THE INDUCTION OF POLYPLOIDY IN PHLOX BY COLCHICINE[1]

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Phlox Drummondi is a diploid species that has been used extensively as an ornamental flowering plant. In this genus 7 is the basic chromosome number for all forms that have been examined cytologically. Most of the species are diploid, but three tetraploid and one triploid species have been reported (Flory 1937). Although *Phlox* has been mentioned in connection with colchicine treatments, the writers do not know of any published description of a colchicine-induced polyploid. The present work was undertaken to observe the response of *Phlox* to colchicine treatment, with the possibility that a form better suited for ornamental purposes and valuable for further experimental studies might be developed.

MATERIALS AND METHODS

By transferring young seedlings from flats where they had been planted in the greenhouse during November 1940, 125 plants of *Phlox Drummondi* were obtained. Fifty of the month-old seedlings were treated by immersing the growing tips in a 0.2 percent aqueous solution of colchicine for 24 hours. Another fifty were treated by spraying the growing parts with an emulsion containing 0.4 percent colchicine (Warmke and Blakeslee 1939). The remaining twenty-five were kept as controls.

Plants were kept in the greenhouse where they began flowering in the early spring. They were later transferred to the field and seed was collected during the summer. Pollen and stomata were examined and Belling's aceto-carmine (45 percent glacial acetic acid saturated with carmine and a trace of iron added) smears of the pollen mother cells made when polyploidy was indicated by morphological characters.

RESULTS

Of the fifty plants treated with the aqueous solution of colchicine, more than half showed effects of the treatment by thickened leaves or distorted growth, indicating the formation of polyploid tissues. Ten of the plants of this group that bloomed had larger stomata (fig. 7) and produced larger pollen grains (fig. 8) than the controls (fig. 5, 6). Several others had large stomata but normal pollen, indicating a periclinal chimera with only the epidermis tetraploid. One plant which produced large pollen had normal stomata. It was probably a periclinal chimera with the epidermis diploid and the tissues from which the pollen was derived tetraploid. Several of the plants had both diploid and tetraploid branches or chimeric branches as well as diploid or tetraploid ones. Of the fifty plants treated by spraying the growing tips with an emulsion containing colchicine,

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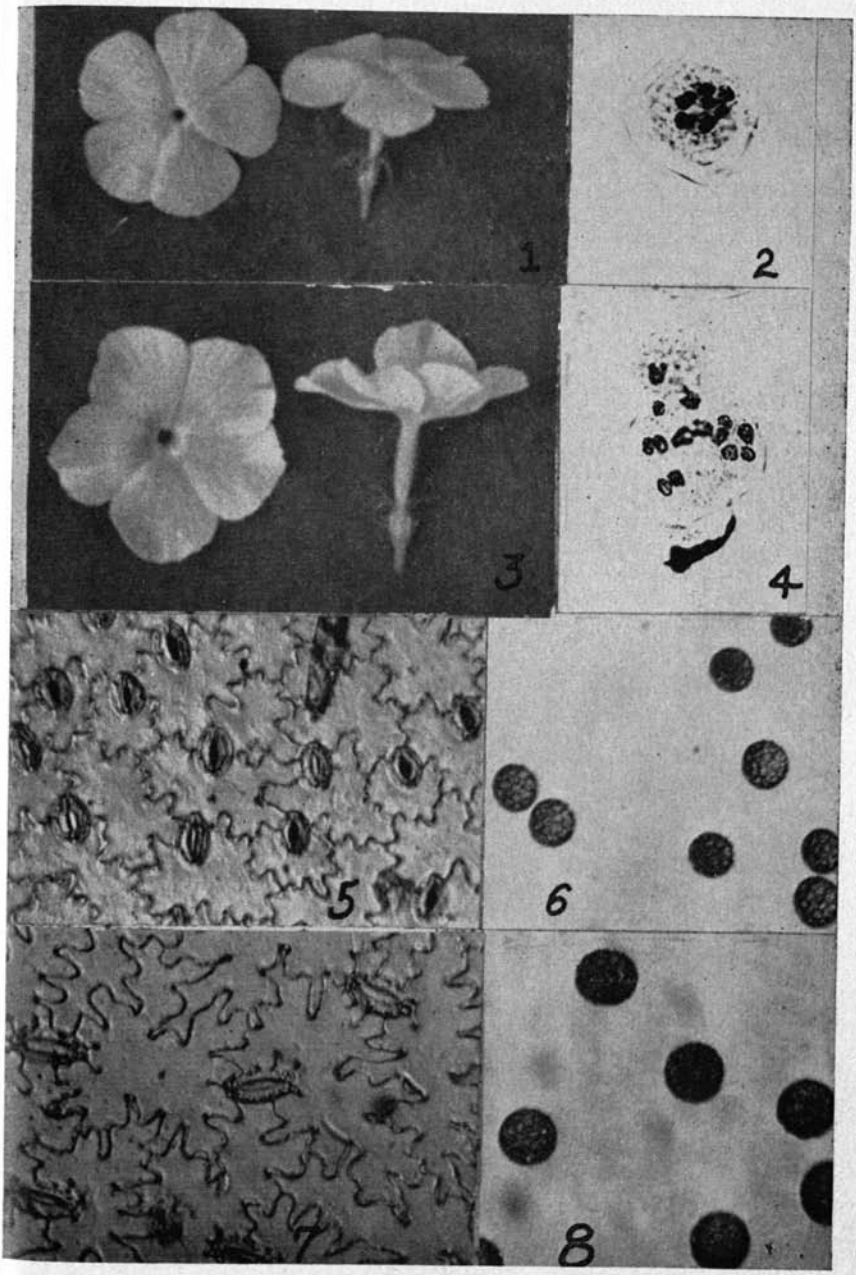
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twenty-four died in a few days and the terminal buds died in the others, further growth being initiated by lateral buds. Only two of these plants that flowered were tetraploid.

The tetraploids as contrasted with the diploids were characterized by larger pollen grains (fig. 6, 8), larger stomata (fig. 5, 7), thicker and broader leaves, larger flowers (fig. 1, 3), larger seed and sturdier branches. The diploid has 14 chromosomes, 7 pairs, forming 7 bivalents at the first meiotic metaphase (fig. 2) and the tetraploid has 28 chromosomes, forming both bivalents and quadrivalents at the first meiotic metaphase (fig. 4). Although no data were taken, the tetraploids appeared less fertile than the diploids. The flowering period, however, was prolonged in the tetraploid plants.

DISCUSSION AND CONCLUSIONS

For *Phlox* the treatment by immersion in an aqueous solution of colchicine proved most effective in inducing polyploidy, the emulsion treatment being too severe for best results. Plants, however, vary in their responses to various concentrations of colchicine as was demonstrated by the writers in treatments of other plants including cotton, *Vinca*, snapdragon, sweet potato, *Datura*, and others. The response of *Phlox* to the colchicine treatment, the low chromosome number, and the ease with which the plants may be grown make it an excellent experimental plant. An increased flower size and a sturdier stem make the tetraploid more desirable as an ornamental plant. Furthermore, decreased fertility in a plant grown primarily for the flowers rather than seed production is desirable since failure to set seed increases the flowering period.

LITERATURE CITED

Flory, W. S. 1937. Chromosome numbers in the Polemoniaceae. Cytologia, Fujii Jubilee Volume: 171-180.

Warmke, H. E. and Blakeslee, A. F. 1939. Induction of simple and multiple polyploidy in *Nicotiana* by colchicine treatment. Jour. of Heredity 30: 418-432.

Fig. 1.—Diploid flower of *Phlox*. × ½.—Fig. 2. Meiotic metaphase, 7 bivalents. × 1000.——Fig. 3. Tetraploid flower of *Phlox*. × ½.—Fig. 4. Meiotic metaphase bivalents and quadrivalents, n = 14. × 1000.— Fig. 5. Diploid epidermis. × 175.—Fig. 6. Diploid pollen. × 450.—Fig. 7. Tetraploid epidermis. × 175.—Fig. 8. Tetraploid pollen. × 450.