Short Communication

Aust. J. Bot., 1977, **25**, 567–70

Reversible Curvature of Style Branches of *Hibiscus trionum* L., a Pollination Mechanism

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Abstract

Hibiscus trionum, like several other members of the Malvaceae, has flowers with prominent styles which can reflex during the first few hours after opening so that stigmas make contact with the anthers. This self-pollination mechanism can be interrupted if stigmas are pollinated before or during bending. They then maintain or regain the erect position and selfing cannot occur. Various treatments which can affect this reversal of bending are described.

Introduction

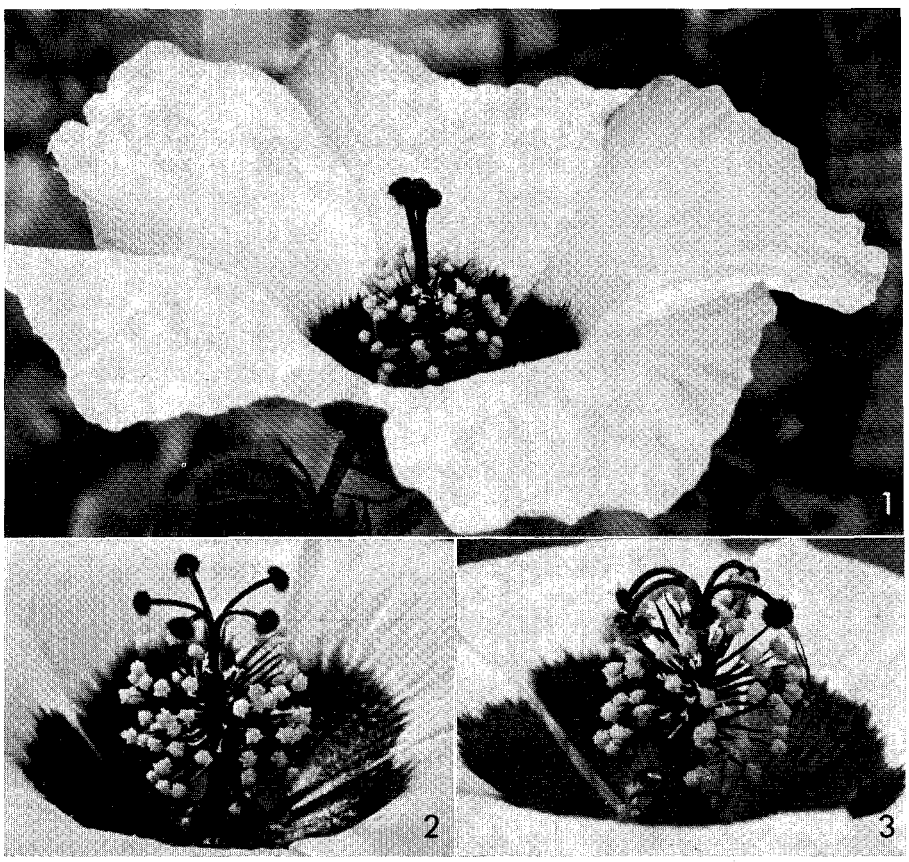
Many species in the family Malvaceae have flowers with prominent styles and a large proportion of these are branched. In many cases the style branches become reflexed so that the stigmas come into contact with dehisced anthers. References to this self-pollination phenomenon occur in botanical literature (for example, Rendle 1925; Vasil and Johri 1964), and illustrations in floras and related literature frequently show it, but the mechanism itself does not appear to have been given much study. A related curvature has been reported for the stigmatic lobes of the sunflower, *Helianthus annuus* L. (Free 1970). We have observed this style bending in *Hibiscus trionum* L., *Lavatera plebeia* Sims., *Sida petrophila* F. Muell., *Pavonia hastata* Cav., *Abutilon fraseri* Hook. and *Malva parviflora* L. It is especially well illustrated by *Hibiscus trionum*, a low annual plant which occurs widespread in arid areas, and as a weed in settled areas, of Australia. This species is native to Australia, as well as to Asia and Africa. We report here some studies aimed at understanding the mechanism of this curvature and its control.

Methods

A clone of 50 plants of *H. trionum* was established by rooting cuttings from one parent plant raised from seed collected near the Stuart Highway in the far north of South Australia. All observations reported were from this clone. Plants were grown in a glasshouse in 15-cm pots containing U.C. soil mix C and supplied at 2-week intervals with a commercial aqueous fertilizer. Certain treatments are set out in Fig. 4, and for each treatment five replicate flowers were selected. Almost invariably results were uniform between replicates; when not, the treatment was repeated. Experiments were done on bright clear days in early December. Washed pollen was obtained by shaking fresh pollen in distilled water for 1 min, and heated pollen by holding fresh pollen in an incubator at 60°C for 30 min.

Results

Flowers of *H. trionum* opened early in the day with the five style branches erect and the stigma lobes in mutual contact (Fig. 1). Under our glasshouse conditions, and also out of doors, when no pollination occurred, the style branches began to reflex by mid morning so that at noon the curvature was *c.* 90° (Fig. 2), and at mid afternoon it approached 180°, thereby bringing the stigma lobes into contact with the anthers (Fig. 3). During non-summer months when the temperature did not exceed 25°C we observed that the style branches could re-straighten after self-pollination so that by late afternoon they were once more erect. Petals closed and withered during the afternoon.



Figs. 1–3. Style branches photographed at 0900 hours (Fig. 1), 1200 hours (Fig. 2) and 1700 hours (Fig. 3).

Certain responses are set out in Fig. 4. If the stigma lobes were heavily pollinated at 0900 hours, the style branches did not bend, and application of pollen to only one stigma lobe was sufficient to keep all style branches erect. A minimum of somewhere between 10 and 30 pollen grains was required; below this minimum the speed and degree of bending was evidently related to the number of pollen grains. Pollen stored for 24 hr at room temperature was effective in preventing pollination, but older pollen was ineffective. Washed pollen and heated pollen were also ineffective.

Whereas pollination of less than five stigma lobes at 0900 hours gave total inhibition of bending, pollination of progressively less than five stigma lobes at noon resulted in progressively less recovery to the erect position by late afternoon. Emasculation did not affect the rate of bending compared with control unpollinated flowers.

Other experiments showed that application of sucrose and application of pollen washings to stigmas, and excision of stigma lobes, did not prevent curvature of style branches. Also if the style was excised at its base and maintained on damp filter paper in a closed dish, the style branches bent as on the intact flower. If the stigma lobes were excised from an excised style, bending was reduced.

We have also applied pollen from seven species in the Malvaceae, which were available in the glasshouse, to stigmas of *H. trionum*. In excess of 100 grains were applied to each lobe. Pollen from *Alyogyne hakeifolia* (Giord.), *Gossypium sturtianum* Willis., *Hibiscus diversifolius* Jacq. and *Hibiscus cannabinus* L., delayed and reduced the bending response as much as when 10 pollen grains from *H. trionum* itself were applied to each stigma lobe, as in Fig. 4. Pollen from *Lavatera plebeia, Sida petrophila* and *Hibiscus rosa-sinensis* L. had no effect.

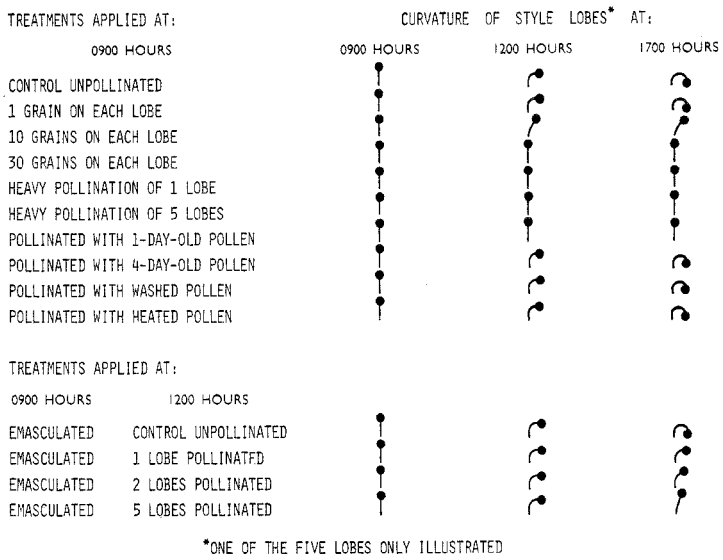


Fig. 4. Effect of different treatments on curvature of style branches. Self- and cross-pollination were equally effective. In every case all five branches acted in unison.

Discussion

The results suggest that inhibition of curvature of the style branches is controlled from the stigma lobes and that it can be counteracted quantitatively and beyond a threshold absolutely if sufficient pollen germinates on the stigma or if sufficient pollen tubes start to grow into the style. The counteracting agent must be readily translocated, because the style branches react in unison.

The significance of the reversible curvature can be differently interpreted. Vasil and Johri (1964) in noting curvature in style branches of *Pavonia zeylanica* Cav. concluded that the plants are self-pollinated and at first sight this appears to be a

mechanism to ensure selfing. A different interpretation, based upon our studies, is that the phenomenon is a mechanism giving first preference to outcrossing but facilitating selfing if outcrossing fails. If flowers are cross-pollinated early in the day no attempt is made to self-pollinate; and if cross-pollination is effected during curvature the curvature is reversed so that selfing will not occur. As yet we have not been able to ascertain whether the pollinator in field plants is avian or insect.

Acknowledgment

The National Research Council of Canada provided a Sabbatical Travel Grant to J. N. A. Lott.

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Manuscript received 12 May 1977