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FLOWERING BEHAVIOUR, CYTOLOGY, AND POLLEN GERMINATION IN GINGER (*ZINGIBER OFFICINALE* ROSC.)

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ABSTRACT

The flowers of *Zingiber officinale* are trimerous, with an attractive labellum, a single fertile stamen, and an inferior ovary with many ovules on an axile placentum. The ovule is anatropus and bitegmic.

Meiosis was highly irregular. Only 37% of the pollen grains was stainable in acetocarmine. Maximum germination observed in an artificial medium was only 14.5 %.

INTRODUCTION

Zingiber officinale, the ginger of commerce, belongs to the family Zingiberaceae, order Scitaminae (Hooker, 1894). The plant is a perennial herb, bearing many sessile tubers and leafy stems. Its reported chromosome numbers are $2n=22$ (Morinaga et al., 1929; Raghavan and Venkatasubban, 1943; Chakravarti, 1952) and $2n=22+2f$ (Darlington and Janaki Ammal, 1945).

Hooker (1894) described ginger as a species very rarely flowering and never setting seeds. We are not aware of any reports on seed setting, or positive results on pollen germination in ginger. This paper describes results on the floral biology, cytology, and pollen germination studies carried out by us.

MATERIALS AND METHODS

Of the 35 germplasm collections maintained in the Institute, all except six flowered. For, meiotic studies, flower buds from the emerging inflorescences of three accessions (W. Local, W. Kunnamangalam, and Peechi) were fixed in Carnoy's fixative between 10 AM and 12 noon. Squash preparations were obtained in acetocarmine. Pollen sterility was estimated by stainability in acetocarmine. Pollen measurements were computed using an ocular micrometer.

In vitro studies of pollen germination were carried out in the accession Bangkok with 27 combinations of artificial media (3 concentrations each of 3 chemicals (sucrose, agar, and gelatin), both in moist chamber (26.5°C) and air conditioned room (25°C).

OBSERVATIONS AND DISCUSSION

The floral structure as well as the meiotic behaviour were similar in all the three types. Flowering started in the last week of October and lasted till early December, the peak being in November. The flower starts opening in the afternoon by about 3 PM. Anthesis also takes place simultaneously. The flowers are trimerous, borne in panicles directly arising from the rhizome. Terminal spikes are also frequently observed. The flower is characterised by a

three lobed labellum, a single 2-lobed fertile stamen, and an inferior, tricarpellary syncarpous ovary. There are many ovules in an axile placentum. The ovule is bitegmic and anatropus. Style, passing through the two lobes of the fertile anther, comes above in such a manner that the stigma remains just above the anther lobes. This floral structure manifests an adaptation suitable for entomophily. Being self incompatible (East, 1940; Fryxell, 1957), allogamy must be expected in ginger. The failure of seed set in ginger may be due to any reasons ranging from defects in micro or megasporogenesis to lack of suitable pollinating agents.

In the present study, only 46.6% PMCs showed 11 IIs (Fig. 1), the rest showing univalents (12.2%), trivalents (12.2%), quadrivalents (9.4%) (Fig. 2), clumping (8.1%), and extra fragments (12.2%) (Fig.3). Of the sporads, 55% were aberrant with 1 (0.1%), 2 (43.5%), 3 (0.4%), 5 (9.3%), 6 (1.7%), 7 or 8 (0.3%) spores (Fig. 4). This high percentage of meiotic irregularities naturally can lead to high percentage of pollen sterility. The stainability of pollen in acetocarmine was only 35%. The pollen grains were heteromorphic, and round with a very thick exine. The diameter of the pollen varied from 77-104μ with an average of 91μ. A striking feature of the pollen grains was the very thick exine (Fig. 5). This exine broke up by the addition of boric acid. Of the different media tried, the medium constituting 8% sucrose, 3% gelatin, and 60 ppm boric acid gave the maximum germination of 14.5% (Fig. 6).

From the above observations, it appears that the failure of fruit set in ginger may not be chromosomal as suggested by Ramachandran (1969. This may be either due to the failure of pollen germination on the stigma, or to incompatibility, if the ovule is viable. This needs further investigations.

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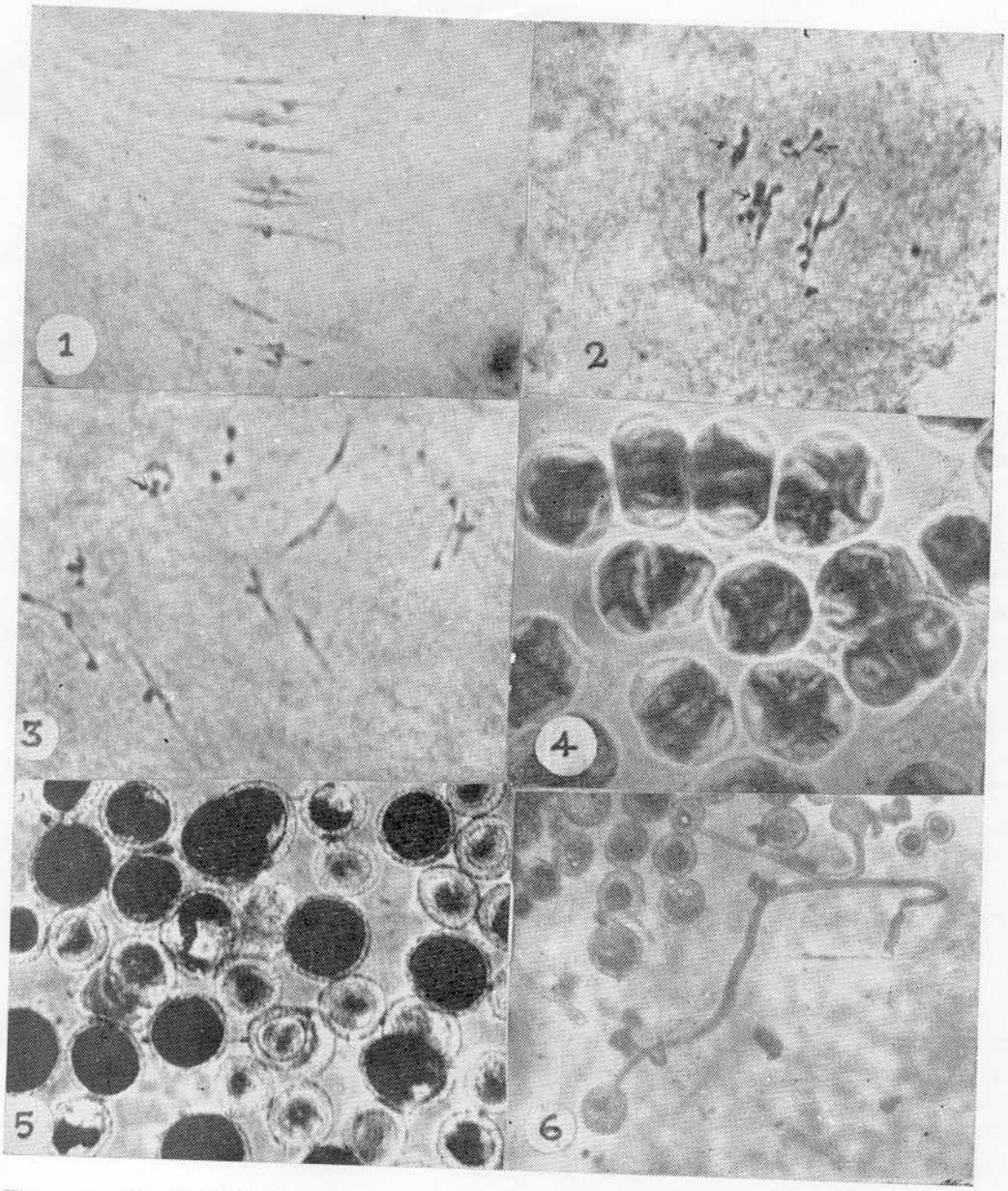

Fig. 1. A cell with 11 bivalents. Fig. 2. A cell with 5 bivalents, 2 trivalents, 1 quadrivalent and fragment. Fig. 3. A cell with 11 bivalents and 2 extra fragments. Fig. 4. Diads and tetrads. Fig. 5. Pollen grains. Note the size difference. Fig. 6. Pollen tube growth in artificial media.