Feminization of Male Flowers of *Cannabis sativa* L. by a Morphactin

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The dioecious nature of *Cannabis sativa* can be altered by environmental conditions and plant hormones [1] and by Ethrel (2-chloroethanephosphonic acid) [2]. Morphactins have been shown to modify significantly the morphology of plant organs. We became interested in studying the effects of morphactin on the developmental morphology of *C. sativa* flowers.

Seedlings of *C. sativa* were raised in earthen pots. They flowered 8 weeks after germination and their sex was determined. Preliminary studies showed that female plants were unaffected by morphactin treatment, and only male plants showed characteristic responses. Most studies were, therefore, conducted using male plants. Sixty male plants were selected for treatment and the number of vegetative and floral nodes were recorded for each. Morphactin IT 3456 (methyl-2-chloro-9-hydroxy-fluorene-(9)-carboxylate) was applied in one foliar spray at three concentrations (100, 250 and 500 ppm) till the point of run off. Triton X-114 at 0.1% was used as wetting agent. Forty-five male plants received morphactin and 15 only

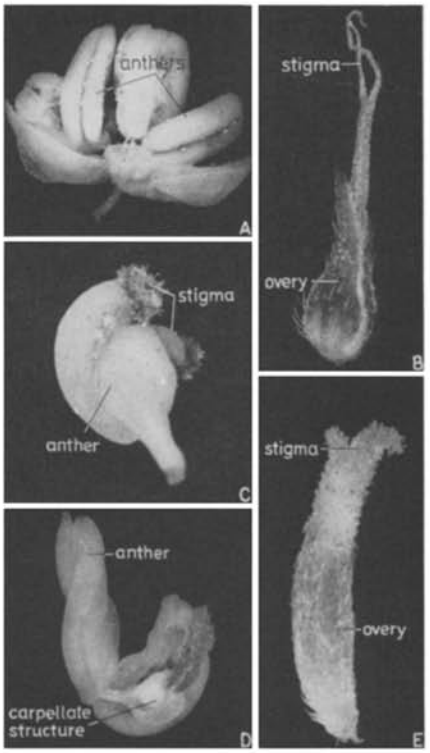

Fig. 1. A Normal male flower with 5 stamens (×6.5). B Normal female flower with bifid stigma (×7.5). C, D and E Flowers from morphactin treated male plants showing stages of feminization. In C the two stamens are bearing stigmatic structures at the apex (×6.5). D shows a stamen which has become modified into a carpellate structure (×7.5). E A stage showing complete feminization of flower (×10.5). (In Fig. 1 B and E read „ovary" instead of „overy")

the wetting agent (controls). All plants were kept under natural conditions obtaining in Delhi during February to July (1970). Morphological changes and flower sex were recorded at weekly intervals.

All treatments caused inrolling and epinasty of old leaves within 3 days of spray, but recovery was noted after 3 weeks. Leaves which developed subsequent to treatment were thicker, coarser and more intensely green than those of controls. Morphactin injured the main shoot tip and promoted vigorous growth of the laterals. The latter bore abnormal leaves; the majority were funnel-shaped and a few were 2- or 3-lobed with entire margin.

The flowers which were present (Fig. 1 A) at the time of spraying dried up and occasionally abscised. New flowers appeared after 3 weeks in plants treated with morphactin at 100 ppm. In these, the perianth became gamophyllous and the stamens joined to form a cup-like structure. Occasionally, fusion of two flowers was noted.

Flowering was delayed by 2 weeks in plants treated with 250 and 500 ppm of morphactin. The newly formed flowers showed fasciation of floral parts and different levels of feminization. The number of stamens varied from 1 to 5. In a few flowers some of the stamens became transformed into carpellate structures (Fig. 1C, D). In many other flowers stamens failed to differentiate and in their place an ovary with a terminal bifid stigma was observed. This condition represented the extreme degree of feminization caused by morphactin treatment (compare Fig. 1E with B). Whereas the plants which received morphactin spray at 100 or 250 ppm started bearing normal leaves and male flowers after 6 weeks of treatment, those treated with 500 ppm remained stunted in growth and produced only abnormal flowers.

Work to elucidate the mechanism of action of morphactin is in progress.

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