Kinetin Removes Self-incompatibility Reaction in Detached Styles of *Lilium longiflorum* Thunb.[1]

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Abstract. **Injection of 100 or 200 ppm 6-furfurylaminopurine (kinetin) into detached *Lilium longiflorum* (Easter lily) styles before pollination removed the differential pollen tube growth attributable to the self-incompatibility reaction so that both compatible and incompatible pollen tubes reached lengths typical of compatible tubes. Prepollination injections of 50 ppm kinetin produced variable results while injection of 1 or 10 ppm kinetin had no effect on pollen tube growth.**

Self incompatibility is an ubiquitous means for the insurance of outbreeding in perfect-flowered Angiosperms. Although both male and female gametes function in matings with other individuals within the species, plants bearing a self-incompatibility system fail to produce seed when self pollinated or mated with certain closely related individuals. About 3000 species encompassing 250 genera and 70 families have been reported to contain some type of self incompatibility (9). In plants with the gametophytic self-incompatibility system, a single gene *(S)* with multiple alleles, prevents normal function of the male gametophyte whenever the *S* allele in the haploid pollen grain matches one of the two *S* alleles in the diploid style. The *S* gene exerts itself in detached *L. longiflorum* styles by limiting incompatible (self) pollen tube growth to about half that of compatible (cross) tubes in 48 hr at 22°C (2). Compatible pollen tubes continue growing in Easter lily styles and eventually reach the ovary while incompatible tubes grow ever more slowly and rarely traverse the entire length of the style before floral and ovular senescence. Easter lily cultivars Ace and Nellie White are self incompatible but cross captible.

One method used to achieve seed set following incompatible pollination of some self-incompatible species in the application of plant growth regulators or hormones such as α-naphthalene acetic acid or indoleacetic acid (IAA) to the exterior of the anther column, corolla, or calyx to prevent floral abscission and induce fruit development (3, 4, 6, 7, 10). Matsubara obtained similar results by applying cytokinin in lanolin externally to lily styles or ovaries (8). The question posed by the success of these techniques is whether the plant growth regulators or hormones in any way affect the self-incompatibility reaction in its control of pollen tube growth or merely maintain ovules receptive for fertilization by slow growing (incompatible) pollen tubes and promote seed development by preventing fruit abscission. Our research indicates that aqueous solutions of kinetin injected into detached *L. longiflorum* styles just before pollination effectively remove the self-incompatibility reaction as determined by differential pollen tube growth (Table 1).

Water placed into the hollow lily style before pollination does not affect subsequent pollen tube growth and thereby serves as a carrier of exogenous materials into the pollen-tube environment *in vivo* (1). We injected aqueous solutions of kinetin into styles immediately before pollination, 1 day after anthesis, and incubated the styles 48 hr at 22°C. About 50 μl of solution fills the hollow lily style. (Solutions were made by autoclaving 10 mg kinetin in 50 ml glass redistilled water (200 ppm) at 121°C for 20 min and diluting, and were used when cooled.) After incubation, we injected aqueous ainiline blue into the style to stain the pollen tubes, bisected the style with a razor blade, and measured the longest pollen tube in each half style to the nearest mm using a dissecting microscope. Half-style values formed subsamples in a completely random experimental design with 4 replications.

In another series of experiments we applied kinetin at 200 ppm to 'Nellie White' styles 1 day before, at, or 1 or 2 days after anthesis to determine whether kinetin affected styles differently through the stylar maturation period. It did not. Pollen tube growth after compatible or incompatible pollination of treated styles, although consistently less, was not significantly different from growth in non-treated compatibly-pollinated styles except 1-day post-anthesis treatment (Table 2). The length of incompatible pollen tubes in styles treated 1-day post anthesis was unusually short in this experiment (see Table 1, 'Nellie White').

The effect of kinetin injected into detached *L. longiflorum* styles on the self-incompatibility reaction reported here differs completely from the results we observed in applying IAA to lily styles by the same method (5). Injection of IAA at 100 ppm before pollination had no significant effect on compatible or incompatible pollen tube growth, while 500 ppm significantly retarded compatible tube growth without affecting incompatible tube growth, and 1000 ppm reduced compatible tube growth to lengths not significantly different from those of incompatible pollen tubes in treated or non-treated styles. Although application of either kinetin or auxin to the exterior of flowers functionally surmounts

Table 2. Pollen tube growth in *L. longiflorum* 'Nellie White' styles treated prior to, at, or following anthesis by prepollination injection with water or with 200 ppm kinetin in water.

Treatment	Days before or after anthesis	Length of pollen tubes (mm) 48 hr after pollination: Incompatible	Compatible
Check	−1	49.0ab[z]	84.4de
Kinetin	−1	80.4de	81.5de
Check	0	56.8abc	85.4e
Kinetin	0	72.9de	81.4de
Check	+1	43.5a	85.6e
Kinetin	+1	69.1cd	77.2de
Check	+2	54.4ab	83.1de
Kinetin	+2	70.8de	79.1de

[z]Mean separation by Duncan's multiple range test, 1% level.

Table 1. Pollen tube growth in detached styles of *Lilium longiflorum* injected immediately before pollination with various aqueous solutions of kinetin.

Kinetin (ppm)	Length of pollen tubes (mm) in 'Nellie White' styles: Incompatible ('Nellie White')	Compatible ('Ace')	Length of pollen tubes (mm) in 'Ace' styles: Incompatible ('Ace')	Compatible ('Nellie White')
0 (check)	59.2a[z]	88.9b	44.4a	92.2c
50	77.9b	87.0b	69.5b	89.6c
100	79.5b	92.6b	93.1c	88.9c
200	83.6b	82.5b	77.9bc	89.9c

[z]Mean separation within cultivars by Duncan's multiple range test, 1% level.

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self-incompatibility in that seeds can be recovered following incompatible pollinations, only kinetin overcomes the self-incompatibility reaction when applied to the pollen tube environment.

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Floral Stalk Topple: A Disorder of *Hyacinthus orientalis* L. and Its Control[1]

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Abstract. **Floral stalk topple, a disorder of greenhouse-forced hyacinths was investigated using 'Pink Pearl', a non-topple type, and 'Blue Giant', topple-prone type. The total floral stalk of 'Blue Giant' was longer than 'Pink Pearl'. The ratio of the scape to inflorescence of 'Pink Pearl' was 1.0 while that of 'Blue Giant' was 1.8. Anatomical sections revealed that 'Pink Pearl' had shorter and narrower pith cells in the scape than 'Blue Giant'. The cellular arrangement of the pith and cortex showed that, in contrast to 'Blue Giant', those of 'Pink Pearl' were tightly interwoven with very few intercellular spaces. Soil drenches of ancymidol at 2 or 4 mg/15 cm pot reduced the incidence of stem topple in 'Blue Giant'. Ancymidol modified cell sizes and shapes and reduced the floral stalk length and scape to inflorescence ratio. It appears that floral stalk topple is related both to the anatomical structure of the cultivar and its floral stalk characteristics.**

Hyacinth cultivars vary with regard to the strength of the floral stalks in greenhouse culture (3). Hyacinths which have strong scapes tend to remain in vertical positions. Those which have weak stems bend just above the nose of the bulb as the inflorescence fully opens (Fig. 1). We propose the name Floral stalk topple (FST) for this disorder. This disorder is not described in the texts by Rees (9) or Schenk (10). FST is not similar to the spitting disorder (1, 2). When FST occurs in commercial greenhouses, the hyacinths require artificial support which adds to the production costs.

Fig. 1. Floral stalk topple of 'Blue Giant' hyacinth.

Because FST has both academic and commercial interest, this study was carried out in 2 parts. First, the basic anatomical and growth characteristics in a topple-prone cultivar ('Blue Giant') and a non-topple cultivar ('Pink Pearl') were determined. Second, since ancymidol reduces the plant height of tulips (6, 11) and lilies (4, 5, 8), studies were carried out to determine if ancymidol could inhibit FST.

'Blue Giant' and 'Pink Pearl' bulbs (17-18 cm) of the 1972 harvest season arriving on Sept. 29, were stored in ventilated trays at 13-17°C. On Nov. 27, 90 bulbs (3 per 15 cm pot) of each cultivar were planted in a sterilized planting medium of 1 soil:1 sand:1 peat (v/v). They were subsequently programmed (3) under moist conditions at 9°C for 6 weeks, 5° for 7 weeks and 1.5° for 1 week. On March 8, 1973, the pots were divided into 3 equal treatments and placed in a completely randomized design in a 17-19° greenhouse. The treatments were: (a) water control, (b) soil drench with ancymidol 2 mg a.i./pot, and (c) soil drench with ancymidol 4 mg a.i./pot. Ancymidol was applied in 100 ml of water per pot on greenhouse day 1. The plants were subsequently watered in a routine greenhouse manner.

Samples were taken for microscopic examinations and for growth measurements on greenhouse days 1, 8, 11, and 15. The microscopic sections were prepared as described by Galun et al. (7).

The floral stalk of the hyacinth is composed of 2 segments (Fig. 1). The lowermost segment is a leafless scape and the uppermost portion is a multiflowered inflorscence. The florets open acropetally.

Although 'Blue Giant' was longer than 'Pink Pearl', the basic growth pattern of the floral stalk of both cultivars in greenhouse culture was similar (Table 1). The entire floral stalk elongated quite slowly for the first 8 days and then increased rapidly until anthesis of the upper most floret which occurred on greenhouse day 15. No cell divisions were observed during the development of the floral stalk in the greenhouse.

Although data are not presented, we observed that the growth of the inflorescence ceased at the time of anthesis of the uppermost floret. On the other hand, the scape continued to elongate until the florets senesced. The growth pattern of the leaves was similar to that of the scape.

In this study, FST occurred with 'Blue Giant', never with 'Pink Pearl'. With 'Blue Giant', 100% of the water controls exhibited FST, while ancymidol at 2 and 4 mg produced 50

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