Economics

Among various treatments, wheat + mustard (9:1) system with North-South direction of sowing gave highest net return of Rs. 6826 and highest return per rupee invested (1.58) (Table-2). This was followed by wheat + mustard (9:1) in East - West direction of sowing and wheat border method of sowing, respectively. Though, wheat equivalent yield was lower with border method of sowing than regular method of sowing along with any direction, the net profit and return per rupee invested was highest owing to decrease in cost of cultivation through 25% save in inputs i.e. seed and fertiliser. All other treatments proved less profitable.

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INVESTIGATION ON EMS AND DES INDUCED MEIOTIC ABERRATIONS IN CHILLI (*Capsicum annum* L.)

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ABSTRACT

EMS and DES were found to be very potent chemical mutagens to induce the meiotic abnormalities in the chromosomes of Chilli (*Capsicum annuum* L.) var. G4. The meiotic abnormalities induced by mutagen were multivalent association, lagging chromosomes, stickiness of chromosomes, precocious movement of chromosomes, bridges, fragments and micronuclei etc. Multivalent association of chromosomes is due to reciprocal translocation in the chromosomes while bridges, laggards and precocious movement are attributed to the paracentric inversion, failure of chiasmata formation in the pairs and discrepancies is the spindle formation respectively. Chromosomal breakage is due to change in molecular constitutes of chromosomes whereas stickiness is result of depolymerisation of nucleic acid caused by mutagen.

KEY WORDS: EMS, DES, Meiotic aberration, Chilli

Mutagenesis is the best method for making alteration in the genotype and to enlarge the genetic variability in a short period of time. Chemical mutagens are widely used to induce the variability in the crop with a view to develop desirable variants. (*Bora et. al* 1961). Various mutants have been developed by using diethyl sulphate (DES) and ethyl methane sulphonate (EMS) but its effects on meiosis of chilli have not been studied comprehensively. Present investigation was undertaken to study the effect of EMS and DES on chromosomes during meiosis in Chilli (*Capsicum annuum* L.)

MATERIALS AND METHODS

One hundred dry seeds of chilli var. G4 in three replicates were presoaked in double distilled water (DDW) for 24 hours at room temperature and then treated with 0.5, 1.0 and 1.5 percent DES and EMS aqueous solution separately for period of 8 hours. After completion of treatment, seeds were washed thoroughly with running tap water. A total number

of 100 seeds taken in three replicates soaked in DDW for a period of 24 hours were used as control. The seeds were sown in earthen pots containing well mixed soil. Treated seedlings when attained the height of 4" to 6" were transplanted in the field. Control plants were also transplanted in the same way. Buds of suitable sizes were selected from randomly selected plants and they were fixed in carnoys fluid for about half an hour. They were transferred to propionic alcohol (1:3) saturated with ferric acetate for a period of 24 hours. Buds were stored in 70 percent alcohol after washing it in same alcohol. Meiosis was studied in propioarmine PMC squashes (Swaminathan *et. al,* 1954) The slides were made permanant by using Butyle alcohol schedule as described by Bhaduri and Ghosh (1954).

RESULTS AND DISCUSSION

Pollen mother cells of treated plants as well as control were examined for different chromosomal aberrations. Meiotic aberrations induced by EMS and DES mutagens were multivalent associations, lagging chromosomes, precocious movement of chromosomes, bridges and fragments etc. Which are described below.

(a) Fragments : Fragments were observed in several pollen mother cells at diakinesis and metaphase I. The fragments percentage calculated in M_1 plants of EMS treatment was 1.33, 2.00 and 2.67 at 0.5, 1.0 and 1.5% respectively. They were however not observed in the next generation. In DES treated populations, the fragments were estimated to be 0.67, 1.33 and 2.00 percent while in subsequent generation they were not observed (Plate I, Figs 1 and 2).

(b) Clumping chromosomes :- Clumping chromosome were observed at both diakinesi and metaphase I in the plants of DES and EMS In M_1 plants of EMS treatment, percentage o

Table 1 : Meiotic abnormalities in M_1 plants treated with EMS

Concen-tration (%)	No. and % of PMCS with clumping	No. and % of PMCS with non oriented bivalents	No. and % of PMCS with precocious movement	No. and % of PMCS with laggards	No. and % of PMCS with bridges	No. and % of PMCS with fragments	Total No. of PMCS scored	No. of PMCS with abnor-malities	% of PMCS with abnor-malities
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Control	-	-	-	-	-	-	300	-	-
0.5%	6	5	8	9	7	4	300	39	13.00
2.00	1.67	3.00	2.33	1.33					
1.0%	11	7	10	12	9	6	300	55	18.33
3.67	2.33	3.33	4.00	3.00	2.00				
1.5%	19	14	13	14	11	8	300	79	26.33
	6.33	4.67	4.33	4.67	3.67	2.67			

Table 2 : Meiotic abnormalities in M_2 plants treated with EMS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Control	-	-	-		-	-	300	-	-
0.5%	4	2	3	4	2	0	300	15	300
1.0%	3	5	2	4	6	0	300	20	6.67
1.5%	4	3	4	5	6	0	300	22	7.33
	1.33	1.00	1.33	1.67	2.00				

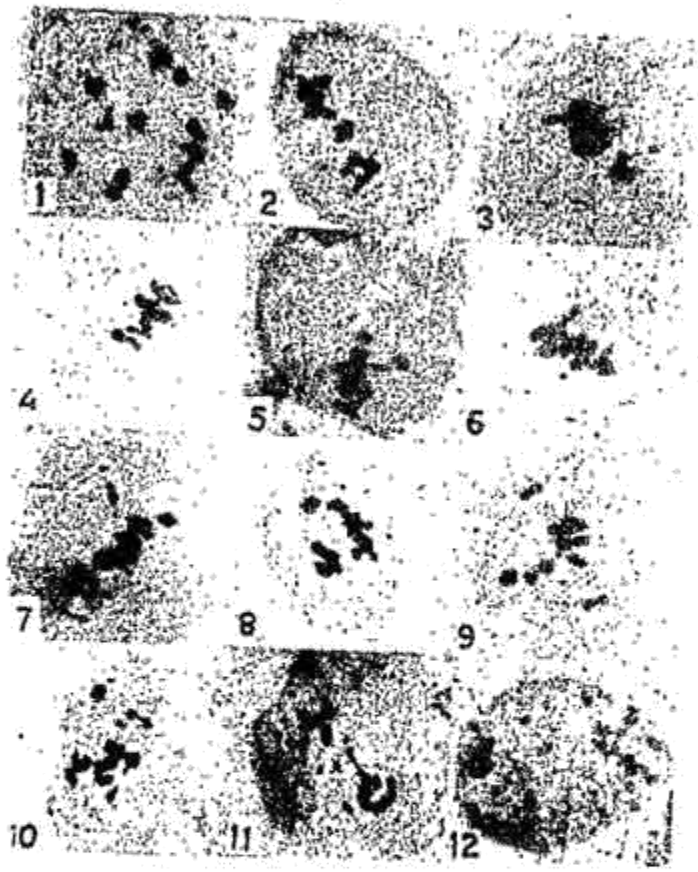

PLATE-1

EXPLANATION OF FIGURES

Figures 1-12 : Different meiotic irregularities induced by EMS and DES

Fig. 1 : Diakinesis showing 5 rod bivalents, 7 ring bivalents and fragment induced by EMS 1.0%.

Fig. 2 : Metaphase I showing fragment and clumping of chromosomes induced by DES 1.5%.

Fig. 3 : Metaphase I showing clumping of chromosomes and non orientation of chromosomes and induced by DES 1.5%.

Fig. 4 : Metaphase I showing clumping of chromosomes induced by EMS 1.5%.

Fig. 5 : Metaphase I showing clumping and non-orientation of chromosomes induced by EMS 1.0%.

Fig 6 : Metaphase I showing clumping of chromosomes induced by DES 1.0%.

Fig. 7-10 : Metaphase I showing precocious movement of chromosomes induced by EMS 1.0%.

Fig. 11 : Anaphase I showing chromosomal bridges formation induced by EMS 1.5%.

Fig. 12 : Anaphase I showing lagging chromosomes induced by DES 0.5%.

clumping chromosomes was in increasing order with an increase of mutagen concentration (2.0, 3.67 and 6.33 percent at 0.5, 1.0 and 1.5 percent respectively) While in M_2 plants lesser percentage (1.33, 1.00 and 1.33) was observed.

In DES treated plants clumping chromosomes were relatively less in number than EMS treated ones (1.67, 2.33, 5.67 percent and 0, 0.67 and 1.00 percent) in M_1 and M_2 plants respectively (Table 1-4).

(c) Non -orientation of chromosomes : Non oriented chromosomes were noted at metaphase I in both generation. In M_1 and M_2 of EMS plants the percentage of non oriented chromosomes was estimated to be 1.67, 2.33, 4.67 and 0.67, 1.67 and 1.00 respectively while in DES treated plants of M_1 and M_2, the percentage was 1.33, 2.00, 3.67 and 0, 1.00 0.67 respectively (Table 1-4), (Plate I Figs 3,5,10).

(d) Chromosomes with precocious movement : Precocious movement of chromosomes at late Diakinesis or metaphase I was observed in PMCS of treated plants. Percentage of PMCS with precocious movement of chromosomes was 2.67, 3.33 and 4.33 in M_1 population while 1.0, 0.67 and 1.33 in M_2 treated plants with EMS. In DES treated plants this abnormality was slightly lesser than EMS. It was calculated to be 2.0, 2.67 and 3.33 in M_1 plants while 0.0 and 0.6 percent in M_2 plants (Table 1-4).

(e) Bridges:- Several PMCS were found with bridge formations in both generations of mutagens. In EMS treated plants of M_1 generation, PMCS were 2.33, 3.00 and 3.67 percent while in M_2 plants they were 0.67, 2.00

Table 3. Meiotic abnormalities in M_1 plants treated with DES

Concent of DES (%)	No. and % of PMCS with clumping	No. and % of PMCS with non oriented bivalents	No. and % of PMCS with precocious movement	No. and % of PMCS with laggards	No. and % of PMCS with bridges	No. and % of PMCS with fragments	Total No. of PMCS scored	No. of PMCS with abnor-malities	% of PMCS with abnor-malities
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Control	-	-	-	-	-	-	300	-	-
0.5%	5	4	6	7	5	2	300	29	9.67
1.67	1.33	2.00	2.33	1.67	0.67				
1.0%	7	6	8	9	8	4	300	42	14.00
2.33	2.00	2.67	3.00	2.67	1.33				
1.5%	17	11	10	13	10	6	300	67	22.33
	5.67	3.67	3.33	4.33	3.33	2.00			

Table 4 : Meiotic abnormalities in M_2 plants treated with DES

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Control	-	-	-	-	-	-	300	-	-
0.5%	0	0	4	4	4	0	300	8	2.67
	0	0	0	1.33	1.33	0			
1.0%	2	3	0	3	2	0	300	10	3.33
	0.67	1 00	0.00	1.00	0:67	0			
1.5%	3	2	2	3	4	0	300	14	4.67
	1.00	0.67	0.67	1.00	1.33	0			

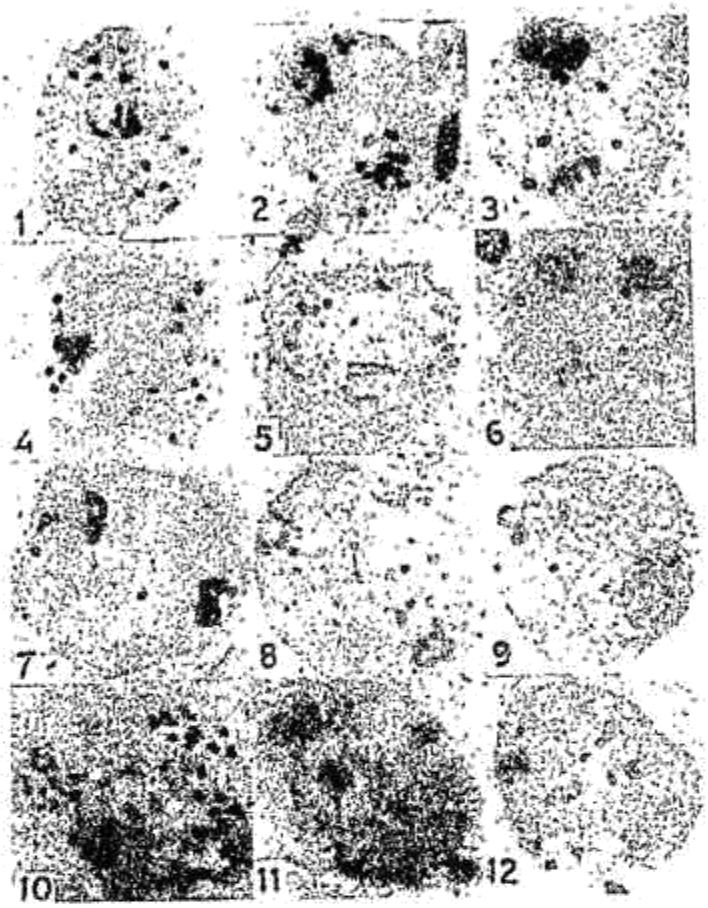

PLATE -II

EXPLANATION OF FIGURES

Fig. 1-12 : Different meiotic abnormalities induced by EMS and DES.

Fig. 1 : Anaphase I showing lagging chromosomes induced by EMS 1.0%.

Fig. 2 : Anaphase I showing lagging chromosomes induced by DES 1.5%.

Fig. 3 : Anaphase I showing stickiness and lagging chromosomes induced by EMS 0.5%.

Fig. 4 : Anaphase I showing irregular distribution and stickiness of chromosomes induced by MS 1.5%.

Fig. 6 : Anaphase I showing stickiness and lagging chromosomes induced by DES 1.5%.

Fig. 7 : Anaphase I Showing stickiness of chromosomes induced by DES 1.5%.

Fig. 8 : Anaphase I showing chromosomes at poles arranged in ring form with lagging chromosomes induced by EMS 1.0%.

Fig. 9 : Few laggards with undivided chromatin material due to stickiness induced by EMS 1.5%.

Fig. 10 : Anaphase II showing laggards induced by DES 1.0%.

Fig. 11-12 : Telophase II showing irregular organization of chromosomes with micronuclei induced by EMS 1.0%.

and 0.67, 2.00 and 2.00 percent. On the other hand DES was less effective in inducing such irregularity. PMCS with bridges in M_1 plants were 1.67 2.67 and 3.33 percent while in M_2 plants they were noted to be 1.33, 0.67 and 1.33 percent. (Table 1-4).

(f) Lagging chromosomes :- Lagging chromosomes were noted at anaphase I anaphase II. It was noted to be 2.33, 3.00, 4.23 percent in M_1 plants and 1.33, 1.00 and 1.00 percent in M_2 plants treated with DES where as in EMS treated population it was recorded to be 3.00, 4.00, 4.67 percent in M_1 and 1.33, 1.33 and 1.67 percent in M_2 plants (Table 1-4).

(g) Multivalent association : Some cells exhibiting trivalents and tetravalents were also recorded in EMS treated plants.

(h) Other irregularities : Besides above abnormalities some cells also exhibited unequal distribution of chromosomes and undivided chromatin mass lying at single pole of the cell. Cells with more than four nuclei forming irregular groups of different chromatin mass and stickiness of chromosomes etc. were also observed (Plate II Figs 4,8,9,10,11 and 12).

As a result of mutagenic treatment of seeds with EMS and DES, PMCS of treated plants exhibited varying degree of meiotic irregularities which increased with increase of concentration of mutagens. It was observed that the chromosomes exhibited high degree of stickiness leading to lossing their identity. It may be due to depolymerisation of nucleic acid caused by mutagenic treatment. Fragments which were obvious during diakinesis and metaphase I were not been beyond this stage, probably they might have reunited or been lost failing to reach the pole. Breakages in the present study is similar to the reports of sax(1941) in irradiated plants which is attributed to the change in the molecular constitutes of chromosomes. Natrajan and Upadhyay (1964) suggested that chemical mutagens might weaken the chromosomes as such and introduce a coiling error or duplication difficulties leading to chromosomal breakage whereas Mikaelson *et al* attributed it to the change in DNA structure inducing break in the strands.

As far as multivalent association of chromosomes of present findings are concerned, they are alike to the reports of Bora *et al* (1961) in Arachis hypogea. Bose and Bose (1972) in tomato and Tarar and Dyansagar (1980) in Turnera Ulmifolia. They have attributed it to the reciprocal translocation. Precocious movement of chromosomes, laggards and bridges have also been reported by Patil and Bora (1961) in *Arachis hypogea* and Swaminathan *et al* (1962) in Barley. They have attributed the precocious movement to the failure of chiasmata formation while bridges are due to paracentric inversion. Gaul *et al* (1966) and Tarar and Dyansagar (1980) reported stickiness and clumping of chromosomes due to depolymerisation of nucleic acid caused by mutagenic treatment.

The presence of chromosomal bridges in present investigation is due to paracentric inversion while the sticky bridges might have been formed as a result of non- separation of chiasmata due to stickiness resulting from disturbances at cytochemical level caused by mutagenic treatment which is similar to the report of Tarar and Dyansagar (1980). The unoriented bivalents or laggards might have resulted from the discrepancies in the spindle formation.

These abnormalities cause an unequal distribution of chromosomes at anaphase I. The presence of micronuclei at tetrad stage of PMC in the plants might have resulted due to non orientation of chromosomes, laggards on chromosomal fragments which are of frequent occurance. Pentad might have formed due to unequal distribution of chromosomes at anaphase II and telophase II.

Meiotically abnormal cells were common in first generation while in subsequent generation most of them are eliminated at various stages of plant development.

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CORRELATION AND PATH ANALYSIS IN RICE FALLOW BLACKGRAM (*Vigna mungo*)

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ABSTRACT

Twenty five genotypes of blackgram were studied for assissing the association between yield and component characters. A significant positive association existed between seed yield, plant height and pod number. The path analysis showed that plant height and pod number have a high direct effect. Besides, plant height exhibited indirect positive effect via pod number, seed number per pod and 100 seed weight.

KEY WORDS : Rice fallow Blackgram, Correlation, Path analysis

Blackgram is one of the important grain legumes of India. However the productivity is very low. To develop elite genotypes, knowledge on interralationship among yield and its component characters and their direct and indirect contribution towards yield is important. Thus it becomes imperative to seek information on the magnitude of association, direct and indirect influence, between yield and different yield component characters.

MATERIALS AND METHODS

Twenty five genotypes of blackgram were grown in a randomised block design with four replications during *rice fallow* season 1996 at Tamil Nadu Rice Research Institute,Aduthurai. The row and plant spacings were maintained as 30 cm and 10 cm respectively. Cultural practices recommended for rice fallow crop were followed. Observations were recorded on five randomly selected plants from each replication for plant