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Sex Chromosomes of *Cannabis sativa*

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## SUMMARY

Excised buds of *Pisum* cultured in White's nutrient solution continue to grow in the dark for periods of several weeks. They therefore offer an opportunity to determine effects of auxins exerted directly on buds.

Indole-3-acetic acid was added to the nutrient solutions in concentrations from 0.0006 to 10.0 mg./l. All but the lowest concentrations inhibited the growth of the buds very markedly during the first few days after application. The inhibition obtained during this time was reversible and was not due to toxicity.

The weak and also the stronger solutions perhaps caused a subsequent stimulation of growth if the buds were transferred from the latter to plain nutrient solutions after short periods, but if the buds were kept in solutions higher than 0.1 mg./l., they

remained shorter than the controls for the duration of the experiments.

Further experiments with *Pisum* seedlings and other evidence are presented which indicate that auxin applied to stems also must reach the lateral buds to inhibit their growth.

It is concluded that even though the inhibiting action be not explainable in terms of concentrations alone, indoleacetic acid can inhibit growth directly in buds; and that whether or not the effectiveness of auxin in correlative inhibition is influenced by an effect on translocation of nutrients or by other factors, auxins applied to decapitated stems probably generally exert an inhibiting action in the lateral buds.

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SEX CHROMOSOMES OF CANNABIS SATIVA<sup>1</sup>

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CANNABIS SATIVA was reported by Strasburger (1909, 1910) to have no sex chromosomes. He showed the haploid number to be 10, the somatic number 20. McPhee (1924) likewise found no sex chromosomes. Working with two Japanese varieties of hemp, Hirata (1924, 1929) observed an unequal pair of chromosomes in the metaphases of the heterotypic division in pollen mother cells. Since no unequal pair was found in the female, but instead an equal pair slightly larger than the other chromosomes, he assumed this large pair in the female to be an XX and the unequal pair in the male XY. The presence of an unequal pair in *Cannabis* was con-

firmed by Sinotô (1928, 1929). Driga (cited by Hoffmann, 1938), investigating a large number of races, found in the male an unpaired three-parted chromosome together with a two-parted chromosome.

Sex chromosomes have not been clearly distinguished in somatic cells. Breslawetz (1932) saw, in somatic divisions in the root tip, one large chromosome which she named the X and another with a median constriction which was smaller than the X but larger than the other chromosomes; this she identified as the Y.

In view of the discrepancy between the observations of Strasburger and McPhee on the one hand, and those of Hirata and Sinotô on the other, it has been suggested by various writers (e.g., Hoffmann, 1938) that varieties of hemp may differ in that some possess and some lack sex chromosomes. Because of

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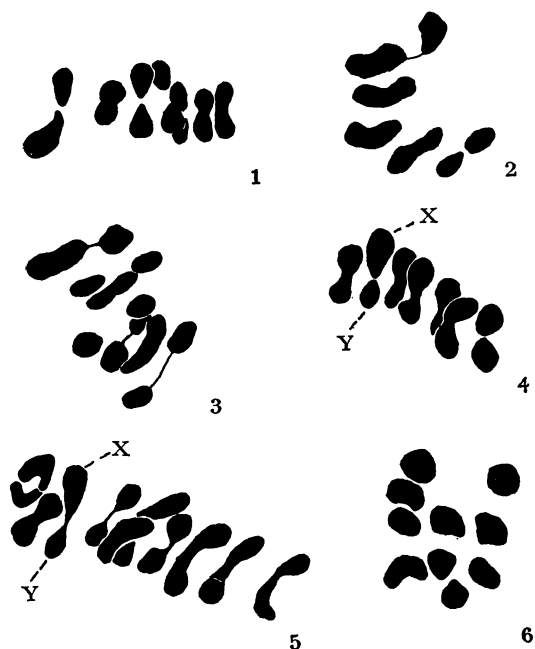


Fig. 1-6. *Cannabis sativa*.—Fig. 1-5. Lateral views of meta-anaphases of the first meiotic division of pollen mother cells. XY pair of unequal size.—Fig. 5. Acetocarmine preparation showing unequal pair.—Fig. 6. Polar view of metaphase showing  $n = 10$ .—Fig. 1-4, 6,  $\times 3650$ . Fig. 5,  $\times 3000$ .

this uncertainty, and particularly since no report has appeared of the occurrence of an XY pair in

American races, it seemed worth while to undertake the study reported in the present paper.

Material of staminate buds was fixed from two different wild stands of hemp in or near Madison, Wisconsin, and from one cultivated variety which was obtained from Professor A. H. Wright of the Agronomy Department of the University of Wisconsin. In favorable lateral views of the metaphases and anaphases of the first meiotic division in pollen mother cells of plants from each location, an unequal pair of chromosomes was very evident (fig. 1-5). Ten pairs of chromosomes are present, as described by the earlier workers already cited. Nine pairs are similar in size, each being composed of equal members. The tenth pair (XY) consists of one chromosome of about the same size as the members of the other nine pairs, and one much larger chromosome.

It is evident that this unequal pair is the sex chromosome pair. From the number of varieties from various parts of the world now known to possess an XY pair it is highly probable that this condition prevails in all varieties of *Cannabis sativa*.

#### SUMMARY

An unequal (XY) pair of sex chromosomes is present in staminate plants of probably all varieties of *Cannabis sativa*.

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