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RESEARCH ARTICLE

Studies on correlation in brinjal varieties in M_3 generation

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SUMMARY

Field trials were conducted to study the effect of physical and chemical mutagens [Gamma rays, Ethyl Methane Sulphonate (EMS) and Diethyl sulphate (DES)] on biometric characters *viz.*, days to 50 per cent flowering, plant height, number of branches, fruits per plant, fruit length, fruit girth, fruit weight and fruit yield per plant and their correlations in five brinjal cultivars *viz*., Angoor, Annamalai, Hissar pragath, PLR 1 and Putheri. The results revealed that there had been strong association between number of fruits per plant and fruit weight with fruit yield per plant in M_3 generation.

Key Words : Brinjal, Mutation, M_3, Correlation

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Brinjal or egg plant (*Solanum melongena,* 2n = 2x = 24) belonging to the family solanaceae is one of the important vegetable crops grown in India and other parts of the world. India is the primary center of origin and it is also extensively grown in Bangladesh, Pakistan, Japan, Germany, U.S.A. and Italy besides South East Asian countries.

Brinjal fruits are rich source of minerals like calcium, magnesium, potassium, iron, zinc and copper. The present investigation was attempted to study the association between eight biometric charecters in five brinjal varieties *viz*., Angoor, Annamalai, Hissar pragath, PLR 1 and Putheri in M_3 generation.

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MATERIAL AND METHODS

Five varieties of brinjal *viz*., Angoor, Annamalai, PLR 1, Putheri and Hissar Pragath were taken to study the effect of physical and chemical mutagens on the biometric characters and their association in M_2 and M_3 generations during 2011-2012. Physical mutagen namely Gamma rays and chemical mutagens namely Ethyl Methane Sulphonate (EMS) and DiEthyl Sulphate (DES) were used for inducing mutation. Well filled 600 seeds per treatment were packed in polythene bags in respect of each genotype and treated in the gamma chamber (^{60}Co) at 10 krad dosage. Similarly, 600 seeds per treatment pre-soaked for 12 hours in distilled water were treated with 0.04 per cent DES and 0.6 per cent EMS for four hours at room temperature ($26\pm2^{o}C$) with intermittent shaking during this period. The treated seeds were washed in running water and used for germination test or for sowing immediately in seed bed. The same procedure was followed for the control, where 600 well filled seeds per genotype were soaked in distilled water

for 12 hours at room temperature (26±2°C) with intermittent shaking during this period.

Genotype wise and treatment wise the seeds from M_1 were mixed, bulked and used for raising the M_2 generation. Genotype wise and treatment wise seeds from M_2 were mixed, bulked and used for raising M_3 generation with three replications in Randomized Block Design The number of plants per treatment was fifty and were transplanted to 3m x 4.5m treatment plot. Ten randomly selected plants were labelled for taking observations of quantitative characters except for days to 50 per cent flowering. Number of days taken from sowing to 50 per cent flowering of treatment population was recorded for each treatment and expressed as number of days to 50 per cent flowering. The height of the main stem of ten plants was measured from the ground level to the apical leaflet, mean was expressed in cm and the number of branches borne on the main axis of 10 plants was counted at the time of harvest and the mean was expressed in numbers. The total number of fruits was counted for each of the randomly selected individual plants at the time of harvest and expressed in numbers. Fruit yield of ten random plants was recorded and the mean was expressed as fruit yield per plant in grams (g).

The data for each character in all the treatments were analysed separately by an appropriate analysis of variance. The estimates of inter component correlation were calculated for M_2 and M_3 generation as per the methods suggested by Goulden (1952).

$$r_{1.2} = \frac{\text{Sum of products of 1 and 2}}{(\text{Sum of squares of 1} \times \text{Sum of squares of 2})^{1/2}}$$

where, R = Correlation co-efficient and 1 and 2 are characters 1 and 2, respectively.

RESULTS AND DISCUSSION

Yield is a complex character and is jointly or independently contributed by many other traits. Selection

Table 1 : Phenotypic correlation for biometric traits of Angoor in M_3 generation

Parameters	Treatments	Plant height	Number of branches per plant	Number of fruits per plant	Fruit length	Fruit girth	Fruit weight	Fruit yield per plant
Days to 50 *per cent* flowering	Control	0.12*	0.22**	-0.18	-0.34**	-0.20	0.16	0.12
	10 krad Gamma rays	0.06	0.02	-0.08	0.10	-0.02	0.02	0.06
	0.04 per cent DES	0.08	0.08	-0.10	0.22*	1.00	0.24**	0.08
	0.6 per cent EMS	0.20	-0.14	0.02	0.04	-0.06	-0.26	0.20*
Plant height	Control		0.62**	-0.17*	0.04	0.01	-0.14	0.06
	10 krad Gamma rays		0.57**	-0.1	-0.05	0.07	0.02	0.11*
	0.04 per cent DES		0.68**	0.08	0.11	0.01	0.10	-0.09
	0.6 per cent EMS		0.72**	-0.05	-0.03	-0.04	0.16	0.07
Number of branches per plant	Control			-0.10	-0.02	0.01	-0.07	0.05
	10 krad Gamma rays			0.05	-0.01	-0.02	-0.02	0.01
	0.04 per cent DES			0.03	0.03	0.03	0.01	0.01
	0.6 per cent EMS			0.03	-0.02	-0.02	0.04	-0.03
Number of fruits per plant	Control				-0.05	0.01	0.25**	0.22**
	10 krad Gamma rays				0.02	-0.04	0.23**	0.41**
	0.04 per cent DES				-0.05	0.01	0.25**	0.21**
	0.6 per cent EMS				-0.01	0.04	0.26**	0.33**
Fruit length	Control					0.02	-0.06	0.05
	10 krad Gamma rays					-0.02	0.04	0.04
	0.04 per cent DES					-0.01	0.02	0.04
	0.6 per cent EMS					-0.01	-0.11	0.11
Fruit girth	Control						0.08	-0.01
	10 krad Gamma rays						0.05	0.05
	0.04 per cent DES						0.02	0.03
	0.6 per cent EMS						0.08	0.03
Fruit weight	Control							0.22**
	10 krad Gamma rays							-0.28**
	0.04 per cent DES							-0.21*
	0.6 per cent EMS							-0.24**

* and ** indicate significane of values at P=0.05 and 0.01, respectively

for yield is more effective when it is based on component characters which are highly heritable and positively correlated. Therefore, to achieve gains in yield by selection, basic information on major contributing traits and their relationship independently with yield is essential. In this direction, correlation analysis suggests the association pattern of component traits with fruit yield and it represents the overall influence of particular trait on target trait without revealing cause and effect relationship when more number of component characters is considered.

In M_3 generation, the genotype Angoor revealed positive and highly significant correlation between number of fruits per plant Vs fruit weight and fruit yield per plant; plant height with number of branches per plant. Interestingly, fruit yield per plant showed negative and

Table 2 : Phenotypic correlation for biometric traits of Annamalai in M_3 generation

Parameters	Treatments	Plant height	Number of branches per plant	Number of fruits per plant	Fruit length	Fruit girth	Fruit weight	Fruit yield per plant
Days to 50 per	Control	0.20*	0.26*	0.56**	-0.18*	0.13	0.42**	-0.10
cent flowering	10 krad Gamma rays	0.10	0.14	0.03	0.36**	0.29**	0.55**	0.05
	0.04 per cent DES	0.13	0.13	0.13	0.03	0.13	0.16	-0.03
	0.6 per cent EMS	0.33**	0.23**	0.23**	0.13	0.16	0.36**	0.63**
Plant height	Control		-0.18	0.15	-0.10	0.07	0.03	-0.18*
	10 krad Gamma rays		0.12	-0.18*	0.08	-0.10	0.07	0.03
	0.04 per cent DES		0.06	0.10	0.23**	0.26**	0.20*	0.20*
	0.6 per cent EMS		-0.33**	0.03	-0.03	0.03	0.10	0.10
Number of	Control			0.10	0.03	0.13	0.16	0.26**
branches per	10 krad Gamma rays			0.07	0.20*	0.10	-0.12	0.23**
plant	0.04 per cent DES			-0.30**	-0.06	0.03	-0.21*	0.39**
	0.6 per cent EMS			-0.18	0.03	-0.16	0.20	0.42**
Number of	Control				-0.13	-0.03	0.36**	0.33**
fruits per plant	10 krad Gamma rays				-0.18*	0.02	0.29**	0.62**
	0.04 per cent DES				-0.07	-0.11	0.55**	0.23*
	0.6 per cent EMS				0.13	0.26**	0.02	0.58**
Fruit length	Control					0.20*	0.29**	0.33**
	10 krad Gamma rays					0.10	0.03	0.21*
	0.04 per cent DES					0.36**	0.07	0.36**
	0.6 per cent EMS					0.03	0.20*	0.27**
Fruit girth	Control						0.10	0.43**
	10 krad Gamma rays						0.42**	0.56**
	0.04 per cent DES						0.55**	0.03
	0.6 per cent EMS						0.16	0.13
Fruit weight	Control							0.26**
	10 krad Gamma rays							0.03
	0.04 per cent DES							0.13
	0.6 per cent EMS							0.29**

* and ** indicate significance of values at P=0.05 and 0.01, respectively

significant association with fruit weight for all the treatments in Angoor. In the genotype Annamalai, fruit yield per plant was positive and highly significantly associated with number of branches per plant, number of fruits per plant and fruit length. The maximum correlation was recorded between fruit yield per plant and number of fruits per plant in the treatment 10 krad gamma rays in Angoor (0.41) and Annamalai (90.62) (Tables 1 and 2, respectively).

The genotype Hissar Pragath showed lower positive or negative, non-significant association among majority of the traits studied. However, fruit yield was positive

Table 3 : Phenotypic correlation for biometric traits of Hissar Pragath in M_3 generation

Parameters	Treatments	Plant height	Number of branches per plant	Number of fruits per plant	Fruit length	Fruit girth	Fruit weight	Fruit yield per plant
Days to 50 per	Control	0.09	0.06	-0.26**	-0.16	0.11	0.07	0.03
cent flowering	10 krad Gamma rays	0.03	0.18	-0.05	0.03	-0.11	-0.16	-0.06
	0.04 per cent DES	0.11	0.09	0.03	-0.14	-0.03	0.02	-0.10
	0.6 per cent EMS	0.14	-0.11	-0.18	0.18	0.12	0.25**	0.48
Plant height	Control		-0.16	0.13	-0.09	0.06	0.03	-0.16
	10 krad Gamma rays		0.11	-0.16	0.07	-0.09	0.06	0.03
	0.04 per cent DES		0.05	0.09	0.29	0.13	0.18	0.18
	0.6 per cent EMS		-0.09	0.03	-0.03	0.03	0.09	0.09
Number of	Control			0.11	-0.16	0.11	0.17	-0.09
branches per	10 krad Gamma rays			0.14	0.12	0.15	0.18	0.29
plant	0.04 per cent DES			0.16	0.03	0.11	0.14	-0.03
	0.6 per cent EMS			-0.16	0.11	0.14	0.12	0.03
Number of	Control				0.23**	0.18	0.18	0.40**
fruits per plant	10 krad Gamma rays				0.23**	0.09	0.09	0.33**
	0.04 per cent DES				0.34**	0.11	0.11	0.21*
	0.6 per cent EMS				0.37**	0.29**	0.29**	0.50**
Fruit length	Control					0.11	0.14	0.38**
	10 krad Gamma rays					0.14	0.32**	0.33**
	0.04 per cent DES					0.03	0.06	0.23*
	0.6 per cent EMS					0.05	0.20*	0.48**
Fruit girth	Control						0.11	0.18
	10 krad Gamma rays						0.32**	0.29**
	0.04 per cent DES						0.18	0.19
	0.6 per cent EMS						0.23**	0.28**
Fruit weight	Control							0.21*
	10 krad Gamma rays							0.29**
	0.04 per cent DES							0.34**
	0.6 per cent EMS							0.37**

* and ** indicate significance of values at P=0.05 and 0.01, respectively

and highly significantly associated with number of fruits per plant, fruit length and fruit weight. The fruit yield per plant was positive and highly significantly associated with the traits number of fruits per plant, fruit girth and fruit weight in the genotype PLR 1. Similarly the fruit weight was highly significant and positively associated with the traits number of branches per plant, number of fruits per plant, fruit length and fruit girth. In the genotype Putheri, fruit yield per plant was positive and highly significantly associated with number of fruits per plant, fruit length and fruit weight. Majority of the associations between traits studied showed minimum affinity towards each other. Maximum association was noted between the traits fruit yield per plant and number of fruits per plant in the treatment 0.6 per cent EMS in Hissar Pragath (0.50) (Table 3), PLR 1 (0.54) (Table 4) and Putheri (0.54)

Table 4 : Phenotypic correlation for biometric traits of PLR 1 in M_3 generation

Parameters	Treatments	Plant height	Number of branches per plant	Number of fruits per plant	Fruit length	Fruit girth	Fruit weight	Fruit yield per plant
Days to 50 per	Control	0.03	0.08	-0.39	0.08	0.23**	0.18	0.19
cent flowering	10 krad Gamma rays	0.01	-0.11	-0.08	0.09	0.18	0.08	0.14
	0.04 per cent DES	0.14	-0.13	0.04	0.06	0.31**	0.17	0.29**
	0.6 per cent EMS	0.08	-0.15	-0.27	0.04	0.29**	0.09	0.28**
Plant height	Control		-0.23**	0.19	0.14	-0.08	0.04	-0.23*
	10 krad Gamma rays		0.15	-0.23	0.25**	0.08	0.30	0.15
	0.04 per cent DES		0.08	0.15	0.21**	0.23**	0.31	0.14
	0.6 per cent EMS		-0.13	0.08	0.21**	0.23**	0.31	0.27**
Number of	Control			-0.13	0.09	0.08	0.31**	0.14
branches per	10 krad Gamma rays			0.21*	0.06	0.31**	0.29**	0.08
plant	0.04 per cent DES			0.02	0.04	0.39	0.48**	0.15
	0.6 per cent EMS			-0.23	0.01	-0.08	0.23**	-0.13
Number of	Control				-0.27**	0.08	0.28**	0.22**
fruits per plant	10 krad Gamma rays				-0.26**	0.03	0.31**	0.39**
	0.04 per cent DES				-0.36**	0.03	0.31**	0.29**
	0.6 per cent EMS				-0.31**	0.08	0.31**	0.54**
Fruit length	Control					0.31**	0.29**	0.08
	10 krad Gamma rays					0.19	0.36**	0.15
	0.04 per cent DES					-0.08	0.31**	-0.23*
	0.6 per cent EMS					0.08	0.29**	0.49**
Fruit girth	Control						0.15	0.29**
	10 krad Gamma rays						0.28**	0.28**
	0.04 per cent DES						0.20*	0.26**
	0.6 per cent EMS						0.37**	0.18
Fruit weight	Control							0.31**
	10 krad Gamma rays							0.24**
	0.04 per cent DES							0.29**
	0.6 per cent EMS							0.39**

* and ** indicate significance of values at P=0.05 and 0.01, respectively

(Table 5).

The maximum positive and significant correlation was observed between the traits fruit yield per plant and number of fruits per plant (0.62) for the mutagenic treatment 10 krad gamma rays in Annamalai. The fruit charecters *viz.*, fruit length, fruit girth and fruit weight expressed higher significant positive correlations. Similar kind of results was reported by earlier workers (Aruna and Veeraragavathathanm, 1997; Negi *et al*., 1999 and Patel and Sarnaik, 2004). The above results are also in consonance with Supe and Nad Kale (1992); Vadivel and Bapu (1988); Singh and Singh (2001) and Patel and Sarnaik (2004) in brinjal.

Kushwah and Bandhyopadhya (2005) reported that number of fruits per plant, fruit diameter and number of pickings had significant positive correlation with yield per

Table 5 : Phenotypic correlation for biometric traits of Putheri in M_3 generation

Parameters	Treatments	Plant height	Number of branches per plant	Number of fruits per plant	Fruit length	Fruit girth	Fruit weight	Fruit yield per plant
Days to 50 per	Control	0.20*	0.36**	0.29**	0.05	0.03	0.26**	0.20
cent flowering	10 krad Gamma rays	0.10	0.03	0.13	0.16	-0.03	0.03	0.10
	0.04 per cent DES	0.13	0.13	0.16	0.16	0.13	0.39**	0.13
	0.6 per cent EMS	0.33**	0.23*	0.03	0.07	-0.1	0.42**	0.33**
Plant height	Control		0.01	0.28**	0.07	0.02	0.23**	0.10
	10 krad Gamma rays		0.13	0.16	0.08	0.11	0.03	0.18
	0.04 per cent DES		0.11	0.13	0.18	0.02	0.16	0.15
	0.6 per cent EMS		0.17	-0.08	-0.05	-0.07	0.26**	0.11
Number of	Control			-0.16	-0.03	0.02	-0.11	0.08
branches per	10 krad Gamma rays			0.08	0.02	0.03	-0.03	0.02
plant	0.04 per cent DES			0.05	0.05	0.05	0.02	0.02
	0.6 per cent EMS			0.05	0.03	-0.03	0.07	-0.05
Number of	Control				0.16	0.02	0.21*	0.36**
fruits per plant	10 krad Gamma rays				0.03	-0.07	0.27**	0.37**
	0.04 per cent DES				0.08	0.02	0.21*	0.34**
	0.6 per cent EMS				0.02	0.07	0.22*	0.54**
Fruit length	Control					0.03	-0.10	0.28**
	10 krad Gamma rays					-0.03	0.07	0.27**
	0.04 per cent DES					-0.02	0.03	0.27**
	0.6 per cent EMS					-0.02	-0.18*	0.28**
Fruit girth	Control						0.13	-0.02
	10 krad Gamma rays						0.08	0.08
	0.04 per cent DES						0.03	0.05
	0.6 per cent EMS						0.13	0.05
Fruit weight	Control							0.23**
	10 krad Gamma rays							0.23**
	0.04 per cent DES							0.18*
	0.6 per cent EMS							0.27**

* and ** indicate significance of values at P=0.05 and 0.01, respectively

plant at genotypic level. Such positive association between number of fruits per plant and fruit yield per has been reported by many workers (Negi *et al*., 1999 and Patel and Sarnaik, 2004 in brinjal; Nandpuri *et al*., 1973; Bhutani and Kallo, 1989; Raijadhav *et al.,* 1996 in tomato and other crops). Similarly in brinjal, Randhawa *et al*. (1989); Mishra and Mishra (1990); Saraswati (1996) and Nalini *et al*. (2009) reported strong association between number of fruits per plant and fruit yield. The entries having maximum number of fruits per plant and heavier fruits were generally observed to yield higher.

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