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Pollen Productivity, Release and Dispersal in *Dodonaea viscosa* (Linn.) Jacq.

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Dodonaea pollen productivity, release and dispersal were studied because of its reported allergenic properties. The estimated pollen productivity per anther was 20,000±6,000, and per flower 1,60,000; 99% of these would be emitted into the air. Anther dehiscence resulting in pollen release occurred from 10.00 to 13.00 with the peak most frequently from 10.30 to 11.30 hr. Rain in the morning resulted in delayed pollen release. After anther dehiscence, pollen would be dispersed sooner or later depending on the existence of turbulent winds.

In concordance with the times of pollen release, airborne pollen exhibited a pronounced circadian rhythm in their incidence, higher concentrations occurring between 10.00 and 14.00, and the peaks recurring between 11.00 and 12.00 hr. Periods of maximum pollen release as well as of pollen incidence in a day were related to periods of greater air turbulence.

The pollen season dynamics in the four consecutive flowering periods varied from year to year. Though the general season extended from late August to the third week of March, the main season was confined to mid-September—late January. The biotic factors affecting the normal growth of the source plants, the internal factors as well as the variation in climate may contribute to the fluctuations in pollen season dynamics.

Key Words: Air-borne pollen, Dodonaea, Anther dehiscence, Pollen dispersal, Pollen productivity, Pollen release

Introduction

As the pollen of *Dodonaea viscosa* (Linn.) Jacq. were shown to be antigenic (Shivpuri & Dua 1963) and reported as one of the components of the airborne pollen flora of different parts of India (Kasliwal et al. 1959 from Jaipur, Dua & Shivpuri 1962 from

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Delhi, Reddi 1970 from Visakhapatnam and Anakapalle, Vishnu-Mittre & Khandelwal 1973 from Lucknow, Deshpande & Chitaley 1976 from Nagpur), a study on pollen productivity, release and dispersal was undertaken to understand the capability of the plant to pollute the ambient air with its pollen.

Material and Methods

At Visakhapatnam (17° 42′ N and 32°18′ E) *Dodonaea viscosa* grows abundantly on the hill slopes as well as on some plain areas. Local people cut the stems for fuel, and thus interfere with the normal growth of the plants.

Observations on the times of anther dehiscence and hence pollen release in the field were done during the flowering season of 1978-'79 near the Indira Gandhi Zoological Park. Twenty flowers distributed over few plants were labelled, and their anthers examined at half-hour intervals, each time scoring the dehisced anthers and recording the prevailing weather conditions.

Terminal velocity of pollen was calculated using the stoke's formula :

$$Vs = 2/9 \frac{\sigma - p}{\mu} . gr^2$$

(see Gregory 1973). Pollen productivity was computed in accordance with Reddi (1976).

A Hirst spore trap (Hirst 1952) was operated in the Zoological Park with its orifice 1.25 m above ground level to study the changes in pollen content of the air in circadian cycles. A cylinder trap (see Reddi 1970) in operation since 1975 on the roof of Botany Building on the Andhra University Campus, Waltair (India) provided the data on the daily variations in airborne pollen in four consecutive flowering seasons viz., 1975-'76, 1976-'77, 1977-'78 and 1978-'79.

Results and Discussion

The male flowers are pendant. The number of anthers per flower is 7-12, 8 being the most frequent. The anthers are linear-oblong, basifixed, dithecous, and dihisce longitudinally. The pollen are monads, spheroidal, dry, non-coherent, 24-33 (29 ± 4) μm in diameter, 3-colporate, contents granular, exine smooth, terminal velocity 1.96 cm/sec., colour yellow.

Pollen productivity: The estimated number of pollen per anther ranged between 10,600 and 27,000, the weighted average being $20.000 \pm 6,000$. The number of stamens being 8, about 1,60,000 pollen could be produced per flower.

To determine whether all the pollen produced in an anther would be liberated into the ambient air, the shrivelled anthers were examined and found that on average 150 pollen remained unliberated within the pollen sacs; this amount made up 0.75% of the total pollen output (weighted average) per anther.

Pollen release: Field observations revealed that in majority of flowers all anthers did not dehisce simultaneously; on average 1-3 days would be required for all the anthers of a flower to complete dehiscence. Even the two lobes of some anthers did not dehisce synchronously.

Table 1 details the observed times of anther dehiscence and the associated weather conditions in the field on five occasions. Anther dehiscence, and hence pollen release on average took place between 09.30 and 13.00 hr with greater frequency during 10.30-11.30 hr.

The anther dehiscence began at and above 25.5°C temperature and below 80% R.H., the rate increasing commensurate with increasing temperature and decreasing R.H. On a rainy day the process was delayed. Thus the drizzling between 07.00 and 10.30 hr on December 26, 1978 caused pollen release between 12.00 and 15.30 hr with a maximum during 12.30-13.00 hr.

Dehiscence is usually said to occur on 'desiccation' of the anther tissue (Percival

Table 1 *Times of* Dodonaea *anther dehiscence in 20 flowers on different plants and the associated weather conditions on 5 occasions*

Time (hr)	24.12.1978				25.12.1978				26.12.1978				27.12.1978				28.12.1978			
	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv
10.00	2	27.8	56	1.2	4	29.5	58	10.7	Drizzling between								3	27.3	51	1.3
10.30	63	28.0	54	1.6	19	28.0	61	8.6	07.00 and 11.30								25	26.0	55	2.5
11.00	45	28.5	52	2.6	50	28.0	59	12.2	Cloudy				13	27.0	67	1.2	44	27.0	52	1.8
11.30	1	27.5	54	2.5	41	28.0	60	13.7					10	25.5	76	1·7	48	27.0	51	1.9
12.00	10	27.5	52	2.9	6	27.5	64	14.6	10	26.1	80	0.7	2	25.0	79	1.5	10	27.0	51	3.0
12.30	Clear sky				3	30.0	55	16.3	36	27.5	74	0.3	Slight drizzling at				Clear sky			
13.00					Partially cloudy				35	28.0	70	0.4	10.00 and 12.00 h.							
13.30									2	26.5	78	0.7								
14.00									9	26.2	80	1.0								
14.30									0	26.1	84	1.2	Partially cloudy							
15.00									3	25.6	78	1.0								
15.30									1	25.9	77	06								

i, No. of anthers dehisced; *ii*, Temperature (°C); *iii*, Relative humidity (%); *iv*, Wind speed (m/sec.)

1965). This was verified by putting two batches of mature anthers, one in sunlight and another in shade as the rate of evaporation from plant tissues differs under these two environmental regimes, it being more in sunlight. The results obtained (table 2) are in the affirmative.

Pollen dispersal: In as much as the flowers are pendant and the pollen dry and non-coherent, as soon as the anthers dehisced the pollen were poured down. If the prevailing winds were turbulent enough, these pollen would be wafted away immediately after release. Otherwise they got deposited

Table 2 Dodonaea *anther dihiscence in two different environmental regimes*

Time (hr)	In shade			In sunlight		
	No. of anthers dehisced*	Temp. (°C)	RH (%)	No. of anthers dehisced*	Temp. (°C)	RH (%)
09.00	0	24.2	64	0	25.9	57
09.30	0	24.7	63	17	27.9	52
10.00	0	26.3	58	25	28.1	48
10.30	10	27.5	53	8	30.0	45
11.00	32	29.0	50			
11.30	5	30.0	45			
12.00	3	30.3	43			

*Sample size=50 anthers

on adjacent plant parts in their path. When considerable atmospheric turbulence developed, the pollen thus deposited would be dispersed.

Circadian periodicity in airborne pollen: The pollen displayed a well-marked periodicity in their incidence in circadian cycle corresponding with the rhythmic variations in pollen release (figure 1). They appeared mainly during the day and were either absent or very few in the night. Their concentrations were greater from 10.00 to 14.00 hr with peaks recurring between 11.00 and 12.00 hr. The peak mean concentration obtained was 1,600/m^3 air. The highest hourly concentration registered was 5,600/m^3 air on December 18 at 11.00, the peak mean hour.

There was a rapid increase in pollen concentration from 09.00 hr in conjunction with increasing temperature and decreasing R.H. (see figure 1). The attenuation from 11.00 hr onwards was also rather sharp until 13.00 hr but thereafter gradual; pollen almost disappeared by 18.00 hr. The rather sharp decrease in pollen concentration was because the sources ceased to actively contribute to the airborne pollen load by 12.00 hr; moreover the atmospheric turbulence which would be greater by then would cause dispersion of the pollen cloud. The delayed anther dehiscence due to drizzling on December 26 naturally resulted in the shifting of the times of pollen incidence in air; thus peak incidence on this ,day occurred between 13.00 and 14.00 as against the usual time, 11.00-12.00 hr (see figure 1).

Seasonal periodicity: Table 3 gives the dynamics of the pollen season in each of the four flowering periods. The main pollen season was estimated following Pathirane (1975). In general the season commenced by late August and ceased by 3rd week of March. Higher levels of incidence occurred

Table 3 Dodonaea *pollen season dynamics in four consecutive flowering seasons at Visakhapatnam*

Flowering season	Collection dates		Date and peak amount/sq cm	Length of main pollen season	Monthly pollen count/sq cm								Seasonal pollen count/sq cm
	First	Last			A	S	O	N	D	J	F	M	
1975—'76	23.9	22.3	27.11 (184)	15.11—3.12	0	8	14	390	112	0	2	4	530
1976—'77	6.9	5.1	16.9 (36)	12.9—10.12	0	92	12	78	32	4	0	0	218
1977—'78	17.11	17.2	5.12 (86)	24.11—29.1	0	0	0	16	312	126	6	0	460
1978—'79	27.8	9.1	27.12 (18)	6.12—30.12	10	2	4	14	96	4	0	0	130

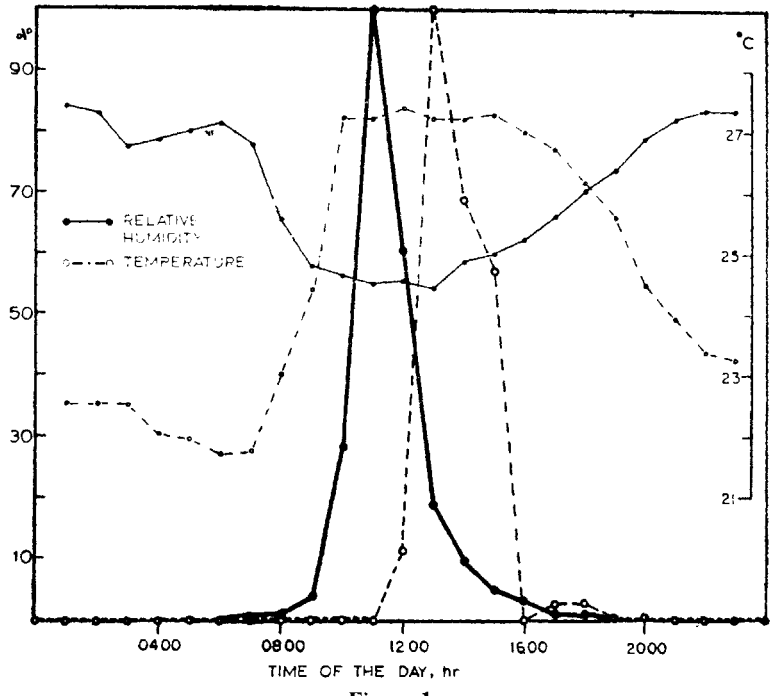

Figure 1

during November-January. The dates of begining and ending of general as well as of main season and their duration varied from season to season (see table 3). The dates as well as the peak pollen count, and the seasonal total too varied. Such year to year variations in the pollen season dynamics have also been reported for other plants both from India (Dua and Shivpuri 1962, Reddi 1970) and abroad (Derrick 1965, Hyde 1969, Kotzamanidou & Nilsson 1977). The human factor interfering with the normal growth of the plants as well as the internal factors might have caused these fluctuations in the pollen season dynamics. The variations in the climatic factors too at least to some extent might be responsible for such variations.

The foregoing account on *Dodonaea* pollen productivity, release and dispersal proved that this plant possessed tremendous potentiality to pollute the ambient air with its pollen. Hence in places of its wide occurrence, the atmosphere would be heavily contaminated with its pollen in the period of its efflorescence.

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