PALYNOLOGY OF *HOLOPTELEA INTEGRIFOLIA* PLANCH

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ABSTRACT

The paper discusses the extent of pollen production and variability in pollen morphology of *Holoptelea integrifolia*. Referring to the high incidence of its pollen in the atmosphere and its high allergenicity, the authors suggest that the practice of planting the trees of *Holoptelea* as graceful shade trees should be discontinued.

INTRODUCTION

HOLOPTELEA INTEGRIFOLIA, is the only species found in India. It is a constituent of mixed deciduous forest throughout India ascending to 700 m in the hills. *Holoptelea* flowers from middle of February to the end of March. The pubescent fasicles of small, greenish flowers appear on leafless trees. This factor may enhance the dispersal of pollen where the leaves do not act as a barrier. In the production of winter buds *Holoptelea* resembles temperate elms.

Pollen morphology of *Holoptelea integrifolia* has been described earlier by Wodehouse (1935), Nair (1965) and Nair and Sharma (1965). Its pollen production per anther has been determined earlier by Nair and Rastogi (1963).

The present paper describes results of the study of pollen production and variability in pollen morphology in several individuals of this taxon and records observations on dispersal and preservation of its pollen grains in sediments at Lucknow besides drawing attention to its allergenicity in the country.

OBSERVATIONS

The flowering twigs have been collected from 13 trees distributed in different parts of the city either occurring in stand or individually. Besides the local collection, one pollen sample was taken from a dried specimen of *Holoptelea integrifolia* collected from Koilabasa dist., Gonda, U.P. and preserved in the Herbarium of the Birbal Sahni Institute of Palaeobotany, Lucknow.

The pollen production by an anther was studied by two methods to assess the error of counting. In one method the anther was burst open on a slide by heating a little and then mounting in 3-4 drops of safranin-stained glycerine-jelly. While in the other, an anther was thoroughly smashed in 10-20 drops of safranin-stained 50% glycerine and then mounting a drop on the slide and counting pollen grains microscopically. From the number of pollen grains per drop, the pollen production by an anther was calculated. An anther of the normal size and in pre-anthesis stage was chosen for the purpose.

Pollen Morphology — All the four methods viz., acetolysis (Erdtman, 1943), Wodehouse's technique (Wodehouse, 1935), Chitaley's technique (Chitaley & Deshpande, 1970) and pollen in safranin-stained distilled water were employed for making pollen slides.

Pollen Diagnosis

(as based upon specimens examined by us)

Pollen grains are 4-6 porate (40·8%, 4-porate; 42·6%, 5-porate and 16·6% 6-porate), spheroidal to suboblate, about 22×27 μ to 27×33 μ (average $27{\cdot}1 \times 33{\cdot}1$ μ). Pore more or less circular with a diameter of about 2·3 to 3·7 μ. Sexine thicker than nexine. Exine about 1·5 μ thick, membranous in a few. Exine consists of small irregular ridges separated by small spaces.

Pollen Production — The pollen production per flower depends upon the number of anthers present in male or hermaphrodite flowers. The number of anthers per flower has been reported variable in Indian trees by earlier botanists and their observations are given below:

Number of anthers as recorded by earlier botanists

Gamble (1915-1936)	4-8	anthers (in trees of Madras)
Kanjilal (1928)	8	(8 in male and 5 in bisexual trees of U.P.)
Duthie (1903-29)	6-7	(in trees of U.P.)
Roxburgh (1820-24, 1832)	7-9	(observations based on the trees of all India)

In trees examined by us 6-14 anthers have been observed (Table 1).

The number of pollen grains/anther as found by us varies from 6,000 to about 15,000. One of the trees growing at Aliganj produces on the average 7,580 pollen grains/anther and a tree a short distance ahead on Kursi Road produces about 11,801 pollen grains per anther. Average 9,810 pollen grains/anther has been found in a tree growing at Rai Bihari Lal Road and a tree growing at Police Lines close to the Rai-Bihari-Lal Road crossing produces on the average 7,682 pollen grains/anther. The four trees selected at the four corners of the stand of *Holoptelea* comprising about 150 trees at Tilak Nagar, Aishbagh have shown the average number of pollen grains/anther as 6,852, 7,357, 9,898 and 9,953 respectively. The trees along Jail Road, the Cariappa Road, at Convent Crossing, in front of New Botany Block in Lucknow University and a tree in Birbal Sahni Institute of Palaeobotany produce on the average 6,307, 10,843, 7,444, 5,951 and 6,901 pollen grains/anther respectively. Nair and Rastogi (1963) reported 8,500 pollen grains per anther in a seven-anthered flower of *Holoptelea integrifolia* growing at Lucknow.

The total production of pollen grains by a flower depends upon the number of stamens and number of pollen grains produced by an anther. We have found the lowest average 44,149 pollen grains per

TABLE 1 — SHOWING THE NUMBER OF STAMENS AND POLLEN PRODUCTION IN TREES OF *HOLOPTELEA INTEGRIFOLIA*

Date	Locality	No. of stamens		Average pollen production/ anther	Average pollen produciton/ flower
		Male	Herma-phrodite		
19.3.71	Cariappa Road	9-14 (Av. 10)	9-14 (Av. 11)	10,843	1,08,430
19.3.71	Rai Bihari Lal Road Crossing	9-12 (Av. 10)	11-13 (Av. 11)	9,810	98,100
21.3.71	Kursi Road	7-11 (Av. 7)	7-11 (Av. 9)	11,801	94,408
19.3.71	Tilak Nagar (III)	7-11 (Av. 8)	10-14 (Av. 11)	9,898	89,082
19.3.71	Tilak Nagar (IV)	7-14 (Av. 9)	7-11 (Av. 8)	9,953	79,624
19.3.71	Police Line	7-11 (Av. 10)	8-12 (Av. 9)	7,682	69,138
21.3.71	Aliganj	6-12 (Av. 7)	9-13 (Av. 11)	7,580	68,220
20.3.71	Birbal Sahni Institute of Palaeobotany	8-10 (Av. 8)	9-11 (Av. 10)	6,901	62,109
19.3.71	Tilak Nagar (I)	7-14 (Av. 9)	7-13 (Av. 9)	6,852	61,668
19.3.71	Convent Crossing	7-11 (Av. 8)	9-11 (Av. 9)	7,444	59,552
19.3.71	Tilak Nagar (II)	7-11 (Av. 8)	7-14 (Av. 9)	7,357	58,856
20.3.71	New Bot. Block, Lucknow University	7-9 (Av. 8)	7-12 (Av. 10)	5,951	53,559
19.3.71	Jail Road	8-11 (Av. 8)	6-8 (Av. 6)	6,307	44,149

flower in a tree growing along Jail Road and as high as 1,08,430 pollen grains per flower in a tree growing along Cariappa Road. A twig bearing about 150 flowers will produce as low as about 6,62,350 and as high as 16,264,500 pollen grains and thus a tree produces enormous number of pollen grains in its short flowering period lasting for about one and a half months (2nd week of Feb. to 4th week of March).

TABLE 2 — SHOWING NUMBER AND PERCENTAGE OF *HOLOPTELEA* POLLEN IN THE POLLEN CONTENT OF SOIL, WATER AND MOSS CUSHION SAMPLES COLLECTED AT LUCKNOW

Sl No.	Sample No.	Date of collection	Localities	No. of pollen of *Holoptelea*	Total pollen count	% of *Holoptelea* pollen in total pollen count	No. of *Holoptelea* trees in the vicinity/on the road
1.	*S.S. 6B	12.4.70	Rae Bareli Road	64	247	26·0	2 trees
2.	S.S. 36	24.10.72	Kanpur Road	12	178	6·7	6 trees
3.	S.S. 37	24.10.72	,,	23	150	15·3	,,
4.	S.S. 1A	2.11.69	Hardoi Road	20	228	9·0	16 trees
5.	S.S. 2A	2.11.69	,,	39	193	20·3	,,
6.	S.S. 7	12.7.70	,,	32	233	13·8	No tree
7.	S.S. 4A	15.3.70	Aish Bagh	78	425	18·3	About 150 trees
8.	†W.S. 8	3.1.71	Mohan Marg	23	142	15·1	5-6 trees
9.	S.S. 12	27.12.70	Hussainabad	52	219	23·7	1 tree
10.	W.S. 1	5.4.70	,,	43	144	29·8	,,
11.	S.S. 21	1.8.71	Residency	—	213	8·4	3-4 trees
12.	‡M.C. 5	1.8.71	,,	38	225	16·2	,,
13.	M.C. 6	1.8.71	,,	4	355	1·5	,,
14.	W.S. 2	1.8.71	River Bank Colony	7	114	6·1	1 tree
15.	S.S. 34	30.1.72	La Martinier's ground	13	214	6·0	,,
16.	S.S. 31	30.1.72	Dilkusha Gardens	5	212	2·4	2 trees
17.	M.C. 1B	25.7.71	Gaughat	7	268	2·6	1 tree
18.	M.C. 4	1.8.71	Cariappa Road	16	216	7·45	4 trees
19.	S.S. 33	30.1.72	Sultanpur Road	15	209	7·2	1 tree
20.	S.S. 20	1.8.71	Mahatma Gandhi Road	34	249	13·6	3 trees
21.	M.C. 3	1.8.71	,,	15	214	7·0	,,
22.	S.S. 32	1.8.71	Kalidas Marg	23	232	10·0	1 tree
23.	S.S. 22	1.8.71	Sardar Patel Marg	22	191	11·5	3 trees
24.	S.S. 1	15.2.69	Birbal Sahni Institute of Palaeobotany	13	203	6·3	,,
25.	S.S. 2	15.2.69	,,	38	119	11·9	3 trees
26.	S.S. 3	,,	,,	18	210	8·5	,,
27.	S.S. 4	,,	,,	177	354	50·0	,,
28.	M.C. 11	27.8.71	,,	4	119	3·3	,,
29.	M.C. 1A	13.7.71	Rai Bihari Lal Road Crossing	50	245	20·0	2 trees
30.	S.S. 9	20.8.70	Kursi Road	98	224	43·7	About 50 trees
31.	S.S. 11	27.12.70	Art's College	57	215	26·4	1-2 trees
32.	S.S. 15	3.1.71	Sitapur Road	19	216	8·7	About 250 trees
33.	S.S. 16	3.1.71	Sitapur Road	35	227	15·4	,,
34.	S.S. 27	23.1.72	,,	37	226	16·4	,,
35.	S.S. 28	23.1.72	,,	27	209	12·9	,,
36.	W.S. 10	31.3.71	,,	12	109	11·0	,,
37.	M.C. 8	22.8.71	,,	23	275	8·3	,,
38.	M.C. 9	22.8.71	,,	32	178	17·9	,,
39.	S.S. 23	23.1.72	Nirala Nagar	35	198	17·6	5-6 trees
40.	S.S. 24	23.1.72	,,	47	213	21·9	,,
41.	S.S. 26	23.1.72	,,	37	207	17·9	,,
42.	S.S. 5A	10.5.70	Barabanki Road	26	215	10·7	4-5 trees
43.	W.S. 3	10.5.70	,,	12	106	11·3	,,

* = S.S — Surface sample.
† = W.S.— Water-sample.
‡ = M.C.— Moss-cushion.

Pollen Preservation — Two water samples, 4 moss-cushions and 15 surface samples collected from different places within Lucknow city and around, were pollen-analysed. The percentage of pollen grains of *Holoptelea integrifolia* preserved ranges from 1·5% to 43·7% of the total pollen count in the samples analysed (cf. Table 2).

Table 2 records interesting results concerning the amount of *Holoptelea* pollen in surface samples in relation to number of *Holoptelea* trees growing in the vicinity. In the absence of any tree in the vicinity as much as 13·8% pollen is recorded (*S.S. 7). The presence of one or two trees is represented by 6·0 to 29·8% pollen (S.S. 6B, S.S. 12, *W.S. 1, W.S. 2, S.S. 34, S.S. 33, S.S. 32, M.C. 1A and S.S. 11). Three to six trees in the vicinity are reflected by 6·7 to 21·9% (S.S. 23, S.S. 24, S.S. 26, S.S. 5A, W.S. 3, S.S. 36, S.S. 37, W.S. 8, S.S. 21, *M.C. 5, M.C. 6, and M.C. 4) and sixteen trees by 9·0 and 20·3% pollen as in S.S. 1A & S.S. 2A respectively. In the areas where the number of trees is about 250, the pollen recorded from the sediment is 8·3 to 17·9% (S.S. 15, S.S. 16, S.S. 27, S.S. 28, W.S. 10, M.C. 8 & M.C. 9). A stand of *Holoptelea* comprising about 150 trees in Aishbagh is reflected by 18·3% (S.S. 4A) and about 50 trees on Kursi Road by 43·7% pollen (S.S. 9). There are a few surface samples (S.S. 10, S.S. 18, M.C. 2, S.S. 13, S.S. 14, W.S. 7, W.S. 9, M.C. 7, S.S. 30, S.S. 8, W.S. 4, M.C. 12 and S.S. 31) which do not record the presence of pollen of *Holoptelea* in the sediments although tree/trees are present in the vicinity. From the above it is apparent that the pollen recovered from the water, moss and soil samples is not dependent upon the trees growing in the vicinity. This may be due to meteorological factors particularly wind direction and probably also the preservation phenomenon of *Holoptelea* pollen which indeed need further investigation.

Pollen Allergenicity — The biochemical studies have revealed two pharmacologically active substances, i.e. Histamine (60 µg/g) and 5 Hydroxytryptamine (22·3 µg/g) (Rai, 1970) in *Holoptelea* pollen.

Pollen in the Atmosphere — The slides exposed to the atmosphere in different parts of the country have revealed the

TABLE 3 — DATA OF ATMOSPHERIC CATCH OF POLLEN OF *HOLOPTELEA* AT SOME STATIONS IN NORTH INDIA

Sl No.	Place	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	% in total annual catch
1.	Delhi (Dua & Shivpuri)	—	0·6%	7·6%	5·8%	2·2%	3·4%	—	—	—	—	—	—	2·5
2.	Almora (Lakhanpal & Nair)	—	—	6·4%	0·05%	—	—	—	—	—	—	—	—	1·87
3.	Jaipur (Kasliwal *et al.*)	—	9·4%	74·4%	15·4%	—	—	—	—	—	—	—	—	16·4
4.	Poona (Kalra & Dumbrey)	112	90.0	30·0	7·0	0·4	—	—	0·2	0·4	—	—	0·6	not recorded
5.	Lucknow 1954-55 (Lakhanpal & Nair)	—	19·2%	79·1%	5·9%	2·8%	2·4%	—	—	—	0·17%	—	—	42·5
6.	Lucknow 1969-70 (authors)	—	—	42·3%	1·17%	0·12%	—	—	—	—	—	—	—	13·0
7.	Lucknow 1970-71 (authors)	—	—	69·9%	17·6%	24·3%	0·3%	0·4%	—	—	—	—	—	35·0

*S.S.= Soil sample; W.S.= Water sample; M.C.= Moss cushion.

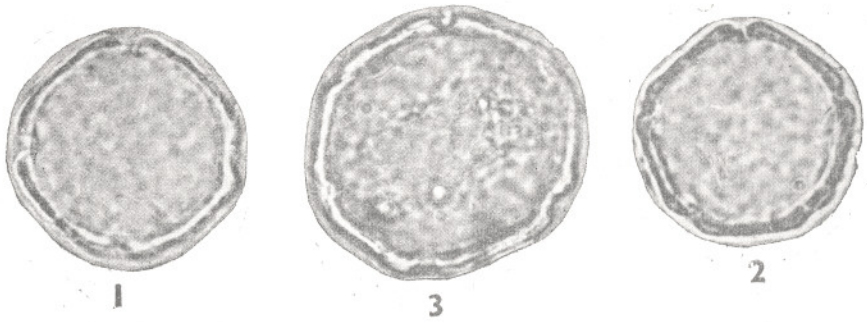

FIG. 1 — A 4-porate pollen grain of *Holoptelea integrifolia* Planch.
FIG. 2 — A 5-porate pollen grain in *Holoptelea integrifolia* Planch.
Fig. 3 — A 6-porate pollen grain of *Holoptelea integrifolia* Planch.

presence of *Holoptelea* pollen in its numerical abundance in total tree pollen counts mainly in the months of Feb., March and April (Table 3). At Delhi, 2·5% (Dua and Shivpuri, 1962); Almora, 1·87%(Lakhanpal and Nair, 1960); Jaipur, 16% (Kasliwal *et al.*, 1959); Lucknow '54-'55, 42·5% (Lakhanpal & Nair, 1958); Lucknow '69-'70, 13% and Lucknow, '70-'71 (as discovered by us) 35% pollen of the total annual pollen catch have been recorded.

The maximum flowering period of *Holoptelea integrifolia* is mainly in the month of March but its pollen grains have been recorded up to the month of October (cf Table 2). These might have been secondarily derived, i.e. blown up from the ground by wind and redeposited. Its flowering in the month of January has been reported from Poona (Kalra & Dumbrey, 1957).

In Delhi area *Holoptelea integrifolia* has been proved to be a high pollen producer and the main allergenic species of the city (Shivpuri, 1964). In Jaipur it is one of the major allergens of the area (Gupta *et al.*, 1959; Kasliwal *et al.*, 1961). Kalra and Dumbrey (1957) have listed *Holoptelea* tree as one of the major plant causing allergy in Poona.

Clinical tests carried out at the Medical College Lucknow have revealed as many as 13 patients allergic to *Holoptelea* pollen. The cutaneous tests performed upon 9 patients showed different grades of positive reaction of sensitivity (Personal communication from Dr. Zafar Jamil of Dept. of Tuberculosis, K. G. Medical College, Lucknow).

CONCLUSION

Although *Holoptelea integrifolia* is useful as a road-side shade tree and also for timber, fodder and oil extracted from it, yet it is a source of seasonal asthma and seasonal rhinites. In view of its harmful effects upon man, this investigation suggests that the plantation of *Holoptelea integrifolia* as road-side trees in the cities should be discouraged.

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