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INCOMPATIBILITY REACTIONS DURING THE FLOWERING PERIOD OF SEVERAL PETUNIA CLONES

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SUMMARY

The style length at anthesis and the pollen tube length after self and cross pollination in flowers which were produced throughout the flowering period on three clones containing various combinations (S_1S_2, S_2S_2, S_3S_3) of S alleles were measured. An increase in style length as the flowering period progressed was found in S_2S_2 and S_3S_3 while no change was observed in S_1S_2. In S_3S_3, a decrease in style length was evident very late in the flowering period. Flowering period had little or no effect on the pollen tube length/style length ratio but this ratio was altered markedly by clone and pollination type. Flowering period had little or no effect on the incompatibility reaction expressed by the ratio of incompatible to compatible pollen tube length but this ratio was markedly altered by clone.

1. INTRODUCTION

The incompatibility reaction in higher plants is influenced not only by genetic and environmental factors but also by the physiological condition of the plant itself (EAST 1929, LINSKENS 1955, 1973). At the end of the flowering period, incompatibility matings frequently result in seed production. This phenomenon which was called "pseudofertility" (EAST & PARK 1917) is known as "end-season fertility". Incompatibility can also be overcome during the bud stage of the flower and as a result, bud pollination is a widely-accepted method to obtain self-pollinated seeds.

Growth inhibition of incompatible pollen tubes is directly proportional to the age of the bud with the degree of inhibition gradually increasing with flower maturation (LINSKENS 1964). However, in very mature or old flowers, the degree of inhibition decreases (ASCHER & PELOQUIN 1966). The presence of "end-season fertility" and flower maturation differences in many incompatible genera such as *Petunia* (LINSKENS 1973), *Theobroma* (NAUNDORF 1959) and *Trifolium* (COHEN & LEFFEL 1963) suggests that incompatibility differences may be present during the flowering period of indeterminately flowering species.

The purpose of this study was to determine the style length at anthesis and pollen tube growth after self and cross pollination in flowers which were

* In commemoration of Marinus van der Donk (1919–1976), a devoted and dedicated collaborator for nearly 20 years, who initiated this project before his untimely death.

produced throughout the flowering period on three clones containing various combinations of S alleles. The effect of flowering period on style length, pollen tube length and the incompatibility reaction was examined in detail.

2. MATERIAL AND METHODS

Three plants from each of three clones of *Petunia hybrida* media vulgaris were used. The clones are as follows and will be identified by their genotypes given in parentheses: W166k(S_1S_2); Ka3(S_2S_2); and T2U(S_3S_3). During the complete experiment, all plants were grown under the same greenhouse conditions with supplementary illumination (16 hr/day) supplied by high pressure Philips lamps (Type 57246 G193). At 9.00 hours daily, all flowers at anthesis on each plant in each clone were selfed or cross pollinated. Cross pollinations were made as follows: $S_1S_2 \times S_3$; $S_2S_2 \times S_3$; and $S_3S_3 \times S_1S_2$. All pollinated flowers were removed 24 hours after pollination with style and pollen tube length measurements taken immediately. Pollen tube lengths were obtained using the fluorescence method of LINSKENS & ESSER (1957). The length measurements were averaged for each week; so weekly rather than daily means were used to describe the results.

3. RESULTS

The average style lengths are presented in *fig. 1*. In S_2S_2 and S_3S_3, a substantial increase in length was found as the flowering period progressed with a decrease occurring later in the flowering period in S_3S_3. In S_1S_2, little or no change was observed over the entire flowering period.

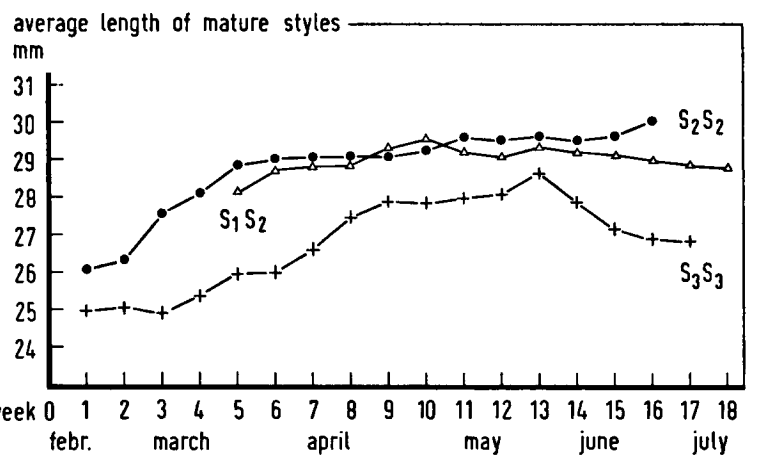

Fig. 1. Length of mature styles as influenced by flowering period and clone.

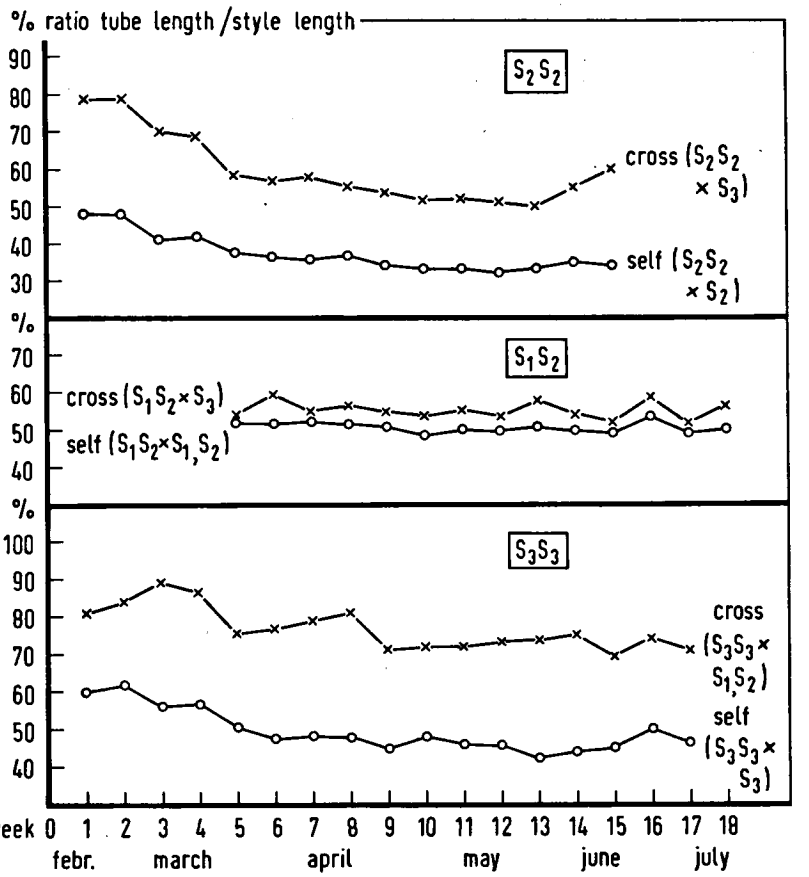

Fig. 2. The ratio of pollen tube length to style length as influenced by flowering period, clone and pollination type.

The ratios of pollen tube length to style length are shown in *fig. 2*. Throughout the flowering period, pronounced differences resulting from clones and pollination types were apparent. In general, the homozygous clones (S_2S_2, S_3S_3) reacted similarly with higher ratios present early in the flowering period after self or cross pollination. In the heterozygous clone (S_1S_2), no substantial differences resulting from flowering period were evident as a result of self or cross pollination.

The intensity of the incompatibility reaction was expressed as the ratio of incompatible pollen tube lengths (*fig. 3*). Generally, flowering period had little or no effect on the intensity of the reaction. However, some minor variation was observed in S_2S_2 and S_3S_3 during the early part of the flowering period. Clones produced the most pronounced effect on inhibition with the greatest degree of inhibition present in the homozygous clones (S_2S_2, S_3S_3). In S_1S_2, the degree of inhibition was very slight.

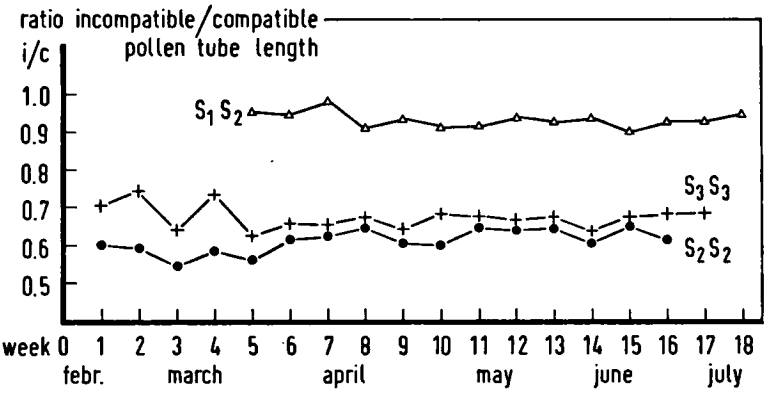

Fig. 3. The ratio of incompatible to compatible pollen tube length as influenced by flowering period and clone.

4. DISCUSSION

The ultimate expression of incompatibility in higher plants is the absence of seed production after self pollination. Since pollen tube growth is the primary controlling factor, pollen tube length is used as an index of the intensity of the incompatibility reaction. However, pollen tube length *per se* is inaccurate if style lengths differ. In this study, clones containing various combinations of S alleles differed considerably in mature style lengths of flowers produced throughout the flowering period. Thus, pollen tube length must be adjusted to style length if valid comparisons of pollen tube lengths are to be made between clones at different times during their flowering periods. The ratio of incompatible to compatible pollen tube length is also used as an index of the intensity of the incompatibility reaction. This ratio was also altered by clone but only slightly by flowering period.

It is apparent that a large number of interacting factors influence the incompatibility reaction. The major genetic factor is the pollen grain-style interaction involving the alleles at the S locus. However, other loci which control the expression of various morphological and physiological characteristics during the life cycle contribute to the reaction. Style length and physiological condition during the flowering period are probably influenced by loci other than the S locus. Therefore, the results of this study clearly indicate that, in the design of experiments and the interpretation of results, the interactions associated with the S locus, loci other than the S locus and environment must be minimized or at least carefully considered.

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