Indian J. Genet., **57** (2): 158–160 (1997)

GAMMA RADIATION AND EMS TREATMENT OF BLACK CUMIN CULTIVARS FOR MUTATIONAL BIOASSAYS

P. K. MITRA* AND G. BHOWMIK

Department of Biotechnology, Gauhati University, Guwahati 781014

(Received: October 10, 1994; accepted: February 8, 1996)

ABSTRACT

Ten different types of chlorophyll mutations were induced in two cultivars of black cumin (*Nigella sativa* L.) after gamma irradiation and EMS treatment. Mutation frequency was proportional to dose for gamma rays, but not for EMS. Higher doses of gamma rays and lower concentration/duration of EMS were most efficient. Difference in the response of both cultivars due to mutagenic treatment indicate variation in the genetic architecture of the two cultivars. Origin and use of black cumin cultivars for mutagen bioassays studies are discussed.

Key words: Black cumin, gamma rays, EMS, mutation frequency.

Chlorophyll mutants are most convenient for evaluating the genetic effect of mutagens in plants [1]. It may help in understanding the genetic architecture of different cultivars and serve as a good index for determining the doses of different mutagens. The paper deals with the treatment of two black cumin cultivars seeds with gamma rays and EMS solution for mutation induction.

MATERIALS AND METHODS

Dry seeds of two cultivars of black cumin (*Nigella sativa* L.), viz. Assam Local and Krishnanagar Selection I, were irradiated with gamma ray doses from 50 to 250 Gy. For chemical treatment, dry seeds were soaked in aqueous solution of ethyl methane sulphonate (EMS) at different concentrations (0.0, 0.1, 0.2, 0.3 and 0.4%) for 4 and 8 h. The treated seeds were sown in field to raise M_1 generation. Selfed seeds from M_1 plants were harvested individually and grown to raise M_2 generation as progeny rows. The chlorophyll mutation frequency was calculated dose wise per 100 M_2 plants [2]. The chlorophyll mutants were classified at seedling stage following the system of [3, 4].

*Present address: North Lakhimpur College, North Lakhimpur 787001.

RESULTS AND DISCUSSION

Ten different types of chlorophyll mutations were isolated in M_2 generation. The results showed interesting relationship of radiation as well as EMS doses with chlorophyll mutation frequency in both cultivars (Table 1).

With few exceptions, either increasing or decreasing chlorophyll mutation frequency was observed depending on the dose and types of mutagen. Dose-dependent increase in the frequency of chlorophyll mutations was reported earlier in several crops [2, 5, 9]. Though a wider spectrum of chlorophyll mutations was observed with lower doses of both mutagens, the chlorophyll mutation frequency was higher at the lower concentration of EMS, but higher doses of gamma rays. Such increase after gamma- irradiation was also reported in *Lathyrus sativus* [5]. All gamma-ray treatments and 4 and 8 h EMS treatments in both cultivars showed similar trend in mutation frequency.

Table 1. Chlorophyll mutation frequency in black cumin (*Nigella sativa* L.) after gamma ray and EMS treatments

Mutagen treatment	Assam Local		Krishnanagar Selection I	
	total M_2 plants	mutation frequency (in %)	total M_2 plants	mutation frequency (in %)
Control	1537	0.00	1641	0.00
Gamma rays:				
50 Gy	3157	1.25	3016	1.59
100 Gy	2231	1.75	2104	1.70
150 Gy	1215	2.63	2047	1.27
200 Gy	412	3.15	592	2.54
250 Gy	123	1.63	157	4.46
EMS:				
0.1%-4h	2439	2.90	2510	2.75
0.2%-4h	2017	2.58	2201	2.22
0.3%-4h	2136	1.80	2095	1.35
0.4%-4h	1856	1.02	1836	1.42
0.1%-8h	2248	2.70	2214	2.36
0.2%-8h	2157	2.16	1957	1.94
0.3%-8h	1801	1.45	1676	1.02
0.4%-8h	1643	0.98	986	1.12

The difference in response to mutagens observed in two cultivars of black cumin is a result of variation in the genotype. In both groups of mutagen-treated plants, higher doses showed decrease and increase in the chlorophyll mutation frequency. It was also seen that the scope of mutation breeding is much greater in cultivar Krishnanagar Selection I than in Assam Local.

The effect of differences in the genetic make up on mutagenic response of a particular locus was reported [10]. Of the two cultivars, Assam Local is an old variety grown from mass selected seeds, whereas Krishnanagar Selection I is a new variety.

REFERENCES

1. A. Gustafsson. 1951. Induction of changes in genes and chromosomes. II. Mutations, environment and evolution. Cold Spring Harb. Symp. Quant. Biol., **4**: 601–632.

2. H. Gaul. 1964. Mutation in plant breeding. Rad. Bot., **4**: 155–232.

3. A. Gustafsson. 1940. The mutation system of chlorophyll apparatus. Lunds Univ. Arsskr, N.F. Adv., 2Bd. **36.** Nr. 11: 1–40.

4. S. Blixt. 1961. Quantitative studies of induced mutations in peas. V. Chlorophyll mutations. Agri. Hort. Genet., **19**: 402–447.

5. Y. S. Nerkar. 1976. Mutation studies in *Lathyrus sativus*. Indian J. Genet., **36**(2): 225–229.

6. A. B. Prasad and A. K. Das. 1980. Studies of induced chlorophyll mutations in *Lathyrus sativus* L. Cytologia, **45**: 335–341.

7. J. R. Bahl and P. K. Gupta. 1982. Chlorophyll mutations in mung [*V. radiata* (L.) Wilczek.]. Theor. Appl. Genet., **63**: 23–26.

8. A. K. Datta and A. K. Biswas. 1985. Induced mutagenesis in *Nigella sativa* L. Cytologia, **50**(3): 545–562.

9. M. Venkateswarlu, B. N. Sushellamma, P. Kumar and K. Subhash. 1988. Studies on induced mutation frequency in *Catharanthus roseus* (L.) G. Don. by gamma rays and EMS individually and its combination. Indian J. Genet., **48**(3): 313–316.

10. N. Nybom and A. Koch. 1965. Induced mutations and breeding methods in vegetatively propagated plants. *In*: The Use of Induced Mutations in Plant Breeding. FAO/IAEA Meeting, Rome. Rad. Bot., **5**(Suppl.): 661–678.