OPEN POLLINATION IN *SANTALUM ALBUM* L.

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ABSTRACT

In a preliminary study on pollen fertility percentages and open pollination in emasculated flowers, leading to fruit formation in *Santalum album* (sandal) were investigated. Open-pollination percentage measured through fruit formation was low. Inter-plant differences both in pollen-fertility and in fruit formation were highly significant. It was observed that though the pollen-fertility percentage is high, fruit formation is low.

সারসংক্ষেপ

শ্বেতচন্দন গাছের প্রত্যক্ষ ও কৃত্রিম পরাগয়নের উপর একটি নিরীক্ষা করা হয়। প্রত্যক্ষ পরাগয়নের মাধ্যমে স্বল্প পরিমাণ ফল সৃষ্টি হয়েছে। গাছে গাছে পরাগ-উর্বরতা এবং ফলধারণ ক্ষমতার উল্লেখযোগ্য পার্থক্য রয়েছে। এ নিরীক্ষায় দেখা যায় যে পরাগ-উর্বরতার হার বেশী থাকা সত্ত্বেও গাছে ফল সৃষ্টির পরিমাণ কম।

INTRODUCTION

Santalum album L. is a tropical tree species and it is assumed that it may be widely cross - pollinated naturally. The extent of natural cross - pollination is supposed to be very wide, as the fruit setting is profuse ; but experimental proof of this is rare. Therefore, a knowledge on the extent of cross-pollination is essential for formulating a suitable breeding method. A preliminary investigation was made on the fruit setting in *S. album* after emasculation and keeping the flowers open for cross-pollination.

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MATERIALS AND METHODS

Within the Forest Research Laboratory Campus in Bangalore, two well-grown healthy trees were identified. In the first plant nine branches, and in the second, seven branches were selected, making a total of sixteen branches. On each branch, one inflorescence was taken for the investigation. Flower-buds which might open the next-day were selected and emasculated. Older flowers and younger buds were eliminated. Before emasculation anthers were carefully examined, whether they were already burst or not. The flowers of tree No. 1 were emasculated on 21.9.1984 and those of tree No. 2 on 22. 9. 1984. Table 1 shows the details.

Table 1. Number of flowers emasculated per branch

Tree No. \ Branches	A	B	C	D	E	F	G	H	I	Total
1	23	6	5	5	13	17	26	6	8	109
2	31	8	37	10	6	16	101	nil	nil	108

The number of flowers varied among inflorescence, depending on the availability of suitable sized flowers. After emasculation, the flowers were left open to facilitate natural out-crossing. Though there is no clear-cut evidence on the vectors for pollination, it was gathered that around 15 different types of insects and ants visit sandal flowers. On 25-9-1984 and on 28-9-1984 observations were noted for the number of fruits formed per branch. The proportion of fruits formed per branch was used to calculate the extent of successful open-pollination and it was assumed that the dropping off of flowers is due to non-fertilization. Analysis of variance was computed to find out apparent genotypic differences, if any, in fruit forming ability.

Fruits are drupe and varies from globose to fusiform to conical in shape. As per the size of the fruit, they can be graded into big, medium and small. Overall mean for length, breadth and weight were found (Bagchi and Sharma, 1987 unpublished) to be 0.6 cm, 0.6 cm and 0.2 gm respectively.

Pollen fertility percentages from five different plants were estimated from the same locality during the period from 25-9-1984 to 30-9-1984. During this period the sky was clear, without any precipitation. The maximum temperature was 24.6 to 26.0° C, the minimum temperature being 18 to 20.5°C, with a relative humidity between 26–40%.

It was observed that flower bud opens between 8.00 A. M. to 9.00 A. M. and anthesis starts as soon as the flower bud opens. It was also observed that during cloudy days opening of bud gets delayed by at

least half-an-hour together with anthesis (Veerendra, unpublished). 25 flowers from each of the 5 plants were chosen at random and slides were prepared using 1% aceto-carmine. Five microscopic fields were observed for each flower and deeply stained pollen grains were counted. The pollen-grains were tricolpate, oval, elliptical and binucleate at the time of shedding. The average size of pollen grain was 30.1 x 26.1 microns. Fertility percentages were calculated and mean of five observations for each flower were used to compute analysis of variance and the details are given in table 2.

RESULTS AND DISCUSSION

It was assumed that if pollen fertility is uniformly genetically controlled, the plant means should not be significantly different. It is seen from Table 2 that the pollen fertility percentages differ significantly between trees. The overall mean pollen fertility percentage was found to be 88.42%.

Table 2. Variability of pollen fertility percentages

Sources of variation	df	Mean Square
Between tree	4	904.3999**
Within tree	120	54.3514

***Indicates significance at 1% level*

It is seen from Table 3 that the percent fruit formation in tree No. 1 varies from 8.7% to a maximum of 40% with a mean of 23.48%. In case of tree No. 2 the same varies from 6.5 to 29.7% respectively, with a mean of 17.6%. The average of minimum is 7.6% and the maximum is 24.85% with an overall mean of 16%.

Table 3. Parameters for fruit formation

Branches	Tree Number 1			Tree Number 2		
	Flowers emasculated	Fruits formed	Percent fruits formed	Flowers emasculated	Fruits formed	Percent fruits formed
A	23	2	8.7	31	2	6.5
B	6	2	33.33	8	0	0
C	5	1	20.00	37	11	29.7
D	5	2	40.00	10	0	0
E	13	2	15.4	6	0	0
F	17	4	23.5	6	1	16.6
G	26	0	0	10	0	0
H	6	0	0	x	x	x
I	8	0	0	x	x	x
Total	109	13	140.93	108	14	52.8
Mean	12.11	1.444	15.6588	15.4286	2.0	7.5429

Table 4. Variability of fruit formation ability

Sources of variation	df	Mean Square
Between trees	1	47.9375**
Within trees	13	5.0385

****Significant at 1% level**

No report on open-pollination percentage in *S. album* has been published so far. A preliminary investigation instituted to have a first hand information shows that both the pollen fertility and fruit formation ability (or fertility of female gametophyte) are significantly different among trees (Table 4), indicating apparent genotypic difference. The overall mean of pollen fertility is 88.42% and of percent fruit formation is 7.54%. These indicate that, though the pollen fertility is high, fertility in terms of fruit formation is very low. The reason may be either the pollen does not reach the stigma or even if it reaches, the pollen is unable to fertilize the ovule. The former may be a physical barrier and the later genotypic. A personal discussion with the entomologists of the Sandal Research Centre, Bangalore revealed that, as has been mentioned earlier, 15 or more different types of insects and ants visit sandal flowers regularly. When so many different types of insects and ants visit sandal flowers, it may be assumed that the pollen is carried to the stigma. If it is so, then the lesser number of fruit formation, which has been observed may be due only to the genotypic differences.

Apart from this, *S. album* reveals a treasure of variations. The crown varies from lax to dense, globose to conical ; leaf thickness varies from thick to palpably thin and the colour varies from deep green to yellow : In some cases anthocyanin content is so high that the leaves abscess quickly. It has also been reported that there are plants which flower (1) throughout the year, (2) twice in a year and (3) once in a year. In heartwood, sapwood and in oil content, the variation is simply remarkable with varying colours and depth. Therefore, it is highly possible that though the sandal is known as a prolific seed bearer, open-pollination is not the only method by which the fruits are formed. This is supported by the present observations and also by the observations of Bagchi and Kulkarni (1985, 1987). Higher non-germination of seeds and seedling mortality may indicate development of zygote by other than the normal method. Analysis of chromosome numbers at the seedling stage may reveal much of the information.

REFERENCES

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