FLORAL VARIABILITIES IN *SOLANUM NIGRUM*—COMPLEX INDUCED THROUGH GAMMA IRRADIATION

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ABSTRACT

Floral anomalies have been induced by various doses of gamma rays in three ploidy groups of *Solanum nigrum*, and maximum frequency of such anomalies occurred in tetraploid at 50 k rad dose. Flowers showed variations in form and number of floral parts. Variation in anther and filament length ratio of stamens was recorded in diploids and tetraploids. Fusion of floral parts occurred in all the three ploidy groups but the frequency was more in tetraploids. Higher doses delayed flowering but early flowering was induced in the diploids at 10 k rad dose.

INTRODUCTION

Ionizing radiations are known to induce early or late flowering and many morphological changes in floral parts in many taxa (Gunckel *et al.*, 1953; Indira & Abraham, 1977; Mathew & Abraham, 1978), but a comparative study in a species complex needs more studies to find out the effects of such irradiation on different ploidy groups of a species. The present paper, an outcome of such a study, describes the floral abnormalities in the essential and non-essential parts of flower by gamma radiation in the species-complex of *Solanum nigrum* L.

MATERIAL AND METHODS

Dry (11 per cent moisture) and soaked (100 per cent moisture) seeds of diploid, tetraploid and hexaploid *Solanum nigrum* were irradiated with 10, 20, 30, 40, 50, 60, and 70 k rad doses of gamma rays in the Radiation Biology Laboratory of the National Botanical Research Institute, Lucknow from a 60 Co source. Irradiated and un-irradiated (control) seeds were sown in the experimental plots. Plants survived up to 40 k rad in the diploid, 50 k rad in tetraploid and 30 k rad in hexaploid. Flowers of different ploidy groups from each treatment, including the control, were fixed in FAA and subsequently stored in 70 per cent ethanol. Photographs of freshly collected materials showing floral variabilities were taken. Microtome sections of flower buds were cut at 10 μm thickness following the paraffin-embedding technique and sections were stained in safranin-fast-green combination.

OBSERVATIONS

The higher doses of gamma irradiation usually resulted in delayed flowering. However, at 10 k rad treatment induction of early flowering was recorded in diploids only. Flowering period, in general, progressively retarded with the increase of dose rates.

Anomalies in floral construction, besides normal flowers, were detected under various doses of treatments ranging from 10 to 40 k rad in diploids, 10 to 50 k rad in tetraploids and 10 to 30 k rad in hexaploids. Floral abnormalities were maximum in tetraploids treated with 50 k rad. Variability in the size of flowers was observed in

 Geophytology, **13**(2) : 180-183, 1983.

many treated plants of all the ploidy groups (Figs. 1, 2, 3). Individual flowers showed frequent modifications in form and number of floral parts. Abnormalities also included modified petal lobes and increase or decrease in the number of petals and stamens (Fig. 4). Fusion of floral parts of varying degrees was seen in a number of cases in all the ploidy groups, but the frequency was maximum in tetraploids at 50 k rad (Fig. 8). Split-petals were observed in several cases of treatments. Flowers with doubling of floral parts were formed in the diploid plants treated with 10 and 20 k rad and in the tetraploids treated with 50 k rad (Figs. 4 & 7). Such cases were not seen in the hexaploids. Cross sections of the pedicels of such flowers showed double the number of vascular strands in comparison to the control (compare Figs. 5, 6). Many flowers of diploid, tetraploid and hexaploid showed zygomorphy (Figs. 1, 2, 3) and the frequency was more in tetraploids of 50 k rad dose treatment.

The androecium normally consisted of five stamens which were equal in size and form in majority of the flowers in various treatments. Variation in the number of stamens per flower ranged between 3 to 10 and percentage of this variability was greater in 40, 50 and 30 k rad in diploid, tetraploid and hexaploid plants, respectively (Table 1).

Table 1. Variation in stamen number in different ploidy groups in relation to treatments.

S.N.	Treatment	Number of stamens		
		Diploid	Tetraploid	Hexaploid
1.	Control	5	5	5
2.	10 k rad	5—10	5—7	5—6
3.	20 ,, ,,	5—10	4—6	5—6
4.	30 ,, ,,	5—7	5—7	5—7
5.	40 ,, ,,	4—7	5—10	——
6.	50 ,, ,,	——	3—10	——

The anthers of the stamens were always longer in comparison to the filaments in all the ploidy groups in control as well as treatments. Taking the anther length into account, it is seen that it increased with the increase of ploidy level in the control (Table 2). In treatments, the anther length decreased over the control at 30 and 40

Table 2. Anther and filament length ratio of different ploidy groups in relation to treatments (measurement in mm).

S.N.	Treatment	Length of anther and filament		
		A F	A F	A F
		Diploid	Tetraploid	Hexaploid
1.	Control	1.5×.5	2.0×1	2.5×1
2.	10 k rad	1.5×.5	2.0×1	2.5×1
3.	20 ,, ,,	1.5×.5	2.0×1	2.5×1
4.	30 ,, ,,	1—1.5×.5	1.5—2×1	2.5×1
5.	40 ,, ,,	1—1.5×.5	1.5—2×1	——
6.	50 ,, ,,	——	1.5—2×1	——

A=Anther; F=Filament

k rads in diploids and at 30, 40 and 50 k rads in tetraploids but at other lower doses it remained at the control level. Hexaploids were unaffected and the proportion of anther/filament length was same in the treatments and the control. The anther and filament length ratio in different ploidy groups in relation to treatments is given in the table 2.

DISCUSSION

Most common floral abnormalities following irradiation are the form, number and fusion of floral parts (GUNCKEL *et al.*, 1953; CHAUHAN, 1969; INDIRA & ABRAHAM, 1977; MATHEW & ABRAHAM, 1978), which have been observed in the present investigation also.

Beside these floral abnormalities, doubling of floral parts due to irradiation has also been seen in some cases during the present investigation. Similar tendency of doubling in floral parts has also been reported by SETHI AND GILL (1969) in barley following E. M. S. and gamma irradiation. According to them, this tendency seems to be physiological rather than genetic in nature. The present authors think that doubling of floral parts is due to fusion of two floral primordia and such flowers were always zygomorphic. Cross sections of the pedicels of such flowers showed nearly double the number of vascular supply in comparison to he control, thus supporting the above idea.

Several arguments have been put forth to explain the causes of floral variabilities as induced by ionizing radiations. Among these, auxin destruction, release of florigen, formation or destruction of an inhibitor or mobilization of materials are considered to be significant.

In *Solanum nigrum* length of stamen filament is always shorter in comparison to the anthers in all the ploidy groups. This relation is constant in control and lower doses of treatments, but in higher doses, the filament and anther length ratio is variable in diploids and tetraploids. However, no variability of anther/filament length ratio was noticed in hexaploids. It seems that under higher doses at low ploidy level the cells giving rise to anther parts are sensitive to radiation, and reduction in length is either due to retardation in growth or cell division. At higher ploidy level (hexaploid), cells of stamen primordia are resistant and have greater tolerance for radiation effect. This is probably the reason that in hexaploids, filament and anther length-ratio remained unaffected.

In general, with the increase of doses flowering was progressively delayed. However, in the present study 10 k rad was found to be stimulatory in diploids only. Also, HASKINS AND MOORE (1935) in *Citrus*, JOHNSON (1948) in *Kalanchoe*, GUNCKEL *et al.*, (1953) in *Tradescantia paludosa*, and SUBASH AND NIZAM (1975) in *Capsicum annuum* reported stimulation in flowering in response to radiation. Early flowering in these plants may be due to early seed germination induced by lower doses of radiation.

ACKNOWLEDGEMENTS

One of us (PSC) is grateful to UPCST for the financial assistance, and to Director, NBRI and Principal, Sri J. N. Degree College for providing facilities.

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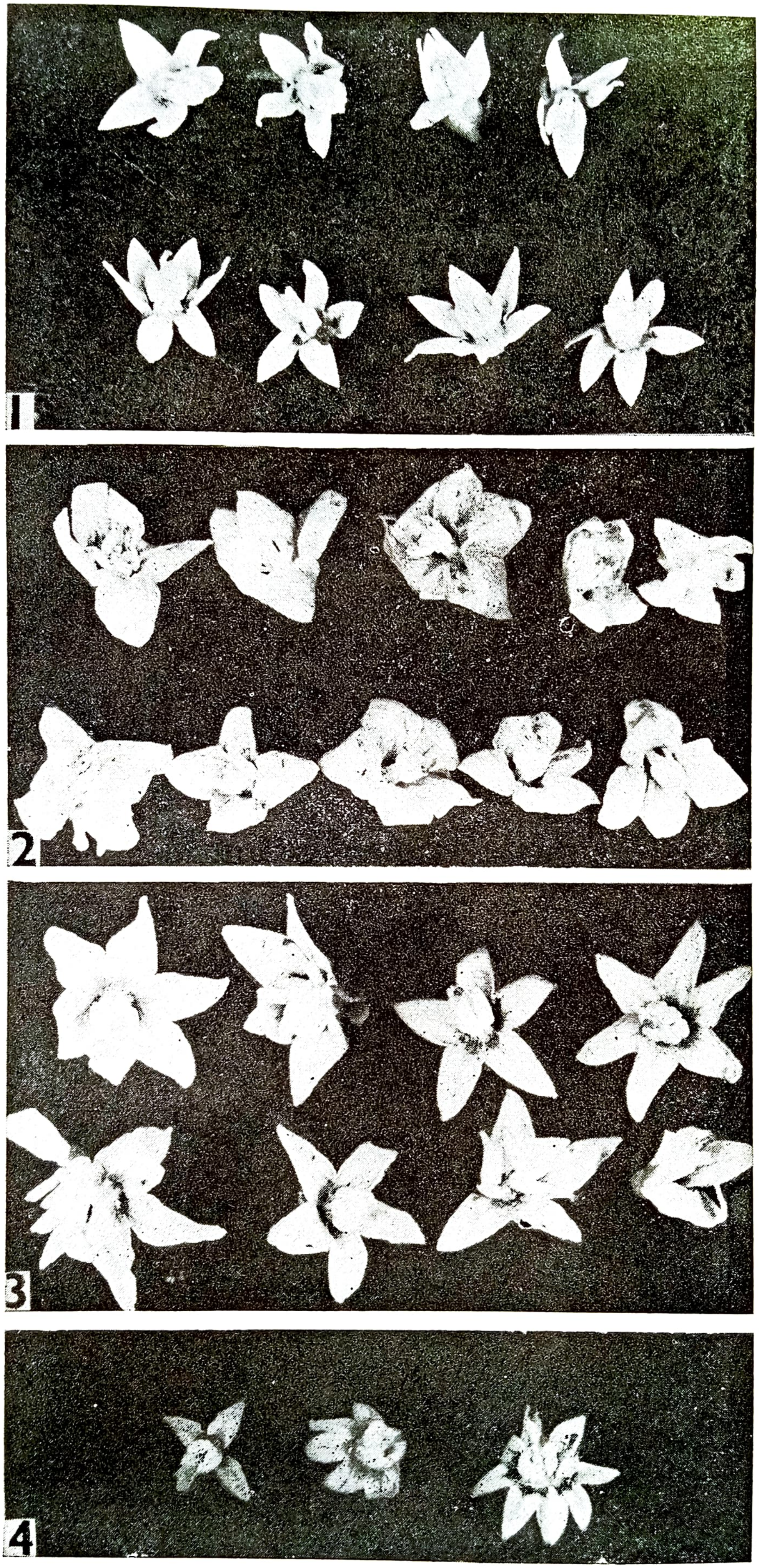
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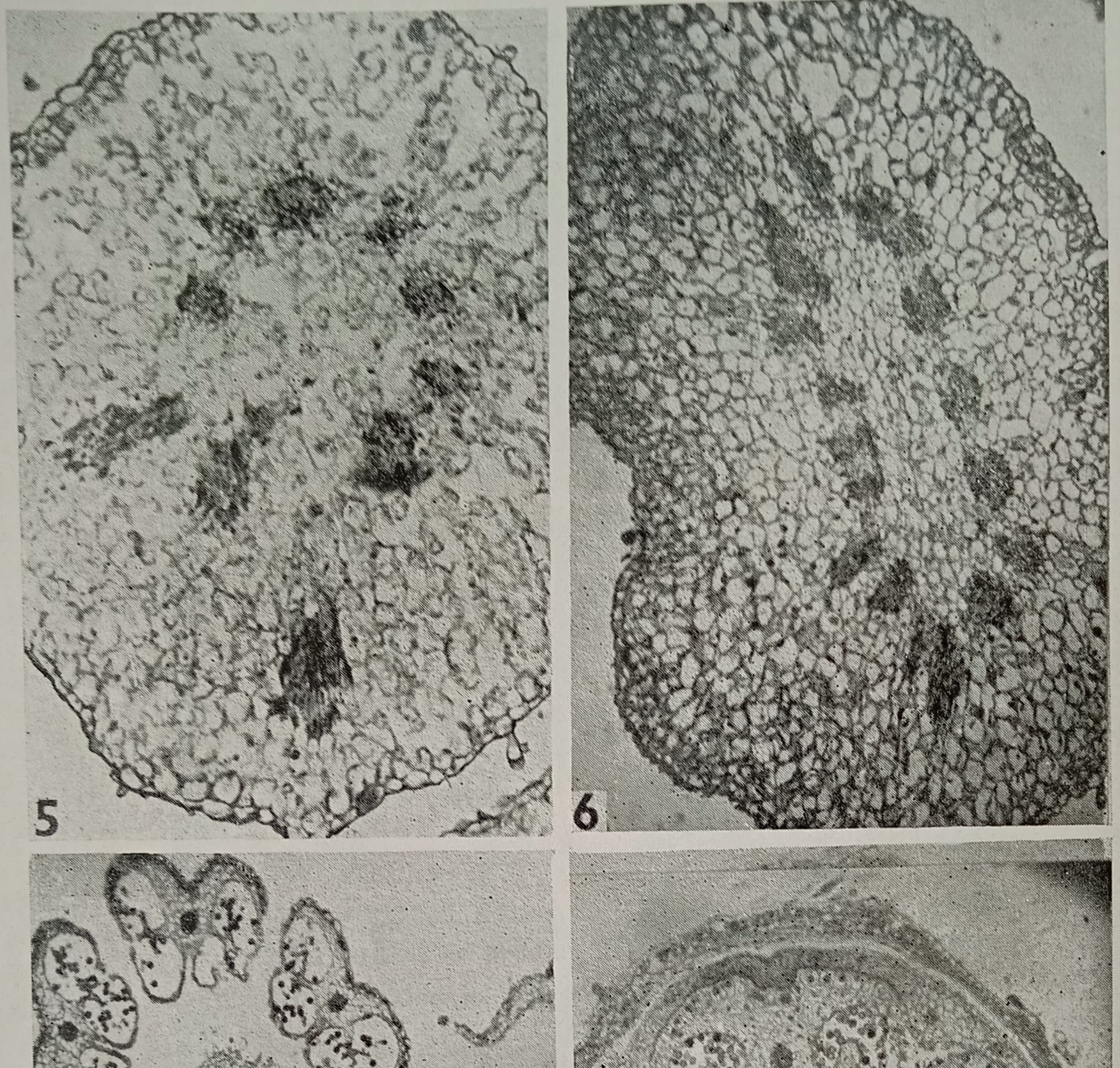
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EXPLANATION OF PLATES

Plate 1

Figures 1-4. Floral anomalies in different ploidy groups observed in various doses of gamma-ray-treatments. 1, deploid; 2, tetraploid; 3, hexaploid; 4, variation in petal number.

Plate 2

Figures 5-8. 5, T.S. pedical of control (tetraploid), × 260; 6, T.S. pedicel of tetraploid (50 k rad) showing double the number of vascular bundles, × 130; 7, T.S. flower bud showing double flower parts, × 58; 8, Fusion of anthers (tetraploid), × 73.