J Indian Bot Soc 66 72-76

Mutagen-Induced changes in Flowering in Diploid and Tetraploid Cytotypes of *Solanum nigrum*

V.S.Kothekar

Department of Botany, Marathwada University,
Aurangabad 431004.

(Accepted December 1985)

The effect of different mutagens on the commencement of flowering and induction of floral abnormalities was studied in the diploid and tetraploid cytotypes of *Solanum nigrum* complex. The flowering was delayed by the mutagenic treatment except 5 kR and 15 kR doses of gamma ray where an early flowering was recorded in both the cytotypes. Certain floral abnormalities were induced in the diploid but not in the tetraploid.

Solanum nigrum L. comprises one of the most widespread and variable species groups of the genus *Solanum*. (Edmonds 1977). Members of this genus exhibit variability and consist of a polyploid series based on X = 12 chromosomes (Bhaduri 1933;Stebbins and Paddock 1949

Even though much has been published on the cytogenetics of Indian forms of *S.nigrum U*.complex (Magoon et al 1962; Tandon and Rao 1966 a,b: Chennaveeraiah and Patil 1968; Venkateswarlu and Krishna Rao 1972), no effort has been made to relate this to classification. Recently the nomenclatural problems of this species group have been settled and the correct names for different cytotypes have been proposed (Hawkes and Edmonds 1972; Henderson 1974; Edmonds 1972, 1977, 1984 a, b).

Ganapati and Rao (1986) attempted to determine the correct taxonomic status of the *S.nigrum* complex occurring in India. On the basis of comparative morphological and cytological studies of the forms collected from different floristic regions of India, they concluded that the diploid, tetraploid and hexaploid cytotypes are in fact *S.americanum* Mill .var. *patulum* Edmonds, *S. villosum* Mill. subsp. *miniatum* (Bernh ex Willd.) Edmonds, and *S.nigrum* L. subsp. *nigrum*, respectively.

A perusal of the related publications clearly revealed that although much of cytogenetical work was done on the different cytotypes of Indian *S.nigrum* complex Kothekar and Dnyansagar 1985; Kothekar 1987)/ none has attempted to study the induced mutational aspect of this group of plants. Therefore, it was planned to induce mutations in the polyploid series of this species by making use of different mutagens such as gamma rays, ethyl methanesulphonate (EMS), diethyl sulphate (DES) and ethylene imine (EI). The present communication deals with the effect of these mutagens on the commencement of flowering and induction of floral abnormalities in the diploid and tetraploid cytotypes of *S.nigrum* complex.

MATERIALS & METHODS

Seeds of diploid and tetraploid cytotypes of *S. nigrum* complex of equal size and uniform moisture content were irradiated with 5, 15, 25 and 35 kR of ^{60}Co rays.They were also subjected to treatment separately with mutagens such as EMS (0.05 %, 0.10% and) 0.15%), DES (0.02 %, 0.06% and 0.10%) and EI (0.0025 %, 0.005 % and 0.0075%)for 18 h. The treated seeds were washed, soaked in distilled deionised water for 3 h and sown in the field. All the treatments were replicated twice. The plants of M_1 generation were carefully studied pertaining to the number of days taken for the commencement of flowering and induction of floral abnormalities in case of diploid and tetraploid cytotypes.

From the seed progeny of the M_1 generation, M_2

Table 1 Data on flowering period of plants raised from Mutagen treated seeds in Diploid and Tetraploid Cytotypes of *Solanum nigrum* L. Complex

Dose/Concentration			Number of days required for commencement of flowering			
			M1 generation		M2 generation	
			Diploid	Tetraploid	Diploid	Tetraploid
Control			50 ± 0.12	60 ± 0.05	49 ± 0.20	60 ± 0.08
Gamma rays		5 KR	45 ± 0.32	58 ± 0.10	44 ± 0.41	57 ± 0.12
		15 KR	48 ± 0.30	58 ± 0.23	46 ± 0.31	56 ± 0.21
		25 KR	55 ± 0.27	63 ± 0.11	54 ± 0.22	62 ± 0.16
		35 KR	60 ± 0.17	66 ± 0.12	58 ± 0.21	64 ± 0.27
EMS	0.05	%	58 ± 0.15	61 ± 0.21	57 ± 0.10	61 ± 0.23
	0.10	%	60 ± 0.20	62 ± 0.28	60 ± 0.21	62 ± 0.26
	0.15	%	62 ± 0.22	63 ± 0.30	62 ± 0.25	62 ± 0.31
DES	0.02	%	61 ± 0.27	64 ± 0.32	59 ± 0.31	63 ± 0.33
	0.06	%	63 ± 0.36	66 ± 0.41	61 ± 0.32	66 ± 0.38
	0.10	%	66 ± 0.38	68 ± 0.42	63 ± 0.34	68 ± 0.39
EI	0.0025	%	59 ± 0.20	62 ± 0.27	58 ± 0.26	61 ± 0.31
	0.005	%	61 ± 0.26	64 ± 0.32	60 ± 0.27	63 ± 0.35
	0.0075	%	64 ± 0.31	65 ± 0.33	63 ± 0.30	63 ± 0.35

generation was grown. It was closely screened in regard to flowering and readings were recorded.

RESULTS & DISCUSSION : The effect of gamma rays on the commencement of flowering in the diploid and tetraploid cytotypes of *S. nigrum* complex was observed in the form of (1) an early flowering at 5 kR and 15 kR in both the cytotypes, and (2) delay in the flowering period at the higher doses of 25 kR and 35 kR (Table 1).With chemical mutagen the flowering was delayed. In the M_2 generation almost the same trend continued.

A significant variation regarding the size of flowers was noted in the plants of M_1 generation of the diploid. Some flowers produced by the treated plants were large.

Variation in the floral parts was also noticed. The number of petals varied from 4 to 7 against the usual 5 in control. Fusion between flowers along their lengths was also noted in the treated population of the diploid. In the tetraploid, however, no such changes were noted.

Early flowering due to gamma ray or EMS treatment has been reported in a few plants: *Rauwolfia serpentina* (Torne,1967) potato, Jauher and Singh 1969, rice (Roy and Jana 1973) and *Turnera ulmifolia* (Tarar and Dnyansagar 1980). According to George and Nayar (1973), induction of an early flowering could be due to physiological changes caused by irradiation. Kuzin *et al* (1972) and Joshi and Bhattacharya (1974) indicated increased production of flowering hormone as the likely reason for the stimulatory effect observed after gamma ray treatment.

Certain floral abnormalities were observed in the diploid population treated with mutagens. Gupta (1969) and Kaicker *et al.* (1971) noted flowers with reduced or increased petal numbers and size in *Portulaca* and *Tithonia* plants, respectively, after gamma ray treatment. The induced variation in floral parts was also reported by Jahagirdar (1975) in *Foeniculum vulgare* and Tarar and Dnyansagar (1980) in *Turnera ulmifolia*. According to Gunckel and Sparrow (1954), the floral abnormalities occur mainly due to physiological or biochemical disturbances. Gupta and Samata (1967) opined that certain disturbances caused by radiation during differentiation of different organs of the floral buds caused the development of floral abnormalities.

Flowering was delayed in diploid and tetraploid exposed to high doses of gamma rays and to chemical mutagens. Reports regarding delayed flowering due to different mutagenic treatments have been made by Bowen *et al.* (1962) in *Chrysenthemum*, Povilaites (1969) in *Nicotiana tabacum*, Jahagirdar (1975) in *Foeniculum vulgare* and Tarar and Dnyansagar (1980) in *Turnera ulmifolia*. Gunckel *et al.* (1953) attributed delayed flowering mainly to the disturbed hormone and enzyme synthesis. Gaikwad (1975) suggested that the changes induced in the cell metabolism which help to increase the period of vegetative phase could be the reason for delayed flowering. It is possible that the damage caused by high doses of mutagen to the primordial or meristematic tissue might have delayed the emergence of floral buds, inducing late flowering.

The diploid plant is relatively more sensitive to the mutagens than the tetraploid as far as flowering is concerned. The sensitive nature of the diploid is further substantiated by the fact that quite a good number of floral variations were induced in its population while in the tetraploid, none of them could be detectable. It looks as if the duplicated state of the genome in the tetraploid gives some sort of protection to the changes caused by mutagens.

Acknowledgement I thank Professor V.R. Dnyansagar for guidance and encouragement.

REFERENCES

BHADURI P N 1933 Chromosome numbers of some Solanaceous plants of Bengal. *J Indian Bot Soc* 12 56-64.

BOWEN H J M., P A CAWSE & M J DICK 1962. The

induction of sports in *Chrysanthemum* by gamma radiation.. Rad Bot 1 297-303.

CHENNAVEERAIAH M S & S R PATIL 1968. Some studies in the *Solanum nigrum* L. complex. *Genet Iber* 20 23-36.

EDMONDS J M 1972. A synopsis of the taxonomy of *Solanum* sect. *Solanum* (Maurella) in South America. *Kew Bull.* 27 95-114.

EDMONDS J M 1977. Taxonomic studies on *Solanum* section *Solanum* (Maurella). *Bot J Linn Soc* 75 : 141-178.

EDMONDS J M 1984 a. Work on the *Solanum nigrum* complex in India - A critique. Solanaceae Newslett. 2 23-28.

EDMONDS J M 1984 b. *Solanum* L. section *Solanum* - a name change in S. *villosum* Miller. *Bot J Linn Soc* 89 · 165-170.

HAWKES J G & J M EDMONDS 1972. *Solanum* L., in *Flora Europaea* 3 (eds) T G Tutin, V H Haywood N A Burges, D M Moore, D H Valentine, S M Walters and D A Webb (Cambridge : Cambridge University Press) 197-199.

HENDERSON R J F 1974. *Solanum nigrum* L. (Solanaceae) and related species in Australia. *Contrib Queensland Herb.* 16 . 1-72.

GAIKWAD P D 1975. Cytogenetic studies in *Coriandrum sativum* Linn. Doctoral Thesis University of Nagpur.

GANAPATI A & G R RAO 1986. Taxonomic status of the *Solanum nigrum* complex found in India. *Proc Indian Acad Sci* (Plant Sci) 96 241 246.

GEORGE K P & G G NAYAR 1973. Early dwarf mutant in linseed induced by gamma rays. *Curr Sci* 42 137-138.

GUNCKEL J E I B MORROW, A H SPARROW and E CHRISTENSEN 1953. Variation in the floral morphology of normal and irradiated plants of *Tradescantia paludosa Bull. Torrey Bot. club* 80 *445-456.*

GUNCKEL J E & A H SPARROW 1954. Aberrant growth in plants induced by ionising radiations. In "*Abnormal and Pathological Plant growth*" *Brookhaven Symp in Biol* 6 252-279.

GUPTA M N 1969. Use of gamma radiation in the production of new varieties of perennial *Portulaca.* In "*Proc Symp on the radiations and radiomimetic substances in mutation breeding*". 206 214.

GUPTA M N & Y SAMATA. 1967 The relationship between developmental stages of flower buds and somatic mutations induced by acute X- and chronic gamma-irradiation in *Cosmos bipinnatus. Rad Bot* 7 225-240.

JAHAGIRDAR H A 1975. Cytogenetic studies in *Foeniculum vulgare* Mill. Doctoral Thesis University of Nagpur.

JAUHER P P & U SINGH 1969. Induced mutagenesis as a tool in potato breeding. In "*Proc Symp on the radiations and radio-mimetic substances in mutation breeding*". 241-246.

JOSHI R K & S BHATTACHARYA 1974. A preliminary report on radiation induced stimulation in rice. In "*Proc Symp on use of radiation and radioisotopes in studies of plant productivity*". Dept of Atomic Energy Bombay 49.

KAICKER U S, VISHNUSWARUP & HARPAL SINGH. 1971. Some radiation induced mutants in *Tithonia. Indian J Genet* 31 218-222.

KOTHEKAR V S & V R DNYANSAGAR 1985. Polyploidy and sensitivity to radiations in *Solanum nigrum L. J. Cytol Genet* 20 79-88.

KOTHEKAR V S 1987. Induced chromosomal aberrations in diploid and tetraploid *Solanum nigrum* L *Cytologia* 52 . 179-182.

KUZIN A M, N M BEREZINA, A D KAUSHANSKY, V N LYSINKOV & K J SUKACH 1972. Theoretical basis and their practical results of the preirradiation on seeds with gamma rays in USSR. *Stimulation Newsletter* 4 1-11.

MAGOON M L, S RAMANUJAM & D C COOPER 1962. Cytological studies in relation to the origin and differentiation of species in the genus *Solanum* L *Caryologia* 15 151-252.

POVILAITES B 1969. Mutagenic effects of diethyl sulphate on certain morphological characters on *Nicotiana tabacum Can J Genet Cytol* 11 · 560-567.

ROY K & M K JANA 1973. EMS induced early mutation in rice *Curr Sci* 42 101-102.

STEBBINS G L Jr & E F PADDOCK 1949. The *Solanum nigrum* complex in Pacific North America. *Madrono* 10 70-81.

TANDON S L & G R RAO 1966 a. Interrelationships within the *Solanum nigrum* complex. *Indian J Genet Plant Breed* 26 130-141.

TANDON S L & G R RAO 1966 b. Biosystematics and origin of the Indian tetraploid *Solanum nigrum* L *Curr Sci* 35 524-525.

TARAR J L & V R DNYANSAGAR 1980. Mutagen induced variation in flowering and floral morphology in plants of *Turnera ulmifolia* Linn *J Indian Bot Soc* 59 167-169.

TORNE S G 1967. Cytogenetic studies in *Rauvolfia serpentina* (L.) Benth Ex Kurz Doctoral. Thesis University of Bombay.

VENKATESWARLU J & KRISHNA RAO 1972. Breeding systems, crossability relationships and isolating mechanisms in the *Solanum nigrum* complex. *Cytologia* 37 . 317-326.