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Sensitivity analysis in Coriander (*Coriandrum sativum* L.)

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Abstract
Coriander (*Coriandrum sativum* L.) is an annual herb, mainly cultivated for its fruits as well as for the tender green leaves. It is native of the Mediterranean region. In India, it is grown in Andhra Pradesh, Tamil Nadu, Karnataka, Rajasthan and Madhya Pradesh. Research waconducted for studying the induced mutation in Coriander two types viz., CO 3 and K selection (Sn-K) were selected. Based on sensitivity studies, four doses of gamma rays (10, 15, 20, 25 kR), four doses of EMS (10, 15, 20, 25 mM) and four doses of combination treatments (10 kR + 10 mM, 10 kR + 15 mM, 15 kR + 10 mM, 15 kR + 15 mM) were attempted. There were differences in the germination percent among controlled, pot studies and field conditions in both the varieties in all treatments. This indicated that the germination response is not only dose, mutagen and genotype dependent but also, affected by the prevailing environmental conditions.

Keywords: Coriander-induced mutation- sensitivity studies- gamma rays and EMS

Introduction
Coriander belongs to the family Apiaceae. It is a smooth, erect annual herb 30 to 70 cm high, lower leaves broad with crenately lobed margins, upper leaves finely cut with lineary lobes and ripe seeds are aromatic and the essential oil content, which varies from 0.1 to 1.0 % used flavouring liquors and to mask the offensive odours in pharmaceutical preparations The dried ground fruits are the major ingredients of the curry powder. The whole fruits are also used to flavour foods like pickles, sauces and confectionary. The young plants as well as the leaves are used in the preparation of chutney and are also used as seasonings in curries, soups, sauces and chutneys. It has medicinal properties too. Fruits are said to have carminative, diuretic, tonic, stomachic and aphrodisiac properties. It is a tropical crop and can be grown throughout the year, except very hot season i.e. March-May for leaf purpose, but for higher grain yield it has to be grown in specific season. A dry and cold weather free from frost especially during flowering and fruit setting stage favours good grain production. Cloudy weather during flowering and fruiting stage favours pest and disease incidences. Heavy rain affects the crop. As an irrigated crop, it can be cultivated on almost all types of soils provided sufficient organic matter is applied. Black cotton soils with high retentivity of moisture is best under rainfed conditions.

Materials and Methods
Two coriander (*Coriandrum sativum* L.) types viz., CO 3 and K Selection (Sn-K) were selected from the germplasm pool The origin and distinguishing key characters of these two genotypes are presented here under:

Table 1: Salient features of the genotypes

Genotype	Institute responsible for development	Parentage and distinguishing key characters
1. CO 3	Horticultural College and Research Institute, Coimbatore	Germplasm selection from A.T.P. 77.
2. Sn-K	N.D.University of Agricultural and Technology, Faizabad	Selection from Kumarganj.

Results and Discussion
i. Germination under controlled condition
The effect of germination studies under controlled conditions are presented here under:
Effect of gamma rays and EMS on seed germination is presented in Tables 2, 3 and 4 Fig.

1, 2, 3, 4, and 5, Plate. I. A gradual reduction (87.00 to 36.00 and 81.00 to 37.00) in the germination was noticed corresponding to an increased in the dosage of gamma irradiation and EMS for both the varieties of CO 3 and EMS. The lethality for 50 percent reduction was noticed at 25 kR for both at 62.07 and 65.43 percent compared to control, while at the highest concentration of 40 kR the germination was 41.38 and 45.68 percent for both the varieties, The treated seeds were sown at the rate of hundred seeds per replication in sterile sand medium (Mikaelson, 1968) [7]

EMS treatment also showed linear reduction with increased dosage. In CO 3 and Sn-K, 50 percent germination reduction was judged between 25 to 30 mM which was 69.41 and 66.29 percent over the control. The highest concentration of 40 mM had 45.88 and 47.19 percent of germination for CO 3 and Sn-K. The varietal mean for CO 3 and Sn-K was 59.44 and 59.31 percent.

ii. Shoot length

There was a progressive reduction in shoot length in both the varieties in gamma treatments with the exception of CO 3 under 20 kR which recorded an increased shoot length of 8.63 cm compared to control which was 7.84 cm. The maximum reduction percent was 60.08 in CO 3 at 40 kR while it was 41.50 percent in Sn-K. All the treatments had a linear reduction in shoot length while the 5 kR treatment recorded the 1.50 percent increased shoot length.

The reduction due to EMS treatments were exhibited, except at 25 mM in CO 3 which increased shoot length at 0.12 percent compared to control. The others had the reduction percent which ranged from 2.37 to 35.66. In Sn-K, the treatments at 5, 10 and 15 mM had the increased shoot length of respectively, 2.54, 11.99 and 4.60 percent. The others had the linear reduction in shoot length. The reduction of shoot length showed differential response due to varieties by recording a mean of 6.47and 7.48 for CO 3 and Sn-K.

iii. Root length

There was linear reduction in root length which ranged from 8.42 to 3.13 cm in CO 3. The treatments 5, 10 kR had the increased shoot length of 9.07 and 9.23 cm compared to control which was 8.45 cm. However, in Sn-K, the root length showed an increase of 3.25 and 5.24 percent which was at 5 and 10 kR compared to control, while all other treatments recorded lower values of root length (Table 4).

Similar to gamma treatments, EMS also resulted in reduction of root length in a linear fashion in CO 3 where the mean values ranged from 5.23 to 9.15 cm. In Sn-K,

5 and 10 mM recorded increased root length of 9.52 and 9.65 cm compared to 8.45 cm in control. All other concentrations recorded gradual reduction in root length which ranged from 97.75 to 71.12 cm

The reduction of root length showed differential response due to varieties by recording a mean of 7.56 and 7.23 for CO 3 and Sn-K.

Table 2: Effect of mutagen on seed germination (percent) in M_0 generation under controlled condition

Treatments		CO 3		Sn-K		Treatment mean	Percent of control
		Mean	Percent of control	Mean	Percent of control		
	C1	87.00	100.00	81.00	100.00	84.00	100.00
Gamma Kr	5	82.00	94.25	75.00	92.59	78.50	93.5
	10	77.00	88.51	69.00	85.19	73.00	86.9
	15	71.00	81.61	62.00	76.54	66.50	79.2
	20	66.00	75.86	58.00	71.60	62.00	73.8
	25	54.00	62.07	53.00	65.43	53.50	63.7
	30	46.00	52.87	46.00	56.79	46.00	54.8
	35	41.00	47.13	42.00	51.85	41.50	49.4
	40	36.00	41.38	37.00	45.68	36.50	43.5
	Mean	59.13		55.25		57.19	
EMS mM	C2	85.00	100.00	89.00	100.00	87.00	100.00
	5	82.00	96.47	87.00	97.75	84.50	97.13
	10	76.00	89.41	82.00	92.13	79.00	90.80
	15	72.00	84.71	76.00	85.39	74.00	85.06
	20	65.00	76.47	67.00	75.28	66.00	75.86
	25	59.00	69.41	59.00	66.29	59.00	67.82
	30	44.00	51.76	48.00	53.93	46.00	52.87
	35	41.00	48.24	46.00	51.69	43.50	50.00
	40	39.00	45.88	42.00	47.19	40.50	46.55
	Mean	59.75		63.38		61.56	
Variety	mean	59.44		59.31		59.75	
			S.ED	CD = (P = 0. 05)		CD = (P = 0. 01)	
Between varieties			0.327	0.162		0.866	
Between treatments			0.981	1.957		2.598	
Variety Vs treatment			1.387	2.767		3.674	

Table 3: Effect of mutagen on shoot length (cm) in M_0 generation under controlled condition

Treatments		CO 3		Sn-K		Treatment mean	Percent of control
		Mean	Percent of control	Mean	Percent of control		
	C1	7.84	100.00	9.35	100.00	8.60	100.00
Gamma kR	5	7.26	92.60	9.49	101.50	8.38	97.38
	10	7.49	95.54	8.73	93.37	8.11	94.30
	15	6.84	87.24	8.41	89.95	7.63	88.66
	20	8.63	110.08	7.23	77.33	7.93	92.21
	25	7.29	92.98	7.13	76.26	7.21	83.84
	30	6.45	82.27	6.47	69.20	6.46	75.12
	35	4.63	59.06	6.58	70.37	5.61	65.17
	40	3.13	39.92	5.47	58.50	4.30	50.00
	Mean	6.47		7.44		6.95	
EMS mM	C2	8.02	100.00	8.26	100.00	8.14	100.00
	5	7.83	97.63	8.47	102.54	8.15	94.77
	10	7.25	90.40	9.25	111.99	8.25	95.93
	15	6.19	77.18	8.64	104.60	7.42	86.22
	20	6.83	85.16	7.28	88.14	7.06	82.03
	25	8.03	100.12	7.63	92.37	7.83	91.05
	30	5.29	65.96	6.47	78.33	5.88	68.37
	35	5.16	64.34	6.42	77.72	5.79	67.33
	40	5.23	65.21	6.01	72.76	5.62	65.35
	Mean	6.48		7.52		7.00	
Variety	mean	6.47		7.48		6.98	
			S.ED	CD = (P = 0. 05)		CD = (P = 0. 01)	
Between varieties			0.038	0.077		0.104	
Between treatments			0.080	0.164		0.220	
Variety Vs treatment			0.114	0.232		0.312	

Table 4: Effect of mutagen on root length (cm) in M_0 generation under controlled condition

Treatments		CO 3		Sn-K		Treatment mean	Percent of control
		Mean	Percent of control	Mean	Percent of control		
	C1	8.45	100.00	8.01	100.00	8.23	100.00
Gamma kR	5	9.07	107.34	8.27	103.25	8.67	105.35
	10	9.23	109.23	8.43	105.24	8.83	107.29
	15	8.42	99.64	7.96	99.38	8.19	99.51
	20	7.91	93.61	6.95	86.77	7.43	90.28
	25	7.43	87.93	6.43	80.27	6.93	84.20
	30	7.21	85.33	6.15	76.78	6.68	81.17
	35	5.21	61.66	6.03	75.28	5.62	68.29
	40	3.13	37.04	5.47	68.29	4.30	52.25
	Mean	7.20		6.96		7.08	
EMS mM	C2	9.29	100.00	8.45	100.00	8.87	100.00
	5	9.15	98.49	9.52	112.66	9.34	105.24
	10	9.11	98.06	9.65	114.20	9.38	105.75
	15	8.73	93.97	8.26	97.75	8.50	95.77
	20	8.21	88.37	7.26	85.92	7.74	87.20
	25	7.94	85.47	6.54	77.40	7.24	81.62
	30	7.83	84.28	6.34	75.03	7.09	79.88
	35	7.21	77.61	6.45	76.33	6.83	77.00
	40	5.23	56.30	6.01	71.12	5.62	63.36
	Mean	7.93		7.50		7.72	
Variety	mean	7.56		7.23		7.40	
			S.ED	CD = (P = 0. 05)		CD = (P = 0. 01)	
Between varieties			0.043	0.089		0.119	
Between treatments			0.092	0.189		0.253	
Variety Vs treatment			0.131	0.267		0.358	

Germination

Seed germination due to gamma irradiation proved a gradual reduction due to increased dosage. It ranged from 38.00 to 85.00 percent in CO 3 and 45.88 to 96.47 percent in Sn-K (Table 2). The fifty percent germination was registered in 25 to 30 kR for both the varieties.

In CO 3 variety, all concentration of treatments recorded as that of gamma irradiation. It ranged from 37.00 to 87.00 percent compared to control which was 89.00 percent. For Sn-K, it was 97.56 to 95.12 percent. The fifty percent germination was registered in 25 to 30 mM for both the varieties. Germination reduction varied between two varieties of CO 3 and Sn-K were 63.69 and 59.06 percent.

Survival

The mutagenic treatments influenced the survival of the M_0

generation. A gradual linear reduction in the survival percent in gamma irradiation was noticed in both the varieties. It ranged between 30.47 to 68.89 and 6.28 to 51.47 percent. The EMS effect also had the same effect, which was respectively between 36.49 to 69.86 and 2.7 to 53.29. The reduction of survival percent showed differential response by the varieties with mean values of 49.64 and 50.98 for CO 3 and Sn-K (Table 3).

The mutagenic treatments at different dosage had different effects on survival, germination, shoot and root length. Though the treatments with both the radiations reduced the germination percentage when compared to control, positive effects were observed in case of shoot and root length. From the above experiment it is evident that mutagenic treatment with EMS at 5mM is found to have superior result of germination percentage- 96.47 percent, 97.75 percent, shoot length percentage -97.63 percent, 102.54 percent and root length percentage – 98.49 percent, 112.66 percent (Table 2,3 and 4) than control and other treatments in both CO3 and Sn-K varieties.

Conclusions

There were differences in the germination percent among controlled, pot studies and field conditions in both the varieties in all treatments. This indicated that the germination response is not only dose, mutagen and genotype dependent but also, affected by the prevailing environmental conditions as evidenced by greater reduction of germination under pot studies.

In the present study, there was a progressive reduction in shoot length in both the varieties in gamma treatments with the exception of CO 3 under 20 kR which recorded in mild stimulatory effect seen in shoot length, while 5 kR treatment recorded the 1.50 percent increased shoot length. The reduction due to EMS treatments was noticed except at 25 mM in CO 3. In Sn-K, the treatments at 5, 10 and 15 mM had the increased shoot length.

The specificity of genotypes and physiological maturity of the seed material as stated by Jaranowski (1976) [1] in peas and Jothi (1979) [2] in lucern confirm these findings. Deformities in cotyledonary leaves and true leaves due to irradiation have been attributed to disturbances of phytochrome (Irvine, 1940) [3], chromosomal aberrations and physiological and biochemical disturbances (Gunckel and Sparrow, 1954) [4] and also inhibitions of DNA synthesis (Pale and Howard, 1956) [5]. Such aberrations had been reported in fenugreek by Sayed (1984) [6], Effect of fast neutrons on seedling growth and metabolism in barley. Neutron irradiation seeds by Mikaelson, K. 1968 [7].

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