A NOTE ON THE DETERMINATION OF SEX OF PLANTAIN FLOWERS

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(With Two Text-figures)

A LARGE amount of work has been done in the present century on the causes underlying sex determination in animals and dioecious plants, but what determines sex of different flowers in a monoecious flowering plant has not received so much attention. Compared with the vast amount of literature bearing on the former question, only a few references can be traced dealing with the latter aspect of sex differentiation, such as the works of Fugii (1895) on *Pinus densiflora*, Schaffner (1921) on *Zea* and *Typha*, Pastrana (1932) on *Begonia Schmidtiana* and Matzke (1938) on *B. semperflorens*. Fugii and Schaffner emphasize the action of nourishment and other environmental factors in the determination of sex, while according to Pastrana even the differentiation of male and female flowers in the monoecious *B. Schmidtiana* is controlled by a chromosomal difference. "The sporophyte has 13 chromosomes. One is unpaired and is absent from the staminate flower, which consequently has 12 chromosomes in contrast to the female flower with 13 chromosomes. The unpaired chromosome is probably concerned with the determination of sex. It fails to enter the stem initial from which the male flower is developed." The critical stages in the actual loss of a chromosome, however, have not been figured by the author. Matzke finds that in *B. semperflorens* well nourished plants are more strongly pistillate in their expression, while those grown in sand and poorly nourished are more strongly staminate. The sex, according to him, "is determined in part by the inherited limits within which its expression may vary. If these limits are narrow, environment has little effect on its expression; if these limits are wide, the environment is of marked importance. In *B. semperflorens* the environment is significant."

In the present note are described some simple experiments performed for determining the cause of sex variation in the flowers of *Musa paradisiaca* Linn. (the plantain). The species of *Musa* are very suitable for this purpose, because the differentiation of sex has not progressed very far in them. Both the male and the female flowers have all the parts.

Only in the male the ovules are abortive and in the female flowers the stamens are abortive. The flowers are thus only functionally unisexual, and their study can throw considerable light on the origin of unisexual from bisexual flowers.

Observations

As is well known, the plantain flowers are borne in a large decurved subterminal spike. As the spike develops, it first produces female flowers in the axils of large red spathaceous bracts. The ovaries of these flowers develop parthenocarpically into fruits, while the other parts and the bracts wither and fall off after a short time. When the spike has been producing female flowers for some time, it begins to produce male flowers. These along with the bracts in the axil of which they appear are only subpersistent, and after remaining on the spike for a short time fall off, leaving behind the naked axis of the spike. The parts of the spike thus producing female and male flowers can be distinguished at any time. This is clear from Fig. 1, which is a photograph of a normal spike of plantain. In the upper part are visible the female flowers now developed into fruits. Below this is the naked axis from which male flowers have fallen off. At the lower end is the unexpanded portion of the spike which will normally produce more male flowers, because a spike when it has once begun to produce male flowers will continue to do so and will produce no more female flowers.

In the experiments performed during the course of the present investigation female flowers were removed at various stages of development and their effect on the formation of subsequent flowers was studied. It was found that when female flowers are removed as they begin to develop into fruits and fruits are not allowed to develop, the formation of male flowers is mostly suppressed and all the flowers continue to develop into fruits. When male flowers have begun to be formed, so that the inflorescence has reached the condition shown in Fig. 1, and the fruits are removed from the upper end, the sex of those which have still to unfold is affected. Instead of developing into male flowers, they develop into female flowers and form fruits just like the flowers at the upper end of the inflorescence. Fig. 2 illustrates such an inflorescence. In this case three groups of fruits are seen. These had developed as follows. When the male flowers had begun to be formed for the first time, some fruits were removed from the upper end. This led to the development of the second group of fruits. Below this male flowers again began to appear. More fruits were now removed from the upper

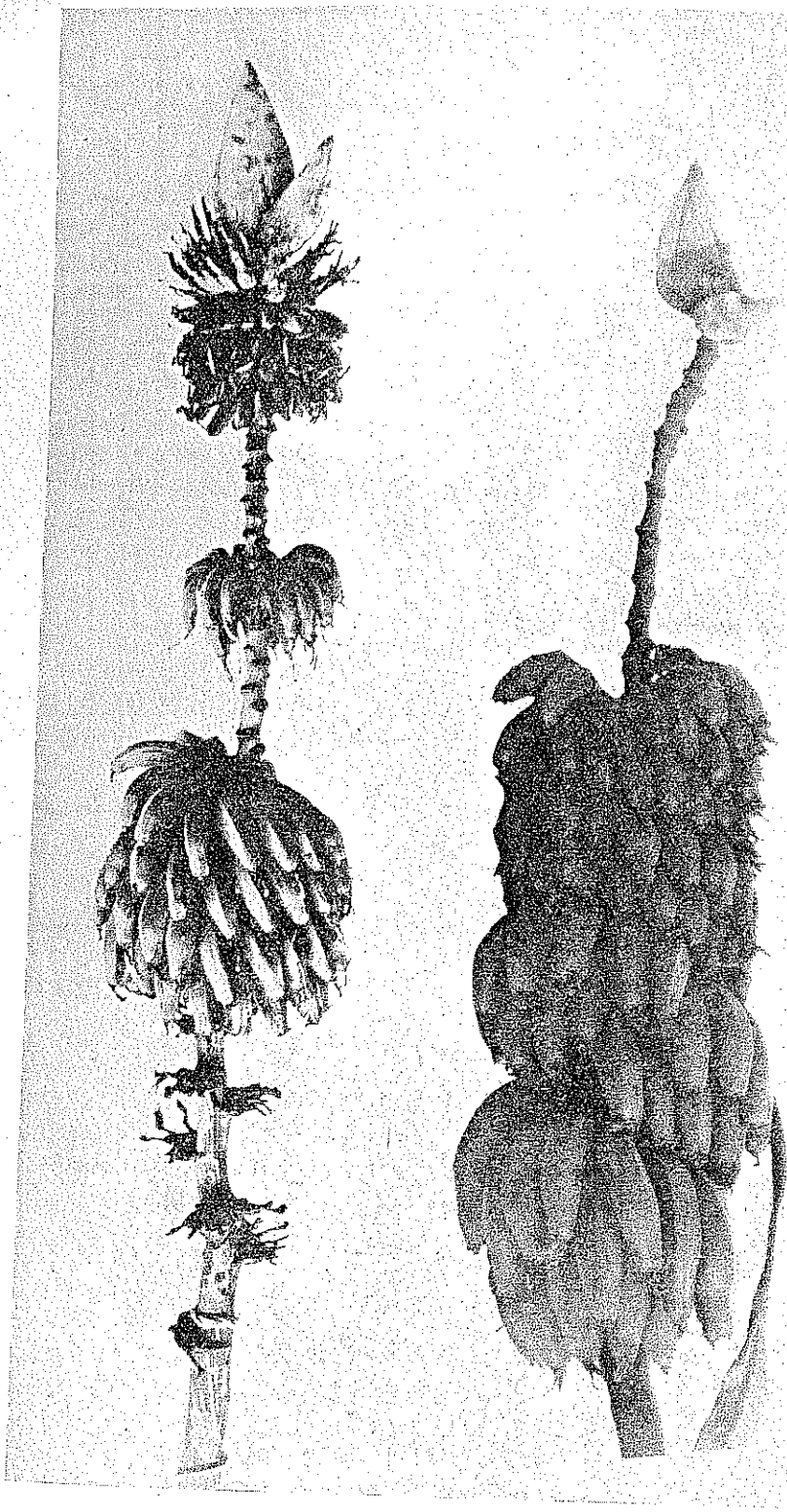

Fig. 1.

Fig. 2.

Fig.1. A normal inflorescence.

Fig. 2. An inflorescence from which fruits had been removed from the upper end on two occasions and which has consequently developed three groups of fruits. Fig. 1, × about 1/6; Fig. 2, × about 1/10.

Both the figures are from *Musa paradisiaca* Linn.

end. This again led to the transformation of some potentially male flowers into female flowers and the development of the third group of fruits. Thus whenever developing fruits were removed from the upper end, female flowers and fruits were formed from the potentially male flowers. The mechanism of this may be explained somewhat as follows. When fruits begin to develop, they draw a large amount of nourishment from the plant. The plant consequently becomes exhausted and the flowers at the distal end of the spike do not receive much nourishment. The pistils of these flowers abort and they develop into male flowers. By removing some of the fruits, some of the nourishment which would have been used up by these fruits becomes available for other flowers. These, therefore, develop into female flowers and fruits.

Conclusion

The sex of the flowers of plantain depends upon the amount of nourishment available. When there is plenty of nourishment, female flowers and fruits are formed. When the plants are exhausted and only a small amount of nourishment is available for the growing flowers, the latter differentiate as male flowers.

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