43	3.71**	0.24
6.	Number of capsules on main stem	11.33	99.15**	7.52
7.	Number of capsules on primary branches	4.37	660.05**	36.51
8.	Number of capsules on secondary branches	25.96	55.84**	8.14
9.	Number of capsules per plant	99.91	1420.67**	100.0
10.	Capsule length (cm)	0.02	0.12	0.013
11.	Number of seeds per capsule	5.18	105.30**	4.88
12.	1000-seed weight (g)	0.00	0.48**	0.00
13.	Seed yield per plant (g)	2.53	98.76**	0.971
14.	Harvest Index (%)	39.06	309.92**	10.836

** Significant at $P = 0.01$ level

4.2 MEAN PERFORMANCE OF THE PARENTS AND HYBRIDS

The data on mean values of 8 parents and 28 F₂ progenies are given in Table 3.

4.2.1 Days to 50 per cent flowering

Among the parents ACV 2 was the earliest to days to 50 per cent flowering (30.00 days) while CO-1 was late to flower (36.33 days). Parents viz., TNAU 20, TMV 6, CIANNO, ACV 2 were earlier to flower compared with parental mean (33.08 days). Among the hybrids CIANNO x ACV 2 (29.67 days) was earliest to flower. Fifteen out of 28 hybrids were found to be earlier in flowering compared to the mean value of hybrids (32.11 days).

4.2.2 Days to maturity

Earliest maturity was displayed by parent TMV 6 (95.00 days) whereas DT9-10-2-25 was late to mature (108 days). Three parents namely CIANNO, TMV 6, ACV 2 were earlier to mature as compared to mean maturity of parents (102.99 days). Among the hybrids, CIANNO x ACV 2 was early in maturity (91.00 days) while CO-1 x DT9-10-2-25 was late in maturity (106.67 days). Twelve out of 28 hybrids were found to be earlier than their mean maturity (97.84 days).

Table 3 : Mean performance of parents and F₂ progenies for fourteen characters in sesame

Sl. No.	Entry	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of primary branches	Number of secondary branches	Number of capsules on main stem	Number of capsules on primary branches	Number of capsules on secondary branches	Number of capsules per plant	Capsule length (cm)	Number of seeds per capsule	1000-seed weight (g)	Seed yield per plant (g)	Harvest index (%)
PARENTS															
1	CO-1	36.33	106.00	110.86	5.76	2.29	21.80	56.77	6.98	88.88	2.73	73.40	3.61	21.50	56.33
2	TNAU 20	31.00	105.00	100.10	4.91	3.12	26.09	48.20	5.98	72.54	2.83	66.93	3.15	13.83	45.33
3	CIANNO	33.00	96.33	96.68	2.93	2.60	23.13	43.05	12.49	79.66	2.18	88.53	3.15	22.71	56.00
4	TMV 6	31.00	95.00	96.25	3.76	2.21	25.75	48.85	10.70	85.31	2.21	69.94	3.22	18.38	72.00
5	VRI-1	35.00	106.00	106.07	5.80	2.51	29.42	48.12	9.48	87.01	2.47	65.70	3.42	21.40	80.00
6	ACV 2	30.00	100.38	96.47	4.05	2.64	27.59	36.51	8.57	72.65	2.91	66.10	3.93	19.30	64.00
7	DT 9-10-2-25	34.00	108.00	59.24	5.78	8.70	3.62	20.50	20.31	44.43	2.98	62.31	3.95	10.84	60.00
8	AVT 26	34.33	107.33	65.64	4.85	2.49	21.00	35.41	6.91	63.35	2.83	69.52	4.24	20.51	59.67
	Mean	33.08	102.99	91.41	4.73	3.32	22.3	42.17	10.17	74.10	2.64	70.3	3.58	18.55	61.66
F₂ PROGENIES															
9	CO-1 x TNAU 20	33.00	106.00	97.43	4.35	2.63	25.72	57.24	6.81	89.77	2.75	73.44	3.31	21.12	54.00
10	CO-1 x CIANNO	31.33	100.67	102.08	4.48	3.41	20.77	40.83	10.29	71.90	2.54	72.38	3.31	161.9	66.33
11	CO-1 x TMV 6	32.00	99.67	117.22	3.25	4.13	26.92	65.68	19.28	111.88	2.82	67.86	3.42	26.24	49.67
12	CO-1 x VRI-1	33.67	99.33	105.95	5.52	3.74	27.59	44.48	11.28	83.40	2.88	73.04	3.07	19.38	54.00
13	CO-1 x ACV 2	34.67	106.33	105.93	4.70	2.47	25.01	45.72	8.57	79.30	2.92	69.11	3.48	18.57	65.33
14	CO-1 x DT 9-10-2-25	34.33	106.67	160.99	6.19	3.40	28.42	64.22	16.80	109.45	2.89	79.57	4.11	31.75	83.33
15	CO-1 x AVT 26	35.00	103.67	146.36	4.95	3.76	43.55	102.19	26.26	172.00	2.92	66.93	4.25	39.86	78.67
16	TNAU 20 x CIANNO	32.67	99.33	111.56	4.76	3.59	28.85	64.44	17.65	110.94	2.89	69.21	3.15	24.73	53.33
17	TNAU 20 x TMV 6	33.00	98.33	107.13	6.15	3.33	27.66	48.59	13.91	90.16	2.92	64.39	4.40	26.19	73.33
18	TNAU 20 x VRI-1	32.67	98.33	92.96	4.03	3.33	20.34	40.89	12.41	73.64	2.90	64.28	3.14	14.36	84.00
19	TNAU 20 x ACV 2	31.67	92.67	104.28	4.44	2.88	23.69	62.46	13.20	99.35	2.95	67.27	3.24	20.83	64.33
20	TNAU 20 x DT 9-10-2-25	32.00	94.67	133.83	6.23	3.16	28.47	58.43	13.25	100.16	3.10	65.56	3.02	18.77	72.00
21	TNAU 20 x AVT 26	31.33	92.67	94.61	5.30	4.54	22.34	39.33	17.22	78.68	3.12	63.21	3.46	17.49	55.67

Contd... Table 3

Sl. No.	Entry	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of primary branches	Number of secondary branches	Number of capsules on main stem	Number of capsules on primary branches	Number of capsules on secondary branches	Number of siliques per plant	Capsule length (cm)	Number of seeds per capsule	1000-seed weight (g)	Seed yield per plant (g)	Harvest index (%)
22	CIANNO x TMV 6	30.33	92.00	100.24	4.12	2.20	20.13	30.16	7.31	65.75	3.00	62.52	3.45	15.27	59.00
23	CIANNO x VRI-1	30.67	91.33	94.89	4.33	2.93	22.44	44.94	11.45	78.74	3.02	60.65	2.94	13.73	67.33
24	CIANNO x ACV 2	29.67	91.00	93.73	3.55	2.44	19.23	35.67	7.19	61.93	2.94	61.82	2.94	11.32	63.33
25	CIANNO x DT 9-10-2-25	32.33	92.00	100.18	3.81	3.39	16.23	26.4	11.16	53.53	2.83	64.01	3.46	12.03	65.00
26	CIANNO x AVT 26	31.33	93.00	114.11	4.29	3.15	23.05	58.87	9.60	91.53	2.36	62.23	2.86	12.53	45.33
27	TMV 6 x VRI-1	34.00	99.00	91.91	4.79	2.73	27.49	40.49	11.28	79.26	2.95	64.30	3.06	16.33	55.00
28	TMV6 x ACV 2	32.33	99.00	101.21	4.47	3.04	26.30	46.04	12.18	106.93	2.93	63.23	3.33	17.48	54.67
29	TMV6 x DT 9-10-2-25	33.00	98.33	120.15	5.40	3.32	26.67	69.39	14.21	79.90	2.96	62.20	3.13	15.29	66.00
30	TMV6 x AVT 26	31.00	100.67	109.25	6.17	3.80	24.67	44.00	12.89	84.52	2.87	63.44	3.15	15.68	71.33
31	VRI-1 x ACV 2	31.67	98.00	103.57	5.31	3.33	20.11	38.81	11.85	70.77	2.78	66.30	3.42	18.90	69.67
32	VRI-1 x DT9-10-2-25	33.00	95.00	102.71	5.78	4.21	19.26	44.68	12.38	76.38	2.77	68.34	3.95	21.07	72.67
33	VRI-1 x AVT 26	30.67	93.33	115.68	5.36	4.02	24.78	68.99	16.89	110.56	2.63	55.50	3.62	19.04	64.67
34	ACV 2 x DT 9-10-2-25	30.33	95.00	113.85	5.58	3.54	25.53	50.64	11.55	87.56	2.82	66.44	3.62	20.98	62.33
35	ACV 2 x AVT 26	30.33	96.67	97.45	4.77	3.13	23.61	62.90	11.24	97.74	2.85	66.20	3.23	23.23	64.67
36	DT9-10-2-25 x AVT 26	31.33	107.00	106.22	5.07	2.79	24.98	61.16	9.35	95.49	2.87	74.93	3.76	22.32	80.00
	Mean	32.11	97.84	108.76	4.92	3.29	23.89	52.04	12.76	91.82	2.86	66.27	3.40	20.20	67.01
	SED	1.07	0.93	3.79	0.32	0.40	2.2	4.93	2.33	8.16	0.09	1.80	0.01	0.80	2.68
	CD at 5%	2.13	1.85	7.54	0.63	0.79	4.38	9.81	4.64	16.24	0.17	3.58	0.01	1.59	5.33
	CD at 1%	2.84	2.46	10.04	0.84	1.06	5.83	13.56	7.02	21.62	0.23	4.78	0.02	2.12	7.10



Table 3 : Mean performance of parents and F₂ progenies for fourteen characters in sesame

Sl. No.	Entry	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of primary branches	Number of secondary branches	Number of capsules on main stem	Number of capsules on primary branches	Number of capsules on secondary branches	Number of capsules per plant	Capitulum length (cm)	Number of seeds per capsule	1000-seed weight (g)	Seed yield per plant (g)	Harvest index (%)
PARENTS															
1	CO-1	36.33	106.00	110.86	5.76	2.29	21.80	56.77	6.98	88.88	2.73	73.40	3.61	21.50	56.33
2	TNAU 20	31.00	105.00	100.10	4.91	3.12	26.09	48.20	5.98	72.54	2.83	66.93	3.15	13.83	45.33
3	CIANNO	33.00	96.33	96.68	2.93	2.60	23.13	43.05	12.49	78.66	2.18	88.53	3.15	22.71	56.00
4	TMV 6	31.00	95.00	96.25	3.76	2.21	25.75	48.85	10.70	85.31	2.21	69.94	3.22	18.38	72.00
5	VRI-1	35.00	106.00	106.07	5.80	2.51	29.42	48.12	9.48	87.01	2.47	65.70	3.42	21.40	80.00
6	ACV 2	30.00	100.38	96.47	4.05	2.64	27.59	36.51	8.57	72.65	2.91	66.10	3.93	19.30	64.00
7	DT 9-10-2-25	34.00	108.00	59.24	5.78	8.70	3.62	20.50	20.31	44.43	2.98	62.31	3.95	10.84	60.00
8	AVT 26	34.33	107.33	65.64	4.85	2.49	21.00	35.41	6.91	63.35	2.83	69.52	4.24	20.51	59.67
	Mean	33.08	102.99	91.41	4.73	3.32	22.3	42.17	10.17	74.10	2.64	70.3	3.58	18.55	61.66
F₂ PROGENIES															
9	CO-1 x TNAU 20	33.00	106.00	97.43	4.35	2.63	25.72	57.24	6.81	89.77	2.75	73.44	3.31	21.12	54.00
10	CO-1 x CIANNO	31.33	100.67	102.08	4.48	3.41	20.77	40.83	10.29	71.90	2.54	72.38	3.31	161.9	66.33
11	CO-1 x TMV 6	32.00	99.67	117.22	3.25	4.13	26.92	65.68	19.28	111.88	2.82	67.86	3.42	26.24	49.67
12	CO-1 x VRI-1	33.67	99.33	105.95	5.52	3.74	27.59	44.48	11.28	83.40	2.88	73.04	3.07	19.38	54.00
13	CO-1 x ACV 2	34.67	106.33	105.93	4.70	2.47	25.01	45.72	8.57	79.30	2.92	69.11	3.48	18.57	65.33
14	CO-1 x DT 9-10-2-25	34.33	106.67	160.99	6.19	3.40	28.42	64.22	16.80	109.45	2.89	79.57	4.11	31.75	83.33
15	CO-1 x AVT 26	35.00	103.67	146.36	4.95	3.76	43.55	102.19	26.26	172.00	2.92	66.93	4.25	39.86	78.67
16	TNAU 20 x CIANNO	32.67	99.33	111.56	4.76	3.59	28.85	64.44	17.65	110.94	2.89	69.21	3.15	24.73	53.33
17	TNAU 20 x TMV 6	33.00	98.33	107.13	6.15	3.33	27.66	48.59	13.91	90.16	2.92	64.39	4.40	26.19	73.33
18	TNAU 20 x VRI-1	32.67	98.33	92.96	4.03	3.33	20.34	40.89	12.41	73.64	2.90	64.28	3.14	14.36	84.00
19	TNAU 20 x ACV 2	31.67	92.67	104.28	4.44	2.88	23.69	62.46	13.20	99.35	2.95	67.27	3.24	20.83	64.33
20	TNAU 20 x DT 9-10-2-25	32.00	94.67	133.83	6.23	3.16	28.47	58.43	13.25	100.16	3.10	65.56	3.02	18.77	72.00
21	TNAU 20 x AVT 26	31.33	92.67	94.61	5.96	4.54	22.34	39.33	17.22	78.68	3.12	63.21	3.46	17.49	55.67

4.2.3 Plant height (cm)

Among the parents CO-1 was found to be tallest (110.86 cm) while DT 9-10-2-25 was shortest (59.24 cm). Six parents viz., CO-1, TNAU 20, CIANNO, TMV 6, VRI-1 and ACV 2 were taller than the parental mean of 91.41 cm. Analysis for plant height in hybrids revealed that CO-1 x DT 9-10-2-25 (160.99 cm) was the tallest while TMV 6 x VRI-1 (91.91 cm) was the shortest. Nine out of 28 F₂ hybrids registered higher values than their mean height (108.76 cm).

4.2.4 Number of primary branches

The mean number of primary branches in parents ranged from 2.93 to 5.8 with a mean of 4.73. The variety CIANNO recorded lowest number of primary branches whereas DT 9-10-2-25 recorded highest number of primary branches. Five parents exceeded the mean value for primary branches. Among hybrids, TNAU 20 x DT 9-10-2-25 recorded maximum number of primary branches (6.23) whereas CO-1 x TMV 6 recorded lowest number of primary branches (3.25). Thirteen out of 28 hybrids surpassed the mean hybrid value of 4.92 for primary branches per plant.

4.2.5 Number of secondary branches

Among the parents DT9-10-2-25 recorded maximum number of secondary branches (8.70) while TMV 6 registered lowest value (2.21). No

parent exceed the parental mean (3.22) other than DT 9-10-2-25. Among the hybrids TNAU 20 x AVT 26 recorded maximum number of secondary branches (4.34) while the cross CIANNO x TMV 6 recorded lowest number of secondary branches (2.20). Sixteen hybrids registered higher values than their mean (3.29).

4.2.6 Number of capsules on main stem

Among parents VRI-1 and DT 9-10-2-25 possessed maximum (29.42) and minimum (3.62) number of capsules on main stem, respectively. Five parents surpassed the mean value for capsules on main stem (22.3). Among hybrids maximum number of capsules on main stem was recorded by CO-1 x AVT 26 (43.55) and minimum by CIANNO x DT 9-10-2-25 (16.30). Sixteen hybrids registered greater values than hybrid mean value (23.89).

4.2.7 Number of capsules on primary branches

The genotype Co-1 recorded maximum number of capsules on primary branches (56.77) while DT 9-10-2-25 registered minimum number of capsules on primary branches (20.5). Five genotypes viz., CO-1, TNAU 20, CIANNO, TMV 6, VRI-1 registered significantly more number of capsules on primary branches than the parental mean value (42.17). Among the hybrids CO-1 x AVT 26 recorded maximum number of capsules on primary branches (102.19) while CIANNO x DT-9-10-2-25 recorded lowest number (26.14). Twelve hybrids had higher number of capsules on primary branches as compared to mean of hybrids (52.04).

4.2.8 Number of capsules on secondary branches

Capsules on secondary branches among the parents was highest in DT 9-10-2-25 (20.31) and lowest in TNAU 20 (5.98). Three parents DT 9-10-2-25, CIANNO and TMV 6 exceeded the parental mean value of (10.17). The hybrid CO-1 x AVT 26 recorded maximum number of capsules on secondary branches (26.26) while the cross CO-1 x TNAU 20 recorded lowest number of capsules on secondary branches (6.81). Eleven hybrids out of 28 registered higher values than mean value of hybrids (12.76) for capsules on secondary branches.

4.2.9 Total number of capsules per plant

Parental mean for total number of capsules per plant ranged from 44.43 to 88.88 with a general mean of 74.10. Four parents recorded higher values as compared to parental mean. Among hybrids CO-1 x AVT 26 recorded maximum number of capsules (172.00) followed by Co-1 x TMV 6 (111.88). Nine hybrids surpassed the hybrid mean value (91.82) for total number of capsules per plant.

4.2.10 Capsule length (cm)

The parent CIANNO recorded low value for capsule length (2.18 cm) while DT-9-10-2-25 registered high capsule length (2.98 cm). Five parents had relatively higher capsule length as compared to mean capsule length of parents (2.64 cm). The hybrid TNAU 20 x AVT 26 displayed maximum

capsule length (3.12 cm) whereas CO-1 x CIANNO displayed minimum capsule length (2.54 cm). Eighteen hybrids exhibited higher values than the hybrid mean (2.86 cm) for capsule length.

4.2.11 Number of seeds per capsule

The genotype CIANNO recorded maximum number of seeds per capsules (88.53), while DT 9-10-2-25 registered minimum number of seeds per capsule (62.31). Two genotypes viz., CO-1 and CIANNO registered significantly higher number of seeds per capsule than the parental mean value (70.3). Among the F_2 progenies maximum number of seeds per capsule was recorded by CO-1 x DT-9-10-2-25 (79.57) and minimum by VRI-1 x AVT 26 (55.5). Thirteen hybrids had higher number of seeds per capsule as compared to mean of progenies (66.27).

4.2.12 1000-seed weight (g)

Among the parents AVT 26 registered the maximum 1000-seed weight of 4.24 g while TNAU 20 and CIANNO registered lowest 1000-seed weight of 3.15 g. Four parents viz., CO-1, ACV 2, DT-9-10-2-25 and AVT 26 had higher seed weight than parental mean weight (3.58 g). Among the hybrids TNAU 20 x TMV 6 recorded the maximum 1000-seed weight (4.4 g) while CIANNO x AVT 26 registered the lowest seed weight (2.86 g). Thirteen F_2 progenies exhibited higher test weight when compared to mean test weight of progenies (3.40 g).

4.2.13 Seed yield per plant (g)

Among the parents highest seed yield was recorded by CIANNO (22.71 g) whereas DT-9-10-2-25 registered lowest yield (10.84 g). Five parents recorded higher grain yield than parental mean (18.55 g). The hybrid CO-1 x AVT 26 emerged as the outstanding cross with seed yield of 39.86 g followed by CO-1 x DT-9-10-2-25 (31.75 g), CO-1 x TMV 6 (26.24 g) and CIANNO x ACV 2 has registered lowest value (11.32 g) of seed yield per plant. Eleven hybrids exhibited greater seed yield as compared to mean hybrid yield (20.2 g).

4.2.14 Harvest Index (%)

Among parents VRI-1 registered maximum harvest index (80.00%) while TNAU 20 registered minimum harvest index (45.33%). Three parents viz., TMV 6, VRI-1 and ACV 2 had higher harvest index than parental mean value (61.66%). Among the hybrids TNAU 20 x VRI-1 recorded maximum harvest index (84.00%) while CIANNO x AVT 26 recorded minimum harvest index (45.33%). Ten hybrids exhibited higher harvest index than mean harvest index of progenies (67.01%).

4.3 GENETIC PARAMETERS

The results on phenotypic and genotypic variance, phenotypic and genotypic co-efficients of variation, heritability and genetic advance of parents

and F_2 s for fourteen characters are presented in Table 4 and 5. Heritability was considered low, when it was less than 20 per cent, medium at 20 to 50 per cent and high at more than 50 per cent. (Stansfield, 1969).

4.3.1 Variability, Heritability and Genetic advance of parents

4.3.1.1 Variability

The phenotypic variances were higher than genotypic variances for all characters. The character plant height recorded highest values for genotypic (341.78) and phenotypic (363.44) variances, followed by number of capsules per plant (185.5 and 285.5), number of capsules on primary branches (113.23 and 149.74), harvest index (108.15 and 118.9) and number of seeds per capsule (63.64 and 68.51). The characters number of capsules on main stem (62.72 and 70.24), days to maturity (25.46 and 26.78), number of capsules on secondary branches (18.69 and 26.83), seed yield per plant (16.89 and 17.81), number of secondary branches (4.712 and 4.956) and days to 50 per cent flowering (4.45 and 6.2) recorded moderate genotypic and phenotypic variances respectively. The characters number of primary branches (1.09 and 1.245), 1000-seed weight (0.173 and 0.175) and capsule length (0.094 and 0.107) recorded lowest genotypic and phenotypic variances respectively.

As the phenotypic and genotypic variances were associated with units, the co-efficient of variation was worked out for valid comparison between the characters. In general, the phenotypic co-efficients of variation were higher

Table 4 : Mean, coefficient of variation, heritability (broad sense), genetic advance and genetic advance as per cent of mean for fourteen characters in 8 parents of sesame

Sl. No.	Character	Mean	Range	Variance		Co-efficient of variation (%)		Heritability Broad Sense (%)	Genetic Advance (GA)	Genetic advance as percent of mean
				Genotypic	Phenotypic	Genotypic	Phenotypic			
1.	Days to 50% flowering	33.08	31.00-36.33	4.45	6.20	6.37	7.53	71.77	3.68	11.12
2.	Days to Maturity	102.99	95.00-108.00	25.46	26.78	4.89	5.02	95.07	10.13	9.83
3.	Plant height (cm)	91.41	59.24-110.86	341.78	363.44	20.22	20.88	94.04	36.93	40.40
4.	No. of primary branches	4.73	2.93-5.80	1.09	1.24	22.67	23.58	87.55	2.01	42.54
5.	No. of Secondary branches	3.32	2.21-8.70	4.71	4.95	65.38	67.05	95.67	4.36	131.32
6.	No. of capsules on main stem	22.3	3.62-29.42	62.72	70.24	35.51	37.58	89.29	15.41	69.1
7.	No. of capsules on primary branches	42.17	20.50-29.42	113.23	149.74	25.23	29.02	76.52	19.06	45.19
8.	No. of capsules on secondary branches	10.17	5.98-20.31	18.69	26.83	42.50	50.93	69.66	7.43	73.05
9.	No. of capsules per plant	74.10	44.43-88.88	185.50	285.50	18.38	22.80	64.97	22.61	30.51
10.	Capsule length (cm)	2.64	2.18-2.98	0.09	0.10	11.62	12.39	87.85	0.59	22.42
11.	No. of seeds per capsule	70.30	62.31-88.53	63.64	68.51	11.34	11.77	92.89	15.83	22.51
12.	1000-seed weight (g)	3.58	3.15-4.24	0.17	0.175	11.61	11.68	98.85	0.85	23.79
13.	Seed yield per plant (g)	18.55	10.84-22.71	16.89	17.81	22.15	22.75	94.83	8.24	44.42
14.	Harvest index (%)	61.66	45.33-80.00	108.15	118.90	16.86	17.68	90.95	20.43	33.13

than genotypic co-efficients of variation. The character number of secondary branches recorded highest genotypic co-efficient of variation (65.38) and phenotypic co-efficient of variation (67.05) followed by number of capsules on secondary branches (42.5 and 50.93), number of capsules on main stem (35.51 and 37.58), number of capsules on primary branches (25.23 and 29.02) and number of primary branches (22.67 and 23.58) seed yield per plant (22.15 and 22.75) and plant height (20.22 and 20.88). The characters number of capsules per plant (18.38 and 22.80), harvest index (16.86 and 17.68), capsule length (11.62 and 12.39), 1000-seed weight (11.61 and 11.68) number of seeds per plant (11.34 and 11.77) recorded moderate genotypic and phenotypic co-efficients of variation, respectively. The characters days to 50 per cent flowering (6.37 and 7.53) and days to maturity (4.89 and 5.02) recorded lowest genotypic and phenotypic co-efficient of variation respectively.

4.3.1.2 Heritability

The highest heritability estimates in broad sense was recorded for 1000-seed weight (98.85%) followed by number of secondary branches (95.67%), days to maturity (95.07%), seed yield per plant (94.83%), plant height (94.04%), number of seeds per capsule (92.89%), harvest index (90.95%), number of capsules on main stem (89.29%), capsule length (87.85%), number of capsules on primary branches (75.62%) days to 50

percent flowering (71.77%). The characters number of capsules on secondary branches (69.66%) and number of capsules per plant (64.97%) showed lowest heritability.

4.3.1.3 Genetic advance as per cent of mean

The character number of secondary branches (131.32%) recorded highest value for genetic advance as per cent of mean followed by number of capsules on secondary branches (73.05%), number of capsules on main stem (69.1%), number of capsules on primary branches (45.19%) seed yield per plant (44.42%), number of primary branches (42.54%) and plant height (40.4%). The characters harvest index (33.13%), number of capsules per plant (30.51%), 1000-seed weight (23.79%), capsule length (22.42%) and number of seeds per capsule (22.51%) recorded moderate genetic advance as per cent of mean. The characters days to 50 percent flowering (11.12%) and days to maturity (9.83%) recorded lowest genetic advance as per cent of mean.

4.3.2. Variability, Heritability and Genetic advance of F₂ progenies

4.3.2.1 Variability

The highest genotypic and phenotypic variances were recorded for number of capsules per plant (467.80 and 567.80) followed by plant height (246.61 and 268.27), number of capsules on primary branches (216.73 and 253.24), harvest index (99.25 and 110.08) and seed yield per plant (37.61 and

Table 5 : Mean, coefficient of variation, heritability (broad sense), genetic advance and genetic advance as per cent of mean for fourteen characters in 28 F₂ progenies of sesame

Sl. No.	Character	Mean	Range	Variance		Co-efficient of variation (%)		Heritability Broad Sense (%)	Genetic Advance (GA)	Genetic advance as percent of mean (%)
				Genotypic	Phenotypic	Genotypic	Phenotypic			
1.	Days to 50% flowering	32.11	30.33-35.00	1.44	3.18	3.74	5.55	45.28	1.66	5.17
2.	Days to Maturity	97.84	91.00-106.67	23.40	24.72	4.94	5.08	94.66	9.69	9.90
3.	Plant height (cm)	108.76	91.91-160.99	246.61	268.27	14.44	15.05	91.94	31.02	28.52
4.	No. of primary branches	4.92	3.25-6.23	0.53	0.68	14.79	19.22	77.03	1.32	26.82
5.	No. of Secondary branches	3.29	2.22-4.34	0.28	0.52	16.14	22.04	53.61	0.80	24.31
6.	No. of capsules on main stem	23.89	16.23-43.55	22.00	29.53	19.63	22.74	74.50	8.34	34.91
7.	No. of capsules on primary branches	52.04	26.14-102.19	216.73	253.24	28.28	30.57	85.58	28.05	53.90
8.	No. of capsules on secondary branches	12.76	6.81-26.26	14.32	22.46	29.65	37.14	63.75	6.22	48.74
9.	No. of capsules per plant	91.82	53.53-172.00	467.80	567.80	23.55	25.95	82.38	40.43	44.03
10.	Capsule length (cm)	3.07	2.44-3.12	0.01	0.03	3.98	5.45	53.57	0.18	5.99
11.	No. of seeds per capsule	66.27	55.50-79.57	23.22	28.10	7.29	7.99	82.63	9.02	13.61
12.	1000-seed weight (g)	3.4	2.86-4.40	0.15	0.15	11.57	11.61	99.35	0.81	23.82
13.	Seed yield per plant (g)	20.2	11.32-39.86	37.61	38.58	30.35	30.74	97.48	12.47	61.73
14.	Harvest index (%)	67.01	49.67-84.00	99.25	110.08	14.86	15.63	90.16	19.48	29.07

38.58). The characters days to maturity (23.40 and 24.72), number of seeds per capsule (23.22 and 28.1), number of capsules on main stem (22.00 and 29.53) and number of capsules on secondary branches (14.32 and 22.46) recorded moderate genotypic and phenotypic variances respectively. The characters days to 50 percent flowering (1.44 and 3.18), number of primary branches (0.53 and 0.68), number of secondary branches (0.282 and 0.526), 1000-seed weight (0.155 and 0.156) and capsule length (0.015 and 0.028) recorded lowest genotypic and phenotypic variances.

The character seed yield per plant recorded highest genotypic (30.35) and phenotypic co-efficient of variation (30.74) followed by number of capsules on secondary branches (29.65 and 37.14), number of capsules on primary branches (28.28 and 30.57), number of capsules per plant (23.55 and 25.95), number of capsules on main stem (19.63 and 22.74). The characters number of seeds per capsule (7.29 and 7.99), days to maturity (4.94 and 5.08), capsule length (3.98 and 5.45) and days to 50 per cent flowering (3.74 and 5.55) recorded lowest genotypic and phenotypic co-efficients of variation.

4.3.2.2 Heritability

Highest heritability estimate was recorded for the character 1000-seed weight (99.35%) followed by seed yield per plant (97.48%), days to maturity (94.66%), plant height (91.94%), harvest index (90.16%), number of capsules

on primary branches (85.58%), number of seeds per capsule (82.63%), number of capsules per plant (82.38%), number of primary branches (77.03%). The characters number of secondary branches (53.61%), capsule length (53.57%) recorded moderate heritability estimates while days to 50 percent flowering (45.28%) recorded lowest heritability estimates.

4.3.2.3 Genetic advance as per cent of mean

The character seed yield per plant (61.73%) recorded highest genetic advance as per cent of mean followed by capsules on primary branches (53.90%), capsules on secondary branches (48.74%), capsules per plant (44.03%), capsules on main stem (34.91%) and harvest index (29.07%). The characters days to maturity (9.90%), capsule length (5.99%) and days to 50 per cent flowering (5.17) recorded lowest genetic advance as per cent of mean.

4.4 COMBINING ABILITY ANALYSIS

Combining ability analysis was carried out based on plot means for eight parents and 28 F_2 progenies. The partitioning of the variation among parents and crosses into those due to general combining ability (GCA) specific combining ability (SCA) and error, along with estimates of component variances for fourteen characters is furnished in Table 6.

4.4.1 Analysis of variance

The mean sum of squares due to GCA and SCA were significant for all the characters except for capsule length which was found to be non-significant. The magnitude of the mean squares due to GCA was more than that of SCA for all characters except for plant height and number of capsules on secondary branches.

The estimates of component variances suggested that specific combining ability variance components were higher than estimates of general combining ability variance components for all characters except for plant height and number of capsules on main stem. The ratio of GCA to SCA was highest for number of capsules on main stem and lowest for seed yield.

4.4.2 General combining ability effects

The estimates of GCA effects of the eight parents under study are furnished in Table 7.

4.4.2.1 Days to 50 per cent flowering

Estimates of GCA effects for days to 50 per cent flowering varied from -1.03 (ACV 2) to 1.57 (CO-1). Three parents viz., CO-1, VRI-1 and DT 9-10-2-25 recorded significant and positive GCA effects, while five parents viz., TNAU 20, CIANNO, TMV 6, ACV 2 and AVT 26 registered significant and negative GCA effects.

Table 6 : Analysis of variance for combining ability in a 8 x 8 diallel of sesame

Sl. No.	Character	Mean sum of squares			σg_i^2	σS_{ij}^2	$\sigma g_i^2 / \sigma S_{ij}^2$
		GCA (df = 7)	SCA (df = 7)	Error (df = 70)			
1	Days to 50% flowering	6.516**	1.727**	0.582	0.050	0.478	0.106
2	Days to maturity	57.920**	20.89**	0.440	0.038	0.362	0.105
3	Plant height (cm)	230.28**	344.22**	7.216	0.631	0.593	1.064
4	Number of primary branches per plant	2.014**	0.361**	0.052	0.0045	0.043	0.106
5	Number of secondary branches per plant	2.390**	0.955**	0.082	0.007	0.067	0.106
6	Number of capsules on main stem	44.711**	30.137**	2.508	0.219	0.207	1.057
7	Number of capsules on primary branches	243.840**	214.05**	12.170	1.064	10.000	0.106
8	Number of capsules on secondary branches	12.350**	20.180**	2.710	0.237	2.231	0.106
9	Number of capsules per plant	529.330**	459.610**	33.330	2.916	27.400	0.106
10	Capsule length (cm)	0.056	0.039	0.004	0.001	0.004	0.100
11	Number of seeds per capsule	53.670**	30.450**	1.627	0.142	1.133	0.125
12	1000-seed weight (g)	0.249**	0.138**	0.000	0.000	0.000	0.100
13	Seed yield per plant (g)	40.010**	31.150**	0.323	0.028	0.266	0.1010
14	Harvest Index (%)	116.860**	99.910**	3.610	0.316	2.969	0.106

** Significant at P = 0.01 level

Table 7 : General combining ability effects of 8 parents for fourteen characters of sesame

Sl. No.	Parents	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of primary branches	Number of secondary branches	Number of capsules on main stem	Number of capsules on primary branches	Number of capsules on secondary branches	Number of capsules per plant	Capsule length (cm)	Number of seeds per capsule	1000-seed weight (g)	Seed yield per plant (g)	Harvest index (%)
1	CO-1	1.57**	4.34**	11.10**	0.26**	-0.18**	2.35**	8.32**	0.36	11.95**	-0.02**	4.46**	0.12**	4.13**	-1.18**
2	TNAU 20	-0.27**	0.11**	0.53	0.13**	-0.04**	1.12**	1.71**	-0.33	1.18	0.09**	-0.59**	-0.10**	-0.36**	-2.85**
3	CIANNO	-0.67**	-3.89**	-3.65**	-0.92**	-0.36**	-2.11**	-5.55**	-1.01**	-8.44**	-0.12**	2.53**	-0.26**	-2.36**	-4.92**
4	TMV6	-0.33**	-1.39**	-0.71	-0.05**	-0.29**	1.33**	-0.07	0.28	1.30	-0.05**	-1.67**	-0.06**	-0.55**	-0.78*
5	VRI-1	0.53**	-0.46**	-2.68**	0.23**	0.02**	0.28	-3.12**	-0.33	-2.92	-0.05**	-2.08**	-0.10**	-0.92**	5.15**
6	ACV 2	-1.03**	-1.16**	-2.37**	-0.35**	-0.38**	0.06	-3.54**	-1.68**	-2.71	0.06**	-1.45**	0.01**	-0.49**	-0.35
7	DT 9-10-2-25	0.33**	1.38**	0.97	0.52**	1.13**	-4.13**	-3.50**	1.96**	-8.47**	0.08**	0.11	0.20**	-1.09**	4.55**
8	AVT 26	-0.13*	1.08**	-3.17**	0.18**	0.09**	1.09**	5.76**	0.75**	8.12**	0.01**	-1.31**	0.18**	1.64**	0.38
	SE (g_i)	0.051	0.03	0.63	0.00	0.01	0.22	1.26	0.23	2.91	0.00	0.14	0.00	0.01	0.32
	SE ($g_i - g_j$)	0.11	0.09	1.44	0.01	0.01	0.50	2.43	0.54	6.60	0.009	0.32	0.00	0.06	0.72
	CD at 5%	0.10	0.077	1.25	0.00	0.01	0.437	2.11	0.45	5.79	0.00	0.28	0.00	0.05	0.63
	CD at 1%	0.13	0.10	1.66	0.00	0.01	0.58	2.51	0.61	7.71	0.00	0.37	0.00	0.07	0.84

* Significant at 0.05 level

** Significant at 0.01 level

4.4.2.2 Days to maturity

The maximum GCA effects was revealed in CO-1 (4.34), while minimum in CIANNO (-3.89). Four parents viz., CO-1, TNAU 20, DT 9-10-2-25 and AVT 26 recorded significant and positive GCA effects, while remaining four parents viz., CIANNO, TMV 6, VR-1 and ACV 2 registered significant and negative GCA effects.

4.4.2.3 Plant height

The GCA effects for this trait had a range between -3.65 (CIANNO) and 11.10 (CO-1). The parent CO-1 scored highest significant and positive GCA effects, while two parents viz., TNAU 20 and DT-9-10-2-25 recorded non-significant and positive GCA effects. Four parents viz., CIANNO, VRI-1, ACV 2 and AVT 26 recorded significant and negative GCA effects while the parent TMV 6 recorded non-significant and negative GCA effects.

4.4.2.4 Number of primary branches

The GCA effects for this trait ranged from -0.92 (CIANNO) to 0.52 (DT 9-10-2-25). Five parents viz., CO-1, TNAU 20, VRI-1, DT 9-10-2-25 and AVT 26 displayed significant and positive GCA effects, while the parents CIANNO, TMV 6, and ACV 2 registered significant and negative GCA effects.

4.4.2.5 Number of secondary branches

The range of GCA effects for number of secondary branches varied from -0.38 (ACV 2) to 1.13 (DT 9-10-2-25). Significant and positive GCA effects were observed in VRI-1, DT 9-10-2-25 and AVT 26. Five parent viz., CO-1, TNAU 20, CIANNO, TMV 6 and ACV 2 displayed negative and significant GCA effects.

4.4.2.6 Number of capsules on main stem

The GCA effects were highest in CO-1 (2.35), while lowest in DT 9-10-2-25 (-4.13). The parents viz., CO-1, TNAU 20, TMV 6 and AVT 26 showed significant and positive GCA effects while VRI-1 and ACV 2 showed non-significant and positive GCA effects. CIANNO and DT 9-10-2-25 showed significant and negative GCA effects.

4.4.2.7. Number of capsules on primary branches

Estimates of GCA effects for capsules on primary branches ranged from -5.55 (CIANNO) to 8.32 (CO-1). Significant and positive GCA effects were observed in three parents viz., CO-1, TNAU 20 and AVT 26. Negative and significant GCA effects were observed in CIANNO, VRI-1, ACV 2 and DT 9-10-2-25. Negative and non-significant GCA effects was observed only in TMV 6.

4.4.2.8 Number of capsules on secondary branches

As far as capsules on secondary branches were concerned, DT 9-10-2-25 (1.96) and AVT 26 (0.75) showed positive and significant GCA effects while the parents CIANNO and ACV 2 showed significant and negative GCA effects. CO-1 and TMV 6 showed non-significant and positive GCA effects while TNAU 20 and VRI-1 showed non-significant and negative GCA effects.

4.4.2.9 Total number of capsules per plant

The range of GCA effects for this trait varied from -8.47 (DT 9-10-2-25) to 11.95 (CO-1). The parents viz., CO-1 and AVT 26 showed significant and positive GCA effects while TNAU 20, TMV 6 showed non-significant and positive GCA effects. The parents viz., CIANNO, DT-9-10-2-25 showed negative and significant GCA effects while VRI-1 and ACV 2 showed non-significant and negative GCA effects.

4.4.2.10 Capsule length

The GCA effects for capsule length ranged from -0.12 (CIANNO) to 0.09 (TNAU 20). Significant and positive GCA effects were recorded in TNAU 20, ACV 2, DT-9-10-2-25 and AVT 26, while other parents viz., CO-1, CIANNO, TMV 6, VRI-1 registered significant and negative GCA effects.

4.4.2.11 Number of seeds per capsule

Estimates of GCA effects for number of seeds per capsule ranged from -2.08 (VRI-1) to 4.46 (CO-1). Highly significant and positive GCA effects were observed in parents viz., CO-1 and CIANNO. Negative and highly significant GCA effects were observed in TNAU 20, TMV 6, VRI-1, ACV 2 and AVT 26.

4.4.2.12 1000-seed weight

The magnitude of GCA effects for 1000-seed weight ranged from -0.26 (CIANNO) to 0.20 (DT 9-10-2-25). Significant and positive GCA effects were noticed for CO-1, ACV 2, DT9-10-2-25, AVT 26, while significant and negative GCA effects were registered in four parents namely, TNAU 20, CIANNO, TMV 6 and VRI-1.

4.4.2.13 Seed yield per plant

For seed yield per plant, the minimum GCA effects of -2.36 was observed in CIANNO while maximum effect of 4.13 was in CO-1. The parents viz., CO-1 and AVT 26 registered significant and positive GCA effects while all other parents viz., TNAU 20, CIANNO, TMV 6, VRI-1, ACV 2 and DT 9-10-2-25 registered significant and negative GCA effects.

4.4.2.14 Harvest index

As far as harvest index was concerned the range is from -4.92 (CIANNO) to 5.15 (VRI-1) and highly significant and positive GCA effects were observed among parents viz., VRI-1 and DT-9-10-2-25 while highly significant and negative GCA effects were observed among parents viz., CO-1, TNAU 20, CIANNO and TMV 8.

4.4.3 Specific Combining Ability Effects

Estimates of specific combining ability effects for fourteen characters of 28 hybrids are displayed in Table 8.

4.4.3.1 Days to 50 per cent flowering

Estimates of SCA effects for days to 50 per cent flowering ranged from -2.07 (VRI-1 x AVT 26) to 1.8 (CO-1 x ACV-2). Highly significant and negative SCA effects were displayed by six hybrids viz., CO-1 x CIANNO, CO-1 x TMV 6, CIANNO x VRI-1, VRI-1 x AVT 26, ACV 2 x DT 9-10-2-25 and DT 9-10-2-25 x AVT 26. Non-significant and negative SCA effects were observed in eleven hybrids. Highly significant and positive SCA effects were observed in CO-1 x ACV 2, CO-1 x AVT 26, TNAU 20 x CIANNO, TNAU 20 x TMV 6, TMV 6 x VRI-1 and TMV 6 x ACV 2. Non-significant and positive SCA effects were observed in CO-1 x DT 9-10-2-25, TNAU 20 x VRI-1, TNAU 20 x ACV 2, CIANNO x DT-10-2-25- and TMV 6 x DT 9-10-2-25.

Table 8 : Specific combining ability effects of 28 F₂ progenies for fourteen characters in a 8 x 8 diallel of sesame

Sl. No.	Hybrid	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of primary branches	Number of secondary branches	Number of capsules on main stem	Number of capsules on primary branches	Number of capsules on secondary branches	Number of capsules per plant	Capsule length (cm)	Number of seeds per capsule	1000-seed weight (g)	Seed yield per plant (g)	Harvest index (%)
1	CO-1 x TNAU 20	-0.63	2.56**	-19.39**	-0.96**	-0.47**	-1.98	-2.87	-5.40*	-9.58	-0.14**	2.40	-0.16**	-2.07**	-5.95*
2	CO-1 x CIANNO	-1.90**	1.23**	-10.55**	0.21**	0.63**	-3.70	-12.01	-1.24	-17.83	-0.14**	-1.78	0.00	-5.00**	8.45**
3	CO-1 x TMV 6	-1.57**	-2.27**	1.64**	0.11**	1.28**	-0.99	7.34	6.45**	12.41	0.07**	-2.09	-0.08**	3.24**	-12.35**
4	CO-1 x VRI-1	-0.77	-3.54**	-7.65**	0.10*	0.57**	0.73	-0.18	-0.93	-11.85	0.13**	3.48*	-0.39**	-3.25**	-13.95**
5	CO-1 x ACV 2	1.80**	4.16**	-7.99**	-0.14**	-0.30**	-1.63	-9.13	-2.29	-16.15	0.06**	-1.07	-0.08**	-4.50**	2.89
6	CO-1 x DT 9-10-2-25	0.10	1.96**	43.73**	0.48**	-0.88**	5.96**	9.33	2.29	19.75	0.01*	7.83**	0.35**	9.28**	15.99**
7	CO-1 x AVT 26	1.23*	-0.74*	33.25**	-0.42**	0.53**	15.88**	38.03**	12.97**	65.71*	0.11**	-3.39*	0.51**	14.67**	15.49**
8	TNAU 20 x CIANNO	1.27**	4.13**	9.51**	0.62**	0.66**	5.61**	18.21	6.79**	31.98	0.10**	0.09	0.06**	8.03**	-2.88
9	TNAU 20 x TMV 6	1.27**	0.63	2.12**	1.14**	0.34**	0.98	-3.13	1.78	1.46	0.06**	-0.53	1.12**	7.69**	12.99**
10	TNAU 20 x VRI-1	0.07	-0.31	-10.07**	-1.26**	0.02	5.29*	-7.78	0.88	-10.84	0.04**	-0.23	-0.11**	-3.78**	17.72**
11	TNAU 20 x ACV 2	0.63	-5.27**	10.93**	-0.27**	-0.02	-1.72	14.22	3.02	14.66	-0.02**	-0.41	-0.12**	2.26**	3.55
12	TNAU 20 x DT 9-10-2-25	-0.40	-5.81**	27.14**	0.65**	-1.26**	7.25**	10.15	-0.37	21.22	0.11**	-1.12	-0.52**	0.81**	6.23*
13	TNAU 20 x AVT 26	-0.60	-7.51**	-7.94**	0.65**	0.97**	-4.10*	-18.21	4.61**	-16.84	0.20**	-2.07	-0.07**	-3.20**	-5.85
14	CIANNO x TMV 6	-1.00	-1.71**	-0.58	0.16**	-0.47**	-3.32	-6.30	-4.15	-13.34	0.35**	-5.51**	0.33**	-1.24**	-4.28
15	CIANNO x VRI-1	-1.53**	-3.31**	-3.96**	0.08*	-0.06	0.04	3.54	0.60	3.88	0.37**	-6.98**	-0.15**	-2.42**	3.12
16	CIANNO x ACV 2	-0.97	-2.94**	-5.43**	-0.11**	-0.15*	-2.95	-5.31	-2.31	-13.14	0.18**	-6.43**	-0.26**	-5.25**	4.62
17	CIANNO x DT 9-10-2-25	0.33	-4.47**	-2.33**	-0.73**	-0.70**	-1.76	-14.88	-1.99	-15.79	0.05**	-5.81**	-0.07**	-3.95**	1.39
18	CIANNO x AVT 26	-0.20	-3.17**	15.75**	0.09*	0.10	-0.16	8.59	-2.33	5.62	-0.14**	-6.17**	-0.51**	-6.17**	-14.11**

Contd... Table 8

Sl. No.	Hybrid	Days to 50% flow- ering	Days to maturity	Plant height (cm)	Number of primary branches	Number of secondary branches	Number of capsules on main stem	Number of capsules on primary branches	Number of capsules on secondary branches	Number of capsules per plant	Capsule length (cm)	Number of seeds per capsule	1000-seed weight (g)	Seed yield per plant (g)	Harvest index (%)
19	TMV 6 x VRI-1	1.47**	1.86**	-9.88**	-0.32**	-0.32**	1.66	-6.41	-0.85	-5.34	0.23**	0.87	-0.23**	-1.62**	-13.35**
20	TMV6 x ACV 2	1.37**	2.56**	-0.90	-0.07	0.39**	0.68	-0.43	1.39	22.12	0.10**	-0.81	-0.07**	-0.90**	-8.18**
21	TMV6 x DT 9-10-2-25	0.67	-0.64	14.70**	0.00	-0.84**	5.24*	22.88*	-0.22	0.84	0.11**	-3.42*	-0.45**	-2.49**	-1.75
22	TMV6 x AVT 26	-0.87	-1.99**	7.95**	1.11**	0.68**	-1.98	-11.77	-0.32	-11.12	0.09**	-0.75	-0.42**	-4.83**	7.75*
23	VRI-1 x ACV 2	-0.17	0.63	3.45**	0.49**	0.37**	-4.46*	-4.61	1.67	-9.82	-0.06**	2.65*	0.06**	0.88**	0.89
24	VRI-1 x DT9-10-2-25	-0.20	-4.91**	-0.76	0.10*	-0.27**	-1.12	1.23	-1.44	1.55	-0.08**	3.13*	0.40**	3.66**	-1.01
25	VRI-1 x AVT 26	-2.07**	-6.72**	16.36**	0.02	1.39**	-0.82	16.27	4.18	19.14	-0.15**	-8.29**	0.09**	-1.10**	-4.85
26	ACV 2 x DT 9-10-2-25	-1.30**	-4.21**	10.07**	0.47**	-0.53**	5.37*	7.61	-0.92	12.51	-0.14**	0.61	-0.03**	3.14**	-5.85
27	ACV 2 x AVT 26	-0.83	-2.24**	-2.19**	0.01	0.10	-1.77	10.61	-0.02	6.11	-0.05**	1.79	-0.41**	2.66**	0.65
28	DT9-10-2-25 x AVT 26	-1.20*	5.56**	3.23**	-0.56**	-1.75**	3.78	8.83	-5.55*	9.62	-0.04**	8.95**	-0.06**	2.35**	11.09**
	SE (S _d)	0.47	0.36	0.59	0.04	0.67	2.06	10.0	2.23	27.40	0.00	1.33	0.00	0.26	2.96
	CD at 5%	0.93	0.71	1.17	0.07	0.13	4.09	19.9	4.44	54.52	0.00	2.64	0.00	0.51	5.89
	CD at 1%	1.24	0.95	1.56	0.10	0.17	5.46	26.5	5.90	72.71	0.01	3.52	0.00	0.66	7.84

* Significant at 0.05 level

** Significant at 0.01 level

4.4.3.3 Days to maturity

Estimates of SCA effects for days to maturity ranged from -7.51 (TNAU 20 x AVT 26) to 5.56 (DT 9-10-2-25 x AVT 26). Sixteen hybrids showed highly significant and negative SCA effects while two hybrids TNAU 20 x VRI-1 and TMV 6 x DT-9-10-2-25 displayed non-significant and negative SCA effects. Eight hybrids recorded highly significant positive SCA effects viz., CO-1 x TNAU 20, CO-1 x CIANNO, CO-1 x ACV 2, CO-1 x DT-9-10-2-25, TNAU 20 x CIANNO, TMV 6 x VRI-1, TMV 6 x ACV 2 and DT-9-10-2-25 x AVT 26 while two hybrids viz., TNAU 20 x TMV 6 and VRI-1 x ACV 2 exhibited non-significant and positive SCA effects.

4.4.3.3 Plant height

Estimates of SCA effects for plant height ranged from -19.39 (CO-1 x TNAU 20) to 43.73 (CO-1 x DT-9-10-2-25). Highly significant and positive SCA effects were obtained for fourteen hybrids viz., CO-1 x TMV 6, CO-1 x DT-9-10-2-25, CO-1 x AVT 26, TNAU 20 x CIANNO, TNAU 20 x TMV 6, TNAU 20 x ACV 2, TNAU 20 x DT-9-10-2-25, CIANNO x AVT 26, TMV 6 x DT 9-10-2-25, TMV 6 x AVT 26, VRI-1 x ACV 2, VRI-1 x AVT 26, ACV 2 x DT 9-10-2-25 and DT-9-10-2-25 x AVT 26. Eleven hybrids displayed highly significantly and negative SCA effects viz., CO-1 x TNAU 20, CO-1 x CIANNO, CO-1 x VRI-1 , CO-1 x ACV 2, TNAU 20 x VRI-1, TNAU 20 x AVT 26, CIANNO x VRI-1, CIANNO x ACV 2,

CIANNO x DT-9-10-2-25, TMV 6 x VRI-1 and ACV 2 x AVT 2, while three hybrids displayed non-significant and negative SCA effects.

4.4.3.4 Number of primary branches

For the trait number of primary branches the hybrids had a range from -1.26 (TNAU 20 x VRI-1) to 1.14 (TNAU-20 x TMV-6). Fifteen hybrids recorded significant and positive SCA effects while three hybrids recorded non-significant and positive SCA effects viz., TMV 6 x DT-9-10-2-25, VRI-I x AVT 26 and ACV 2 x AVT 26. Nine hybrids recorded significant and negative SCA effects viz., CO-1 x TNAU 20, CO-1 x ACV 2, CO-1 x AVT 26, TNAU 20 x VRI-1, TNAU 20 x ACV 2, CIANNO x ACV 2, CIANNO x DT-9-10-2-25, TMV 6 x VRI-1 and DT-9-10-2-25 x AVT 26. Non-significant and negative SCA effects was recorded by TMV 6 x ACV 2.

4.4.3.5 Number of secondary branches

The range of SCA effects for number of secondary branches varied from -1.75 (DT 9-10-2-25 x AVT 26) to 1.39 (VRI-1 x AVT 26). Highly significant and positive SCA effects were recorded by CO-1 x CIANNO, CO-1 x TMV 6, CO-1 x VRI-1, CO-1 x AVT 26, TNAU 20 x CIANNO, TNAU 20 x TMV 6, TNAU 20 x AVT 26, TMV 6 x ACV 2, TMV 6 x AVT 26, VRI-1 x ACV 2 and VRI-1 x AVT 26. Non significant and positive

SCA effects were observed by three hybrids. Highly significant and negative SCA effects were observed by twelve hybrids whereas non-significant and negative SCA effects were observed by TNAU 20 x ACV 2 and CIANNO x VRI-1.

4.4.3.6 Number of capsules on mainstem

The range of SCA effects for this trait ranged from -4.46 (VRI-1 x ACV 2) to 15.88 (CO-1 x AVT 26). Highly significant and positive SCA effect were observed in CO-1 x DT-9-10-2-25, CO-1 x AVT 26, TNAU 20 x CIANNO, TNAU 20 x VRI-1, TNAU 20 x DT-9-10-2-25, TMV 6 x DT 9-10-2-25 and ACV 2 x DT 9-10-2-25. Non-significant and positive SCA effect were observed in six hybrids. Highly significant and negative SCA effects were observed in TNAU 20 x AVT 26 and VRI-1 x ACV 2 while non-significant and negative SCA effects were observed in thirteen hybrids viz., CO-1 x TNAU 20, CO-1 x CIANNO, CO-1 x TMV 6, CO-1 x ACV 2, TNAU 20 x ACV 2, CIANNO x TMV 6, CIANNO x ACV 2, CIANNO x DT-9-10-2-25, CIANNO x AVT 26, TMV 6 x AVT 26, VRI-1 x DT 9-10-2-25, VRI-1 x AVT 26 and ACV 2 x AVT 26.

4.4.3.7 Number of capsules on primary branches

Capsules on primary branches recorded SCA effects that ranged from -18.21 (TNAU 20 x AVT 26) to 38.03 (CO-1 x AVT 26). Highly significant

and positive SCA effects were recorded in CO-1 x AVT 26 and TMV 6 x DT-9-10-2-25. Non-significant and positive SCA effects were recorded in twelve hybrids. Non-significant and negative SCA effects were recorded in fourteen hybrids. No hybrid recorded highly significant and negative SCA effects.

4.4.3.8 Number of capsules on secondary branches

Magnitude to SCA effects for capsules on secondary branches ranged from -5.55 (DT-9-10-2-25 x AVT 26) to 12.97 (CO-1 x AVT 26). Highly significant and positive SCA effects were recorded in CO-1 x TMV 6, CO-1 x AVT 26, TNAU 20 x CIANNO and TNAU 20 x AVT 26. Non significant and positive SCA effects were recorded in eight hybrids. Highly significant and negative SCA effects were observed in CO-1 x TNAU 20 and DT-9-2-25 x AVT 26. Non-significant and negative SCA effects were observed in fourteen hybrids.

4.4.3.9 Total number of capsules per plant

SCA estimates for number of capsules per plant varied from -17.83 (CO-1 x CIANNO) to 65.71 (CO-1 x AVT 26). Fifteen hybrids exhibited non-significant and positive SCA effects. Only one hybrid exhibited significant and positive SCA effect i.e, CO-1 x AVT 26. Remaining all hybrids exhibited non-significant and negative SCA effects.

4.4.3.10 Capsule length

For capsule length, the lowest SCA effects of -0.15 (VRI-1 x AVT 26) and the highest SCA effects of 0.37 (CIANNO x VRI-1) were observed. Highly significant and positive SCA effects were observed in CO-1 x TMV 6, CO-1 x VRI-1, CO-1 x ACV 2, CO-1 x DT-9-10-2-25, CO-1 x AVT 26, TNAU 20 x CIANNO, TNAU 20 x TMV 6, TNAU 20 x VRI-1, TNAU 20 x DT 9-10-2-25, TNAU 20 x AVT 26, CIANNO x TMV 6, CIANNO x VRI-1, CIANNO x ACV 2, CIANNO x DT 9-10-2-25, TMV 6 x VRI-1, TMV 6 x ACV 2, TMV 6 x DT-9-10-2-25 and TMV 6 x AVT 26. Remaining all hybrids exhibited highly significant and negative SCA effects.

4.4.3.11 Number of seeds per capsule

The range of SCA effects for number of seeds per capsule varied from -8.29 (VRI-1 x AVT 26) to 8.95 (DT-9-10-2-25 x AVT 26). Highly significant and positive SCA effects were observed in five hybrids viz., CO-1 x VRI-1, CO-1 x DT-9-10-2-25, VRI-1 x ACV 2, VRI-1 x DT-9-10-2-25 and DT-9-10-2-25 x AVT 26. Non-significant and positive SCA effects were observed in five hybrids. Highly significant and negative SCA effects were observed in eight hybrids and non-significant and negative SCA effects were observed among ten hybrids.

4.4.3.12 1000-seed weight (g)

The magnitude of SCA effects ranged from -0.52 (TNAU 20 x DT-9-10-2-25) to 1.12 (TNAU 20 x TMV 6). Eight out of 28 hybrids recorded highly significant and positive SCA effects while on nineteen hybrids highly significant and negative SCA effects were noticed.

4.4.3.13 Seed yield per plant

The maximum SCA effects for seed yield per plant was observed in CO-1 x AVT 26 (14.67), while minimum was noticed in CIANNO x AVT 26 (-6.17). Highly significant and positive SCA effects were observed in CO-1 x TMV 6, CO-1 x DT-9-10-2-25, CO-1 x AVT 26, TNAU 20 x CIANNO, TNAU 20 x TMV 6, TNAU 20 x ACV 2, TNAU 20 x DT-9-10-2-25, VRI-1 x ACV 2, VRI-1 x DT-9-10-2-25, ACV 2 x DT-9-10-2-25, ACV 2 x AVT 26 and DT-9-10-2-25 x AVT 26. Remaining all hybrids exhibited highly significant and negative SCA effects.

4.4.3.14 Harvest index

The magnitude of SCA effects ranged from -14.11 (CIANNO x AVT 26) to 17.72 (TNAU 20 x VRI-1). Eight out of 28 hybrids recorded highly significant and positive SCA effects while seven hybrids exhibited non-significant and positive SCA effects. Six hybrids recorded highly significant and negative SCA effects and seven hybrids exhibited non-significant and negative SCA effects.

4.5 THE SEGREGATION PATTERN

Segregation pattern of F_2 progenies for seed yield per plant, number of capsules per plant and for three best crosses (for seed yield per plant, number of capsules per plant, number of branches per plant and 1000-seed weight) were depicted graphically (Fig.1,2,3,4,5 and 6). Appropriate class intervals were chosen to group F_2 progenies for the above attributes and the percentage of plants falling in each class interval was indicated (Table 9, 10, 11, 12, 13 and 14). The percentage of F_2 plants showing higher values in comparison with the mean value of the concerned F_2 progenies for seed yield per plant and number of capsules per plant were indicated in Table 11.

4.5.1 Segregation pattern for number of capsules per plant

In the cross combination CO-1 x TNAU 20, the F_2 mean was 89.77 while the parental means were 88.88 and 72.54 respectively. The F_2 mean and mean of the first parent were in the class interval of 80.10-120.09 whereas the mean of the second parent occupied the class interval of 40.10-80.09. The F_2 mean was exceeded by 44.44 per cent in the population.

In the F_2 population of the cross CO-1 x CIANNO, the mean number of capsules per plant was 71.90, while the parental means were 88.88 and 78.66 respectively. The F_2 mean and the mean of the second parent were in the class interval of 40.10-80.09 whereas first parent mean was in the class

Table 9 : Segregation pattern in F₂ generation of sesame for number of capsules per plant

Sl. No.	Cross	Class interval (%)										Mean		
		0.00-40.09	40.10-80.09	80.10-120.09	120.10-160.09	160.10-200.09	200.10-240.09	240.10-280.09	280.10-320.09	320.10-360.0	P ₁	P ₂	F ₂	
1.	CO-1 x TNAU 20	—	39.96	32.19	23.31	2.22	—	—	—	—	88.88	72.54	89.77	
2.	CO-1 x CIANNO	4.44	34.41	51.06	8.88	—	—	—	—	—	88.88	78.66	71.90	
3.	CO-1 x TMV 6	—	12.21	36.63	29.97	17.76	2.55	—	—	—	88.88	85.31	111.88	
4.	CO-1 x VRI-1	—	32.19	46.62	15.54	3.33	—	—	—	—	88.88	87.01	83.40	
5.	CO-1 x ACV 2	9.99	29.97	54.39	4.44	—	—	—	—	—	88.88	72.65	78.31	
6.	CO-1 x DT 9-10-2-25	1.11	19.98	37.74	24.42	7.77	5.55	3.33	—	—	88.88	44.43	109.45	
7.	CO-1 x AVT 26	—	7.77	15.54	18.87	17.76	9.99	15.54	4.44	3.33	88.88	63.35	172.00	
8.	TNAU 20 x CIANNO	—	17.76	34.61	23.31	17.76	—	—	—	—	72.54	78.66	110.94	
9.	TNAU 20 x TMV 6	4.44	27.75	36.63	16.65	9.99	5.44	—	—	—	72.54	85.31	90.16	
10.	TNAU 20 x VRI-1	9.99	45.51	33.30	7.77	3.33	—	—	—	—	72.54	87.01	73.64	
11.	TNAU 20 x ACV 2	8.88	38.85	25.53	12.22	13.32	1.11	—	—	—	72.54	72.65	99.35	
12.	TNAU 20 x DT-9-10-2-25	2.22	9.99	29.97	32.19	19.98	5.55	—	—	—	72.54	44.43	100.16	
13.	TNAU 20 x AVT 26	11.11	29.97	42.18	16.65	—	—	—	—	—	72.54	63.35	78.68	

Contd... Table 9

Sl. No.	Cross	Class interval (%)									Mean		
		0.00-40.09	40.10-80.09	80.10-120.09	120.10-160.09	160.10-200.09	200.10-240.09	240.10-280.09	280.10-320.09	320.10-360.0	P ₁	P ₂	F ₂
14.	CIANNO x TMV 6	8.88	33.30	41.07	11.10	1.11	1.11	—	1.11	—	78.66	85.31	65.75
15.	CIANNO x VRI-1	17.76	34.41	42.18	5.55	—	—	—	—	—	78.66	87.01	78.74
16.	CIANNO x ACV 2	21.09	44.40	35.52	—	—	—	—	—	—	78.66	72.65	61.93
17.	CIANNO x DT 9-10-2-25	28.86	47.73	23.31	—	—	—	—	—	—	78.66	44.43	53.53
18.	CIANNO x AVT 26	15.54	21.09	26.64	24.42	11.10	1.11	2.22	—	—	78.66	63.35	91.53
19.	TMV6 x VRI-1	13.32	33.30	45.51	3.33	1.11	1.1	—	—	—	85.31	87.01	78.26
20.	TMV6 x ACV 2	11.11	41.07	39.96	6.66	—	—	—	—	—	85.31	72.65	106.93
21.	TMV6 x DT 9-10-2-25	7.77	17.76	41.07	31.08	2.22	—	—	—	—	85.31	44.43	79.90
22.	TMV 6 x AVT 26	5.55	26.64	37.74	28.86	—	—	—	—	—	85.31	63.35	84.52
23.	VRI-1 x ACV 2	6.66	49.94	31.19	11.10	—	—	—	—	—	87.01	72.65	70.77
24.	VRI-1 x DT 9-10-2-25	14.43	38.85	23.31	17.76	3.33	—	—	—	—	87.01	44.43	76.38
25.	VRI-1 x AVT 26	7.77	26.64	21.09	29.97	13.32	—	—	—	—	87.01	63.35	110.56
26.	ACV 2 x DT 9-10-2-25	6.66	27.75	37.74	22.20	2.22	1.11	1.11	1.11	—	72.65	44.43	87.56
27.	ACV 2 x AVT 26	4.44	33.30	29.97	21.09	5.55	2.22	1.11	1.11	—	72.65	63.35	97.74
28.	DT 9-10-2-25 x AVT 26	3.33	18.87	39.96	25.53	11.10	1.11	—	—	—	44.43	63.35	95.49

interval of 80.10-120.09. The F_2 mean was exceeded by 36.63 per cent of the population.

In Co-1 x TMV 6, the F_2 population had a mean of 111.88 with parental means of 88.88 and 85.31 respectively. The means of F_2 and the parental means occupied the class interval of 80.10-120.09. About 28.86 percent of the population showed higher values than mean value.

For the cross Co-1 x VRI-1, the F_2 mean was 83.40 while the parental means were 88.88 and 87.01 respectively. Both parental means and F_2 mean were in the class interval of 80.10-120.09. The mean of F_2 was exceed by 32.19 per cent of the population.

For the cross Co-1 x ACV 2, the mean number of capsules per plant was 79.31. The means of the parents were 88.88 and 72.65 respectively. the F_2 mean and the mean of the lesser parent fall in the class interval of 40.10-80.09, while the mean of the better parent fall in the class interval of 80.10-120.09. The F_2 mean was exceeded by 36.63 per cent of the population.

The segregating population of Co-1 x DT 9-10-2-25 had a mean of 109.45 with parental means of 88.88 and 44.43 respectively. The F_2 mean and the better parent mean occupied the class interval of 80.10-120.09 while the lesser parent mean was in the class interval of 40.10-80.09. The mean of F_2 was exceeded by 32.19 per cent of the population.

The cross Co-1 x AVT 26 showed a F_2 mean of 172.00 with parental means of 88.88 and 63.35 respectively. The F_2 mean, better parent mean and lesser parent mean were occupied the class interval of 160.10-200.09, 80.10-120.09 and 40.10-80.09 respectively. About 36.63 per cent of the population exceeded the F_2 mean.

For the cross TNAU 20 x CIANNO, the mean of the F_2 population was 110.94 with parental means of 72.54 and 78.66 respectively. The mean of the F_2 population and both parental means were occupied the class intervals of 80.10-120.09 and 40.10-80.09 respectively. The F_2 mean was exceeded by 31.08 per cent of the population.

In the cross combination TNAU 20 x TMV 6 the F_2 progenies showed a mean value of 90.16. The parental means were 72.54 and 85.31 respectively. The F_2 mean and the better parent mean occupied the class interval of 80.10-120.09 while lesser parent lay in the class interval 40.10-80.09. About 32.19 per cent of the population had higher values than the mean value.

For the cross combination TNAU 20 x VRI-1, the F_2 mean was 73.64. While the parental means were 72.54 and 87.01 respectively. The mean of the F_2 and mean of the lesser parent occupied the class interval 40.10-80.09, while the better parent occupied the class interval of 80.10-120.09. The F_2 mean was exceeded by only 31.08 per cent of the population.

In the cross, TNAU 20 x ACV 2, the F_2 mean recorded a value of 99.35 with parental means of 72.54 and 72.65 respectively. The F_2 mean and the parental means lay in the class interval of 80.10-120.09 and 40.10-80.09 respectively. About 41.07 per cent of the population exceeded the F_2 mean value.

For the cross TNAU 20 x DT 9-10-2-25, the mean of the population was 100.16 and the parental means were 72.54 and 44.43 respectively. The mean of F_2 population, the mean of parents were in the class interval of 80.10-120.09 and 40.10-80.09 respectively. The mean of F_2 was exceeded by 32.19 per cent of the population.

For the cross TNAU 20 x AVT 26, the mean of the population was 78.68 and the parental means were 72.54 and 63.35 respectively. The mean of the F_2 population and mean of the parents were in the class interval of 40.10-80.09. The mean of F_2 was exceeded by 32.19 per cent of the population.

The F_2 mean for the cross CIANNO x TMV 6 was 65.75 and the parental means were 78.66 and 85.31 respectively. The F_2 mean, the mean of the of the lesser parent lay in the class interval of 40.10-80.09, while the mean of the better parent was in the class interval of 80.10-120.09. The F_2 mean was exceeded by 33.33 per cent of the population.

In CIANNO x VRI-1, F_2 had a mean value of 78.74, while the parental means were 78.66 and 87.01 respectively. The F_2 mean and the mean of first parent were in the class interval of 40.10-80.09 and the mean of second parent in 80.10-120.09 class interval. The F_2 population mean was exceeded by 34.41 per cent of the population.

For the cross, CIANNO x ACV 2 the mean number of capsules per plant was 61.93 while mean number of capsules per plant in parents were 78.66 and 72.65 respectively. The F_2 and parental means were occupied a class interval of 40.10-80.09. The F_2 mean was exceeded by 39.96 per cent of the population.

In the cross CIANNO x DT 9-10-2-25, the mean of the F_2 population was 53.53 while the parental means were 78.66 and 44.43 respectively. The F_2 mean and parental means lay in the class interval of 40.10-80.09. The F_2 mean was exceeded by 32.19 per cent of the population.

For CIANNO x AVT 26, the F_2 mean was 91.53 while the means of the parents were 78.66 and 63.35 respectively. The parental means were in the class interval of 40.10-120.09. About 38.85 per cent of the population had higher values than mean value of F_2 .

The F_2 mean for the cross TMV 6 x VRI-1 was 79.26 and the means of the parents were 85.31 and 87.01 respectively. The parental means and F_2 mean were in the class interval of 80.10-120.09 and 40.10-80.09 respectively. The F_2 mean was exceeded by 32.19 per cent of the population.

In the cross TMV 6 x ACV 2, the F_2 mean was 106.93, while the parental means were 85.31 and 72.65 respectively. The mean of the first parent and F_2 were in the class interval of 80.10-120.09, while the mean of the second parent was in the class interval of 40.10-80.09. The F_2 mean was exceeded by 16.65 per cent of the population.

The F_2 mean of the cross TMV 6 x DT 9-10-2-25 was 79.90 while the parental means were 85.31 and 44.43 respectively. The F_2 mean and the second parent mean were in the class interval of 40.10-80.09 while first parent mean lay in the class interval of 80.10-120.09. About 31.08 per cent of the population showed high values than F_2 mean.

For the cross TMV 6 x AVT 26, the F_2 mean was 84.52 and the parental means were 85.31 and 63.35 respectively. The F_2 mean, the mean of the better parent occupied the class interval of 80.10-120.09, while the mean of the lesser parent was in the class interval of 40.10-80.09. The F_2 mean was exceeded by 27.75 per cent of the population.

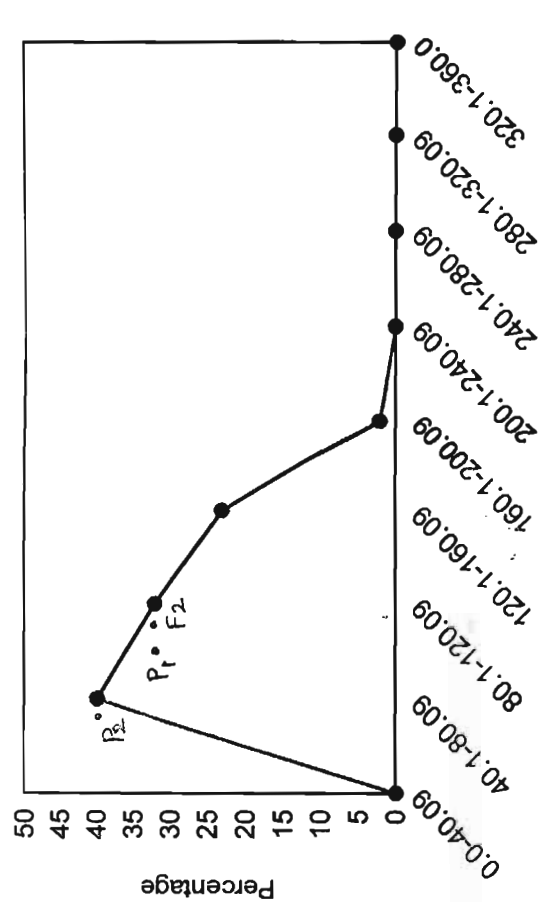
The segregating population of the cross VRI-1 x ACV 2 showed a mean of 70.77 with parental means of 87.01 and 72.65 respectively. The F_2 mean, the mean of the lesser parent were in the class interval of 40.10-80.09 and better parent mean lay in the class interval of 80.10-120.09. About 28.86 per cent of the population showed higher values than the mean value of F_2 .

For the cross, VRI-1 x DT 9-10-2-25, the mean number of capsules per plant was 76.38 while the mean number of capsules per plant in parents was 87.01 and 44.43 respectively. The mean of F_2 , the mean of the lesser parent occupied the class interval of 40.10-80.09 while the mean of the better parent was in the class interval of 80.10-120.09. The F_2 mean was exceeded by 29.97 per cent of the population.

In the cross VRI-1 x AVT 26, the mean of F_2 population was 110.56 and the parents means were 87.01 and 63.35 respectively. The F_2 mean and better parent mean occupied the class interval of 80.10-120.09 while the lesser parent mean lay in the class interval of 40.10-80.09. The F_2 mean was exceeded by 39.96 per cent of the population.

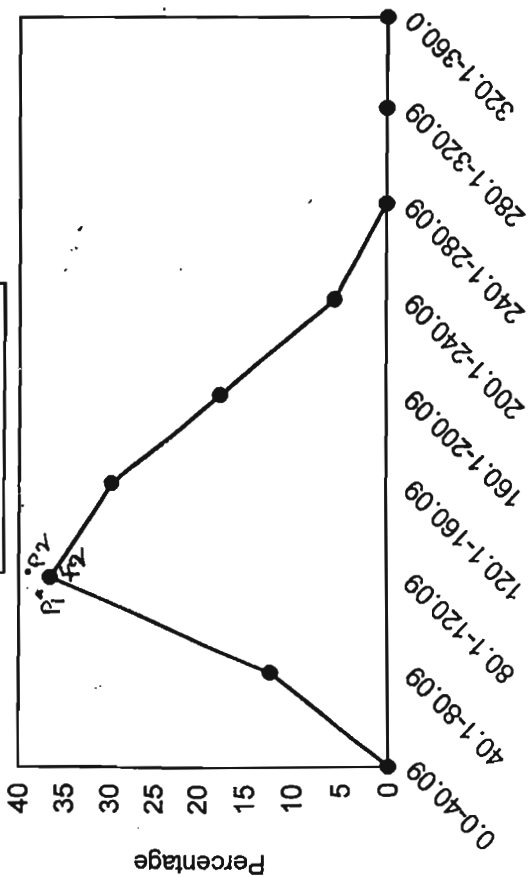
For ACV 2 x DT 9-10-2-25, the F_2 mean was 87.56 and the parental means were 72.65 and 44.43 respectively. The F_2 mean and the parental

Fig 1 : Segregation pattern in F_2 generation of sesame for number of capsules per plant



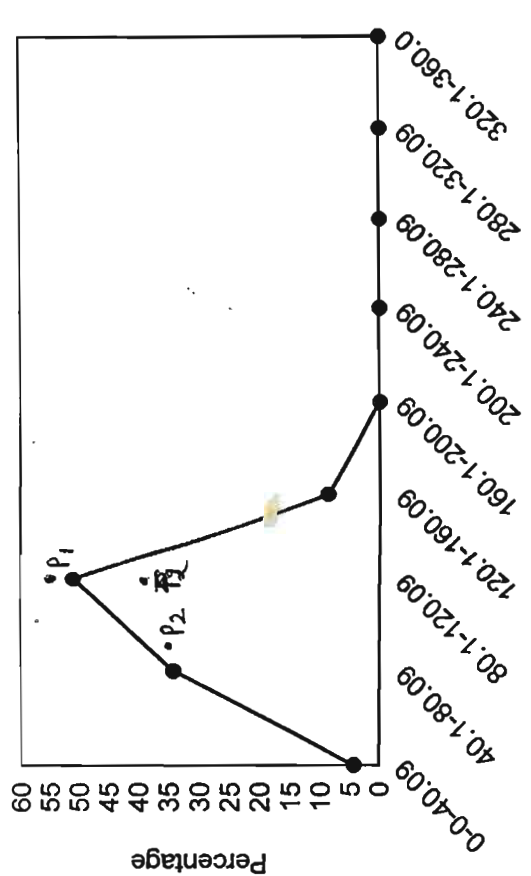
Class interval

CO-1 x TNAU 20



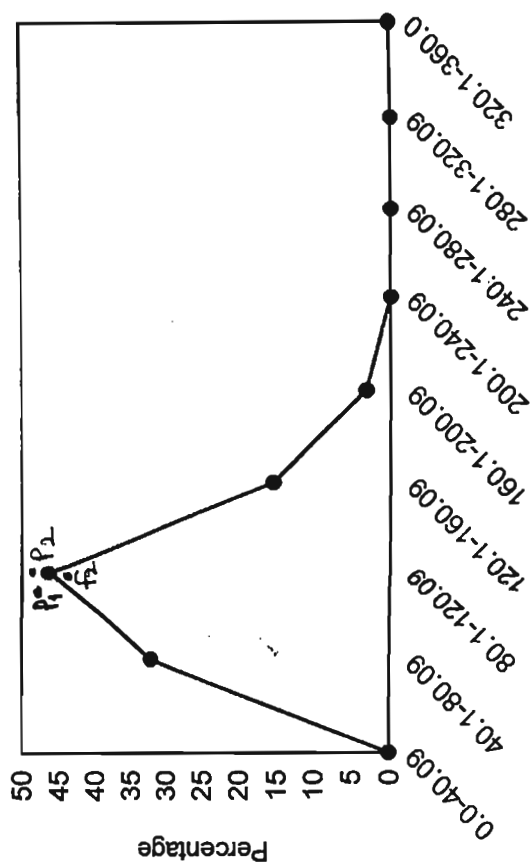
Class interval

CO-1 x TMV 6



Class interval

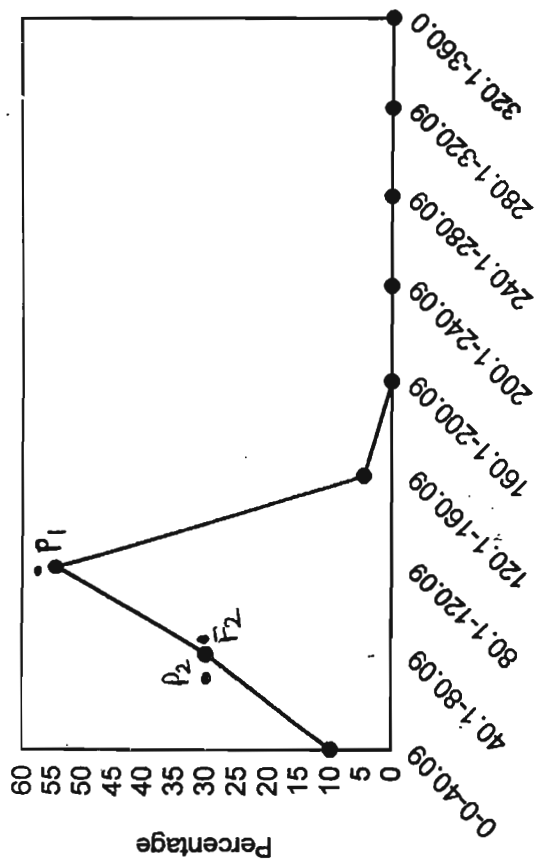
CO-1 x CIANNO



Class interval

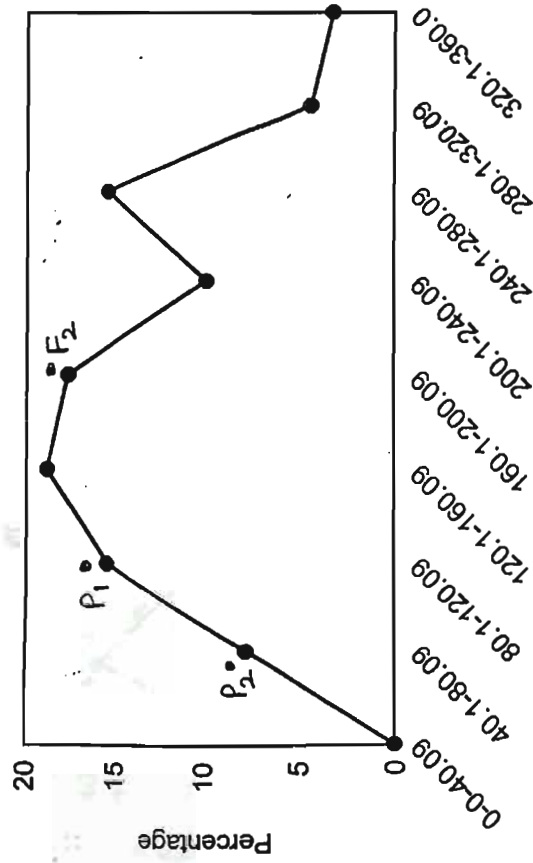
CO-1 x VRI-1

Fig1: Segregation pattern in F_2 generation of sesame for number of capsules per plant



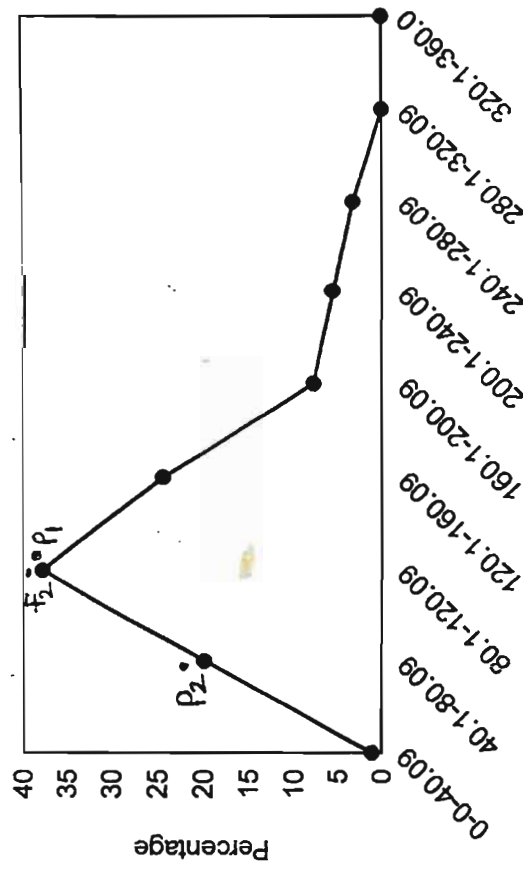
Class interval

CO-1 x ACV 2



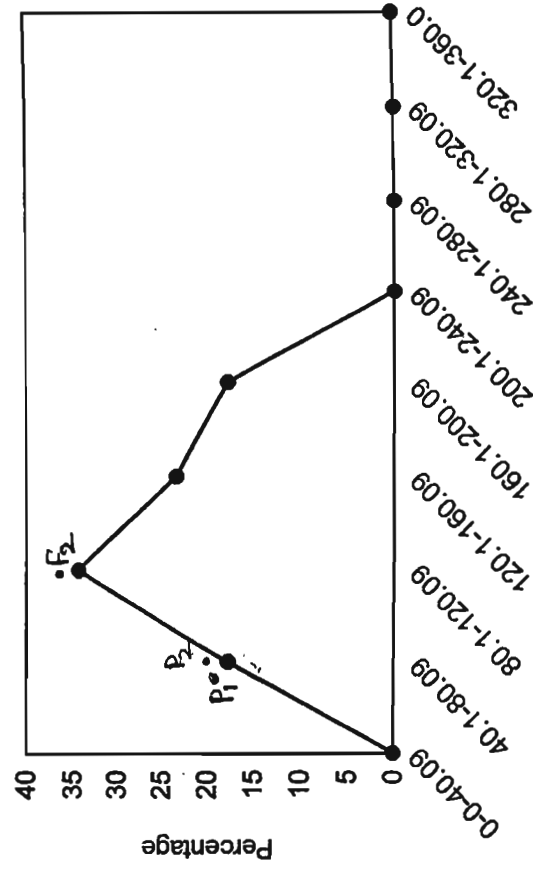
Class interval

CO-1 x AVT 26



Class interval

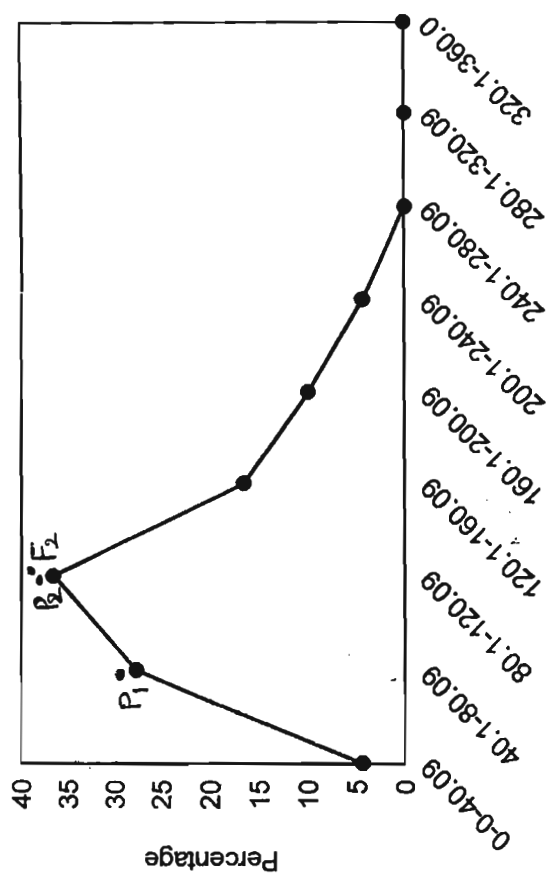
CO-1 x DT 9-10-2-25



Class interval

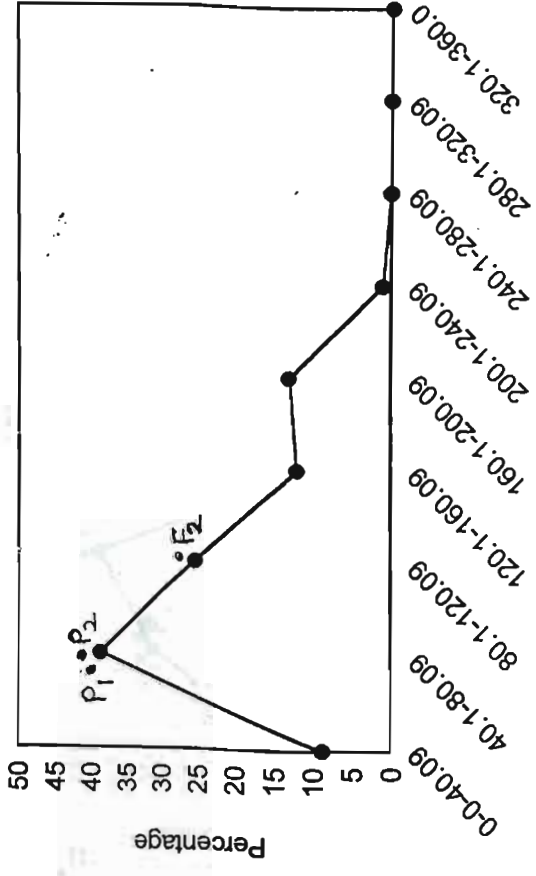
TNAU 20 x CIANNO

Fig 1: Segregation pattern in F_2 generation of sesame for number of capsules per plant



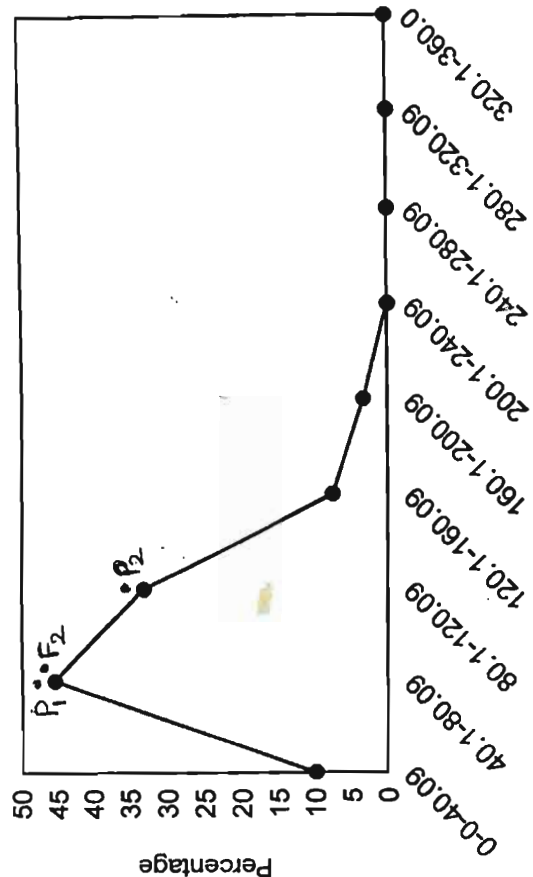
Class interval

● TNAU 20 x TMV 6



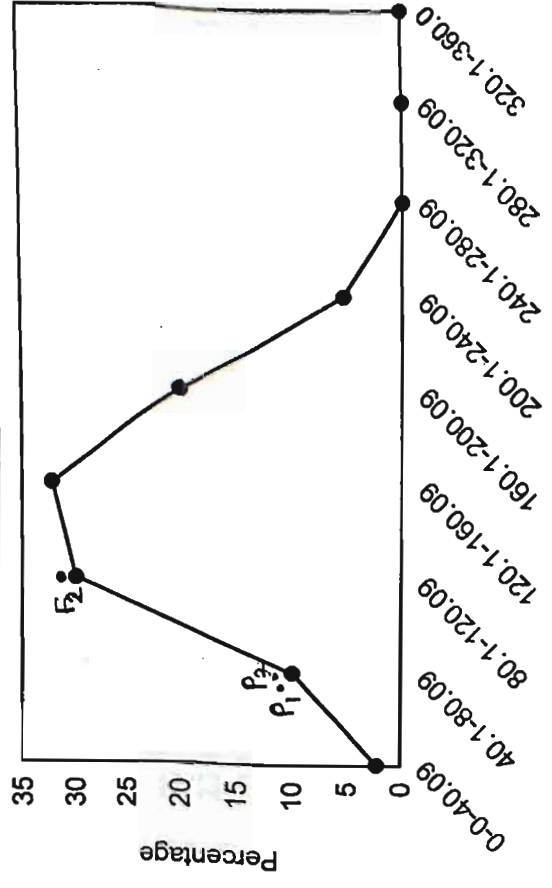
Class interval

● TNAU 20 x ACV 2



Class interval

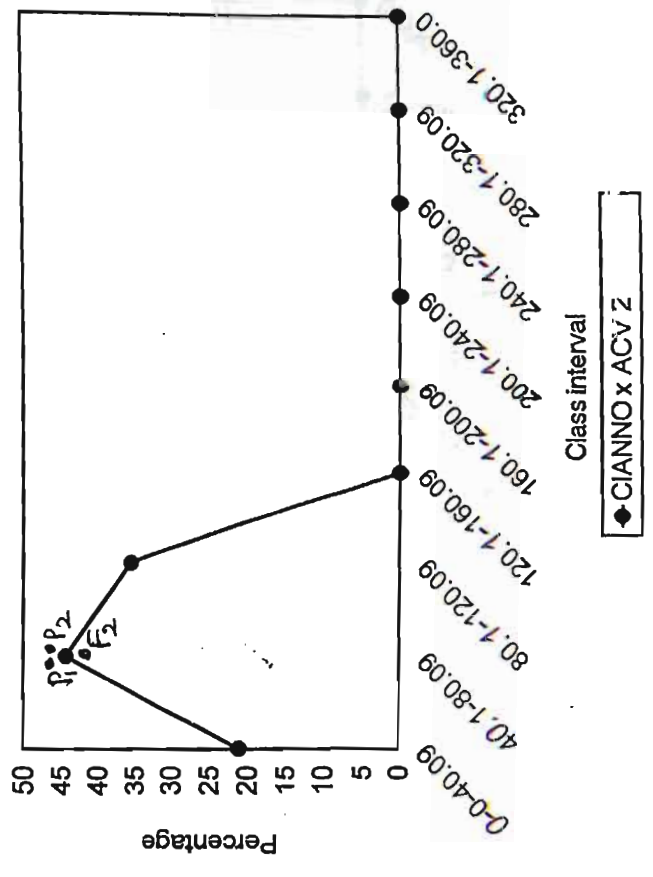
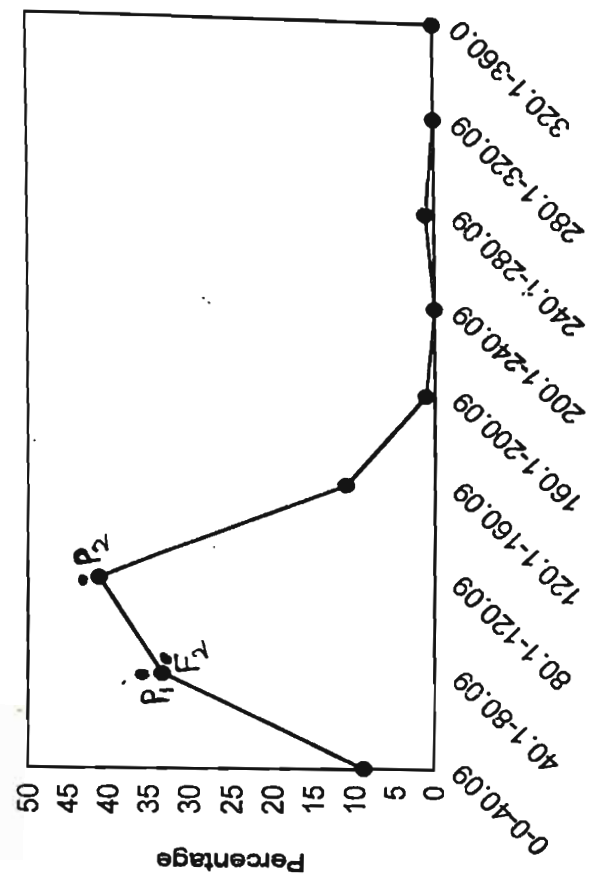
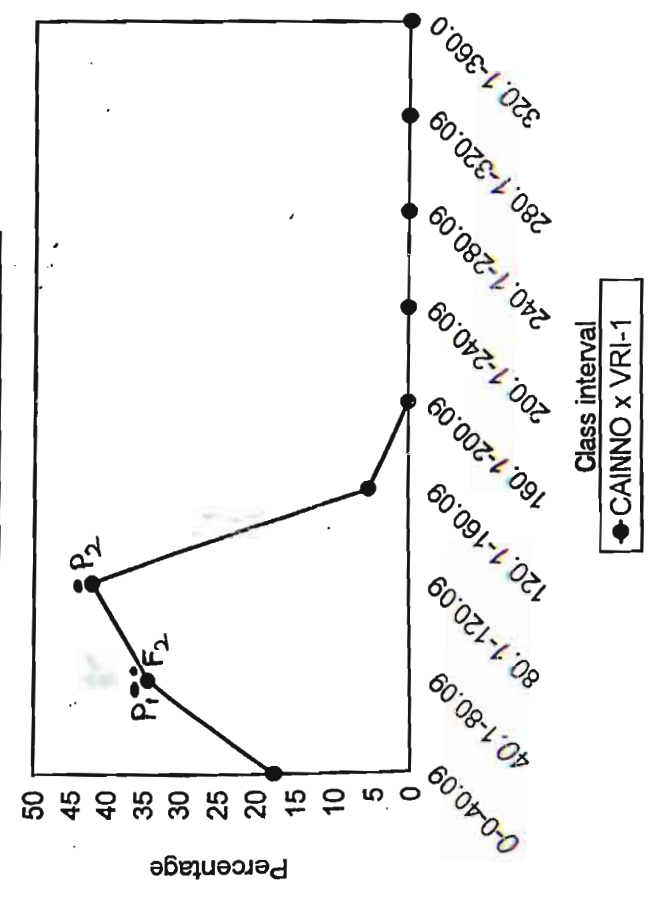
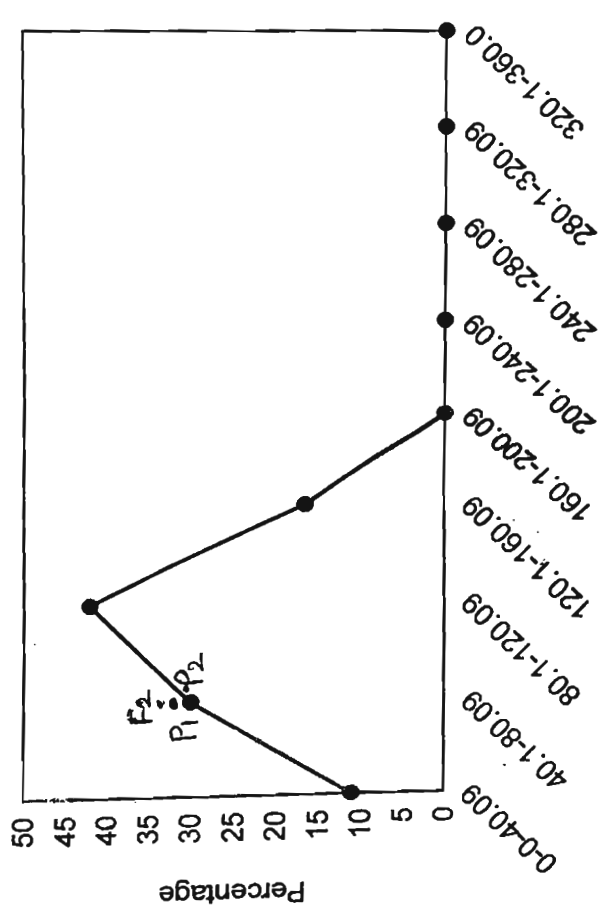
● TNAU 20 x VRI-1



Class interval

● TNAU 20 x DT 9-10-2-25

Fig 1 : Segregation pattern in F_2 generation of sesame for number of capsules per plant



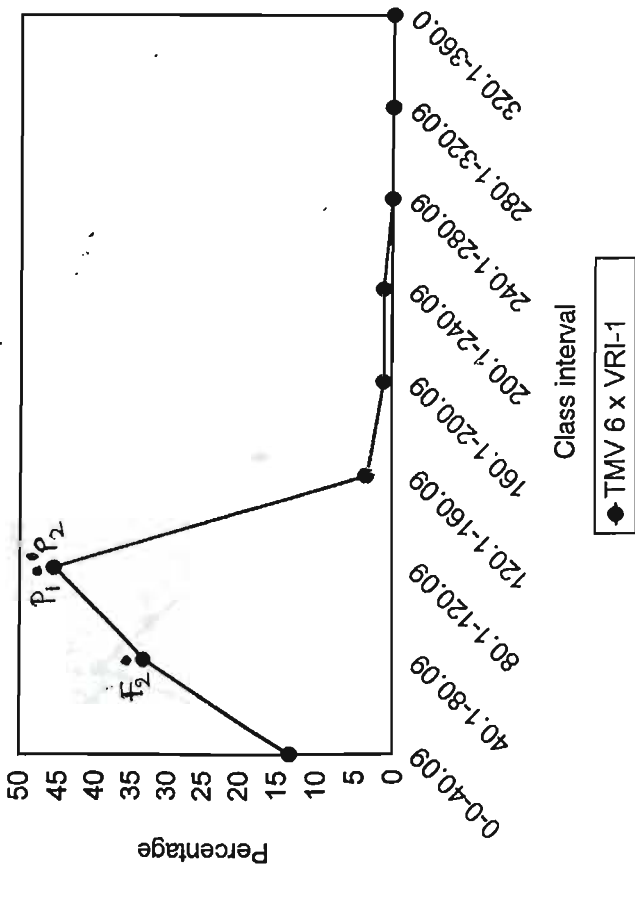
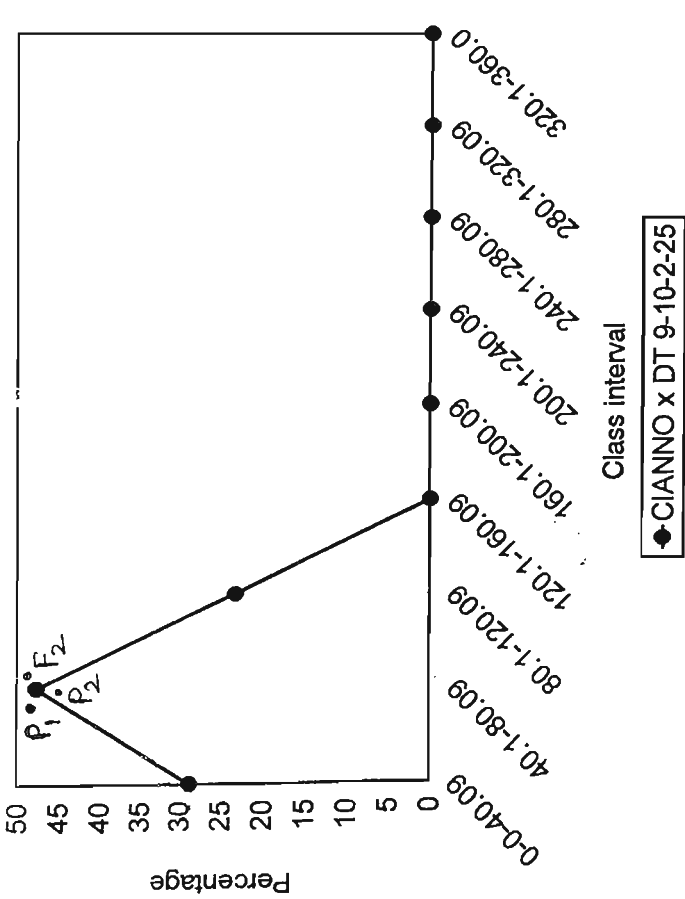
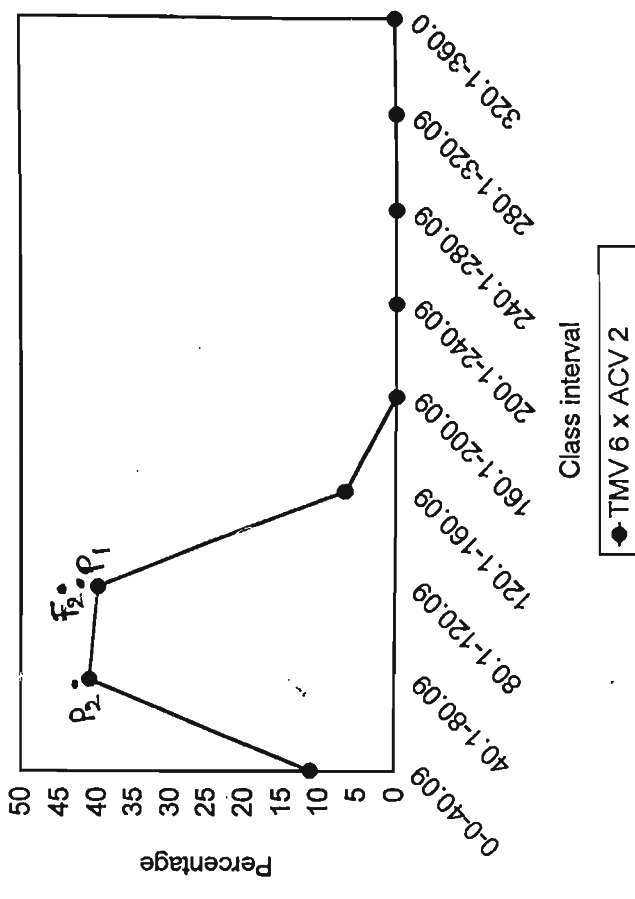
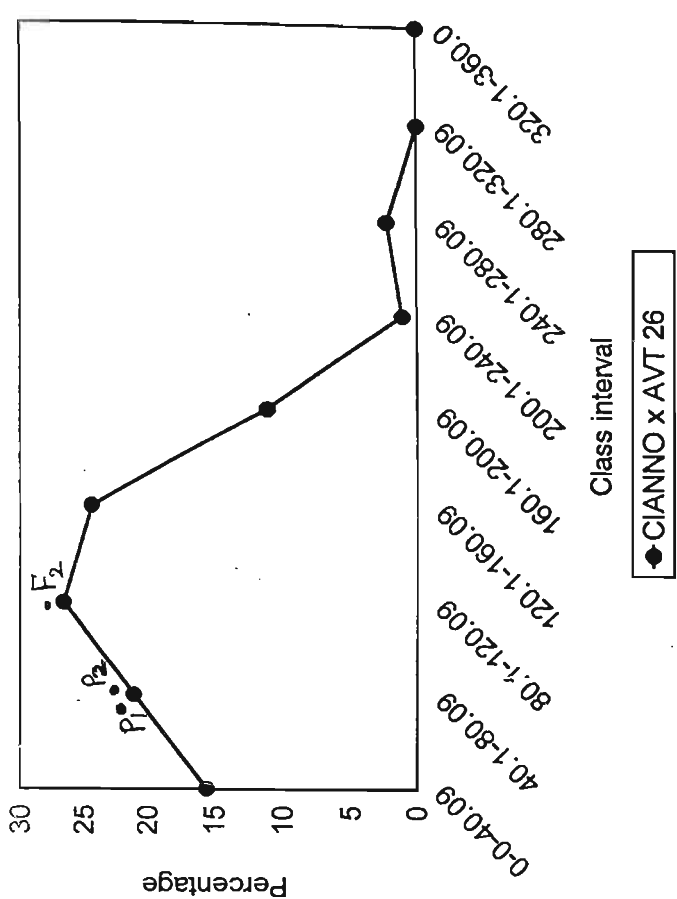
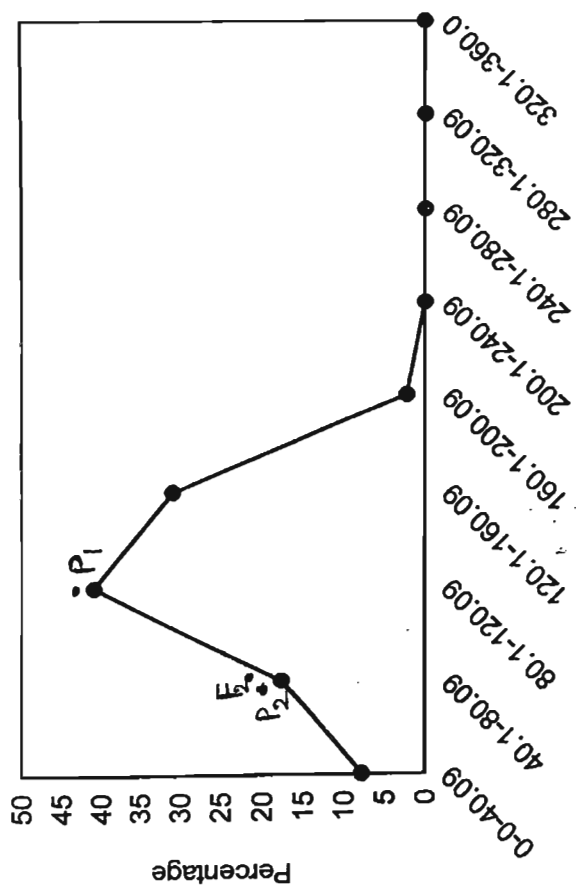
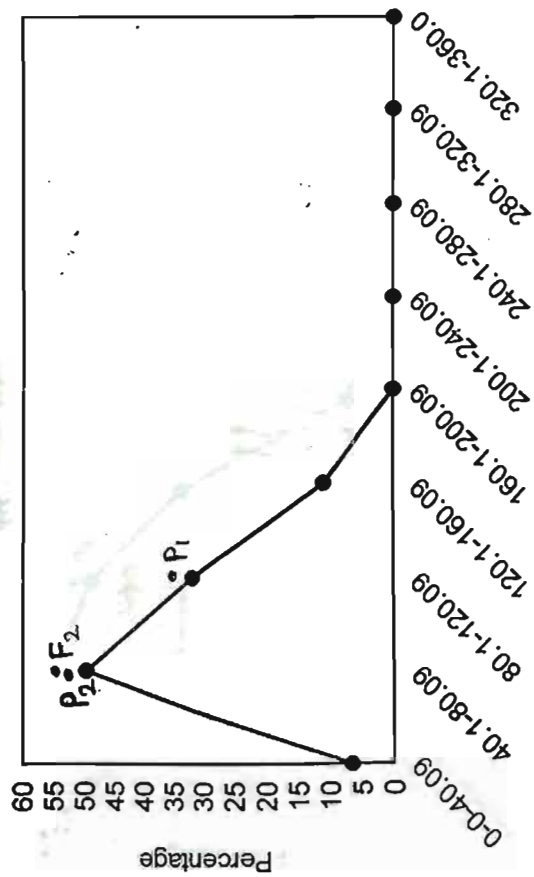


Fig 1.: Segregation pattern in F_2 generation of sesame for number of capsules per plant



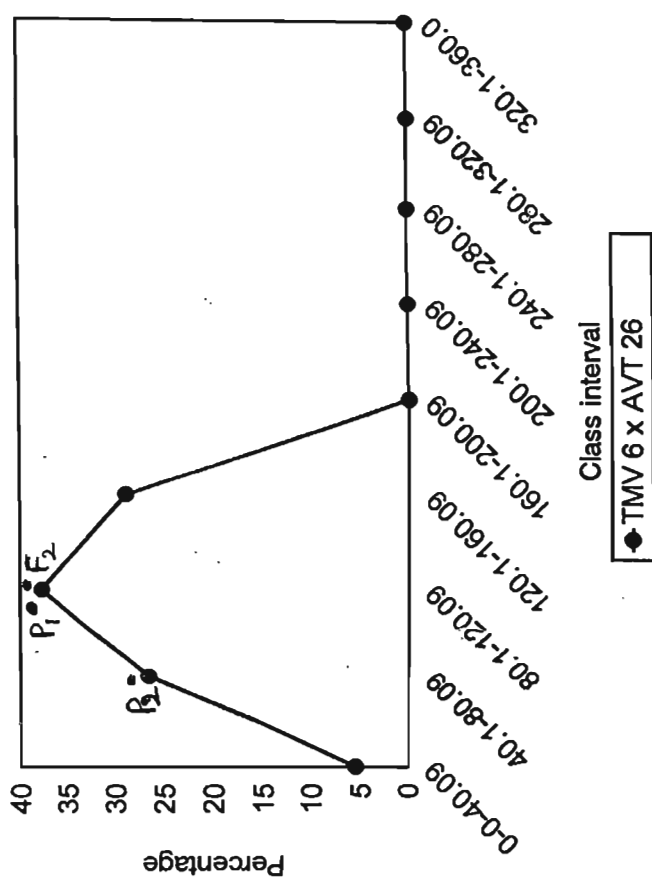
Class interval

TMV 6 x DT 9-10-2-25



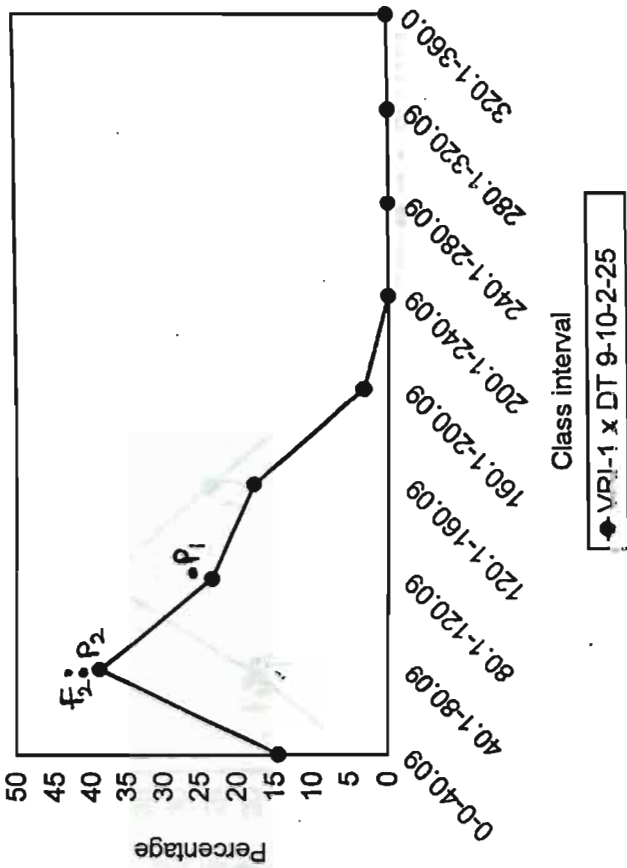
Class interval

VRI-1 x ACV 2



Class interval

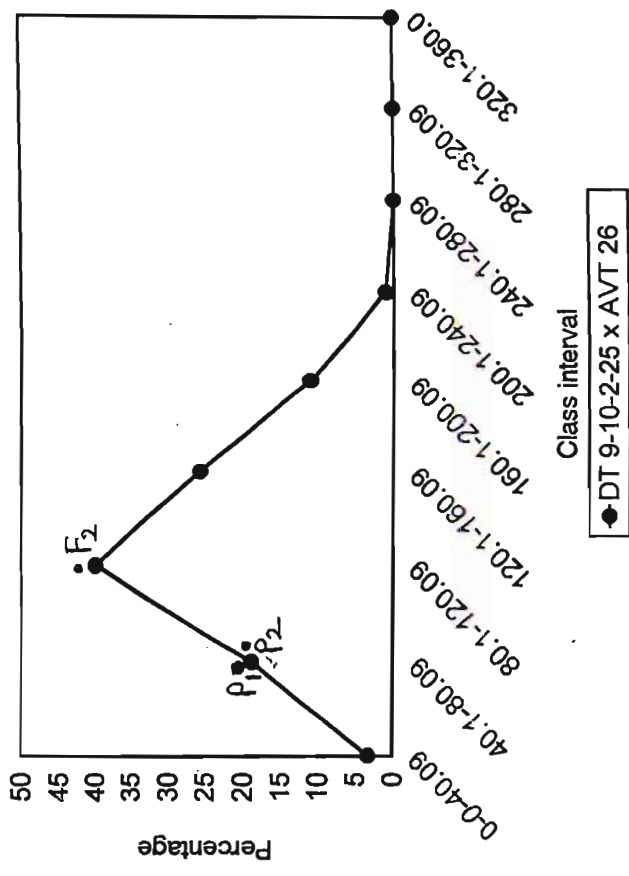
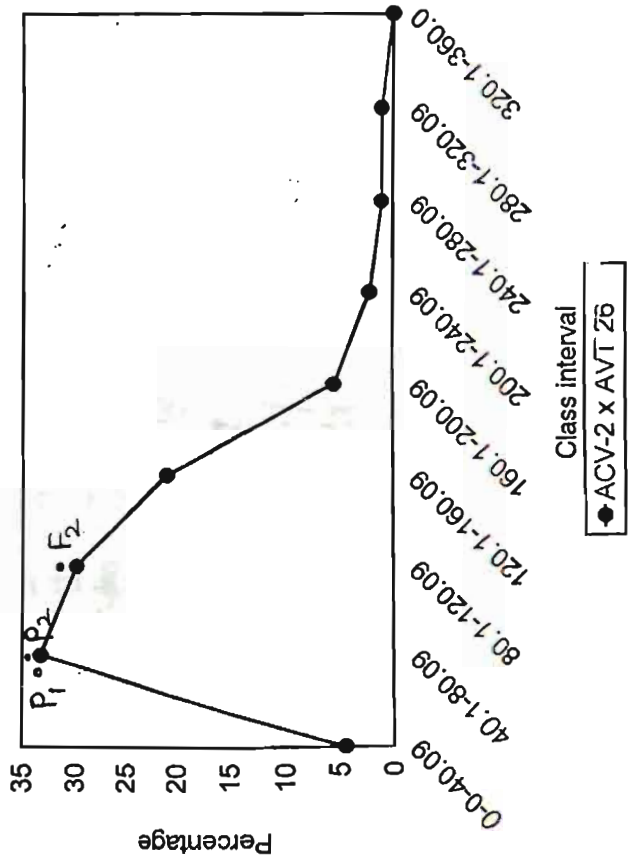
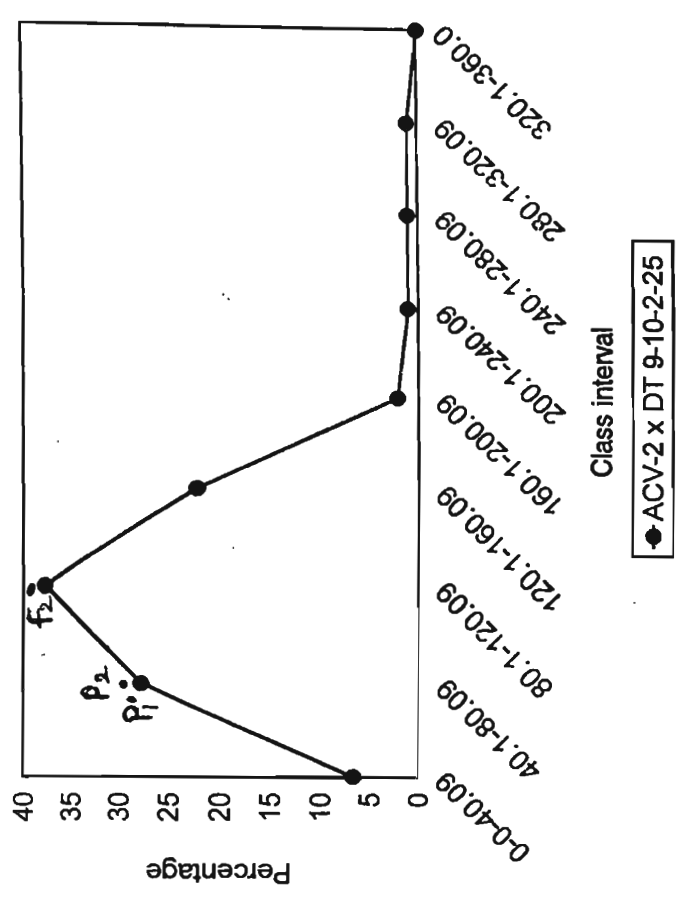
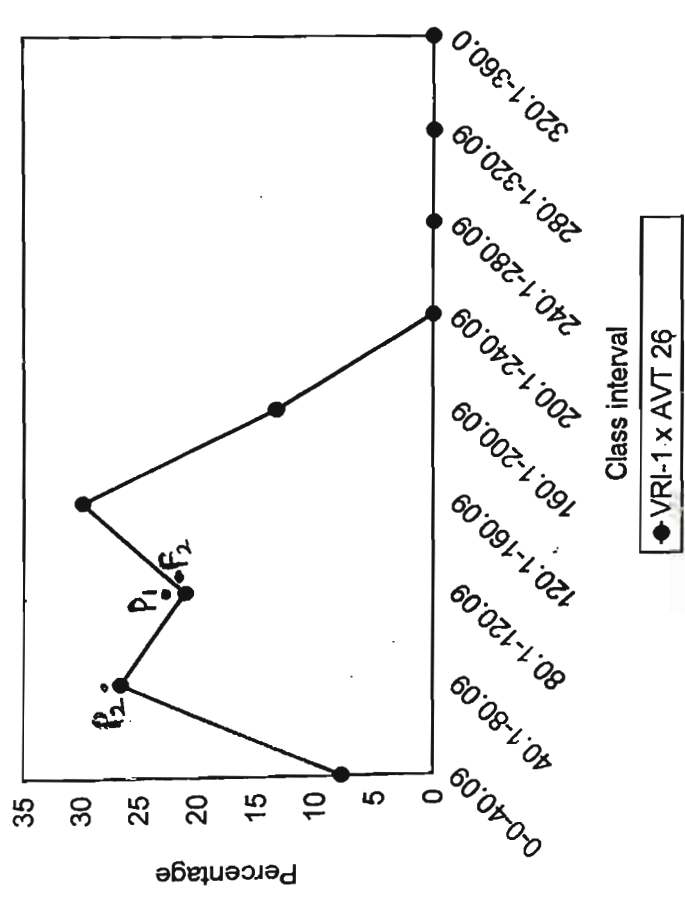
TMV 6 x AVT 26



Class interval

VRI-1 x DT 9-10-2-25

Fig 1 : Segregation pattern in F_2 generation of sesame for number of capsules per plant



means were occupied the class intervals of 80.10-120.09 and 40.10-80.09 respectively. The F_2 mean was exceeded by 33.30 per cent of the population.

In the cross combination of ACV 2 x AVT 26, the F_2 mean was 97.74, while the parental means were 72.65 and 63.35 respectively. The mean of the F_2 and the mean of parents occupied the class interval of 80.10-120.09 and 40.10-80.09 respectively. About 34.41 per cent of the population showed higher values than mean value of F_2 .

The segregating population of the cross DT 9-10-2-25 x AVT 26 showed a mean of 95.49 with parental means of 44.43 and 63.35 respectively. The mean of F_2 and mean of parents were in the class interval of 80.10-120.09 and 40.10-80.09 respectively. The F_2 mean was exceeded by 43.29 per cent of the population.

4.5.2 Seed yield per plant

In the cross combination Co-I x TNAU 20, F_2 had recorded a mean yield of 21.12. The parental means were 21.50 and 13.83 respectively. The F_2 mean and the mean of better parent lay in the class interval of 18.10-24.09, while the mean of lesser parent occupied the class interval of 12.10-18.09.

Table 10 : Segregation pattern in F₂ generation of sesame for seed yield per plant

Sl. No.	Cross	Class interval (%)										Mean		
		0-6.0	6.10-12.09	12.10-18.09	18.10-24.09	24.10-30.09	30.10-36.09	36.10-42.09	42.10-48.09	48.10-54.09		P ₁	P ₂	F ₂
1.	CO-1 x TNAU 20	—	4.44	29.97	43.29	15.54	4.44	1.11	1.11	—		21.50	13.83	21.12
2.	CO-1 x CIANNO	—	25.55	36.63	31.08	9.99	4.44	2.22	1.11	—		21.50	22.71	16.19
3.	CO-1 x TMV 6	—	5.55	13.32	46.62	33.30	1.11	—	—	—		21.50	18.38	26.24
4.	CO-1 x VRI-1	—	11.11	26.64	34.41	21.09	2.22	2.22	2.22	—		21.50	21.40	19.38
5.	CO-1 x ACV 2	—	13.33	35.52	46.62	4.44	—	—	—	—		21.50	19.30	18.57
6.	CO-1 x DT 9-10-2-25	—	1.11	5.55	34.41	27.75	39.96	13.32	4.44	—		21.50	10.84	31.75
7.	CO-1 x AVT 26	—	—	4.44	46.62	22.20	44.40	16.65	3.33	2.22		21.50	20.51	39.86
8.	TNAU 20 x CIANNO	—	4.44	23.31	7.77	27.75	11.10	2.22	—	—		13.83	22.71	24.73
9.	TNAU 20 x TMV 6	—	16.66	22.20	6.66	6.66	4.44	2.22	—	—		13.83	18.38	26.19
10.	TNAU 20 x VRI-1	1.11	22.22	17.76	28.86	5.55	3.33	1.11	—	—		13.83	21.40	14.36
11.	TNAU 20 x ACV 2	2.22	18.88	19.98	49.95	16.65	2.22	—	—	—		13.83	19.30	20.83
12.	TNAU 20 x DT-9-10-2-25	—	11.10	26.64	47.73	23.31	1.11	2.22	—	—		13.83	10.84	18.77
13.	TNAU 20 x AVT 26	—	21.09	33.30	44.40	22.20	3.33	2.22	—	—		13.83	20.51	17.49

Contd... Table 10

Sl. No.	Cross	Class interval (%)									Mean		
		0-6.0	6.10-12.09	12.10-18.09	18.10-24.09	24.10-30.09	30.10-36.09	36.10-42.09	42.10-48.09	48.10-54.09	P ₁	P ₂	F ₂
14.	CIANNO x TMV 6	—	16.65	45.51	35.52	6.66	1.11	—	—	—	22.71	18.38	15.27
15.	CIANNO x VRI-1	—	26.64	49.95	19.98	2.22	—	—	—	—	22.71	21.40	13.73
16.	CIANNO x ACV 2	3.33	32.19	44.40	17.76	1.11	1.11	—	—	—	22.71	19.30	11.32
17.	CIANNO x DT 9-10-2-25	7.77	45.51	33.30	7.77	3.33	2.22	—	—	—	22.71	10.84	12.03
18.	CIANNO x AVT 26	2.22	51.06	22.20	21.09	1.11	1.11	1.11	—	—	22.71	20.51	12.53
19.	TMV 6 x VRI-1	—	35.52	45.51	17.76	2.22	—	—	—	—	18.38	21.40	16.33
20.	TMV 6 x ACV 2	—	13.32	34.41	41.07	4.44	2.22	1.11	—	—	18.38	19.30	17.48
21.	TMV 6 x DT 9-10-2-25	1.11	35.52	45.51	17.76	2.22	—	—	—	—	18.38	10.84	15.29
22.	TMV 6 x AVT 26	3.33	32.19	52.17	9.99	1.11	1.11	—	—	—	18.38	20.51	15.68
23.	VRI-1 x ACV 2	1.11	9.99	23.31	41.07	22.20	1.11	1.11	—	—	21.40	19.30	18.90
24.	VRI-1 x DT 9-10-2-25	—	7.77	25.53	57.72	4.44	1.11	2.22	—	—	21.40	10.84	21.07
25.	VRI-1 x AVT 26	—	8.88	39.96	32.19	19.98	—	—	—	—	21.40	20.51	19.04
26.	ACV 2 x DT 9-10-2-25	—	6.66	26.64	52.17	8.88	3.33	1.11	—	—	19.30	10.84	20.98
27.	ACV 2 x AVT 26	—	21.09	18.87	27.75	24.42	4.44	3.33	—	—	19.30	20.51	23.23
28.	DT 9-10-2-25 x AVT 26	—	13.32	17.76	22.20	24.42	17.76	4.44	—	—	10.84	20.51	22.32

The mean of seed yield of the cross Co-I x CIANNO was 16.19 with parental means of 21.50 and 22.71 respectively. The mean of the F_2 population fall in the class interval of 12.10-18.09 while both the parental mean were in the class interval of 18.10-24.09. The F_2 mean was exceeded by 49.95 percent of the population.

For the cross Co-1 x TMV 6, the mean of the F_2 population was 26.24, while the parental means were 21.50 and 18.38 respectively. The parental means lay in the class interval of 18.10-24.09 while the mean of the population was in the class interval of 24.10-30.09.

The cross Co-1 x VRI-I showed a mean value of 19.38 and its parents recorded mean values of 21.50 respectively. The F_2 mean and the parental means were in the class interval of 18.10-24.09. About 45.51 percent of the population recorded higher values than the mean value of F_2 .

In Co-1 x ACV 2, the mean of F_2 progenies was 18.57 and the parental means were 21.50 and 19.30 respectively. The mean of F_2 progenies and parents were occupied the class interval of 18.10-24.09. The F_2 mean was exceeded by 41.07 percent of the population.

In Co-1 x DT 9-10-2-25, the segregating population recorded a mean of 31.75 with parental means of 21.50 and 10.84 respectively. The F_2 mean lay in the class interval of 30.10-36.09. The better parent and less parent means lay in the class intervals 18.10-24.09 and 6.10-12.09 respectively. The F_2 mean surpassed by 51.06 per cent of the population.

For the cross Co-1 x AVT 26, the F_2 mean was 39.86 and the parental means were 21.50 and 20.51 respectively. F_2 mean fall in the interval 36.10-42.09 and parental means fall in the interval of 18.10-24.09. The F_2 mean was exceeded by 36.63 percent of F_2 progenies.

The segregating population of the cross TNAU 20 x CIANNO recorded a mean value of 24.73, while the parents recorded mean of 13.83 and 22.71 respectively. The F_2 mean lay in the interval of 24.10-30.09 and better parent and lesser parent lay in the interval of 18.10-24.09 and 12.10-18.09 respectively. The F_2 mean was surpassed by 19.98 percent of population.

For the cross combination TNAU 20 x TMV 6 the mean of the segregating generation was 26.19 and parental means are 13.83 and 18.38 respectively. The mean of F_2 and better parent lay in the class interval of 18.10-24.09 while the lesser parent lay in the class interval 12.10-18.09.

In the cross combination TNAU 20 x VRI-1, the F_2 mean was 14.36 and parental means were 13.83 and 21.40 respectively. The F_2 mean and lesser parent mean fall in the interval 18.10-24.09. The F_2 mean was exceeded by 66.60 percent of the population.

In the cross TNAU 20 x ACV 2, the F_2 mean recorded a value of 20.83 with parental means of 13.83 and 19.30 respectively. The F_2 mean and better parent mean lay in the class interval of 18.10-24.09 while the lesser parent lay in the class interval of 12.10-18.09. The F_2 mean was exceeded by 32.19 percent of population.

The F_2 mean for the cross TNAU 20 x DT 9-10-2-25 was 18.77 and parents means were 13.83 and 10.84 respectively. The F_2 , better parent and lesser parent means were lay in the class intervals 18.10-24.09, 12.10-18.09 and 6.10-12.09 respectively. The F_2 mean was exceeded by 45.51 percent of the population showed higher values than the mean value.

The segregating population of the cross TNAU 20 x AVT 26 showed a mean of 17.49 with parental means of 13.83 and 20.51 respectively. The F_2 mean and lesser parent mean were in class interval of 12.10-18.09 and better parent mean lay in class interval 18.10-24.09. About 48.84 per cent of the population showed higher values than the mean value.

For the cross CIANNO x TMV 6 the F_2 mean was 15.27 and the parental means were 22.71 and 18.38 respectively. The F_2 mean and parental means were in the class interval of 12.10-18.09 and 18.10-24.09 respectively. About 44.44 per cent of the population showed higher values than the mean value of the population.

In the cross CIANNO x VRI-1 the F_2 and parental means were 13.73, 22.71 and 21.40 respectively. The F_2 mean and parental mean were in the class interval of 12.10-18.09 and 18.10-24.09 respectively. The F_2 mean was exceeded by 31.08 per cent of population.

For the cross CIANNO x ACV 2 the F_2 and parental means were 11.32, 22.71 and 19.30 respectively. The F_2 mean and parental mean fall in the interval 6.10-12.09 and 18.10-24.09 respectively. The F_2 mean was exceeded by 42.18 per cent of population.

For CIANNO x DT 9-10-2-25, the F_2 and parental means were 12.03, 22.71 and 10.84 respectively. The F_2 and lesser parent mean fall in the class interval 6.10-12.09 and better parent in 18.10-24.09.

The segregating population of CIANNO x AVT 26 showed a mean value of 12.53 with parental means of 22.71 and 20.51 respectively. The F_2

and parental means lay in the class interval of 12.10-18.09 and 18.10-24.09 respectively. The F_2 mean was exceeded by 23.31 per cent of population.

In TMV 6 x VRI-1, F_2 recorded a mean of 16.33. The parental means were 18.38 and 21.40 respectively. The F_2 and parental means lay in the class intervals of 12.10-18.09 and 18.10-24.09 respectively. The F_2 mean was exceeded by 24.42 per cent of the population.

The F_2 mean for the cross TMV 6 x ACV 2 was 17.48 and the means of the parents were 18.38 and 19.30 respectively. The F_2 mean and parental means were in the class interval of 12.10-18.09 and 18.10-24.09 respectively. The F_2 mean was exceeded by 27.75 per cent of the population.

The segregating population of the cross TMV 6 x DT 9-10-2-25 showed a mean of 15.29 with parental means of 18.38 and 10.84 respectively. The F_2 and parental mean lay in the class intervals of 12.10-18.09, 18.10-24.09 and 6.10-12.09 respectively. About 28.86 per cent of the population showed higher values than the mean value.

For TMV 6 x AVT 26, the F_2 and parental means were 15.68, 18.38 and 20.51 respectively. The F_2 mean and parental mean lay in class intervals of 12.10-18.09 and 18.10-24.09 respectively. The F_2 mean was exceeded by 17.76 percent of the population.

and parental means lay in the class interval of 12.10-18.09 and 18.10-24.09 respectively. The F_2 mean was exceeded by 23.31 per cent of population.

In TMV 6 x VRI-1, F_2 recorded a mean of 16.33. The parental means were 18.38 and 21.40 respectively. The F_2 and parental means lay in the class intervals of 12.10-18.09 and 18.10-24.09 respectively. The F_2 mean was exceeded by 24.42 per cent of the population.

The F_2 mean for the cross TMV 6 x ACV 2 was 17.48 and the means of the parents were 18.38 and 19.30 respectively. The F_2 mean and parental means were in the class interval of 12.10-18.09 and 18.10-24.09 respectively. The F_2 mean was exceeded by 27.75 per cent of the population.

The segregating population of the cross TMV 6 x DT 9-10-2-25 showed a mean of 15.29 with parental means of 18.38 and 10.84 respectively. The F_2 and parental mean lay in the class intervals of 12.10-18.09, 18.10-24.09 and 6.10-12.09 respectively. About 28.86 per cent of the population showed higher values than the mean value.

For TMV 6 x AVT 26, the F_2 and parental means were 15.68, 18.38 and 20.51 respectively. The F_2 mean and parental mean lay in class intervals of 12.10-18.09 and 18.10-24.09 respectively. The F_2 mean was exceeded by 17.76 percent of the population.

In the cross VRI-1 x ACV 2 the mean of F_2 and parents were 18.90, 21.40 and 19.30 respectively. The F_2 and parents means occupied the class interval of 18.10-24.09. The F_2 mean was exceeded by 43.29 per cent of the population.

For the cross VRI-1 x DT 9-10-2-25 the F_2 and the parental means were found to be 21.07, 21.40 and 10.84 respectively. The F_2 and better parent mean lay in the class interval of 18.10-24.09 and lesser parent occupied 6.10-12.09 class interval. The F_2 mean was surpassed by 13.32 per cent of the population.

The cross VRI-1 x AVT 26 showed a mean value of 19.04 with parental means of 21.40 and 20.51 respectively. The F_2 and parents mean occupied the class interval of 18.10-24.09. The F_2 mean was exceeded by 37.74 per cent of the population.

In ACV 2 x DT 9-10-2-25 the F_2 and parents mean were 20.98, 19.30 and 10.84 respectively. The F_2 and better parent occupied class interval of 18.10-24.09 and lesser parent 6.10-12.09. The F_2 mean was surpassed by 17.76 percent of the population.

Fig 2 : Segregation pattern in F_2 generation of sesame for seed yield per plant

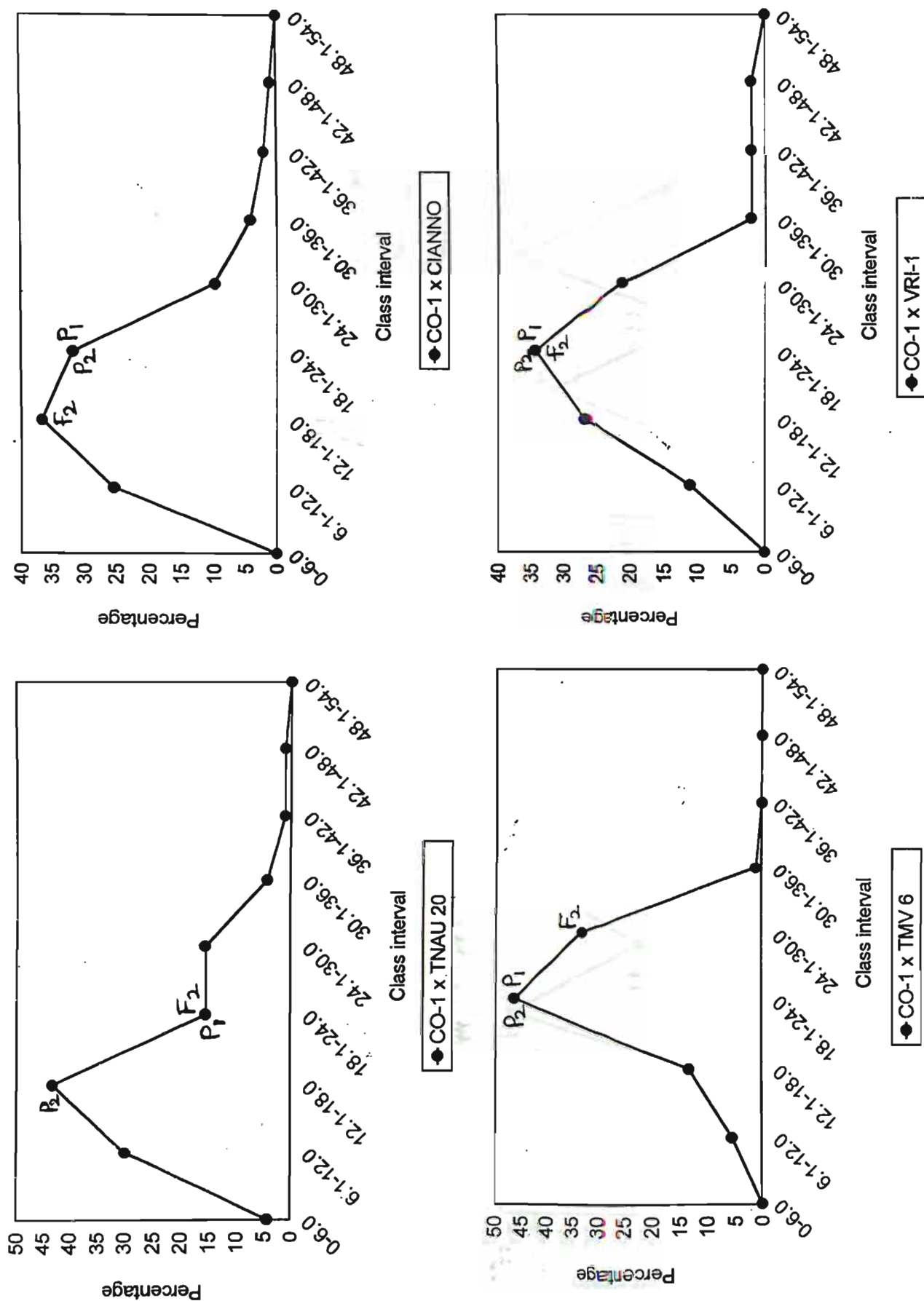


Fig 2 : Segregation pattern in F_2 generation of sesame for seed yield per plant

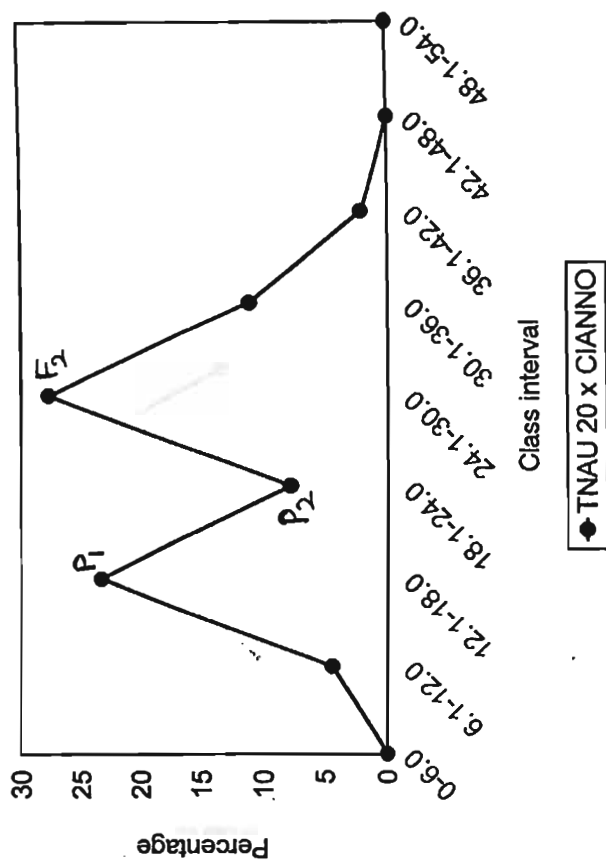
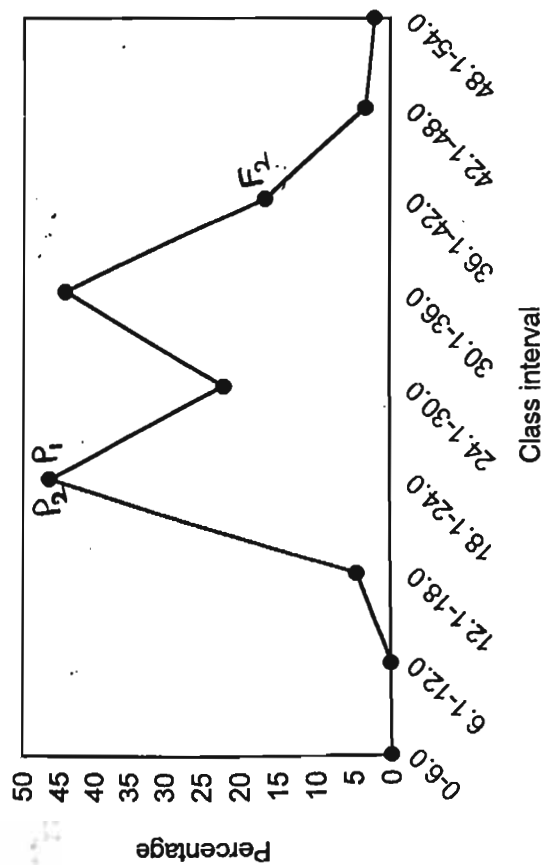
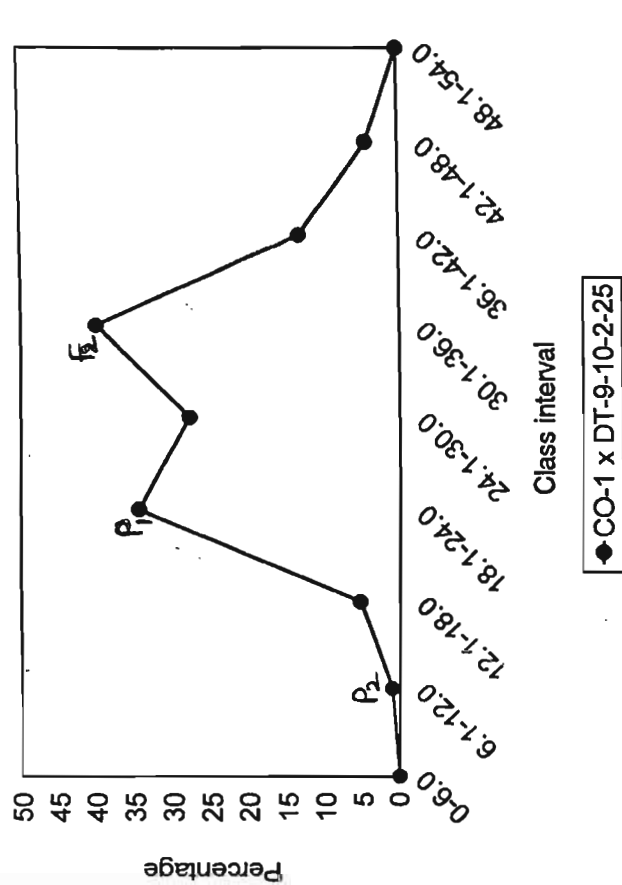
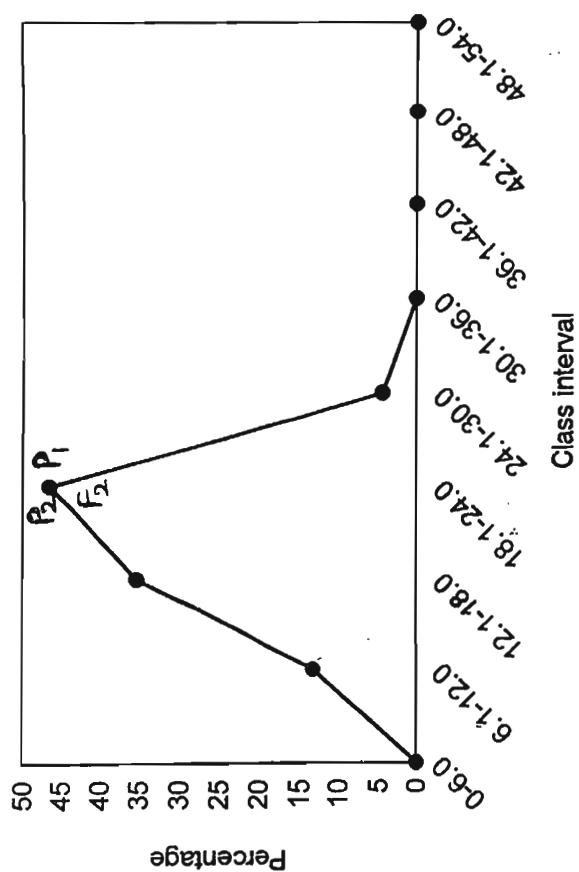


Fig 2.: Segregation pattern in F_2 generation of sesame for seed yield per plant

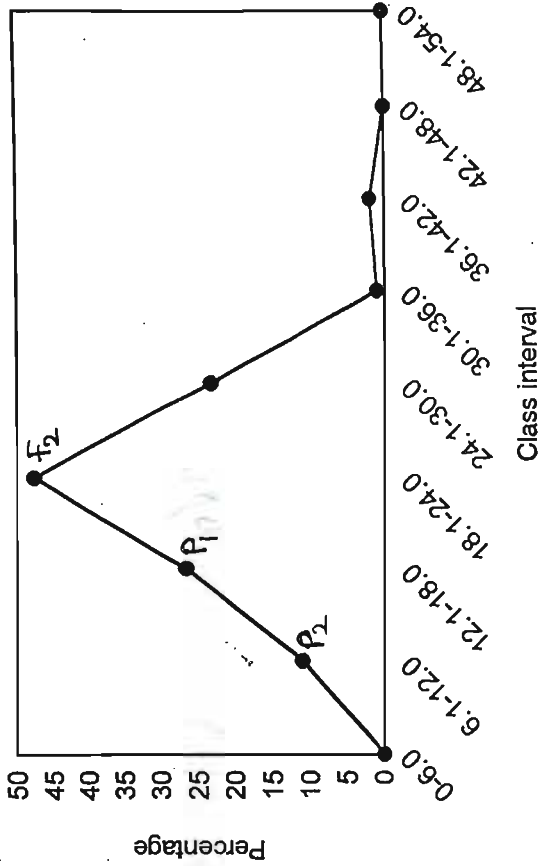
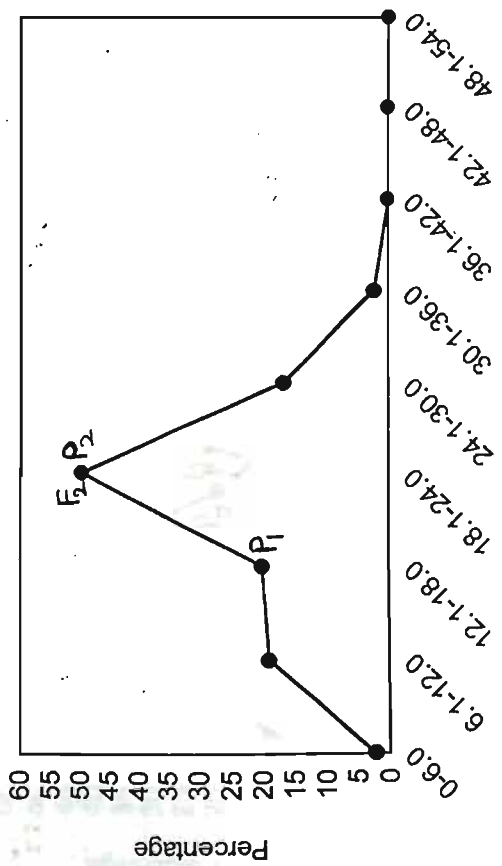
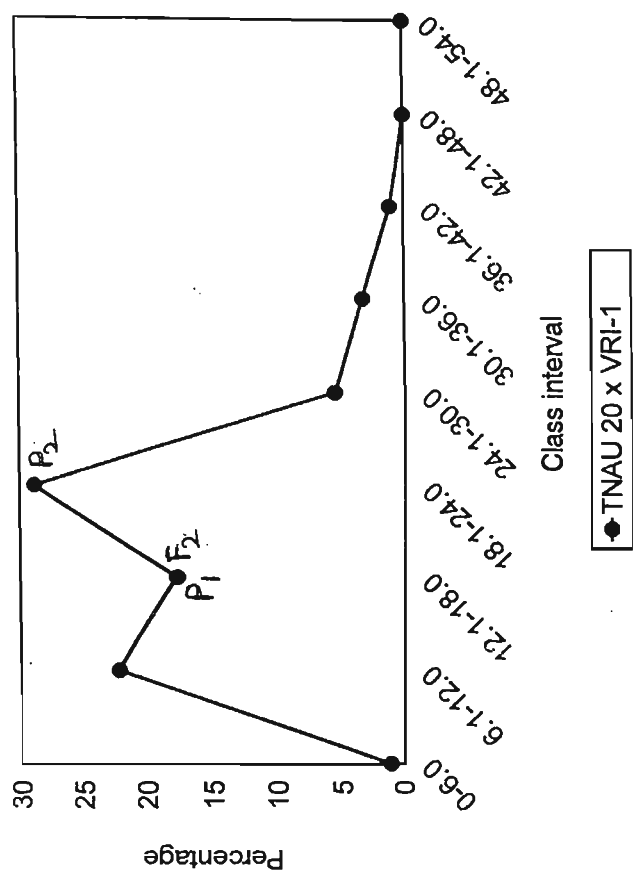
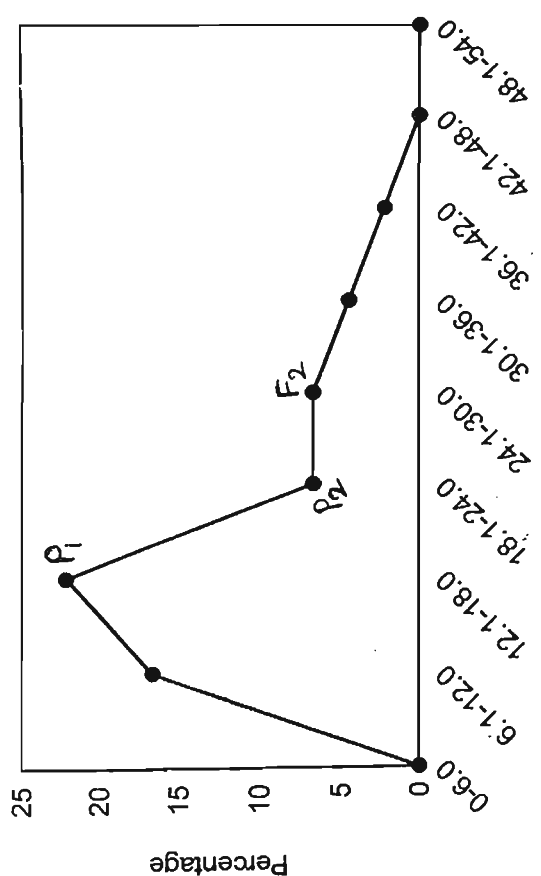
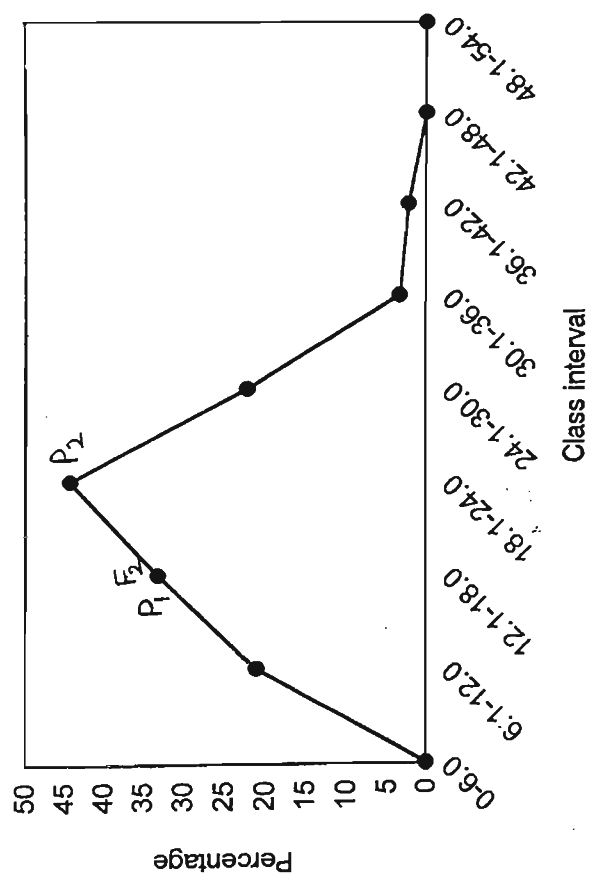
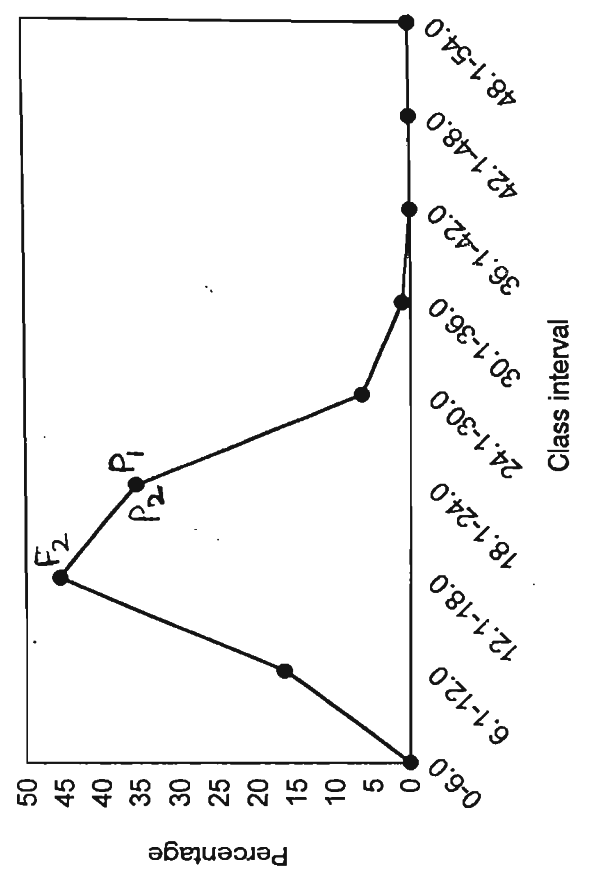


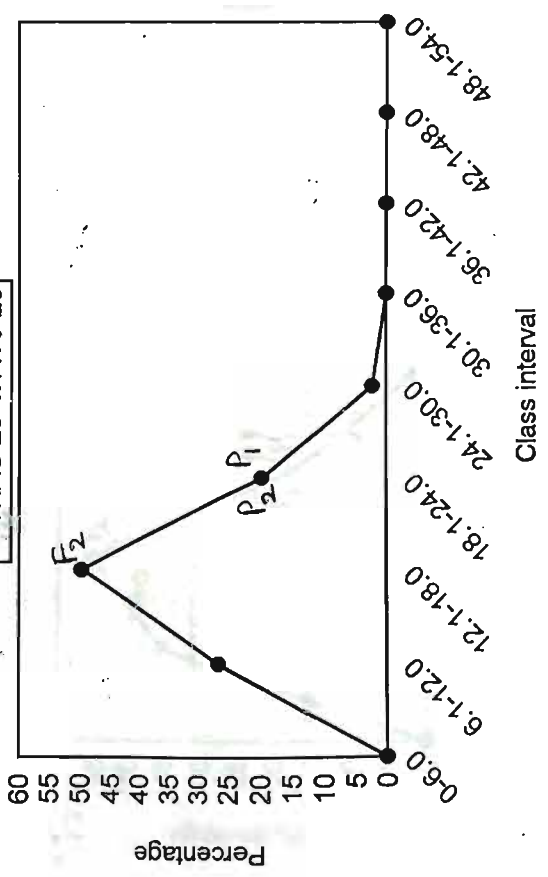
Fig 2.: Segregation pattern in F_2 generation of sesame for seed yield per plant



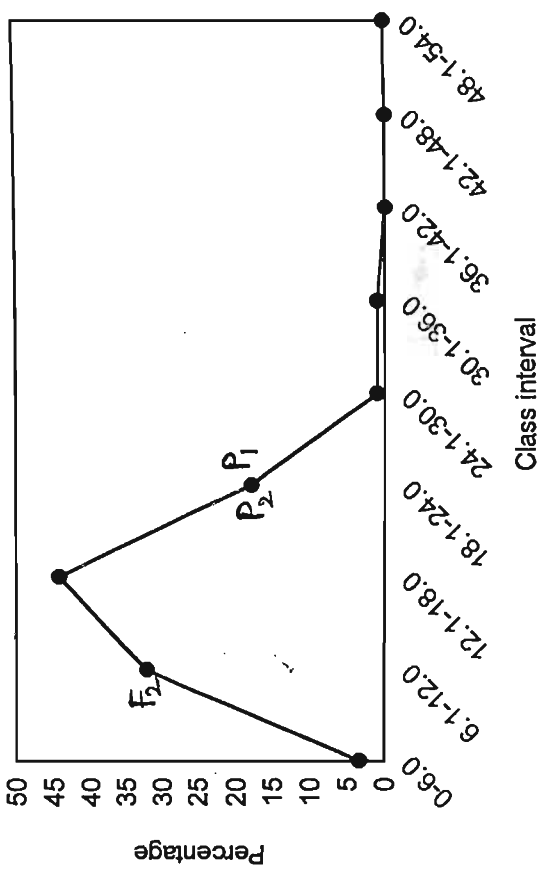
● TNAU 20 x AVT 26



● CIANNO x TMV 6



● CIANNO x VRI-1



● CIANNO x ACV 2

Fig 2 : Segregation pattern in F_2 generation of sesame for seed yield per plant

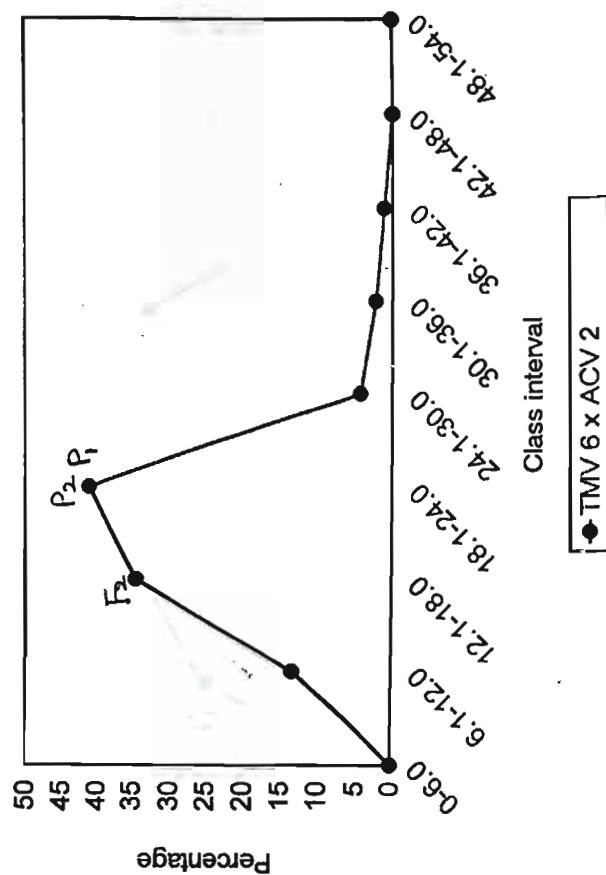
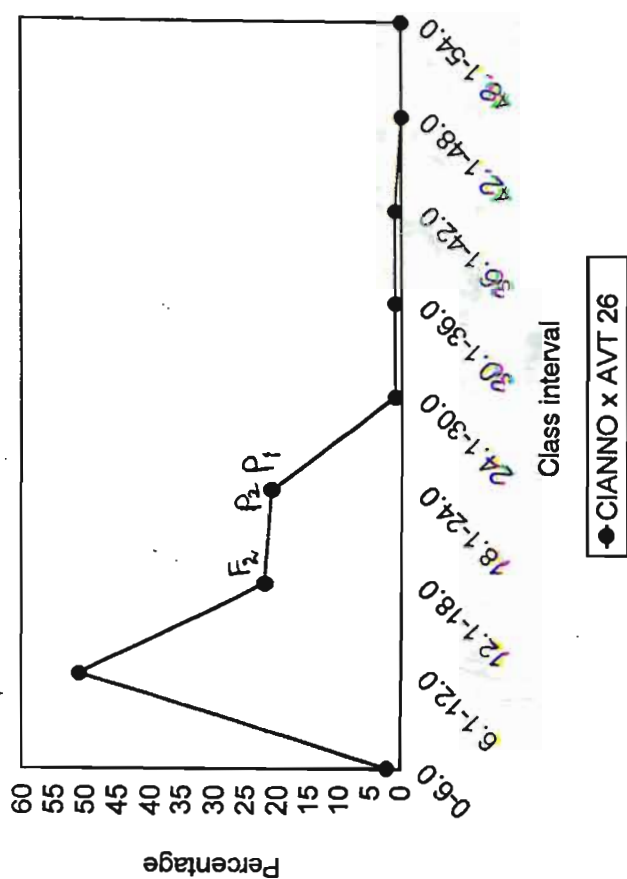
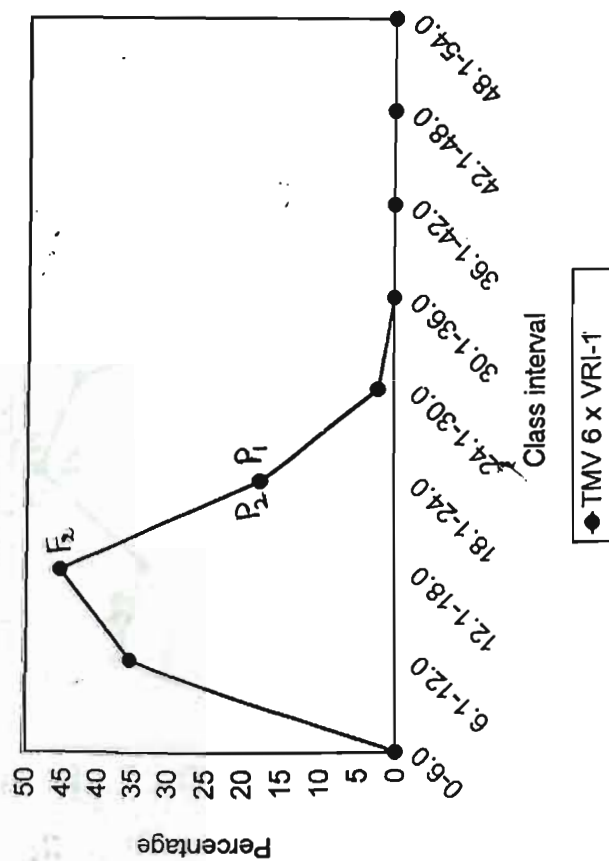
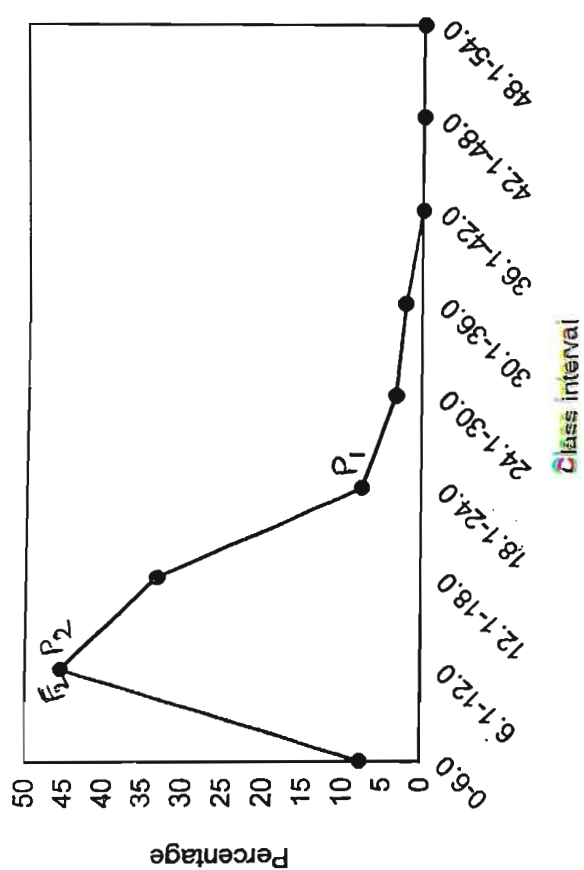
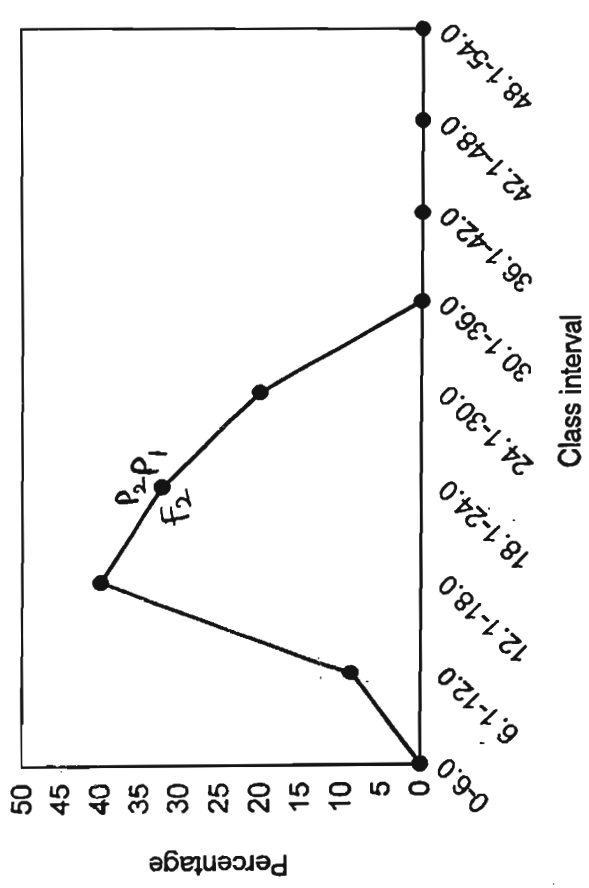
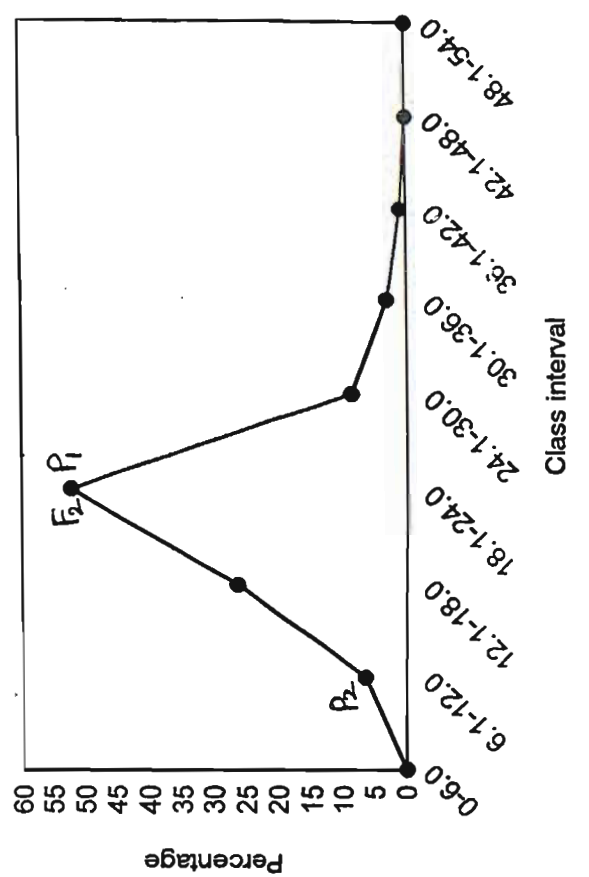


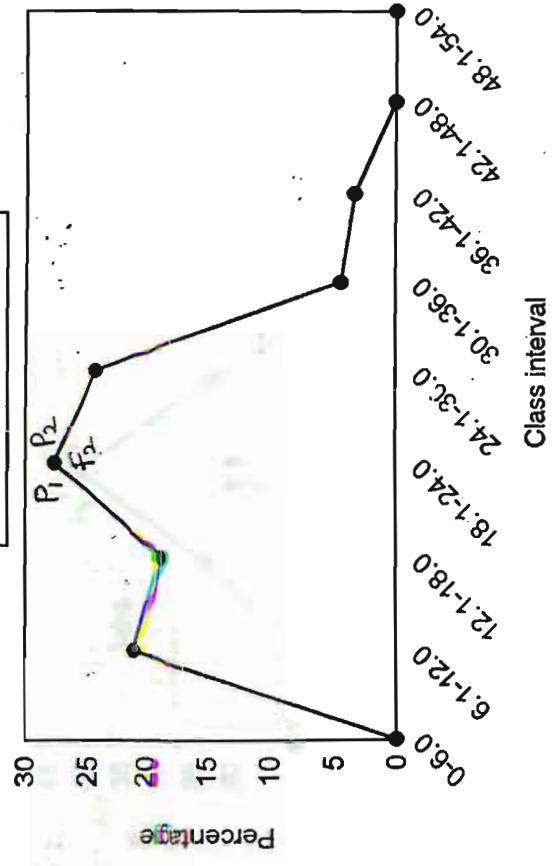
Fig 2.: Segregation pattern in F_2 generation of sesame for seed yield per plant



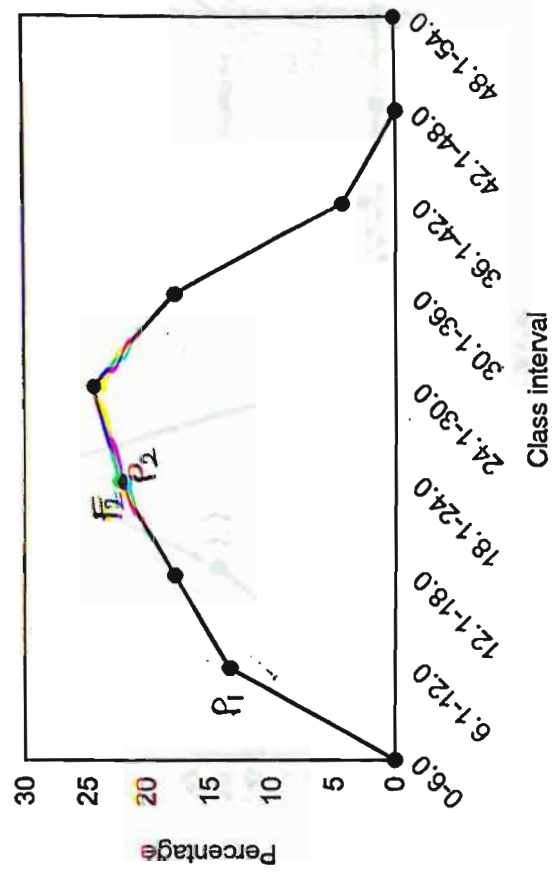
● VRI-1 x AVT26



● ACV 2 x DT 9-10-2-25

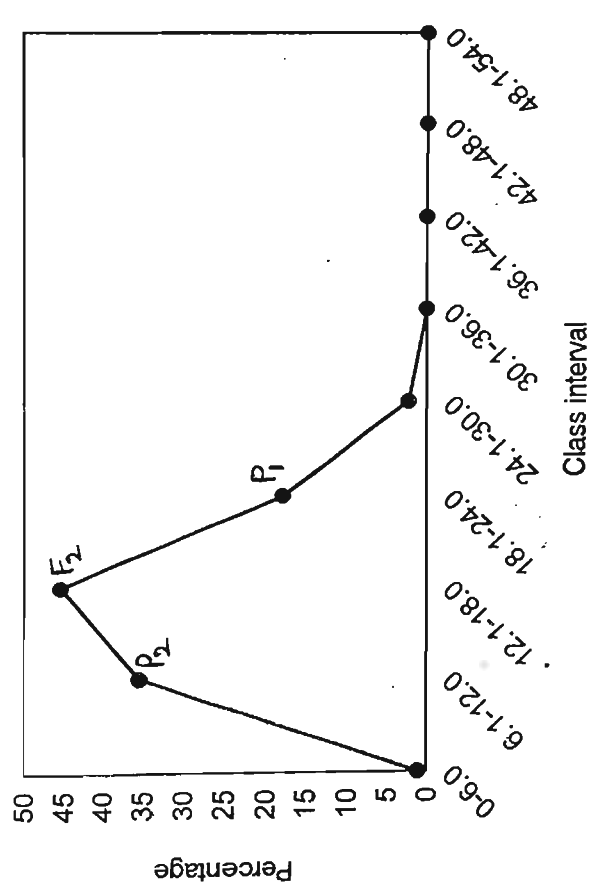


● ACV 2 x AVT 26

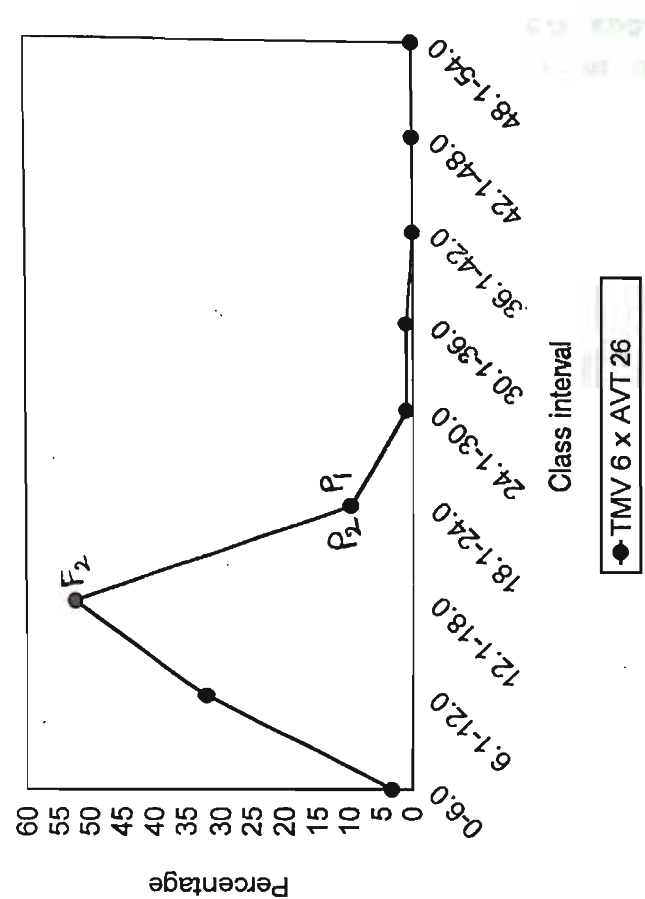


● DT 9-10-2-25 x AVT 26

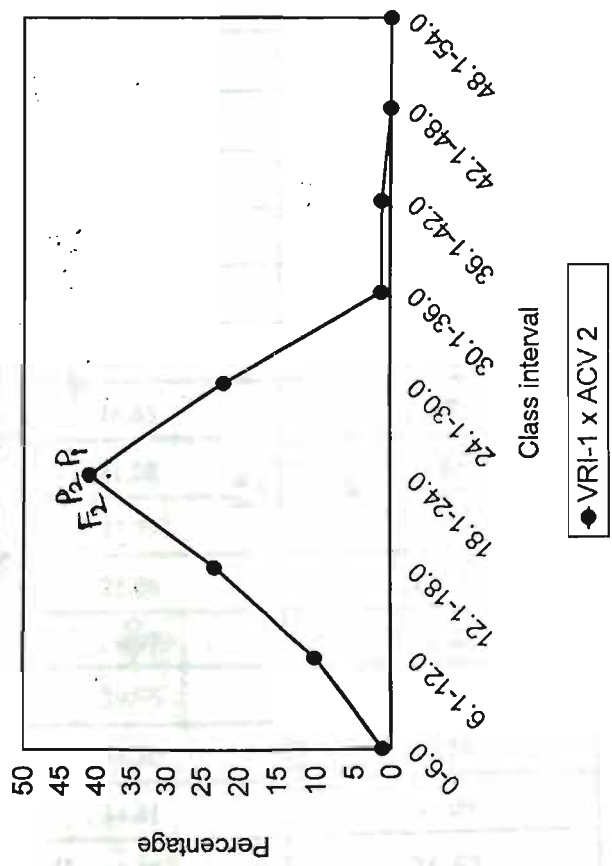
Fig 2.: Segregation pattern in F_2 generation of sesame for seed yield per plant



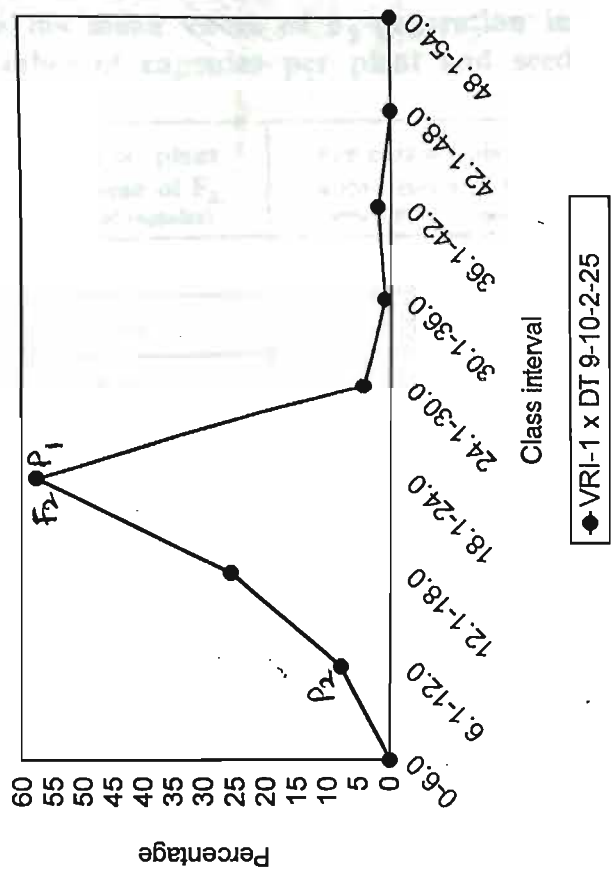
● TMV 6 x DT 9-10-2-25



● TMV 6 x AVT 26



● VRI-1 x ACV 2



● VRI-1 x DT 9-10-2-25

Table 11 : Per cent of plants above the mean value of F_2 generation in individual crosses for number of capsules per plant and seed yield per plant

Sl.No.	Cross	Per cent of plant above mean of F_2 (number of capsules)	Per cent of plant above mean of F_2 (seed yield per plant)
1	CO-1 x TNAU 20	44.44	33.33
2	CO-1 x CIANNO	36.63	49.95
3	CO-1 x TMV 6	28.86	17.76
4	CO-1 x VRI-1	32.19	45.51
5	CO-1 x ACV 2	36.63	41.07
6	CO-1 x DT 9-10-2-25	32.19	51.06
7	CO-1 x AVT 26	36.63	36.63
8	TNAU 20 x CIANNO	31.08	19.98
9	TNAU 20 x TMV 6	32.19	8.58
10	TNAU 20 x VRI-1	31.08	66.60
11	TNAU 20 x ACV 2	41.07	32.19
12	TNAU 20 x DT-9-10-2-25	32.19	45.51
13	TNAU 20 x AVT 26	32.19	48.84
14	CIANNO x TMV 6	33.33	44.44
15	CIANNO x VRI-1	34.41	31.08
16	CIANNO x ACV 2	39.96	42.18
17	CIANNO x DT-9-10-2-25	32.19	22.20
18	CIANNO x AVT 26	38.85	23.31
19	TMV6 x VRI-1	32.19	24.42
20	TMV6 x ACV 2	16.65	27.75
21	TMV6 x DT 9-10-2-25	31.08	28.86
22	TMV 6 x AVT 26	27.75	17.76
23	VRI-1 x ACV 2	28.86	43.29
24	VRI-1 x DT 9-10-2-25	29.97	13.32
25	VRI-1 x AVT 26	39.96	37.74
26	ACV 2 x DT 9-10-2-25	33.30	17.76
27	ACV 2 x AVT 26	34.41	21.09
28	DT 9-10-2-25 x AVT 26	43.29	36.63

For ACV 2 x AVT 26 the F_2 mean and the parental means were 23.23, 19.30 and 20.51 respectively. The F_2 and parental means occupied the same class interval of 18.10-24.09. About 21.09 per cent of population exceeded the mean value of F_2 .

For the cross DT 9-10-2-25 x AVT 26 the F_2 mean and the parental means found to be 22.32, 10.84 and 20.51 respectively. The F_2 mean and mean of better parent were in the class interval of 18.10-24.09 and lesser parent in class interval of 6.10-12.09. The F_2 mean was surpassed by 36.63 per cent of the population.

4.5.3 Number of Branches per Plant

For best three crosses the segregation pattern is showed in Table 12.

The cross Co-1 x DT 9-10-2-25 had a F_2 mean of 9.59, while the parental means were 8.05 and 14.48 respectively. The mean of lesser parent was in the class interval of 6.10-8.09 while better parent in 14.10-16.09 and F_2 in 8.10-10.09.

For the cross Co-1 x AVT 26 the F_2 and parental means were 8.71, 80.5 and 7.34 respectively. The F_2 and parental means occupied the class interval of 8.10-10.09 and 6.10-8.09 respectively.

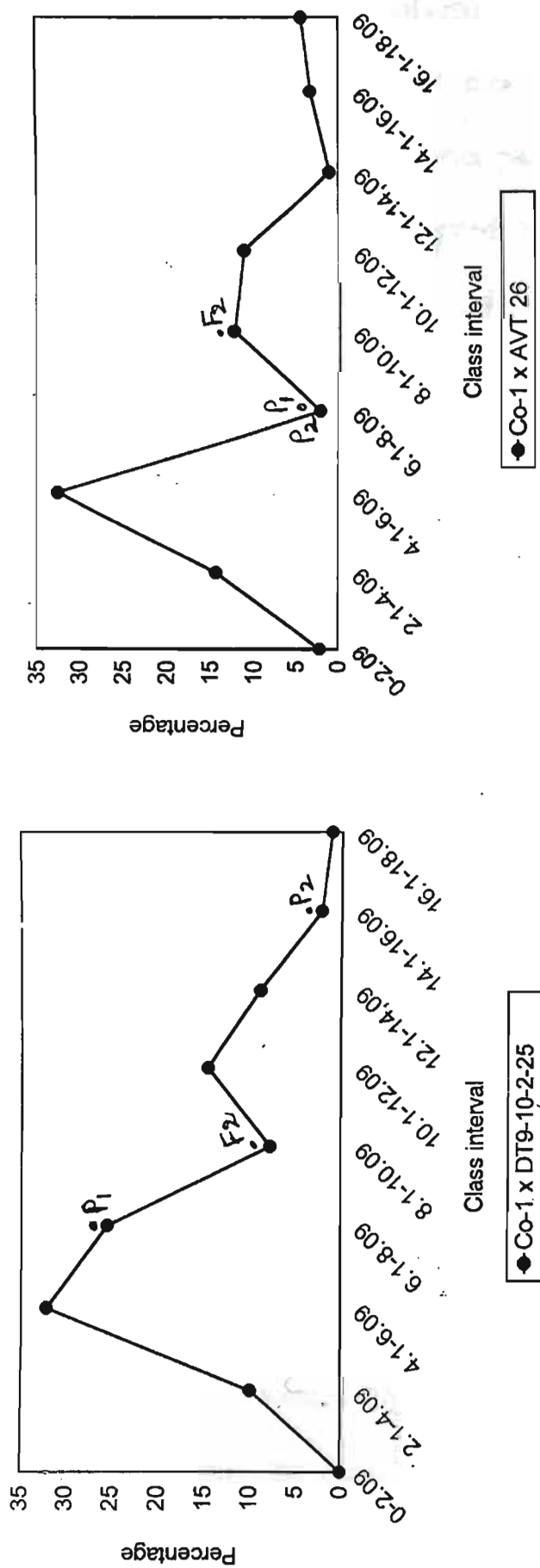
Table 12 : Segregation pattern in F₂ generation of sesame for total number of branches per plant in three crosses

Sl. No.	Cross	Class Intervals (%)									Mean		
		0-2.09	2.10-4.09	4.10-6.09	6.10-8.09	8.10-10.09	10.10-12.09	12.10-14.09	14.10-16.09	16.10-18.0	P ₁	P ₂	F ₂
1	CO-1 x DT 9-10-2-25	—	10.00	32.22	25.55	7.77	14.44	8.88	2.22	1.11	8.05	14.48	9.59
2	CO-1 x AVT 26	2.22	14.44	32.44	22.22	12.22	11.11	1.11	3.33	4.44	8.05	7.34	8.71
3	CO-1 x TMV 6	1.11	16.66	38.88	20.00	13.33	8.88	2.22	1.11	—	8.05	5.97	7.38

Table 13 : Segregation pattern in F₂ generation of sesame for number of capsules per plant in three crosses

Sl. No.	Cross	Class Intervals (%)									Mean		
		0-40.0	40.10-80.09	80.10-120.09	120.10-160.09	160.10-200.09	200.10-240.09	240.10-280.09	280.10-320.09	320.10-360.09	P ₁	P ₂	F ₂
1	CO-1 x DT 9-10-2-25	—	30.00	43.33	21.11	1.1	2.22	2.22	1.11	—	88.88	44.43	109.45
2	CO-1 x AVT 26	—	4.44	14.44	33.33	31.11	8.88	4.44	1.11	1.11	88.88	63.35	172.00
3	CO-1 x TMV 6	2.22	27.77	45.55	18.88	1.11	2.22	—	—	—	88.88	85.31	111.88

Fig³ : Segregation pattern in F_2 generation of sesame for number of branches per plant in three crosses



The segregating population of the cross Co-1 x TMV 6 showed a mean value of 7.38 with parental means of 8.05 and 5.97 respectively. The F_2 mean and the mean of better parent occupied the class interval of 6.10-8.09 while lesser parent occupied the class interval of 4.10-6.09.

4.5.4 Number of Capsules per Plant

For best three crosses the segregation pattern is showed in Table 13.

The cross Co-1 x DT 9-10-2-25 had a F_2 mean of 109.45, while the parental means were 88.88 and 44.43 respectively. The F_2 mean and the mean of the better parent were in the class interval of 80.10-120.09 and lesser parent mean lay in the class interval of 40.10-80.09.

The segregating population of the cross, Co-1 x AVT 26 showed a mean value of 172.0 with parental means of 88.88 and 63.35. The F_2 and the parental means lay in the class interval of 160.10-200.09, 80.10-120.09 and 40.10-80.09 respectively.

For the cross Co-1 x TMV 6, the F_2 mean was 111.88, while the parental means were 88.88 and 85.31 respectively. The F_2 and the parental means occupied the class interval of 80.10-120.09.

Fig 4 : Segregation pattern in F_2 generation of sesame for number of capsules per plant in three crosses

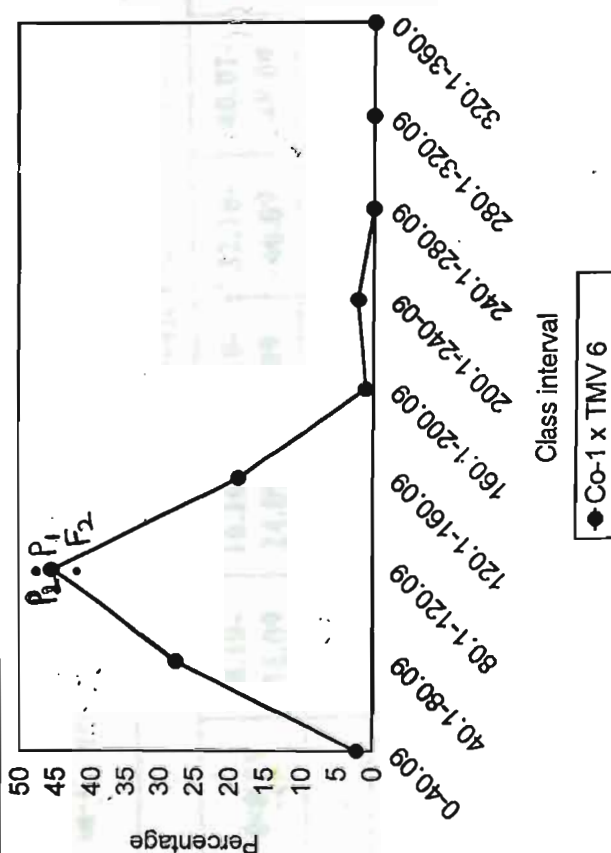
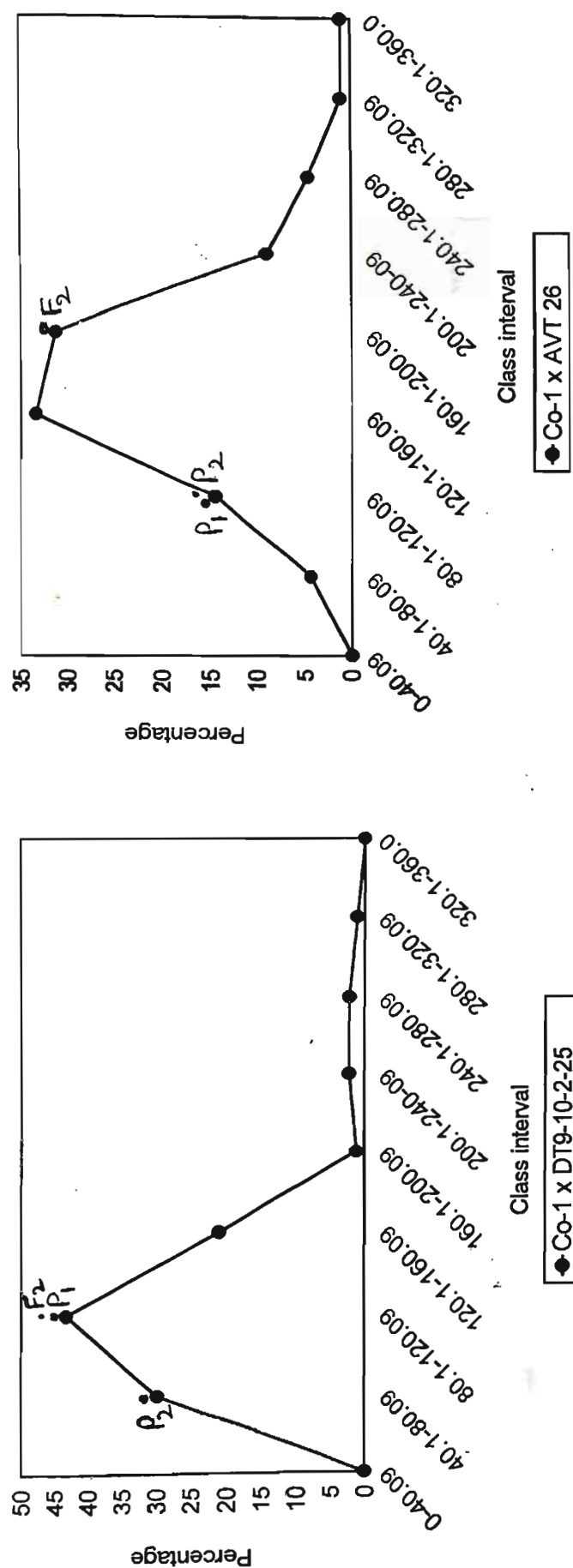


Table 14 : Segregation pattern in F₂ generation of sesame for 1000-seed weight in three crosses

Sl. No.	Cross	Class Intervals (%)						Mean		
		0.00-0.809	0.810-1.609	1.610-2.409	2.410-3.209	3.210-4.009	4.010-4.80	P ₁	P ₂	F ₂
1	CO-1 x DT 9-10-2-25	—	—	3.33	11.11	63.13	22.57	3.61	3.95	4.11
2	CO-1 x AVT 26	—	—	4.44	10.45	50.22	34.89	3.61	4.24	4.25
3	CO-1 x TMV 6	—	1.11	7.77	45.55	38.88	6.69	3.61	3.22	3.42

Table 15 : Segregation pattern in F₂ generation of sesame for seed yield per plant in three crosses

SL No.	Cross	Class Intervals (%)							Mean		
		0-8.09	8.10- 16.09	16.10- 24.09	24.10- 32.09	32.10- 40.09	40.01- 48.09	48.10 -56.0	P ₁	P ₂	F ₂
1.	CO-1 x DT 9-10-2-25	—	4.44	10.00	44.40	36.66	2.22	2.22	21.50	10.84	31.75
2.	CO-1 x AVT 26	—	1.11	12.20	20.00	28.88	34.44	3.30	21.50	20.51	39.86
3.	CO-1 x TMV 6	—	14.44	52.20	33.33	—	—	—	21.50	18.38	26.24

4.5.5 1000-seed Weight

For best three crosses the segregation pattern is showed in Table 14.

The cross Co-1 x DT 9-10-2-25 had a F_2 mean of 4.11, while the parental means were 3.61 and 3.95 respectively. The F_2 mean and the mean of the parents were in the class interval of 4.01-4.80 and 3.21-4.00 respectively.

For the cross Co-1 x AVT 26, the F_2 mean was 4.25, while the parental means were 3.61 and 4.24 respectively. The F_2 mean and the mean of better parent occupied the class interval of 4.01-4.80, while lesser parent occupied the class interval of 3.21- 4.00.

The segregating population of the cross, Co-1 x TMV 6 showed a mean value of 3.42 with parental means of 3.61 and 3.22 respectively. The F_2 mean and the parental means occupied the class interval of 3.21-4.00.

4.5.6 For Seed Yield per Plant

For best three crosses the segregation pattern is showed in Table 15

For the cross Co-1 x DT 9-10-2-25, the F_2 mean and the parental means were found to be 31.75, 21.50 and 10.84 respectively. The F_2 mean occupied the class interval of 24.10-32.09, the better and lesser parent occupied the class intervals of 16.10-24.09 and 8.10-16.09 respectively.

Fig 5 : Segregation pattern in F_2 generation of sesame for 1000-seed weight in three crosses

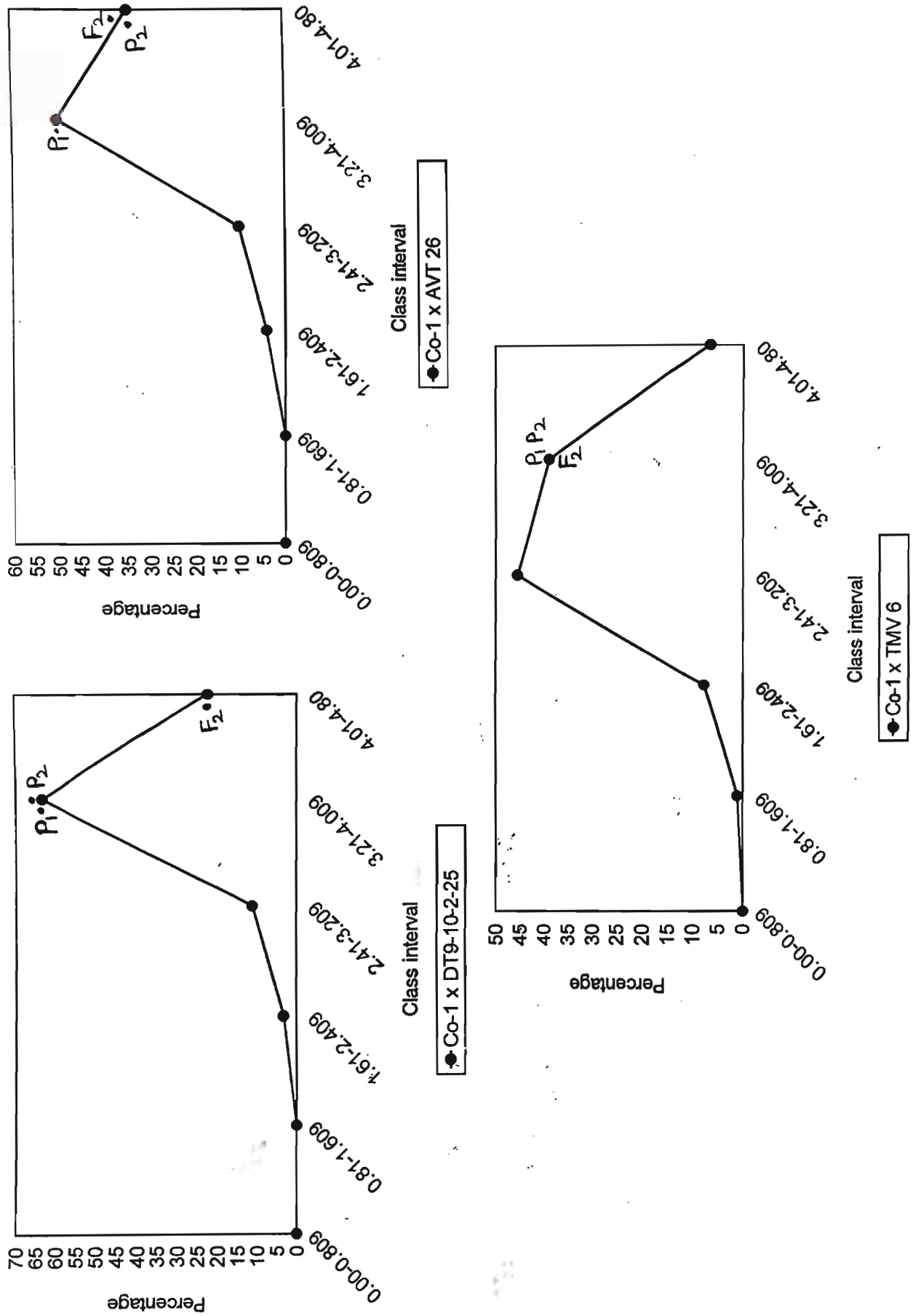
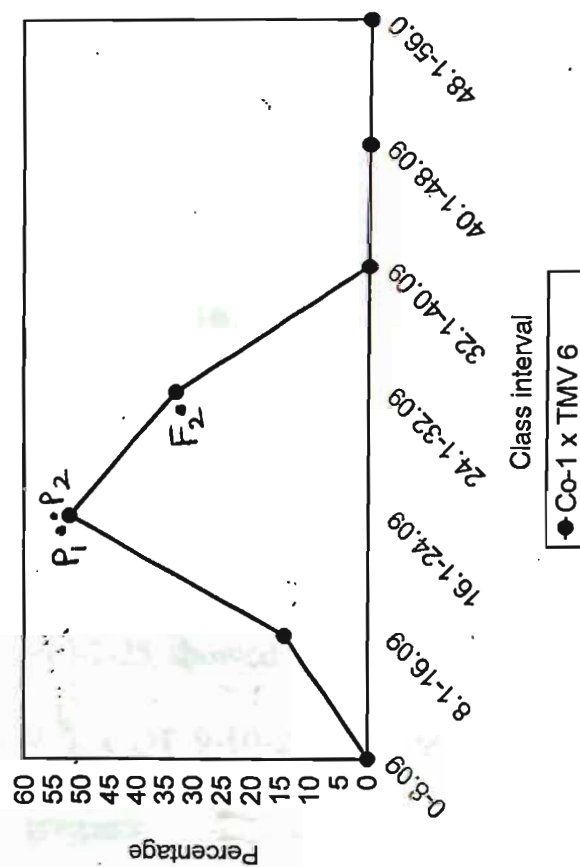
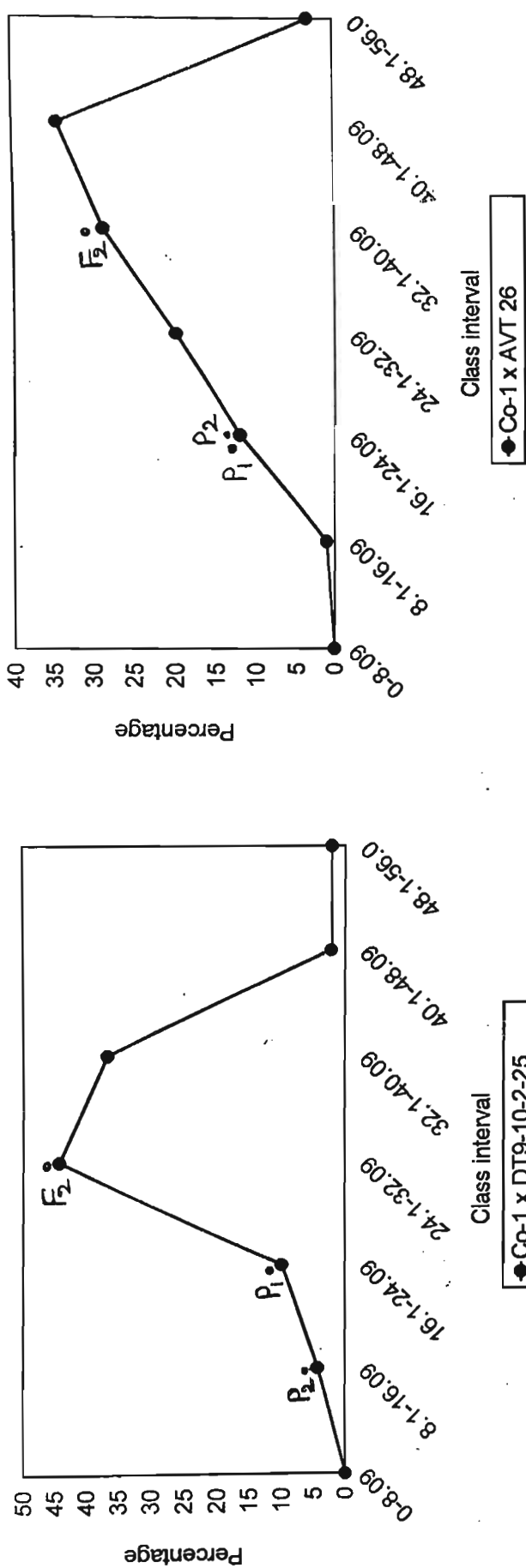


Fig 6 : Segregation pattern in F_2 generation of sesame for seed yield per plant in three crosses



The cross Co-1 x AVT 26 showed a mean yield of 39.86 while the parental means were 21.50 and 20.51 respectively. The F_2 mean and parents mean lay in the class intervals of 32.10-40.09 and 16.10-24.09 respectively.

The segregating population of Co-1 x TMV 6 showed a mean seed yield of 26.24. The parents showed mean values of 21.50 and 18.38 respectively. The F_2 mean and parents mean lay in the class interval of 24.10-32.09 and 16.10-24.09 respectively.

The transgressive segregants for yield and its components in the F_2 generation for ten crosses were presented in Table 16.

For plant height percentage of total transgressive segregants ranged from 53.3%-92.2% while significantly transgressive segregants ranged from 32.4%-86.1%. The cross VRI-1 x DT 9-10-2-25 showed more number of total transgressive segregants while ACV 2 x DT 9-10-2-25 showed more number of significantly transgressive segregants.

For number of branches per plant total transgressive segregants ranged from 4.4% - 45.5% and significantly transgressive segregants 9.0%-28.8%. The cross TNAU 20 x TMV 6 and VRI-1 x AVT 26 showed more number of total transgressive segregants while Co-1 x AVT 26 showed more number of significantly transgressive segregants.

Table 16 : Percentage of total transgressive segregant (TTS) and significantly transgressive segregants (STS) in the F₂ generation

Sl. No.	Crosses	Plant height		Number of branches per plant		Number of capsules per plant		1000-seed weight		Seed yield per plant	
		TTS	STS	TTS	STS	TTS	STS	TTS	STS	TTS	STS
1.	CO-1 x TMV 6	87.7	62.2	34.4	23.3	56.6	43.3	25.4	16.3	50.4	39.2
2.	CO-1 x DT 9-10-2-25	89.5	71.5	8.8	1.1	88.8	72.2	10.7	6.5	45.7	28.4
3.	CO-1 x AVT 26	88.1	70.6	38.8	28.8	90.12	87.2	13.8	6.1	60.5	43.2
4.	TNAU 20 x CIANNO	76.6	61.7	42.2	18.8	75.5	64.3	57.6	48.9	36.7	24.3
5.	TNAU 20 x TMV 6	53.3	50.3	45.5	23.1	70.0	71.2	70.1	65.2	40.5	32.1
6.	VRI-1 x DT 9-10-2-25	92.2	34.4	15.5	2.22	43.2	28.3	40.3	28.4	52.7	40.2
7.	VRI-1 x AVT 26	82.1	46.4	45.5	27.1	43.2	49.5	30.5	18.4	62.4	32.1
8.	ACV 2 x DT 9-10-2-25	91.5	86.1	8.8	0.0	37.3	40.1	40.9	30.3	50.7	29.7
9.	ACV 2 x AVT 26	90.7	85.4	25.5	20.1	43.4	32.4	28.4	19.3	35.4	19.5
10.	DT 9-10-2-25 x AVT 26	84.4	81.3	4.4	1.1	70.6	63.2	40.7	25.9	41.3	26.4

For number of capsules per plant total transgressive segregants ranged from 43.2%-90.12% while significantly transgressive segregants ranged from 28.4%-87.2%. The cross Co-1 x AVT 26 showed more of total transgressive and significantly transgressive segregants.

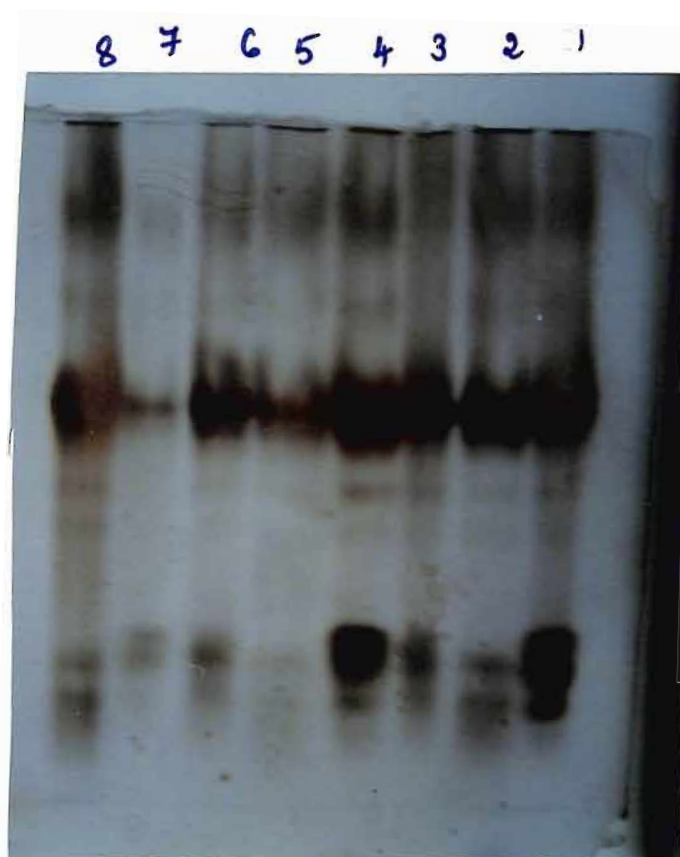
For 1000-seed weight the total transgressive segregants ranged from 10.7%-70.1% while significantly transgressive segregants ranged from 6.1%-65.2%. The cross TNAU 20 x TMV 6 showed more percent of total transgressive segregant and significantly transgressive segregants.

For seed yield per plant total transgressive segregants ranged from 35.4%-62.4% while significantly transgressive segregants ranged from 19.5%-43.2%. The cross VRI-1 x AVT 26 showed more percentage of total transgressive segregants while Co-1 x AVT 26 showed more percentage significantly transgressive segregants.

4.6 ELECTROPHORETIC ANALYSIS OF ISOZYME ESTERASE

Isozyme profiles of seed esterase for different parents were presented in Fig. 7. The results indicated that a total of 6 bands were identified. Two more intense bands were observed for cultivars Co-1 and TMV 6 and one more intense band was observed in cultivars TNAU 20, CIANNO, VRI-1, ACV 2 and AVT 26. Different bands exhibited different

ELECTROPHORETIC ANALYSIS OF
ISOZYME ESTERASE



1. CO-1
2. TNAU20
3. CIANNO
4. TmV6

5. VRI-1
6. ACV2
7. DT9-10-2-25
8. AVT26

Chapter V

Discussion

CHAPTER - V

DISCUSSION

Sesame is an important oil seed crop of India, contributing thirty two per cent of total oil seed production. But the average productivity of the presently available varieties is less and hence there is a need to evolve high yielding varieties. Any crop improvement programme's success mainly depends on the nature and magnitude of the genetic variability and gene action involved for the economically important characters. The efficiency of selection in breeding programmes depends on the extent of genetic variability present in the population. The natural variability for yield and its component traits are very narrow in a highly self pollinated crop like sesame and the scope of selection is less. However, proper evaluation of the extent of genetic variation available for yield and yield attributes, their heritability values and genetic advance that could be effected will be of immense value to the breeders. The adoption of appropriate breeding approaches based on biometrical genetics involving combining ability is useful in providing all sorts of genetic information about the parents and the crosses for characters under study.

The present investigation was carried out to study the genetic analysis of yield and yield components by using twenty eight F_2 progenies and their eight parents derived out of an 8 x 8 diallel cross (without reciprocals). The

parents and F_2 progenies were subjected to combining ability analysis using Method II and Model I Griffing (1956). Mean performance, variability, heritability and genetic advance, combining ability as well as segregation pattern of the crosses were estimated and discussed briefly.

The results of genetic investigation conducted on 8 parents and their 28 F_2 progenies of a half diallel are discussed in this chapter under the following topics.

5.1 MEAN PERFORMANCE

5.2 GENETIC PARAMETERS

5.3 COMBINING ABILITY

5.4 SEGREGATION PATTERN

5.5 ISOZYME STUDY

5.1 MEAN PERFORMANCE OF PARENTS AND F_2 PROGENIES

Considerable variation present in the parents and F_2 populations can be seen from the mean values for different characters (Table 3). A perusal of mean performance of parents indicated that ACV 2 was the earliest to flower (30.00 days) followed by TNAU 20 and TMV 6 (31.00 days) while CO-1 was late to flower (36.33 days). With regard to maturity TMV 6 was the earliest (95.00 days) followed by CIANNO (96.33 days). DT 9-10-2-25 was very late to maturity (108.00 days) followed by AVT 26 (107.33 days), CO-1

and VRI-1 (106.00 days). ACV 2 and TMV 6 could be effectively utilized for obtaining hybrids with earliness.

Among the F_2 progenies CIANNO x ACV 2 (medium x early) was the earliest (29.67 days) to flower followed by CIANNO x TMV 6 (medium x early), ACV 2 x DT 9-10-2-25 (early x late) and ACV 2 x AVT 26 (early x late). The cross very late to flower was CO-1 x AVT 26 (late x late, 35.00 days). Regarding maturity CIANNO x ACV 2 (medium x early) was the earliest (91.00 days) followed by CIANNO x VRI-1 (Medium x late, 91.33 days). The cross very late to mature was CO-1 x DT 9-10-2-25 (late x late, 106.67 days). The cross CIANNO x ACV 2 (medium x early) displayed mean value below to that of earliest flowering parent (ACV 2) and earliest maturing parent (TMV-6).

As far as plant height was concerned CO-1 recorded highest mean performance (110.86) followed by VRI-1 (106.07) and the lowest mean was recorded by DT 9-10-2-25 (59.24). The highest plant height (160.99) in F_2 progenies was recorded by CO-1 x DT 9-10-2-25 (high x low) followed by CO-1 x AVT 26 (high x high, 146.36), TNAU 20 x DT 9-10-2-25 (high x low, 133.83). These crosses can be used to develop tall genotypes in future.

Primary and secondary branches of sesame are the main sources of sink bearing the capsule. More number of branches were accompanied with increase in seed yield. Among the parents VRI-1 and DT 9-10-2-25 recorded maximum primary branches while the crosses TNAU 20 x DT 9-10-2-25 (high x high, 6.23) recorded maximum number of primary branches followed by CO-1 x DT 9-10-2-25 (high x high, 6.19), TMV 6 x AVT 26 (medium x high 6.17) and VRI-1 x DT 9-10-2-25 (high x high, 5.78). An improvement in number of branches per plant will directly increase the seed yield. So DT 9-10-2-25 and VRI-1 can be used in future breeding programme for increasing number of branches per plant.

Secondary branches bears maximum capsules hence secondary branches also plays a major role in increasing the yield. Among the parents DT 9-10-2-25 recorded maximum number of secondary branches as it is a determinate genotype. The crosses TNAU 20 x AVT 26 (low x medium) and VRI-1 x DT 9-10-2-25 (low x high) recorded maximum number of secondary branches.

Capsules are the sources of sinks (seeds) which directly influences the seed yield. Capsules distributed on main stem, primary and secondary branches decides the seed yield of the plant. For number of capsules on main stem the parents VRI-I and ACV 2 recorded high mean values for this trait (29.42 and 27.59 respectively), but the parent DT 9-10-2-25 recorded low

mean value (3.62), the crosses CO-1 x AVT 26 (43.55) recorded maximum number of capsules on main stem. The crosses involving as DT 9-10-2-25 one of the parent i.e., CO-1 x DT 9-10-2-25 and TNAU 20 x DT 9-10-2-25 recorded maximum number of capsules on main stem. This shows that DT 9-10-2-25 can be used as one of the parent to improve this trait.

As for as number of capsules on primary branches was concerned, CO-1 recorded the highest mean performance (56.77) followed by TMV 6 (48.55) and the lowest mean was displayed by DT 9-10-2-25 (20.50). The highest number of capsule bearing primary branches in F_2 population was recorded by CO-1 x AVT 26 (102.19, high x medium), TMV 6 x DT 9-10-2-25 (high x low, 69.39). An improvement in number of capsules on primary branches per plant will directly increase the seed yield. So CO-1 and TMV 6 can be used in future breeding programme for increasing number of capsules on primary branches.

For capsules on secondary branches per plant the parent DT 9-10-2-25 showed highest mean value (20.31) followed by CIANNO (12.49). Among the F_2 population CO-1 x AVT 26 (low x low, 26.26) and CO-1 x TMV 6 (low x medium, 19.28) recorded maximum number of capsules on secondary branches. The cross involving CIANNO x DT 9-10-2-25 (high x high, 11.16) recorded medium number of capsule bearing secondary branches per plant.

This indicates that parents with high *per se* may not always have the compatibility to evolve promising hybrids, further it may be due to diversion of photosynthate to sinks (capsules) on primary branches and main stem rather than to secondary branches. The parent DT 9-10-2-25 had the habit of cluster bearing at the tip of secondary branches with more number of secondary branches.

Among the parents CO-1 recorded the maximum number of capsules per plant followed by VRI-1 and TMV 6. The cross CO-1 x AVT 26 (high x medium, 172.00), CO-1 x TMV 6 (high x high, 111.88) and TNAU 20 x CIANNO (110.94 medium x medium) recorded maximum number of capsules per plant. So, the parents Co-1, VRI-1 can be used in future breeding programme for increasing number of capsules per plant.

The parent DT 9-10-2-25 registered the highest mean performance for capsules length (2.98 cm) closely followed by ACV 2 (2.91 cm). Among the crosses TNAU 20 x AVT 26 (high x high, 3.12 cm) TNAU 20 x DT 9-10-2-25 (high x high, 3.10 cm) recorded maximum mean values. This indicates the importance of the genotypes DT 9-10-2-25 and TNAU 20 in increasing pod length.

Out of 8 genotypes studied, CIANNO recorded the highest mean performance for number of seeds per capsule (88.53) followed by CO-1 (73.40). Among crosses, CO-1 x DT 9-10-2-25 (high x medium, 79.57), DT 9-10-2-25 x AVT 26 (medium x medium, 74.93), CO-1 x TNAU 20 (high x medium, 73.44) and CO-1 x CIANNO (high x high, 72.38) recorded high mean values for this trait. This shows that CO-1 has got high influence in increasing number of seeds per capsule.

The parent AVT 26 registered the highest mean performance for 1000 seed weight (4.24 g) followed by DT 9-10-2-25 (3.95 g). In F_2 crosses TNAU 20 x TMV 6 (medium x medium, 4.40 g) showed high mean value followed by CO-1 x AVT 26 (high x high, 4.25 g), CO-1 x DT 9-10-2-25 (high x high, 4.11 g) and VRI-1 x DT 9-10-2-25 (medium x high, 3.95). The crosses involving either AVT 26 or DT 9-10-2-25 as one of the parents recorded high mean for 1000-seed weight indicating the importance of these two parents in increasing 1000-seed weight.

Seed yield determines economic value of parents and crosses. The highest yielder among parents was CIANNO (22.71 g) followed by CO-1 (21.50 g) and VRI-1 (21.40 g). Among F_2 crosses, CO-1 x AVT 26 (high x high, 39.86 g) recorded the highest seed yield per plant followed by CO-1 x DT 9-10-2-25 (high x low, 31.75 g), CO-1 x TMV 6 (26.24, high x medium),

TNAU 20 x TMV 6 (26.19, medium x medium), TNAU 20 x CIANNO (medium x high 24.73). This indicates the importance of CO-1 as one of the parent in increasing the seed yield per plant.

Among the parents, VRI-1 showed highest mean for biomass (80.00%) followed by TMV 6 (72.00%). In F_2 crosses, TNAU 20 x VRI-1 (low x high, 84.00%) recorded the highest mean performance followed by CO-1 x DT 9-10-2-25 (medium x medium, 83.33).

To sum up, the parent ACV 2 recorded as the best parent for days to 50 per cent flowering, while TMV 6 was early to maturity these two parents can be used to produce early hybrids. The use of CO-1 for imparting increased plant height, number of capsules on primary branches, number of capsules per plant and seed yield per plant DT 9-10-2-25 for number of primary branches, number of secondary branches, number of capsules on secondary branches and capsule length; VRI-1 for number of capsules on secondary branches and biomass, CIANNO for number of seeds per capsule and seed yield were appeared to be promising parents for future breeding programmes.

In F_2 populations, CO-1 x AVT 26 was better yielder than the parents involved in this cross. This cross also showed better mean values for number

Fig. 8 : Mean performance of parents and $\bar{F}_2$ progenies for number of capsules per plant

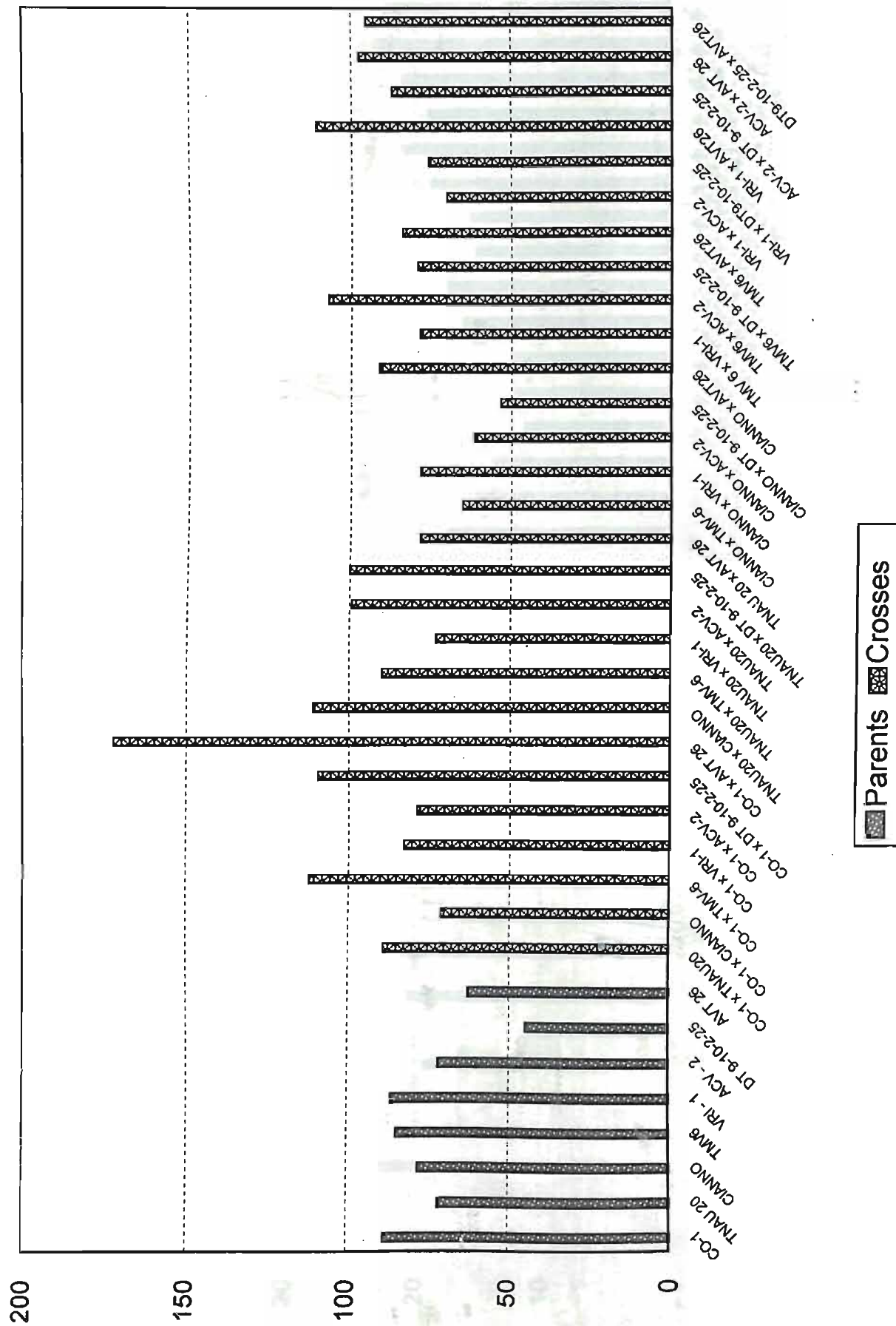
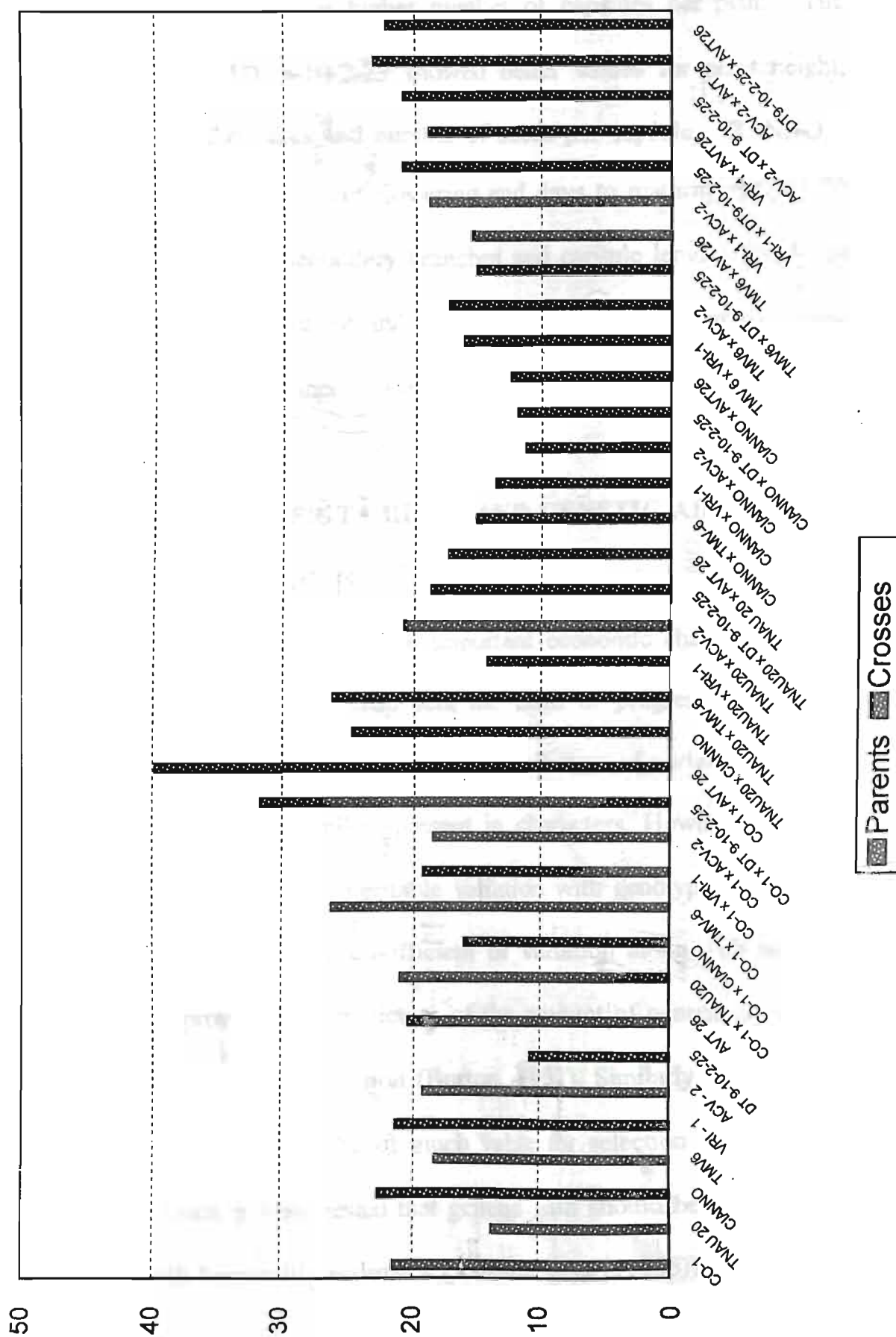


Fig. 9 : Mean performance of parents and F₂ progenies for seed yield per plant



of capsules on secondary branches capsules on main stem, and capsules on primary branches resulting in higher number of capsules per plant. The population CO-1 x DT 9-10-2-25 showed better values for plant height, number of primary branches and number of seeds per capsule, CIANNO x ACV 2 for days to 50 per cent flowering and days to maturity, TNAU 20 x AVT 26 for number of secondary branches and capsule length; TNAU 20 x TMV 6 for 1000-seed weight and TNAU 20 x VRI-1 for biomass. These crosses can be further advanced to obtain desired segregants.

5.2 VARIABILITY, HERITABILITY AND GENETIC ADVANCE AS PER CENT OF MEAN

The amount of variability for important economic characters in the germplasm collection of any crop sets the limit of progress that can be achieved through selection. Information on co-efficient of variation is useful in measuring range of variability present in characters. However, it is not possible to assess the extent of heritable variation with genotypic co-efficient of variation alone. Genotypic co-efficient of variation along with heritable estimates would provide a better picture of the amount of genetic advance to be expected by phenotypic selection (Burton, 1952). Similarly, the estimates of heritability alone will not be of much value for selection on phenotypic performance. Hence, it is suggested that genetic gain should be considered in conjunction with heritability estimates (Johnson *et al.* (1955)).

In the present study the estimates of phenotypic co-efficient of variation for all characters were higher than the estimates of genotypic co-efficient of variation which may be due to interaction of genotypes with the environment. The results obtained are discussed hereunder.

In the parents, the phenotypic co-efficients of variation (PCV) were slightly greater than the genotypic co-efficients of variation (GCV) for all the characters, which may be due to interaction of genotypes with the environment (Table 4). Highest GCV and PCV was observed for number of secondary branches followed by capsules on secondary branches, capsules on main stem, capsules on primary branches and number of primary branches.

However, moderate GCV and PCV was observed for capsule length, 1000-seed weight and number of seeds per capsule, while low PCV and GCV were observed for days to 50 per cent flowering and days to maturity. This result was in consonance with findings of Baruah and Goud (1998), John Joel and Thangavelu (1997) for secondary branches ; Anil Kumar (1999) for capsules on secondary branches; John Joel and Thangavelu (1997) for capsules on main stem; Anil Kumar (1999) for capsules on primary branches; Baruah and Goud (1993) for total number of capsules; Ashoka Vardhana Reddy (1999) for capsule length, Patil and Sheriff (1996) for 1000-seed weight, Ashoka Vardhana Reddy *et al.* (2001) for number of seeds per capsule and harvest index.

In case of F_2 progenies high GCV and PCV were observed for characters seed yield per plant, number of capsules on secondary branches, number of capsules on primary branches, number of capsules per plant, number of capsules on main stem and number of secondary branches. The characters days to maturity, capsule length and days to 50 per cent flowering recorded low GCV and PCV. It shows selection would not be effective for these characters. This results was in consonance with studies of Anil Kumar (1999) for seed yield, Govindarasu *et al.* (1990) for capsules on secondary branches, Ashoka Vardhana Reddy (1999) for capsules on primary branches John Joel and Thangavelu (1997) for days to maturity, Shadakshari *et al* (1995) for days to 50 per cent flowering and capsule length.

Heritability and Genetic advance as per cent of mean

Plant breeding exploits the heritable portion of variability constituting genetic variability. Information on heritability and genetic advance as per cent of mean will give a clear picture about criteria for selection. However, it is not necessary that a character showing high heritability will also exhibit high genetic advance. If high heritability is accompanied by high genetic advance as per cent of mean, it indicates that the inheritance is due to additive gene effects which are fixable, hence, selection is effective for such characters. If high heritability is accompanied by low genetic advance as per cent of mean, it indicates non-additive gene effects and selection for such trait may not be rewarding.

In the present investigation in case of parents high heritability coupled with high genetic advance as per cent of mean was recorded for number of secondary branches, number of capsules on main stem, number of capsules on primary branches number of capsules on secondary branches and seed yield per plant where as in crosses seed yield per plant, number of capsules on primary branches, number of capsules on main stem and number of capsules per plant showed high heritability with high genetic advance. These traits with high heritability coupled with high genetic advance as per cent of mean are attributed to additive gene effects, thus these traits are least influenced by environment, so simple selection for these characters would be very effective. These results were in accordance with Govindarasu *et al.* (1990), John Joel and Thangavelu (1997) and Ashoka Vardhana Reddy *et al.* (2001) for number of primary branches per plant, number of secondary branches per plant and number of capsules on main stem. Shadokshari *et al.* (1995), Patil and Sheriff (1996), Anil Kumar (1999), Ashoka Vardhana Reddy (2001) for seed yield per plant, Vanisri *et al.* (1999), John Joel and Thangavelu (1997) and Ashoka Vardhana Reddy *et al.* (2001) for number of capsules per plant.

The characters 1000-seed weight, plant height, number of seeds per capsule, number of primary branches per plant and harvest index showed high heritability coupled with moderate genetic advance as per cent of mean in

In the present investigation in case of parents high heritability coupled with high genetic advance as per cent of mean was recorded for number of secondary branches, number of capsules on main stem, number of capsules on primary branches number of capsules on secondary branches and seed yield per plant where as in crosses seed yield per plant, number of capsules on primary branches, number of capsules on main stem and number of capsules per plant showed high heritability with high genetic advance. These traits with high heritability coupled with high genetic advance as per cent of mean are attributed to additive gene effects, thus these traits are least influenced by environment, so simple selection for these characters would be very effective. These results were in accordance with Govindarasu *et al.* (1990), John Joel and Thangavelu (1997) and Ashoka Vardhana Reddy *et al.* (2001) for number of primary branches per plant, number of secondary branches per plant and number of capsules on main stem, Shadakshari *et al.* (1995), Patil and Sheriff (1996), Anil Kumar (1999), Ashoka Vardhana Reddy (2001) for seed yield per plant, Vanisri *et al* (1994), John Joel and Thangavelu (1997) and Ashoka Vardhana Reddy *et al.* (2001) for number of capsules per plant.

The characters 1000-seed weight, plant height, number of seeds per capsule, number of primary branches per plant and harvest index showed high heritability coupled with moderate genetic advance as per cent of mean in

both parents and crosses indicating that these traits would be improved by simple selection methods. Kandaswamy (1985), Mishra *et al.* (1995), Shadakshari *et al.* (1995) for plant height, Bhele *et al.* (1987), Anil Kumar (1999) for 1000-seed weight, Shadakshari *et al.* (1995), Ashoka Vardhana Reddy *et al.* (2001) for number of seeds per capsule reported similar results.

High heritability with low genetic advance was observed for days to maturity and days to 50 per cent flowering in both the parents and crosses, these results were supported by John Joel and Thangavelu (1997), Jayalakshmi *et al.* (1998) and Ashoka Vardhana Reddy *et al.* (2001) for days to 50 per cent flowering. Mishra *et al.* (1995) and Anil Kumar (1999) for days to maturity.

The present investigation revealed that both in parents and F_2 progenies estimates of GCV, PCV, heritability and genetic advance as per cent of mean were high for seed yield per plant, plant height, number of capsules on primary branches, number of capsules per plant indicating the presence of considerable heritable variation. Hence, simple selection could be effective for improvement of these characters. On the other hand, days to maturity, days to 50 per cent flowering had low GCV and PCV with low genetic advance. Hence, these characters are highly influenced by environment and are controlled by non-additive gene effects in such cases selection alone would

be ineffective. So biparental mating to release the locked up variability followed by selection could be suggested to isolate superior segregants.

5.3 COMBINING ABILITY

Estimates of variances due to GCA and SCA provide a basis for detection of the predominant role of additive and non-additive gene effects respectively. The GCA and SCA effects help to identify the parents and crosses that are responsible for bringing about a particular type of gene action. The estimation of GCA of parents is important as it attributes to fixable gene effects including additive x additive gene interaction. On the other hand, SCA variances are non-fixable and caused by non-additive gene action including dominant and epistatic interactions. For improvement of self pollinated crops, high SCA effects of a particular cross combination will be useful if it is accompanied by high GCA effect of the respective parents, unlike in cross pollinated crops wherein predominant SCA effects are of primary consideration (Raghavaiah and Joshi, 1986).

The GCA and SCA effects were computed for eight parental genotypes and their 28 F_2 progenies respectively and are discussed here under.

Days to 50 per cent flowering :

The estimates of variance due to GCA / SCA ratio revealed that non-additive gene action plays major role in determining the inheritance of the trait days to 50 per cent flowering. This result was in conformity with studies of Das and Gupta (1999) and Jayalakshmi *et al.* (2000). The parents ACV 2 and CIANNO showed significant negative SCA effects. The cross CIANNO x ACV 2 (high x high) showed negative SCA effects indicating the presence of additive gene effects. The crosses CO-1 x TMV 6 (low x high), CO-1 x CIANNO (low x high) VRI-1 x AVT 26 (high x low) showed significant negative SCA effects this shows the presence of non-additive gene action. The cross involving the parents combination of high and high, CO-1 x VRI-1 (low x low) recorded negative SCA effect this also indicates the predominance of dominance and epistatic i.e. non-additive gene action. These results were in agreement with studies of Shinde *et al.* (1993) Das and Gupta (1999) and Jayalakshmi *et al.* (2000).

Selection based on GCA performance of parents and *per se* performance of crosses would be useful. A negative and significant SCA effects for days to 50 per cent flowering in the crosses indicates the possibility of improvement for this trait. The cross combinations involving high x low general combiners for this trait would be improved by intermating of the superior selects in the segregating generations in all possible combinations followed by pedigree method of breeding.

DAYS TO MATURITY

Analysis of variance for days to maturity revealed significance of mean squares due to GCA and SCA, indicating the presence of both additive and non-additive gene action. However variance for GCA / SCA ratio indicated the predominance of non-additive gene action. This result was in agreement with the reports of Dora and Kamala (1986), Khorgade *et al.* (1988) and Dikshit and Swain (2001).

The parents TMV 6 and CIANNO mature early and also recorded negative GCA effects, while late maturing parents CO-1 and DT 9-10-2-25 displayed positive GCA effects. This confirms the relationship between *per se* performance of parents and their GCA effects. The parents TMV 6 and CIANNO were identified as good combiners for generating early maturing hybrids. The cross involving CIANNO x TMV 6 (early x early) showed negative SCA effects which indicates the presence of additive gene action. The cross CO-1 x TMV 6 (late x early), CIANNO x DT 9-10-2-25 (early x late) TMV 6 x AVT 26 (early x late) exhibited significant negative SCA effects which indicates the presence of non-additive gene action, while the crosses CO-1 x AVT 26 (late x late), TNAU 20 x DT 9-10-2-25 (late x late), TNAU 20 x AVT 26 (late x late) exhibited significant negative effects indicating the presence of non-additive gene action. The study based on these cross combinations suggested the presence of both non-additive and additive

gene action. Hence biparental mating followed by recurrent selection in early generation would be helpful in exploitation of both additive and non-additive gene action controlling this trait.

PLANT HEIGHT

Importance of both additive and non-additive gene actions were observed in inheritance of plant height as the mean squares of SCA and GCA were high and significant. However the variance due to GCA / SCA indicated the predominance of additive gene action, this view was reported by Reddy *et al.* (1984), Dora and Kamala (1986), Fatteh *et al.* (1995) and Devasena *et al.* (2001).

The parents with high mean performance for plant height namely CO-1 recorded positive GCA effects while VRI-1 recorded negative GCA effects. The crosses CO-1 x DT 9-10-2-25 (high x high) and TNAU 20 x DT 9-10-2-25 (high x high) recorded significant positive SCA effects, which indicates the presence of additive gene action. The crosses CO-1 x CIANNO (high x low), CO-1 x VRI-1 (high x low), CO-1 x ACV 2 (high x low) exhibited significant negative SCA effects indicating the presence of non-additive gene action, while the crosses VRI-1 x ACV 2 (low x low), VRI-1 x AVT 26 (low x low) exhibited significant negative SCA effects which indicates the presence of additive gene effects. Study based on the GCA

effects suggested that the parents CO-1, DT 9-10-2-25 and TNAU 20 can be employed to develop tall genotypes. The cross with high SCA effect can be forwarded to further generation and selection in later generation would be useful for this trait.

NUMBER OF PRIMARY BRANCHES

For the character number of primary branches, variance due to GCA was lesser in magnitude than SCA, showing the pre-ponderance of non-additive gene action for inheritance of this trait, compared to additive genetic effects. Thiagarajan and Ramanathan (1995), Ram (1995), Kamala (1999) and Jayalakshmi *et al.* (2000) claimed support for this report. The magnitude of GCA for parents had relationship with their *per se* performance, as evident in case of DT 9-10-2-25 and CIANNO having recorded highest and lowest, *per se* performance and GCA effects respectively.

The crosses CO-1 x DT 9-10-2-25 (high x high) TNAU 20 x DT 9-10-2-25 (high x high) and TNAU 20 x AVT 26 (high x high) registered positive SCA effects indicating the presence of additive gene action. The crosses CO-1 x CIANNO (high x low), CO-1 x TMV 6 (high x low) and ACV 2 x DT 9-10-2-25 (low x high) exhibited significant positive SCA effects which may be due to presence of non-additive gene effects, while CIANNO x TMV 6 (low x low) reported significant positive SCA effects which indicates the

presence of over dominance and epistatic gene actions. The parents DT 9-10-2-25, CO-1, VRI-1 were identified as best combiners, while CO-1 x DT-9-10-2-25, TNAU 20 x DT 9-10-2-25, TNAU 20 x AVT 26, TMV 6 x AVT 26 were identified as best crosses, as they have exhibited high SCA effects. Since non-additive gene effects are non-heritable, these crosses can be exploited for genetic improvement through biparental mating, followed by recurrent selection in early generation. This helps in utilization of both additive and non-additive gene actions.

NUMBER OF SECONDARY BRANCHES

Combining ability analysis showed that both additive and non-additive gene effects play an equal role in governing inheritance of secondary branches. However, the variance due to GCA / SCA reveals the preponderance of non-additive gene effects. This result was in consonance with results of Kamala (1999) and Jayalakshmi *et al.* (2000).

The determinate parent DT 9-10-2-25 expressed the highest mean number for secondary branches and maximum GCA effects. The crosses CO-1 x DT 9-10-2-25 (low x high), TNAU 20 x DT 9-10-2-25 (low x high), CIANNO x DT 9-10-2-25 (low x high) and TMV 6 x DT 9-10-2-25 (low x high) exhibited significant negative SCA effects indicating the presence of non-additive gene effects, while VRI-1 x DT 9-10-2-25 (high x high) and

DT 9-10-2-25 x AVT 26 (high x high) registered significant negative SCA effects which indicates the presence of non-additive gene action, parents with highest GCA effects will not necessary generate top specific hybrid combinations (Ranganathan *et al.* 1973, Khaleque *et al.* 1977, Singh 1977, Rao *et al.* 1980), while CO-1 x CIANNO (low x low), CO-1 x TMV 6 (low x low) and TNAU 20 x CIANNO (low x low) exhibited significant positive SCA effects which reflects the presence of overdominance and epistatic gene actions. Hence, these hybrids can be exploited in later generations to evolve superior genotypes with higher secondary branches through biparental mating.

NUMBER OF CAPSULES ON MAIN STEM

Anova for the character capsules on main stem showed significant mean squares due to GCA and SCA. However, the variance for GCA / SCA indicated that the magnitude of GCA effects were higher than that of SCA, visualizing the preponderance of additive gene action. This result was in agreement with studies of Mansouri and Ahmadi (1999), Das and Gupta (1999) and Ashoka Vardhana Reddy *et al.* (2001).

The parent CO-1, TMV 6 and TNAU 20 were identified as good combiners. The cross CO-1 x AVT 26 (high x high) and TNAU 20 x VRI-1 (high x high) recorded significant positive SCA effects indicating the presence of additive gene action, while the crosses CO-1 x DT 9-10-2-25 (high x low),

TNAU 20 x CIANNO (high x low), TNAU 20 x DT 9-10-2-25 (high x low) and TMV 6 x DT 9-10-2-25 (high x low) exhibited significant and positive SCA effects reflecting the significance of non-additive gene actions.

NUMBER OF CAPSULES ON PRIMARY BRANCHES

The estimates of variance components revealed that variance due to SCA was greater than that due to GCA suggesting the importance non-additive gene action, in the expression of capsules on primary branches. Kamala (1999) and Jayalakshmi (1999) have obtained similar results. On contrary, Ramesh *et al.* (1998), Das and Gupta (1999) and Ashoka Vardhana Reddy (2001) have claimed additive gene action. Kadu *et al.* (1992) emphasized the presence of both additive and non-additive gene effects for inheritance of capsule on primary branches.

The parent CO-1 displayed maximum GCA effects followed by AVT 26. The cross CO-1 x AVT 26 (high x high) has recorded significantly positive SCA effects which indicates the presence of additive gene action, while the crosses TNAU 20 x CIANNO (high x low), TNAU 20 x ACV 2 (high x low) and VRI-1 x AVT 26 (low x high) recorded positive SCA effects indicating the presence of non-additive gene effects. The cross TMV 6 x DT 9-10-2-25 (low x low) exhibited significant positive SCA effects which indicates the presence of overdominance and epistatic gene actions.

Since the crosses have significant additive and non-additive genetic variance (epistatic) for this trait, recurrent selection involving mating in all possible combination and further selection would be useful.

NUMBER OF CAPSULES ON SECONDARY BRANCHES

The components of variance due to SCA was greater than that variance due to GCA for the character capsules on secondary branches, revealing the presence of non-additive gene action for this trait. The presence of non-additive gene action would require heterozygosity in the populations. This type of gene action is non-fixable, hence breeding methods involving selection, intermating the selects and reselection may help in genetic improvement of this character. Non-additive gene action for this trait was confirmed by Shindi *et al.* (1991) and Jayalakshmi *et al.* (2000). In contrast, Das and Gupta (1999) claimed additive gene action while Kadu *et al.* (1992) stressed the importance of both additives and non-additive gene action. The estimates of GCA effects revealed that the parent DT 9-10-2-25 was the best combiner and there was a good relationship between its *per se* performance and their GCA effects. The crosses CO-1 x DT 9-10-2-25 (high x high), CO-1 x AVT 26 (high x high) and CO-1 x TMV 6 (high x high) exhibited positive SCA effects which reflects the presence of additive gene action, while the crosses TNAU 20 x AVT 26 (low x high) and VRI-1 x AVT 26 (low x high) registered positive SCA effects indicating the presence of non-

additive gene action. The crosses TNAU 20 x CIANNO (low x low) and TNAU 20 x ACV 2 (low x low) exhibited positive SCA effects which reflects the presence of epistatic and overdominance effects. Recurrent selection may help in exploitation of this gene action to improve capsules on secondary branches.

NUMBER OF CAPSULES PER PLANT

The mean squares due to GCA and SCA were significant, but variance for GCA / SCA ratio revealed the predominance of SCA components i.e., non-additive gene action. This result was in conformity with reports of Ramalingam *et al.* (1990), Goyal and Kumar (1991), Manivannan and Ganesan (2000) and Karuppaiyan *et al.* (2000).

The parent CO-1 recorded maximum GCA effects as well as high *per se*. CO-1 along with AVT 26 was identified as best parents. The crosses CO-1 x AVT 26 (high x high) exhibited significant positive SCA effects this indicates the presence of additive gene action while the crosses CO-1 x DT 9-10-2-25 (high x low), TNAU 20 x CIANNO (high x low) TNAU 20 x ACV 2 (high x low), TMV6 x ACV 2 (high x low) VRI-1 x AVT 26 (low x high) and ACV 2 x AVT 26 (low x high) recorded positive SCA effects indicating the presence of non-additive gene action. The crosses CO-1 x AVT 26, CO-1 x DT 9-10-2-25, CO-1 x TMV 6 were identified as best crosses as

they have high SCA effects. Therefore, these crosses can be forwarded through simple selection because they are having high additive component.

CAPSULE LENGTH

The mean squares due to SCA and GCA were lower and non-significant as compared to other traits, due to lack of genetic variability between the parents. The variance due to GCA / SCA ratio stresses the role of non-additive gene action, as the component of variance due to SCA was greater than their corresponding GCA components. This result was in agreement with findings of Narkhede and Sudhir Kumar (1991a and 1991b). The mean performance of the parents and their GCA effects revealed that parents TNAU 20 and DT 9-10-2-25 were identified as **best** combiners. The study on crosses involving TNAU 20 x DT 9-10-2-25 (high x high) and TNAU 20 x AVT 26 (high x high) showed significant positive SCA effects indicating the presence of additive gene action, while the crosses TNAU 20 x CIANNO (high x low) and CIANNO x ACV 2 (low x high) exhibited significant positive SCA effects indicating the presence of non-additive gene effects, while the crosses CIANNO x TMV 6 (low x **low**), CIANNO x VRI-1 (low x low) and TMV6 x VRI-1 (low x low) recorded significant positive SCA effects indicating the presence of **overdominance** and epistatic gene actions. Therefore, these crosses can be forwarded through biparental mating followed by recurrent selection in early generation for genetic improvement of this trait.

NUMBER OF SEEDS PER CAPSULE

The mean squares due to GCA and SCA were significant, but variance for GCA / SCA ratio revealed the predominance of SCA components, i.e., non-additive gene action. This result was in conformity with reports of Mishra and Yadav (1996), Kamala (1999), Mcharo *et al.* (2000) and Mishra and Sikarwar (2001).

The parent CO-1 recorded maximum GCA effects as well as high *per se*. CO-1 along with CIANNO was identified as best parents. The cross CO-1 x DT 9-10-2-25 (high x high) exhibited positive SCA effects involving additive gene effects, while the crosses CO-1 x TNAU 20 (high x low), CO-1 x VRI-1 (high x low), VRI-1 x DT 9-10-2-25 (low x high), DT 9-10-2-25 x AVT 26 (high x low) and ACV 2 x DT 9-10-2-25 (low x high) recorded positive SCA effects indicating the presence of non-additive gene action, while the crosses VRI-1 x ACV 2 (low x low) and ACV 2 x AVT 26 (low x low) exhibited positive SCA effects reflecting the action of epistatic genes and overdominance. The crosses CO-1 x DT 9-10-2-25, DT 9-10-2-25 x AVT 26, VRI-1 x DT 9-10-2-25 were identified as best crosses as they had high SCA effects. Therefore these crosses can be forwarded through biparental mating followed by recurrent selection in early generation for genetic improvement of this trait.

1000-SEED WEIGHT

Both additive and non-additive gene actions were observed to control the inheritance of 1000-seed weight, as mean squares due to both GCA and SCA were significant confirming the results of Kadu *et al.* (1992) and Das and Gupta (1999). However, non-additive gene action was reported by Manosuri and Ahmadi (1998) and Kamala (1999), while additive gene action for this trait was reported by Sajjanar *et al.* (1995) and Mishra and Yadav (1996). The parents DT 9-10-2-25, CO-1 and AVT 26 were found to be good combiners as all these parents displayed high *per se* performance besides good general combining ability. The crosses CO-1 x AVT 26 (high x high), CO-1 x DT 9-10-2-25 (high x high) involving good general combiners exhibited positive SCA effect indicating the presence of additive gene effects while crosses involving at least one good general combiner CIANNO x AVT 26 (low x high), CO-1 x TMV6 (high x low), CIANNO x DT 9-10-2-25 (low x high), TMV 6 x DT 9-10-2-25 (low x high) and TNAU 20 x AVT 26 (low x high) exhibited negative SCA effect indicating the role of non-additive gene action. The crosses namely TNAU 20 x TMV 6, VRI-1 x ACV 2, TNAU 20 x CIANNO involving low x low combining parents exhibited significant positive SCA effects indicating importance of over dominance and epistatic gene action. Hence, crosses involving low x low and high x low parental combinations can be advanced through recurrent selections while high x high combinations can be advanced by performing simple selection to improve this trait.

SEED YIELD PER PLANT

Analysis of variance for combining ability showed that mean squares due to GCA and SCA were highly significant for this trait indicating the importance of both additive and non-additive gene actions in the inheritance. But considering the magnitude of SCA variance indicated that the inheritance of this trait was mostly governed by non-additive gene action. This result was in harmony with studies of Fatteh *et al.* (1995), Mishra and Yadav (1996) and Jayalakshmi (2000), while Kadu *et al.* (1992) and Manivannan (1997) reported the importance of both additive and non-additive gene action for this trait.

Two parental lines namely CO-1 and AVT 26 exhibited positive and significant GCA effects. The cross involving the parents CO-1 x AVT 26 (high x high) had shown significant positive SCA effects indicating the action of additive genes, while the crosses CO-1 x TMV 6 (high x low), CO-1 x DT 9-10-2-25 (high x low), ACV 2 x AVT 26 (low x high) and DT 9-10-2-25 x AVT 26 (low x high) exhibited significant positive SCA effects indicating the presence of non-additive gene effects. The high yield potential in the cross combinations (high x low) was attributed to interaction between positive alleles from good combiner and negative alleles from poor combiners (Dubey 1975). The high yield from such crosses would be unfixable in subsequent generations, while heterosis involved in high x high combinations

would involve interaction between positive x positive alleles and can be fixable in subsequent generations if no repulsion phase linkages were involved (Singh *et al.* 1971). The crosses involving TNAU 20 x CIANNO (low x low), TNAU 20 x TMV 6 (low x low), TNAU 20 x ACV 2 (low x low), VRI-1 x DT 9-10-2-25 (low x low) and ACV 2 x DT 9-10-2-25 (low x low), recorded significant positive SCA effects indicating the presence of over dominance and epistatic gene action. There are instances where low x low combiner produced the best cross combinations (Khaleque *et al.* 1977, Rahman *et al.* 1981, Amirthadevarathinam 1983). Such a behaviour has been attributed to over dominance and epistasis (Rahman *et al.* 1981).

The crosses CO-1 x DT 9-10-2-25, CO-1 x AVT 26 and CO-1 x TMV 6 were identified as best crosses based on high *per se* performance and SCA effects, compared to other crosses. Over dominance and epistasis was evident in above crosses where low GCA value parents (DT 9-10-2-25 and TMV 6) were involved. The cross CO-1 x AVT 26 can be advanced through simple selection where as other crosses CO-1 x DT 9-10-2-25 and CO-1 x TMV 6 can be advanced through biparental or diallel selective mating system or any other form of recurrent selection in the early generation to exploit this non-additive gene action.

HARVEST INDEX

The mean squares due to GCA and SCA were significant, but variance for GCA / SCA ratio revealed the predominance of SCA components i.e., non-additive gene action. This results was in conformity with reports of Narkhede and Sudhir Kumar (1991).

The parent VRI-1 recorded maximum GCA effects VRI-1 along with DT 9-10-2-25 were identified as best parents. The crosses VRI-1 x DT 9-10-2-25 (high x high) and VRI-1 x AVT 26 (high x high) recorded negative SCA effects indicating the action of non-additive genes, while the crosses CO-1 x DT 9-10-2-25 (low x high), CO-1 x AVT 26 (low x high), TNAU 20 x VRI-1 (low x high), TNAU 20 x DT 9-10-2-25 (low x high) and TMV 6 x AVT 26 (low x high) exhibited significant positive SCA effects indicating the role of non-additive genes, while the crosses CO-1 x CIANNO (low x low), TNAU 20 x ACV 2 (low x low), CIANNO x ACV 2 (low x low) exhibited positive SCA effects indicating the role of epistatic and overdominant gene effects. Thus presence of both additive and non-additive genes actions were confirmed as stated by Kadu *et al.* (1992), Dikshit and Swain (2001) and Devasena *et al.* (2001). The crosses CO-1 x DT 9-10-2-25, CO-1 x AVT 26, TNAU 20 x VRI-1 and DT 9-10-2-25 x AVT 26 were identified as best crosses as they had high SCA effects. Therefore, these crosses can be forwarded through biparental mating followed by recurrent selection in early generation for genetic improvement of this trait.

Table 17 : List of two best parents, best F_2 progenies (based on *per se* performance), best general combiners and best specific combiners identified for fourteen characters in a 8 x 8 diallel of sesame

Sl. No.	Character	Best parents	Best F_2 s	Best general combiners	Best specific combiners
1.	Days to 50 per cent flowering	ACV 2 TNAU 20	CIANNO x ACV 2 CIANNO x TMV 6	ACV 2 CIANNO	CO-1 x CIANNO CO-1 x TMV 6
2.	Days to maturity	TMV 6 CIANNO	CIANNO x ACV 2 CIANNO x VRI-1	TMV 6 CIANNO	CO-1 x TMV 6 CIANNO x TMV 6
3.	Plant height (cm)	CO-1 VRI-1	CO-1 x DT 9-10-2-25 CO-1 x AVT 26	CO-1 DT 9-10-2-25	CO-1 x DT 9-10-2-25 TNAU 20 x DT 9-10-2-25
4.	Number of primary branches	VRI-1 DT 9-10-2-25	TNAU 20 x DT 9-10-2-25 CO-1 x DT 9-10-2-25	DT 9-10-2-25 CIANNO	CO-1 x DT 9-10-2-25 TNAU 20 x DT 9-10-2-25
5.	Number of secondary branches	DT 9-10-2-25 TNAU 20	TNAU 20 x AVT 26 VRI-1 x DT 9-10-2-25	DT 9-10-2-25 AVT 26	CO-1 x CIANNO CO-1 x TMV 6
6.	Number of capsules on main stem	VRI-1 ACV 2	CO-1 x AVT 26 CO-1 x DT 9-10-2-25	CO-1 TNAU 20	CO-1 x AVT 26 CO-1 x DT 9-10-2-25
7.	Number of capsules on primary branches	CO-1 TMV 6	CO-1 x AVT 26 TMV 6 x DT 9-10-2-25	CO-1 AVT 26	CO-1 x AVT 26 TNAU 20 x CIANNO
8.	Number of capsules on secondary branches	DT 9-10-2-25 CIANNO	CO-1 x AVT 26 CO-1 x TMV 6	DT 9-10-2-25 AVT 26	CO-1 x DT 9-10-2-25 CO-1 x AVT 26
9.	Number of capsules per plant	CO-1 VRI-1	CO-1 x AVT 26 CO-1 x TMV 6	CO-1 AVT 26	CO-1 x AVT 26 CO-1 x DT 9-10-2-25
10.	Capsule length (cm)	DT 9-10-2-25 ACV 2	TNAU 20 x AVT 26 TNAU 20 x DT 9-10-2-25	TNAU 20 DT 9-10-2-25	TNAU 20 x DT 9-10-2-25 TNAU 20 x AVT 26
11.	Number of seeds per capsule	CIANNO CO-1	CO-1 x DT 9-10-2-25 DT 9-10-2-25 x AVT 26	CO-1 CIANNO	CO-1 x DT 9-10-2-25 CO-1 x TNAU 20
12.	1000-seed weight	AVT 26 DT 9-10-2-25	TNAU 20 x TMV 6 CO-1 x AVT 26	DT 9-10-2-25 CO-1	CO-1 x AVT 26 CO-1 x DT 9-10-2-25
13.	Seed yield per plant	CIANNO CO-1	CO-1 x AVT 26 CO-1 x DT 9-10-2-25	CO-1 AVT 26	CO-1 x AVT 26 CO-1 x DT 9-10-2-25
14.	Harvest Index	VRI-1 TMV 6	TNAU 20 x VRI-1 CO-1 x DT 9-10-2-25	VR-1 DT 9-10-2-25	VRI-1 x DT 9-10-2-25 VRI-1 x AVT 26

5.4 SEGREGATION PATTERN

The segregation pattern of a cross through light on genetic width of that crosses and helps breeder to identify superior individual plants. Segregation pattern was studied for important attributes i.e, number of capsules per plant and seed yield per plant in 28 F_2 progenies, and for number of branches per plant and 1000-seed weight for three best crosses. The percentage of plants exceeding their mean value were considered as beneficial.

Number of capsules per plant had shown high mean values in the crosses Co-1 x AVT 26, TNAU 20 x CIANNO, Co-1 x DT 9-10-2-25 and VRI-1 x AVT 26. Above 40 per cent of the segregant in each of the crosses Co-1 x TNAU 20, TNAU 20 x ACV 2 and DT 9-10-2-25 x AVT 26 exceeded their respective means. These crosses had shown higher proportion of segregants with high values than the overall mean of the crosses. Selection can be made in the above crosses to obtain recombinants with higher number of capsules.

The crosses Co-1 x AVT 26, Co-1 x DT 9-10-2-25, Co-1 x TMV 6, TNAU 20 x CIANNO exhibited high mean seed yield per plant. The crosses Co-1 x CIANNO, Co-1 x VRI-1, Co-1 x ACV 2, TNAU 20 x DT 9-10-2-25, TNAU 20 x AVT 26, CIANNO x TMV 6, CIANNO x ACV 2

and VRI-1 x ACV 2 had above 40 percent of the segregants in each of the crosses with higher mean value than the respective cross for seed yield.

The crosses Co-1 x DT 9-10-2-25 and TNAU 20 x VRI-1 had shown higher proportions of segregants (i.e. above 50 per cent) with high mean value than the overall mean value (20.20) of the crosses. Since the crosses showed higher proportion of plants with high seed yield than their overall mean, selection will be effective for seed yield in these crosses.

SEGREGATION PATTERN IN F_2 GENERATION OF SESAME FOR THREE CROSSES

The cross Co-1 x DT 9-10-2-25 recorded high mean value and more number of segregants for number of branches per plant, the cross Co-1 x AVT 26 recorded high mean value and more number of segregant for number of capsules per plant, 1000-seed weight and seed yield per plant. These crosses can be utilized to obtain high yielding genotypes in future generations.

TRANSGRESSIVE SEGREGANTS

Transgressive segregants in the F_2 may arise due to dominance and dominance interactions which are fixable, or due to the recombination of genes with positive effects and responsible for the production of transgressive segregants in the future generations. These findings also reveal

that the parents differed for many genes and the introgression of genes from different lines created a large amount of genetic variability for yield and yield components.

The highest number of total transgressive segregants (TTS) in the F_2 generation for plant height was observed in VRI-1 x DT 9-10-2-25, and significantly transgressive segregants (STS) observed in ACV 2 x DT 9-10-2-25.

The highest number of total transgressive segregants in the F_2 generation for number of branches per plant was observed in TNAU 20 x TMV 6 and VRI-1 x AVT 26 and significantly transgressive segregants for Co-1 x AVT 26.

The highest number of total transgressive segregants and significantly transgressive segregants in the F_2 generation for number of capsules per plant was observed in the cross CO-1 x AVT 26.

Highest number of total transgressive segregants and significantly transgressive segregant in the F_2 generation for 1000-seed weight was observed in the cross TNAU 20 x TMV 6.

The higher number of total transgressive segregants for seed yield per plant was observed in the cross VRI-1 x AVT 26 and significantly transgressive segregants for Co-1 x AVT 26.

Those crosses which gave a high frequency of transgressive segregants for seed yield per plant, number of branches per plant, number of capsules per plant, 1000-seed weight and plant height may be preferred to other crosses in a breeding programme.

ELECTROPHORETIC ANALYSIS OF ISOZYME ESTERASE

The occurrence of multiple forms of an enzyme popularly called isozymes has been used as a tool to estimate genetic diversity and trueness to type (Smith and Smith, 1992). The isozyme markers have been extensively used for clarifying the taxonomic and phylogenetic relationship in plants (Mowrey and Werner, 1990). The polymorphism was observed for seed esterase isozyme.

In the present study cultivars exhibited both quantitative and qualitative differences for the band width and band intensity. The R_m values indicated the different mobility pattern suggesting presence of different molecular weights for the bands. Electrophoretic mobility values ranged from 0.375 to 0.79 indicating a wider range of variability in the molecular

weights for esterase bands.

The determinate parent DT 9-10-2-25 showed some variation in banding pattern when compared with all other indeterminate parents. At Em values of 0.5, 0.55 and 0.79 the determinate parent did not show any bands when compared with indeterminate parents. The parents VRI-1 and DT 9-10-2-25 showed some what less number of bands when compared with other parents.

Considering all the preceding drawbacks in morphological markers, one can go for the estimation of genetic diversity using DNA markers in conjunction with species specific morphological and isozyme markers as diagnostic tools to have complete genome coverage of species involved.

Chapter VI

Summary

CHAPTER-VI

SUMMARY

Sesame (*Sesamum indicum* L. $2n=26$) is one of the important oilseed crops grown in India. Although India ranks first in area its productivity is very low in comparison with world's average productivity. This may be due to lack of high yielding varieties suitable for cultivation and susceptibility of existing cultivars to pests and diseases. Thus continuous efforts are needed to improve and develop new varieties through a planned and purposeful breeding programme.

An investigation was undertaken during Rabi 2001-2002 to identify the superior parents and F_2 cross combinations and to conceptualise breeding strategy for yield improvement in sesame (*Sesamum indicum* L.). The present investigation was taken up with a view to estimate combining ability effects and various genetic parameters for yield and yield contributing characters in sesame. Besides an attempt has been made to study the segregating pattern of F_2 progenies and electrophoretic analysis of esterase enzyme.

Eight genotypes of sesame and their 28 F_2 progenies derived from 8 x 8 diallel cross excluding reciprocals were evaluated in a randomized block design with three replications. Data was recorded on fourteen characters viz.,

days to 50 per cent flowering, days to maturity, plant height, number of primary branches, number of secondary branches, number of capsules on main stem, number of capsules on primary branches, number of capsules on secondary branches, number of capsules per plant, capsule length, number of seeds per capsule, 1000-seed weight, seed yield per plant and harvest index.

Based on mean performance of parental lines for seed yield per plant and other characters. Co-1, CIANNO, VRI-1 and DT 9-10-2-25 appeared to be promising. Among F_2 progenies Co-1 x AVT 26, Co-1 x DT 9-10-2-25, Co-1 x TMV 6 and TNAU 20 x TMV 6 may be preferred. These cross combinations could be advanced for recognising desirable segregants possessing high seed yield per plant and other desirable attributes in future generations.

The analysis of genetic parameters revealed high genotypic and phenotypic coefficients of variation, heritability and genetic advance as per cent of mean for the characters plant height, number of capsules on primary branches, number of capsules per plant, number of secondary branches and seed yield per plant in both parents and F_2 crosses which in turn implies the presence of additive gene effects and suggesting that simple selection might be useful for improving these traits.

Based on segregation pattern it can be deduced that the cross, Co-1 x TNAU 20 showed high proportion of segregants followed by DT 9-10-2-25 x AVT 26. For seed yield per plant the cross TNAU 20 x VRI-1 showed high proportion of segregants followed by Co-1 x DT 9-10-2-25. The highest number of total transgressive segregants and significantly transgressive segregants were observed in cross Co-1 x AVT 26 for number of capsules per plant, TNAU 20 x TMV 6 for 1000-seed weight and for seed yield per plant highest number of total transgressive segregants in the cross VRI -1 x AVT 26 and significantly transgressive segregants in cross Co-1 x AVT 26.

Combining ability analysis revealed that Co-1 was a good general combiner for seed yield per plant, plant height, number of capsules on main stem, number of capsules on primary branches, number of capsules per plant and number of seeds per capsule. The genotype ACV 2 was the best general combiner for early flowering, while DT 9-10-2-25 for number of secondary branches, number of primary branches, number of capsules on secondary branches and 1000-seed weight. Among the F_2 progenies, Co-1 x AVT 26 registered significant and desirable SCA effects for number of capsules on main stem, number of capsules on primary branches, number of capsules on secondary branches, number of capsules per plant and seed yield per plant; Co-1 x DT 9-10-2-25 for plant height; TNAU 20 x AVT 26 for days to maturity; TNAU 20 x TMV 6 for number of primary branches

and 1000-seed weight; CIANNO X VRI-1 for capsule length; DT 9-10-2-25 x AVT 26 for number of seeds per capsule and TNAU 20 x VRI-1 for biomass.

Preponderance of non-additive gene action was observed for all the characters except plant height and number of capsules on main stem. Hence, biparental mating, followed by recurrent selection in later generation can be done to utilise both additive and non-additive gene actions. So the crosses Co-1 x AVT 26, Co-1 x DT 9-10-2-25, TNAU 20 x AVT 26, TNAU 20 x TMV 6, CIANNO x VRI-1, DT 9-10-2-25 x AVT 26 and TNAU 20 x VRI-1 can be advanced to next generation to get superior varieties.

Isozyme analysis was done using seed esterase for the sesame cultivars. The E_m values ranged from 0.375-0.79. The parents Co-1 and TMV 6 showed the E_m values of 0.375, 0.50, 0.55, 0.708, 0.75 and 0.79. The parents TNAU 20, CIANNO, ACV 2 and AVT 26 showed the E_m values of 0.375, 0.50, 0.55, 0.75 and 0.79. The parent VRI-1 showed E_m value of 0.375, 0.75 and 0.79. The parent DT 9-10-2-25 showed a E_m value of 0.375, 0.708 and 0.75.

By comparison of genetic relationship among different genotypes of sesame using isozyme approach, it was observed that it may be a more reliable method for studying the genetic diversity between different genotypes.

Literature Cited

LITERATURE CITED

- Ananda Kumar C R and Sree Rangaswamy S R 1987 Combining ability for yield in sesame. *Journal of Oilseeds Research* 4: 238-241.
- Anil Kumar V 1999 Genetic divergence and character association studies in sesame (*Sesamum indicum* L.) M.Sc. (Ag.) Thesis Acharya N.G. Ranga Agricultural University, Andhra Pradesh.
- Anitha N 1988 Studies on genetic divergence, heterosis and combining ability in *Sesamum indicum* L. M.Sc. (Ag.) Thesis Tamilnadu Agricultural University, Coimbatore.
- Amirthadevarathinam A 1963 Combining ability and heterosis in dry and semidry paddy. *Madras Agriculture Journal*. 70: 233-247.
- Ashoka Vardhana Reddy P 1999 Metroglyph and canonical analysis studies in sesame (*Sesamum indicum* L.) M.Sc. (Ag.) Thesis Acharya N.G. Ranga Agricultural University, Andhra Pradesh.
- Ashoka Vardhana Reddy P Reddissekhar M Ranganatha 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.
- Backiyarani S Devarathinam A A and Shanthi S 1997 Combining ability studies on economic traits on sesame (*Sesamum indicum* L.) *Crop Research Hissar* 13(1): 121-125.

- Backiyarani S Amirthadevarathinam A Rajendra C and Shanti S 1998 Diallel analysis of sesame (*Sesamum indicum* L.) for physiological traits. Crop Research Hisar 15(1): 85-90.
- Balsane A G Pawar B B and Dumbre A D 1980 Are multiple cross-multiple pollen hybrids an answer for productive populations in *Brassica campestris* Var. Brown Sarson. Theor. Appl. Genet 58:5-10.
- Baruah D P and Goud J V 1993 Variability studies in hybrid and segregating populations in sesame. Madras Agricultural Journal 80: 210-214.
- Bhele O S Khorgade P W and Narkhede M N 1987 Estimates of genetic parameters. Correlation co-efficients and path analysis in sesame (*Sesamum indicum* L) PKV Research Journal 11: 118-122.
- Burton G W 1952 Quantitative inheritance in grasses. Preceding of 6th International Grassland Congress held at Pennsylvania State College, PA US.1 : 277-283.
- Chandrasekhara B 1990 Studies on genetic divergence and inter relationship in sesame (*Sesamum indicum* L.) M.Sc. (Ag.) Thesis Acharya N.G. Ranga Agricultural University, Andhra Pradesh.
- Chavan G V and Chopde P R 1981 Correlation and path analysis of seed yield and its components in sesame Indian Journal of Agricultural Sciences 51: 627-630.
- Choudhari P N Zope R E Patel D M and Joshi B P 1984 Combining ability in sesame. Journal of Maharashtra Agricultural Universities 2: 30-33.

- Das K and Choudhury R K 1998 Combining ability analysis in sesame (*Sesamum indicum* L.) Journal of the Agricultural Science Society of North East India 11(2): 208-211.
- Das S and Gupta T D 1999 Combining ability in sesame Indian Journal of Genetics and Plant Breeding. 59(1): 69-75.
- Devaraj N 1996 Combining ability analysis in sesame (*Sesamum indicum* L.) M.Sc. Thesis Submitted to University of Agricultural Sciences, Bangalore, 100 pp.
- Devasena N Muralidharan V and Punitha D 2001 Combining ability for yield related traits in sesame (*Sesamum indicum* L.) Journal of Oilseeds Research 18(1): 115-117.
- Dharmalingam V and Ramantham T 1993 Combining ability for yield and its components in sesame. *Oleagineux paris* 48(10): 421-424.
- Diaz A and Layrisse A 2001 Isozyme resemblance among forty sesame accessions. Sesame and Safflower. Newsletter (16): 32-35.
- Diskhit U N and Swain D 2001 Combining ability and heterosis for yield and yield components in sesame (*Sesamum indicum* L.) Journal of Oilseeds Research 18(1): 28-31.
- Dora K B and Kamala T 1986 Heterosis and gene action in sesamum. Indian Journal of Agricultural Sciences 56(10): 690-694.
- Dubey R S 1975 Combining ability in cigar filter tobacco. Indian Journal of Genetics and Plant Breeding 35: 76-82.

Dumbre A D Pawar P K and Pawar B B 1990 Combining ability studies in sesame through diallel analysis. *Journal of Maharashtra Agricultural Universities*. 15(2): 211-214.

FAO 2000 FAO Bulletin of Statistics, Food and Agricultural Organisation of the United Nations, Rome.

Fatfeh V G Shah R M and Bodar D G 1982 Studies on combining ability in sesame. *Madras Agricultural Journal* 69: 145-150.

Fatfeh U G Patel N A Chaudhuri F P Dangaria C J and Patel P G 1995 Heterosis and combining ability in sesame. *Journal of Oilseeds Research* 12(2): 184-190.

Godawat S L and Gupta S C 1986 Variability and association for agronomical traits in sesame (*Sesamum indicum* L.) *Indian Journal of Agricultural Research* 20: 192-196.

Govindarasu R Rathinam M and Sivasubramanian P 1990 Genetic variability in sesame (*Sesamum indicum* L.) *Madras Agricultural Journal* 54: 1030-1033.

Goyal S N and Sudhir Kumar 1991 Combining ability for yield components and oil content in sesame. *Indian Journal of Genetics and Plant Breeding* 51(3): 311-314.

Grieshammer U and Wynne J L 1990 Isozyme variability in mature seeds of US peanut cultivars and collections. *Peanut Science* 17: 72-75.

Griffing 1956 Concept of general and specific combining ability in relation to diallel crossing system. Australian Journal of Biological Sciences 9: 963-93.

Gupta T R 1981 Combining ability analysis of yield components in sesamum (*Sesamum indicum* L.) Madras Agricultural Journal 68: 281-288.

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

Hanson W D 1963 Heritability. In : Hanson W D and Robinson H F (ed) Statistical genetics and plant breeding Published in 1982. National Academy of Science and National Research Council, Washington DC: 125-139.

Janardhanam V Ratnakar B Sreerama Reddy N Satyanarayana G and Subramanyam D 1981 Genotypic, Phenotypic and Environmental variability, Heritability estimates and genetic advance in sesamum (*Sesamum indicum* L.). The Andhra Agricultural Journal 28: 105-108.

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

Jayalakshmi V Raja Reddy C Hariprasad Reddy K 2000 Combining ability analysis for yield and yield components in sesamum. The Andhra Agricultural Journal 47(3&4): 197-200.

- John Joel and Thangavelu S 1997 Variability, heritability and genetic advance in sesame. Madras Agricultural Journal 72: 156-161.
- Johnson H W Robinson H F and Comstock R E 1955 Estimates of genetic and environmental variability in soybeans. Agronomy Journal 47: 314-318.
- Kadu S Narkhede M N and Khorgade P W 1992 Studies on combining ability in sesamum. Journal of Maharashtra Agricultural Universities 17(3): 392-393.
- 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.
- Kanaka Durga K Raghunathan G Ranganatha A R G and Sharma P S 1994 Studies on the combining ability for morpho-physiological, reproductive and yield attributes in sesame. International Journal of Tropical Agriculture 12 (3-4) : 248-254.
- Kandaswami M Sundaram M K Sridharan C S and Rangaswamy S R S 1990 Genetic variability in sesame. Madras Agricultural Journal 77: 359-398.
- Kandaswamy M 1985 Genetic variation and genotype environment interaction in sesame. (*Sesamum indicum* L.) Madras Agricultural Journal 72: 156-161.

- Karuppaiyan R Ramasamy P Arulmozhi N Santha S and Sundaresan N
2000 Heterosis and inbreeding depression in sesame. Journal of
Oilseeds Research 17: 260-264.
- Khaleque M A Joardeo O I and Eunus A M 1977 Heterosis and combining
ability in a diallel cross of rice (*Oryza sativa* L.) Bangladesh Journal
of Agriculture Science 4: 137-145.
- Khorgade P W Patil M M and Narkhede M N 1988 Line x Tester analysis
for combining ability in sesame. Journal of Maharashtra Agricultural
Universities 13: 67-70.
- Khorgade P W Deshmukh A V Narkhede M N and Raut S K 1989
Combining ability for yield and its components in sesame. Journal of
Maharashtra Agricultural Universities 14(2): 164-166.
- Krishnadoss D Kadamavanasundaram M Ramalingam R S and Rajasekharan
S. 1987 Combining ability study in sesamum. Indian Journal of
Agricultural Sciences 57: 85-88.
- Lacks G D and Stalker H T 1993 Isozyme analysis of *Arachis* species and
interspecific hybrids. Peanut Science 20: 76-81.
- Lush J L 1940 Intrasire correlation and regression of offspring on dams as a
method of estimating heritability of characters. Proceedings of
American Society of Animal Production 33: 243-301.

- Lush J L 1949 Heritability of quantitative character in farm animals. Proceedings of 8th Congress of Genetics. Hereditas 35 (Suppl.) : 356-375.
- Manivannan N 1997 Combining ability in sesame (*Sesamum indicum* L.) Journal of Oilseeds Research 14(2): 165-167.
- Manivannan N and Ganesan J 2000 Combining ability analysis in sesame through diallel analysis 17: 249-254.
- Mansouri S and Ahmadi M R 1998 Study of combining ability and gene effect on sesame lines by diallel cross method. Iranian Journal of Agricultural Science 29(1): 47-55.
- Mcharo T M Ayiecho P O and Nyabundi J O 1998. Combining ability for morphological and yield related traits in sesame. Sesame and Safflower News Letter (14): 15-21.
- Mishra A K Raghu J S Ghurayya R S Alis A and Raghuwanshi R S 1995 Variability association analysis in multicapsule types of sesame (*Sesamum indicum* L.) Crop Research Hisar 19: 439-443.
- 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 and Sikarwar R S 2001 Heterosis and combining ability analysis in sesame. Sesame and Safflower. Newsletter, 16: 1-5.

- Mowrey B D and Werner D J 1990 Phylogenetic relationship among species of prunus as inferred isozyme markers. Theoretical and Applied Genetics 80:129-133.
- Narkhede B N and Sudhir Kumar 1991a Combining ability in sesame. Journal of Maharashtra Agricultural Universities 16(2): 190-192.
- Narkhede B N and Sudhir Kumar 1991b Genetics of seed yield and yield components in sesame. Journal of Maharashtra Agricultural Universities 16(2): 193-195.
- Padmavathi N 1987 Heterosis and combining ability analysis in sesame (*Sesamum indicum* L.) M.Sc. (Ag.) Thesis Tamilnadu Agricultural University Coimbatore.
- Parani M Ramalingam R S Singh K N and Sree Rangasamy 1997 Identification of *Sesamum alatum* x *Sesamum indicum* hybrid using protein, Isozyme and RAPD markers. Indian Journal of Genetics and Plant Breeding 57(4): 381-388.
- Pathak H C and Dixit S K 1988 Genetic analysis of single stemmed sesame (*Sesamum indicum* L.) Indian Journal of Genetics 48(3): 325-330.
- Pathak H C and Dixit S K 1992 Genetic variability and interrelationship studies in black seeded sesame (*Sesamum indicum* L.). Madras Agricultural Journal 79: 94-100.
- Pathirana R 1999 Combining ability for yield and agronomic characters in sesame cultivars of diverse origin. Egyptian Journal of Agronomy 21: 1-13.

- Patil R R and Sherif R A 1996 Genetic variability heritability and genetic advance studies in sesame. *Current Research* 25: 23-27.
- Pawar B B Pawar P K and Dumbre A D 1990 Combining ability studies in sesame through diallel analysis. *Journal of Maharashtra Agricultural Universities* 15(2): 211-214.
- Rahman M Patwary A Kaudmiah A J 1981 Combining ability in rice. *Indian Journal of Agriculture Science* 51: 543-546.
- Raghavaiah P and Joshi M G 1986 Combining ability studies on Emer wheat. *Indian Journal of Genetics and Plant Breeding* 46(3): 476-483.
- Ram T 1995 Combining ability in sesame (*Sesamum indicum* L.) in rainfed conditions. *Annals of Agricultural Research* 16(3): 311-316.
- Ramalingam A Muralidhar V and Mohammed Shariff N 1990 Combining ability studies in sesame. *Journal of Oil Seeds Research* 7: 75-77.
- Ramesh S Sheriff R A Rao A M and Gangappa E 1998 Combining ability in sesame (*Sesamum indicum* L.). *Crop Research Hisar* 15(2-3): 238-244.
- Ranganathan T B Menon P M and Sree Rangaswamy S R 1973 Combining ability for earliness and yield in dwarf rice varieties, *Madras Agriculture Journal* 60: 1134-1138.
- Rao A V Krishna T S and Prasad A S R 1980 Combining ability analysis in rice. *Indian Journal of Genetics and Plant Breeding*. 37: 384-387.

Reddy M B Reddy M V and Rana B S 1982 Combining ability studies in sesame. Indian Journal of Genetics and Plant Breeding 44: 314-318.

Reddy M B Reddi M V and Rana B S 1984 Character association and path co-efficient analysis in parents and F_1 hybrids of sesame, Madras Agricultural Journal 71; 147-151.

SAI 1997 Statistical abstract India

Sajjanar G M Giriraj K and Nadaf H L 1995 Combining ability in sesame. Crop improvement 22(2): 250-254.

Saravanan T Thiruganan Kumar S and Ganesan J 2000 Combining ability and heterosis for earliness characters in sesame (*Sesamum indicum* L.) Sesamum and Safflower NewsLetter (15): 7-13.

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 R L and Chauhan 1985 Combining ability in sesame. Indian Journal of Genetics and Plant Breeding 45: 45-49.

Shinde Y M Badhe P L Patel D M and Deokar 1993 Genetic evaluation of some lines in sesame Journal of Maharashtra Agricultural Universities 10(1): 22-24.

- Singh T H Gupta S P and Phul P S 1971 Line x tester analysis of combining ability in cotton. Indian Journal of Genetics and Plant Breeding 31: 316-321.
- Singh P V 1977 Combining ability for grain yield and panicle characters in rice. Indian Journal of Genetics and Plant Breeding 37: 384-387.
- Singh V K Singh H G and Chauhan Y S 1983 Combining ability in sesame. Indian Journal of Agricultural Science 53: 305-310.
- Sivasubramanian S and Madhava Menon P 1973 Genotypic and Phenotypic variability in rice. Madras Agricultural Journal 60: 1093-1096.
- Smith J S C and Smith O S 1992 The description and assessment of distance between inbred lines of maize. The utility of morphological, biochemical and genetic descriptions and a scheme for testing of distinctiveness between inbred lines. Maydica 34: 151-161.
- Solanki Z S and Gupta D (2001) Combining ability and heterosis studies for seed yield and its components in sesame. Sesame and Safflower - Newsletter (16): 9-12.
- Solanki Z S and Paliwal R V 1981 Genetic variability and heritability studies on yield and yield components in sesame. Indian Journal of Agricultural Sciences 51: 554-556.
- Stalker H T Philips T D Murphy J P and Jones T M 1994 Variation of isozyme patterns among *Arachis* species. Theoretical and Applied Genetics 87: 746-755.

Stansfield W D 1969 Theory and problems of genetics. Mc Graw Hill, New York.

Thangavelu M S and Rajasekharan S 1982 Studies on genetic variability in *Sesamum* (*Sesamum indicum* L.) Madras Agricultural Journal 69: 780-783.

Thirugnama Kumar S Thangavelu S Rangaswamy S R S and Ganesan J 2001 Genetics and Breeding for large seed size in sunflower (*Sesamum indicum* L.) Sesame and Safflower Newsletter 16: 23-27.

Thiyagarajan K and Ramanathan T 1995 Inheritance of seed yield in sesame under different environments. Madras Agricultural Journal 82(12): 640-642.

Umesh Kumar Reddy O and Stephen dorairaj N 1990 Variability, heritability and genetic advance in sesame (*Sesamum indicum* L.). Madras Agricultural Journal 77: 398-400.

Vallejos C E 1993 Enzyme activity staining ; Isozymes in plant genetics and breeding part A (eds Tanksley SD and T Jorton). Elsevier, Amsterdam pp. 469-512.

Vanisri S Raghunatham G Ranganatha A R G and Sharma P S 1994 Studies on character association and path analysis in sesame (*Sesamum indicum* L.). Journal of Research APAU 22 (3 & 4) : 93-96.

