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HERMAPHRODITISM IN THE RUBBER TREE *Hevea brasiliensis* (Willd. ex Adr. de Juss.) Müell. Arg.

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ABSTRACT

The aim of this work was to obtain information about the reproductive biology of *Hevea brasiliensis* (Willd. ex Adr. de Juss.) Müell. Arg. The internal organization of the flowers of 13 clones of the species (GT 711, PR 107, Fx 25, AVROS 1328, RRIM 526, RRIM 600, Tjir 1, Tjir 16, IAC 1, IAC 2, IAN 2652, IAN 2813 and PB 86) was studied by analyzing the histological sections of flower buds. Among female flowers 25.8% were hermaphrodites (in clones GT 711, Tjir 16, PR 107 and AVROS 1328). There was evidence of protandry and cleistogamy in *H. brasiliensis*.

INTRODUCTION

Rubber trees |*Hevea brasiliensis* (Willd. ex Adr. de Juss.) Müell. Arg.| are monoecious and normally have unisexual flowers grouped in inflorescences (Bouychou, 1963; Compagnon, 1986). The inflorescences have up to 3000 flowers, with a mean proportion of one female to six male flowers (Bouychou, 1963).

In general, flowers are from 3.5 to 8.0 mm long, the male flower being smaller than the female. Clones vary in flower form and color. The female flower has an ovary formed by three carpels welded into one sessile stigma. Each carpel delimits a locule containing only one ovule. The male flower has 10 sessile stamens arranged in two verticils, with five stamens each.

MATERIAL AND METHODS

Thirteen clones of *H. brasiliensis* (Willd. ex Adr. de Juss.) Müell. Arg. were studied, namely: GT 711, PR 107, AVROS 1328, Fx 25, RRIM 526, RRIM 600, Tjir 1, Tjir 16, IAC 1, IAC 2, IAN 2652, IAN 2813 and PB 86. Closed floral buds from 30-year old rubber trees of the Instituto Agronômico de Campinas were studied.

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Flower buds were fixed in Carnoy (3:1 absolute ethyl alcohol/glacial acetic acid) and stored in 70% alcohol under refrigeration. They were mounted in parafin blocks, sectioned and stained with Heidenhein's ferric hematoxilin.

RESULTS AND DISCUSSION

Male flowers

The typical structure of the male rubber tree flowers was observed in all the clones studied in the present work, except in some flowers of clone PR 107 in which six stamens occurred (instead of five) (Figure 1) and of clone AVROS 1328, where six locules were observed (and not four) (Figure 2). No female structures were found in the male flowers.

Female flowers

Female flowers with a typical structure of *H. brasiliensis* were observed in all the analysed clones, though in some clones there were female flowers with abnormalities.

Tetraloculated ovaries (Figure 3) were found in clones GT 711, RRIM 526, AVROS 1328 and PR 107. Alterations in carpel number is the most common anomaly in *Hevea* (Bouychou, 1963).

Two flowers were found, one in clone GT 711 and the other in RRIM 526 with two ovules in the same locule (Figure 4).

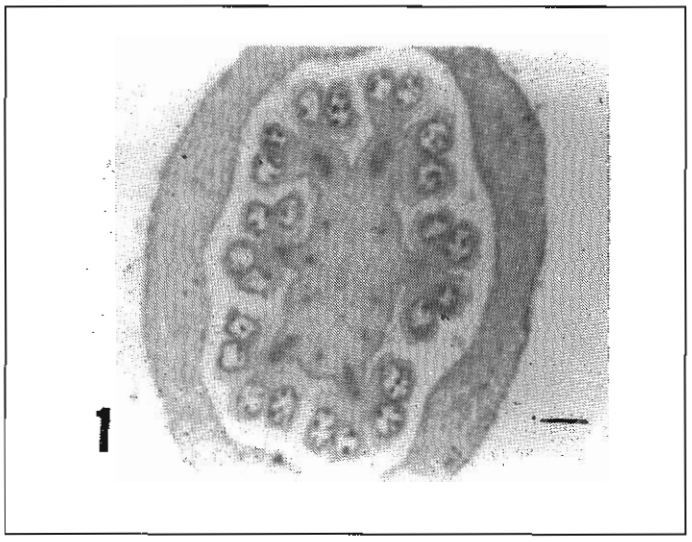

Figure 1 - Male flower of PR 107 with six anthers. Bars correspond to 150 µm, except for Figure 4 where they correspond to 20 µm.

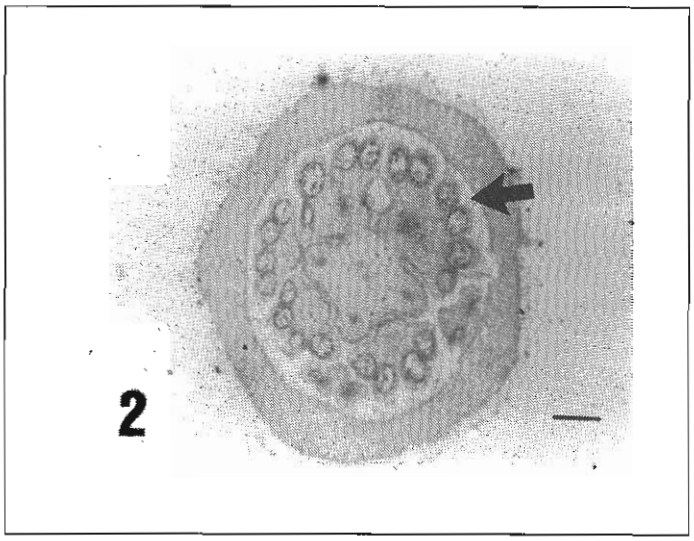

Figure 2 - Male flower of AVROS 1328 with one of the anthers having six locules (arrow).

Hermaphrodite flowers

Among the flowers analyzed in the clones GT 711, AVROS 1328, PR 107 and Tjir 16,25.8% showed hermaphroditism (Figures 3 and 5). It was impossible to distinguish by sight a female flower from a hermaphrodite one because externally both have the same morphology.

A previous study (Bouychou, 1963) found hermaphroditism to be much rarer. In two clones, Fx 25 and RRIM 526, the analyzed flowers were always exclusively of one sex and in the rest (RRIM 600, Tjir 1, IAC 1, IAC 2, IAN 2652, IAN 2813 and PB 86) there was no evidence of hermaphroditism.

In the majority of the hermaphroditic flowers, the pollen grains were already mature or in post-meiotic differentiation while the embrionic sac mother cells (ESMC), in most of the cases, still were in prophase I of meiosis. In rare cases meiosis occurred simultaneously in ESMC and PMCs (pollen mother cells). Only one case was seen where the embrionic sac was already formed while the PMCs were in metaphase I. Therefore there is evidence of protandry in the rubber tree, or rather, the pollen is produced before the oosphere in the hermaphroditic flowers.

As all the floral buds were studied before anthesis, and in many cases the pollen grains were already mature and the ESMC were still developing, there is evidence that cleistogamy occurs in the hermaphroditic flower, in other words, that pollination occurs before the opening of the flower. Sedgley and Attanayake (1988) afirm that there is a mechanism of autoincompatibility in the rubber tree which acts in the ovary, but it is not known whether it is pre- or post-zygotic.

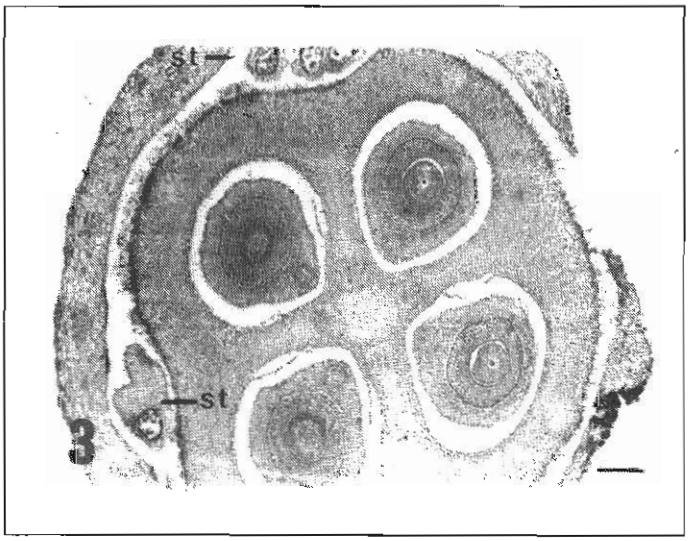

Figure 3 - Hermaphrodite flower of GT 711 in cross section with tetraloculated ovary and stamens (st) with mature pollen grains.

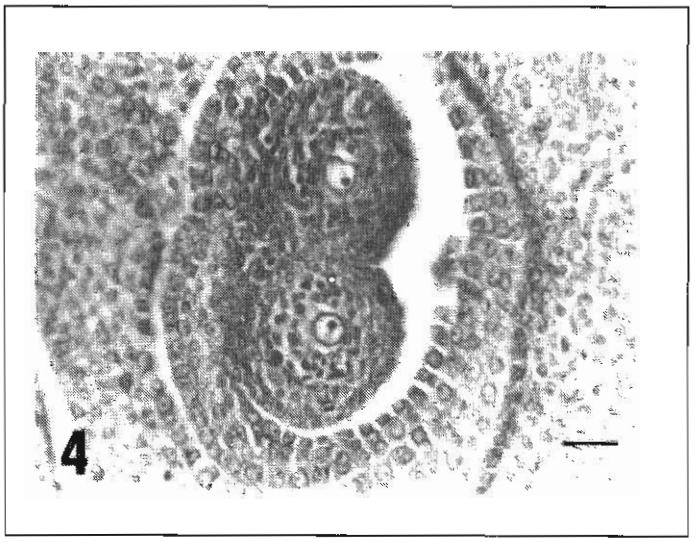

Figure 4 - Cross section of female flower showing two ovules in the same locule, in clone RRIM 526.

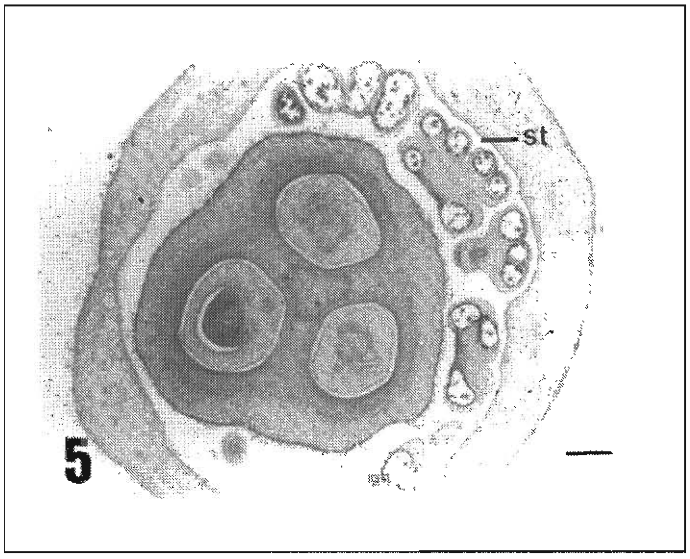

Figure 5 - Cross section of hermaphrodite flower with a tri-loculated ovary surrounded by stamens (st), with mature pollen grains. Clone Tjir 16.

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RESUMO

O objetivo do trabalho foi o de obter informações sobre a biologia reprodutiva de *Hevea brasiliensis* (Willd. ex Adr. de Juss.) Müell. Arg. Através da análise de cortes histológicos de botões florais em vários estádios de desenvolvimento foi realizado um estudo da organização interna das flores de 13 clones da espécie (GT 711, PR 107, AVROS 1328, Fx 25, RRIM 526, RRIM 600, Tjir 1, Tjir 16, IAC 1, IAC 2, IAN 2652, IAN 2813 e PB 86). Dentre as flores masculinas observaram-se sempre as estruturas típicas, com poucas exceções. Do total de flores femininas analisadas a maioria apresentou as estruturas características mas, surpreendentemente, 25,8% delas foram hermafroditas (nos clones GT 711, PR 107, AVROS 1328 e Tjir 16). Os resultados mostraram evidências de ocorrência de protandria e cleistogamia em *H. brasiliensis*, cuja importância é discutida.

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