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Occurrence and Significance of Polypetalous Variant in *Phlox drummondii* Hook

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Seeds of yellow and white varieties of *Phlox drummondii* Hook were irradiated with gamma-rays at different doses ranging from 10 to 50 Krad. Germination, survival, pollen fertility and seed setting were studied in M_1 generation alongwith some important chromosomal aberrations. A polypetalous variant was observed at 10 Krad in white variety, showing suppression of meiosis as indicated by mitotic division in PMCs. It may be taken to support the view that Polemoniaceae might have evolved from polypetalous caryophyllaceous stock.

Key Words: Induced mutation, Polypetalous flower in *Phlox*

Introduction

Mutation breeding has been of great help in ornamental breeding. In fact, some type of induced changes usually considered destructive when observed in other plant species might become highly prized in ornamental plants (Sparrow & Konzak 1968). The present study was undertaken to explore the potentiality for the induction of promising variations through gamma-irradiation and also to study the varietal radiosensitivity in *Phlox drummondii* an ornamental of family Polemoniaceae with numerous varieties. So far in literature there is no indication of radiation studies on this plant. In this paper a special emphasis has been given on the irradiation induced polypetalous variant.

Materials and Methods

Dry seeds (moisture content 8%) of yellow and white varieties of *Phlox drummondii* were irradiated at 10,20,30,40 and 50 Krad of Co^{60} gamma rays (dose rate 49 sec/Krad; temperature $19.5 \pm 2.0°C$). Seeds were sown in the usual manner. Germination, survival, pollen fertility and seed setting were studied in M_1 generation. Meiosis was scored in temporary acetocarmine preparations.

Results and Discussion

Germination was better in both the varieties in irradiated seeds. But at 30 Krad a decrease in germination was noted in both.

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The percentage of survival decreased with increase in dose. In white, there was no survival beyond 20 Krad, while in yellow, survival up to 30 Krad was noted. Yellow variety was more radioresistant though germination was better in white variety.

Pollen fertility was found to be directly correlated with dose. As expected, seed setting was inversely correlated with dosage.

Chromosome number of the species is 2n=14 (Mayer 1944). The frequency of chromosome aberrations increased with dosage. Translocations, were noted in 32% and 20% plants of yellow variety at 10 and 20 Krad respectively. In white, they were present in 23, 20 and 66% plants at 10, 20 and 30 Krad respectively. As expected, with increase in multivalent frequency in these translocation heterozygotes, pollen fertility decreased.

Univalent frequency increased with doses in both the varieties. Chromosome clumping at metaphase was observed in a yellow variety plant at 20 Krad.

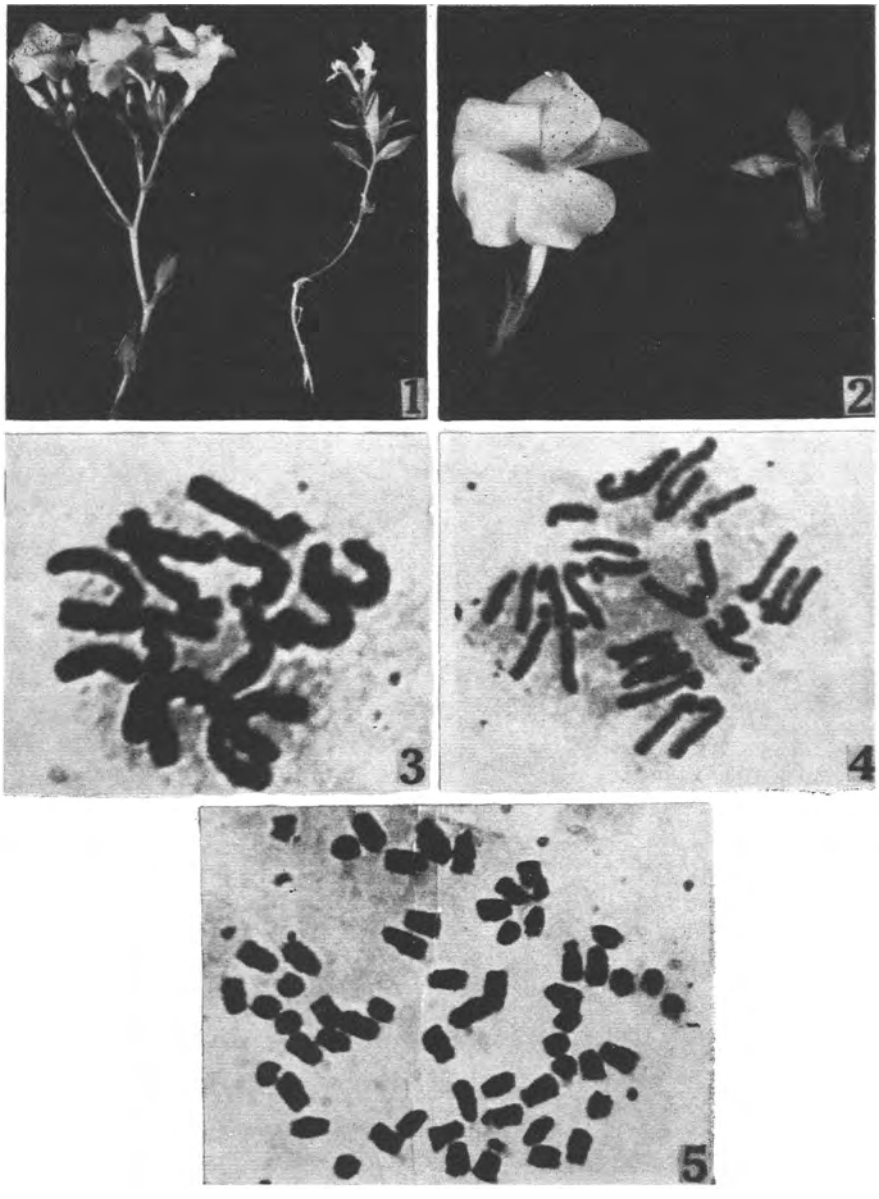
A polypetalous variant was isolated in white variety at 10 Krad. This plant was small, weak and unable to remain erect without support (figure 1). It has only two branches in comparison to about 15 in controls. The leaves were small and narrow. Only five inflorescences each having 4 to 5 flowers were formed as against the normal plant with numerous inflorescences. The flowers were small and petals were narrow and free (figure 2). The corolla tube was missing. The petals (5 to 8) were attached to the thalamus separately. Stamens were epipetalous and usually 5 in number but reduced in size. Gynoecium was normal with a stout style and four long stigmata but the size of the ovary was reduced. The control flowers (figure 2) have 5 petals which form a corolla tube with 5 epipetalous stamens and a gynoecium with slightly long style and short stigmas.

Total suppression of meiosis was displayed by the polypetalous variant in which the chromosome number was 2n=14 (figures 3, 4). The chromosomes in PMCs were similar to somatic ones without pairing. At metaphase they oriented normally on the equator of the spindle (figure 3) followed by normal separation at anaphase (figure 4). This variant displayed total pollen sterility.

Suppression of meiosis was also observed in some PMCs in a plant of yellow variety at 20 Krad. About 15% PMCs displayed clearcut somatic division of chromosomes (figure 5). Such PMCs also displayed variation in chromosome numbers like 14, 28 and 56. Such a situation could arise either due to two somatic divisions without reduction in a normal PMC or single somatic division in a binucleate PMC.

Suppression of division in the sporogenous cells at some stage or the other were cited in *Allium schoenoprasum* (Levan 1936), *Datura* (Satina & Blakeslee 1935) under natural conditions, *Tradescantia* (Sax 1937) under experimentally induced conditions. Joshi and Raghuvanshi (1968) reported the presence of nondividing PMCs in the sporogenous tissue of *Allium tuberosum* and *A. cepa*. Although in *A. tuberosum* and *A. cepa* there was complete suppression of nuclear division during gametogenesis yet transformation of sporogenous tissue into PMC and PMC into pollen grain took place. In the present study nuclear division was not suppressed. Instead of meiosis, the chromosome underwent normal mitotic division but pollen grains were formed. Obviously the genetic mechanism responsible for transformation of the sporogenous tissue into pollen mother cells had not been disturbed.

This polypetalous variant of *Phlox drummondii* throws some light on the phylogeny of its family Polemoniaceae. The



Figures 1–5 *1*, Branch of control plant (left) and polypetalous variant (right); *2*, Flower of control (left) and polypetalous variant (right); *3*, Somatic chromosomes at metaphase in a PMC; *4*, PMC showing somatic chromosomes at anaphase; *5*, PMC showing 56 somatic chromosomes in a plant of yellow variety at 20 Krad

taxonomic and phylogenetic aspect of this family remained perplexing to the botanists. Bessey (1915), derived it from Boraginaceous stock and Hallier (1912) from Linaceae. Hutchinson (1969) derived Polemoniales from the Caryophyllaceous stock on the basis of the similarity between some species of *Phlox*, such as, *P. bifida* Beck and some Caryophyllaceae, such as species of *Silene* and *Lychnis*. He regarded Polemoniaceae to be not in a very advanced stage of sympetaly, as shown by the fact that the stamens were often inserted at unequal height and there was contorted aestivation of corolla. He concluded that a *Phlox* with free petals would have a striking resemblance to some members of the family Caryophyllaceae. The present report of polypetalous variant may well give some support to the view that the Polemoniaceae might have evolved from polypetalous caryophyllaceous stock.

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