

## PRELIMINARY OBSERVATIONS ON FLOWERING, POLLEN GERMINATION AND FRUIT-SET IN *HEVEA* SPECIES

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### ABSTRACT

*The low fruit set following hand pollinations is a hindrance to rapid progress in Hevea breeding. Observations were made on flowering time, its effect on pollen germination and on fruit set, in an attempt to solve this problem. Increased pollen germination of the pollen collected after anthesis and higher fruit set from the pollinations after anthesis were observed in this preliminary work.*

### INTRODUCTION

The low fruit set resulting from hand pollination programmes of *Hevea* hinders the progress of *Hevea* breeding. The Rubber Research Institute of Malaysia (RRIM) claims that the average percentage fruit set is 3% for the first flowering season and 8% for the second flowering season for the period from 1969 to 1980 (Ghandhimathi Harihar and H. V. Yeang 1984). In Sri Lanka it is always below 3%. In this paper we present the preliminary observations made during 1984 and 1985, on the time of flowering, its effect on pollen germination and fruit set following hand pollination.

### MATERIALS AND METHODS

#### Flowering

Three species of *Hevea*, *Hevea brasiliensis* cultivar K. H. 440, *Hevea spruceana*, *Hevea nitida* were observed from November to December in 1984 to study the time of anthesis.

Both male and female flowers were observed at hourly intervals during the day until all the flowers of the selected inflorescences opened.

#### Pollen germination

An experiment was carried out to study the germination of pollen collected before and after the opening of the male flowers. Pollen samples from the clone K. H. 440 of *Hevea brasiliensis* were collected before anthesis at 9.30 a.m., 11.30 a.m. and after anthesis at 1.30 p.m. and 2.30 p.m.

Pollen germination was done using a solution containing 15% sucrose, 0.06% calcium nitrate and 0.04% boric acid as described by Samaranayake *et al* (1979). Pollen

was dusted with a camel hair brush on to the medium contained in the concavities of double cavity glass slides. Four concavities were prepared for each sample collected at four different times of the day. Four counts of 100 pollen grains per concavity were made to estimate percentage pollen germination. This observation was repeated on 5 days. Mean germination percentage over all four counts and over all 5 days for each treatment was used in the analysis.

#### **Effect on pollination before and after anthesis**

This experiment was carried out at Eladuwa State Plantation in the flowering season of 1985 in an experimental area planted in 1979 south west monsoon season.

##### **(a) Pollination before anthesis :**

In the conventional method, hand pollination is done in the morning before 11.00 a.m. using male and female flowers still unopened but due to open on the same day afternoon. Therefore in the conventional method, pollination is done before the anthesis of flowers.

##### **(b) Pollination after anthesis :**

Female flowers of the selected mother trees and male flowers of the male parent which were due to open in the afternoon of the same day were bagged in the morning. After opening of the female flowers, they were pollinated using anther columns of opened male flowers. Pollinated female flowers were kept bagged for 3 days to prevent natural cross pollination.

A crossing programme based on a statistical design was not possible as the flowering of trees in this experimental area was sparse and staggered. Due to this reason it was possible to study only one cross.

The cross used for this trial was PB 86  $\times$  RRIC 102, of *Hevea brasiliensis* using PB 86 as the female parent. Equal number of pollinations from each treatment per pollinator per day was carried out. Total number of 450 pollinations was done for each treatment. Two months after the pollination, observations were made on the number of fruit set in each treatment.

Field observations made during 1985 flowering season indicated that in PB 86 and RRIC 102 flowers opened in the afternoon as in the case of KH 440.

## **RESULTS AND DISCUSSION**

### **Flowering**

*Hevea nitida* began its flowering (opening of flowers) in the morning reaching the peak around the 0900 h and almost completed before noon. *Hevea brasiliensis* and *Hevea spruceana* flowering began in the afternoon and peak flowering occurred between 1200 h and 1500 h as shown in Table 1.

Table 1. Percentage flowering at observed time intervals

SPECIES	SEX TYPE	TIME INTERVAL (In hours)										
		06—07	07—08	08—09	09—10	10—11	11—12	12—13	13—14	14—15	15—16	16—06
<i>H. brasiliensis</i>	♂	0.0	0.0	0.0	0.0	0.0	0.0	15.23	46.74	34.92	2.01	1.10
	♀	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.04	43.7	35.56	3.7
<i>H. nitida</i> <sup>o</sup>	♂	0.0	26.7	59.0	7.6	1.9	0.95	2.9	0.0	0.0	0.0	0.0
	♀	0.0	26.7	59.0	7.6	1.9	0.95	2.9	0.0	0.0	0.0	0.0
<i>H. spruceana</i>	♂	0.2	0.0	0.0	0.0	0.0	0.0	9.0	50.5	19.0	6.5	14.8
	♀	3.3	1.1	0.0	0.0	0.0	0.0	0.0	1.1	29.3	34.8	30.4

♂ — Male

♀ — Female

\* Average over male and female count is given since the number of flowers in the observed inflorescences were few.

Opening of male flowers began earlier than the female flowers in all observed species as is apparent in Table 1.

### **Pollen germination**

The germination percentages relevant to different times of pollen collection were transformed to inverse sine (Table 2a) and subjected to an analysis of variance. The results of the analysis of variance (ANOVA) are presented in Table 2b. Observed mean germination percentages (untransformed) and transformed means are given in Table 2c

From Table 2b it is seen that there is a significant difference in germination between the pollen collected in the morning (before anthesis) and in the afternoon (after anthesis). But there are no significant differences between 9.30 a.m. and 11.30 a.m. and between 1.30 p.m. and 2.30 p.m. with respect to percentage of pollen germination.

### **Effect of pollination before and after anthesis**

Table 3 shows the number of pods observed 2 months after pollination for the two methods of pollinations, *viz.* before and after anthesis of flowers. Data when analysed using chi-square test for homogeneity of binomial samples showed that fruit set from the pollinations after anthesis was significantly higher than the fruit set from the pollinations before anthesis (Table 3).

Pollen used for the pollinations before anthesis was collected from unopened male flowers around 7.00 a.m. where as pollen used for the pollinations after anthesis was from opened male flowers collected around 1.30 p.m. In the study, on pollen germination, it was observed that the pollen collected from opened male flowers gives a higher percentage of germination. This increased germination ability of the pollen collected after anthesis may be one of the contributory factors for the higher fruit set in the treatment in which pollination was done after anthesis. Another factor may be that the stigma of the just opened female flower are more receptive to the incoming pollen than the stigma of unopened female flower.

However, more detailed studies are required to confirm these findings before any alteration to the present hand pollination technique is made.

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*Table 2 a. Mean germination percentages transformed for statistical comparisons*

Time of pollen collection	DAYS				
	1	2	3	4	5
9.30 a.m.	12.84	14.40	1.43	16.89	7.42
11.30 a.m.	19.65	4.05	21.08	14.10	20.96
1.30 p.m.	24.16	16.30	19.25	—	—
2.30 p.m.	23.82	27.10	18.91	27.62	20.21

*Table 2 b. Anova of percentage germination of pollen collected at different times of the day*

Source	d.f.	m.s.	F
Morning Vs Afternoon (9.30 & 11.30 Vs 1.30 & 2.30)	1	351.194	10.763 **
9.30 a.m. Vs 11.30 a.m.	1	72.146	NS
1.30 p.m. Vs 2.30 p.m.	1	24.688	NS
Error	14	32.62	

\*\*Significant at 1%

NS — Not Significant

*Table 2 c. Actual and transformed mean germination percentage for treatments (Times)*

Treatment (Time)	Transformed	Mean Actual
(9.30 & 11.30)	13.28	5.28%
(1.30 & 2.30)	22.17	14.24%
9.30	10.59	3.38%
11.30	15.96	7.57%
1.30	19.90	11.59%
2.30	23.5	15.94%

Table 3: Fruit set from pollinations before and after anthesis

Time of pollination	No. of pollinations	Fruit set	Observed chi-square value
Before Anthesis	450	1	6.47*
After Anthesis	450	9	

\* Significant at 5%

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