INDIAN JOURNAL OF FORESTRY

Vol. 5 (4), 265-270, 1982

FLORAL BIOLOGY OF BHALIA (*MAUGHANIA MACROPHYLLA* (WILLD.) O. KTZE.

S.C. SRIVASTAVA AND P. KUMAR

Division of Agronomy and Plant Genetics, Indian Lac Research Institute, Namkum, Ranchi-834010.

Abstract

Bhalia (*Maughania macrophylla*) is known to be one of the minor lac host of regional importance for growing both *kusmi* and *rangeeni* strains of lac insects. The inflorescence is racemose type and panicle blooms during September/October with purple acuminate corolla of papilionaceous nature. The period required for flowering from bud initiation to full bloom stage varied from 8 to 10 days and length of flower varied from 12 to 14 mm. The appropriate time of anthesis was recorded from 6 to 7 a.m. during sunny morning weather in the fourth phase of bud development. The pollens collected between 4-1/2 to 5 hr after a dehiscence showed maximum viability. The average size of fresh pollen grain was 37.89 μ and 95% pollens were found viable in 0.5% acetocarmine solution. The pollen germination was maximum on a medium comprising 45% sucrose solution and 1% agar-agar. The pollens stored at room temperature were viable up to 72 hr and at frigidaire condition upto 140 hr. The viability of pollens decreased with the increased period of storage. The stigma becomes receptive 38 to 40 hr before anthesis and persists upto only 2 to 4 hr after anthesis. The pod formation after artificial pollination of emasculated flowers confirmed the pollen viability *in vivo*. The above study will be useful in successful hybridization between *M. macrophylla* and *M. chappar*.

Introduction

Maughania macrophylla (Willd.) O. Ktze. earlier named as *Flemingia congesta* Roxb.; Baker (Anonymous, 1956; Raizada, 1956 and Hooker, 1879), is a leguminous, errect and perennial shrub which grows about 2.5 m in height under cultivation. It is found at lower elevations throughout India and in Andaman Islands (Lal *et al.*, 1962; Krishnaswami *et al.*, 1962; Srinivasan, 1956 and Glover, 1937). The inflorescence is of racemose type and panicle blooms during September/October with purple

acuminate corolla of papilionaceous nature. It is known to be one of the minor lac host of regional importance for growing both *kusmi* and *rangeeni* strains of lac insect (Krishnaswami *et al.*, 1962; Krishnaswami, 1960; Srinivasan, 1956 and Glover, 1937).

Traditional hosts like *kusum, ber* and *palas* takes 10 to 15 years to grow, require huge area for plantation and their irregular stands interfere with cultural operations and guarding. The competition between agricultural crops and lac is eroding cultivator's interest in lac cultivation as the youth tribals are now moving fast towards intensive agriculture and they also do not know climbing on the trees. This plant species is assuming importance due to its capacity to produce superior quality *kusmi* lac, quick growing habit, thrive on poor lands, manageable shape and size and may be integrated with general agriculture (Lal *et al.*, 1976).

Out of the two *Maughania* species, *M. macrophylla* has better plant characters for the growth of lac insects, while *M. chappar* has profuse tillering capacity. With a view to combine these two characters interspecific hybridization programme has been taken up and the studies on floral biology of *M. macrophylla* has been completed as the adequate knowledge of floral biology is a prerequisite to the plant breeder for successful hybridization (Janki *et al.*, 1968).

Material and Methods

The present investigation was undertaken on 2 years old *bhalia* bushes at Institute plantation during September/October. The floral behaviour was studied from the flowers showing signs of development. The whole bud development was recorded in six different phases. Pollen viability was determined by staining technique using 0.5% acetocarmine solution as well as by pollen germination method (Vasil, 1962; Oakes, 1958 and Ostapenko, 1956) using sucrose and agar-agar medium. The viability of pollen grains was tested by germinating the pollens *in vitro* using the various concentrations of sucrose solution and 1 percent agar-agar media. Germination percentage of pollen collected at different hours after dehiscence of anthers was tested by using most standardized medium of 45% sucrose solution and 1% agar-agar. Pollen germination and receptivity of stigma *in vivo* was tested by artificial pollination of emasculated flowers in varying periods (before and after anthesis). The method of preserving the pollens was to collect and store the pollens intact in the flower under different conditions.

Results and Discussion

Floral survey : The inflorescence of *bhalia* was of racemose type and the flower was of papilionaceous nature. On an average 36.7 cm long terminal shoots produced, 14 1 number of inflorescences and 74 number of flower per inflorescence. Initiation of flowering started in the last week of August and it was maximum during middle of September. It lasted up to the middle of October. On an average seven buds per inflorescence were found dead and sheded off. Sehgal and Singh (1967) also reported that in case of guava, the duration of flowering varied from 27 to 39 days during April/May in Delhi conditions. However, in spring season the flowering started in the second week of February and lasted up to first week of April.

Emergence of buds and its development : A perusal of Table 1 revealed that the nature and development of floral bud was identical to that of pea group. The young buds took 2 to 3 days to emerge from the enclosed sheaths from the day, bud primordia were marked and were measured from initiation of bud upto the full bloom stage after every 48 hr interval. The period required from bud initiation to full bloom stage varied from 8 to 10 days and the length of the flower measured 12 to 14 mm. The development of buds were

Table 1. Bud emergence and its development, pollen storage and stigma receptivity of *M. macrophylla*

Emergence of bud & its development						Stigma receptivity			Pollen storage		
Phases of bud development	Period (day)	Length of bud (mm)	Temperature °C		RH	Pollination hour before and after anthesis	Stigma receptivity	Pod formation	Period	% of viability in 0·5% acetocarmine. Room temp. (27.7°C) & RH (74%)	Fregidaire temp (9.4°C) & RH (21%)
	Range	Range	Max	Min	%			%	hr		
*First	2-3	3-6	32 0	22.7	82	Before 60-62	$	—	3	92.10	92.1
Second	2-4	5-8	33.0	23.8	85	,, 46-46	$	—	24	57.3	60.3
Third	3-5	7-10	33.0	23.8	85	,, 38-40	+	initiated	36	57.2	57.6
Fourth	4-6	9-11	29.5	22.2	100	,, 24-26	+	60	48	50.2	55.2
Fifth	7-9	10-13	25.0	22.2	97	at anthesis	+	40	60	38.0	35.8
Sixth	8-10	12-14	25.0	22.2	97	after 8-10 hr	$	—	138	—	10.7

*included the period of Emergence from enclosed sheath, + receptive, $ non-receptive.

Table 2. Time of dehiscence of anthers in *bhalia*

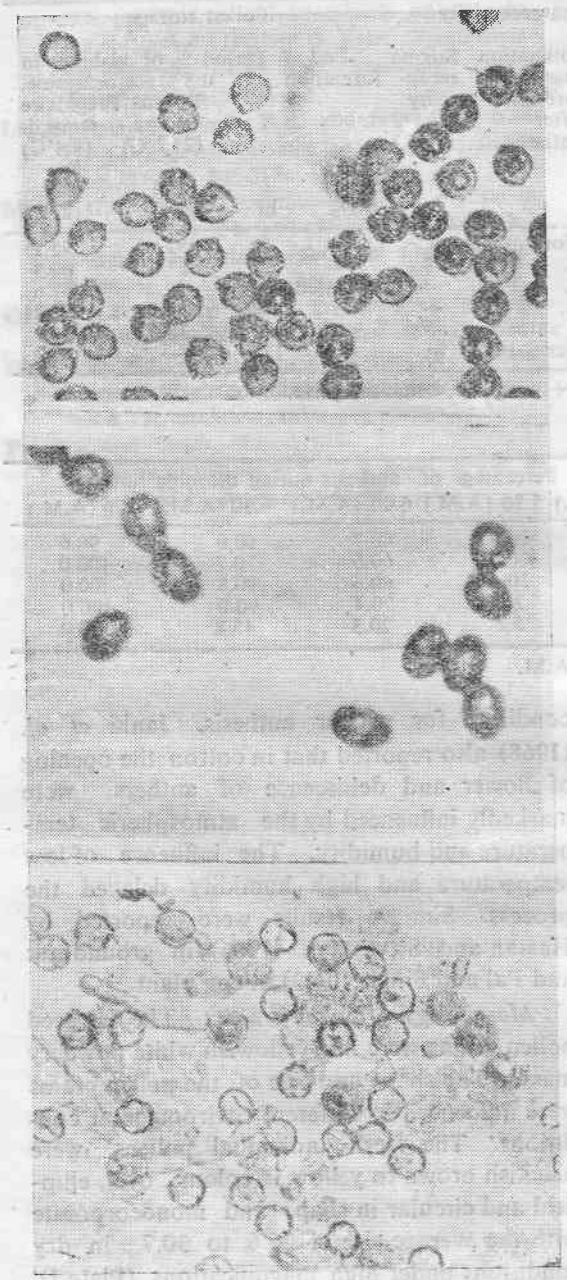
Temperature °C		Relative Humidity	Percentage of anthesis during morning hours					
Maximum	Minimum	Percent	Sunrise (A.M.)	5.00 (A.M.)	5.30 (A.M.)	6.00 (A.M.)	6.30 (A.M.)	7.00 (A.M.)
27.8	26.7	79	5.29	5.29	20.8	40.7	60.6	90.6
28.3	26.7	78	5.30	10.6	20.8	60.5	70.7	100.0
27.8	27.2	78	5.31	5.2	30.4	60.5	80.8	100.0
27.8	27.2	77	5 31	10.3	25.6	70.4	90.0	100 0
27.8	27.8	76	5.33*	—	5.2	20.3	45.8	80.0

*The morning hour weather was foggy, cloudy upto 7.00 A.M.

classified into six phases. The full bloomed flower was having purple dark base with acuminate corolla. The present findings are in confirmity with those of Hassan and Srivastava (1966) who reported that buds differed in shape and size in ground-nut (*Arachis hypogaea* L.).

Anthesis : The dehiscence of anther was recorded in the fourth stage of bud development when the petals peeped out from the bud with light purple colour and acuminate margin. The appropriate time of dehiscence was recorded between 6 and 7 a m. (Table 2). The maximum anthesis was noted during clear night and sunny-morning weather. A little bit late anthesis was observed during mist, cloudy night and foggy morning weather. The present findings indicated that the anthesis was influenced by atmospheric temperature and humidity. The rate of anthesis was more in high temperature and low humidity. Dry and cool dry weather was found most suitable condition for proper anthesis. Janki *et al.* (1968) also reported that in cotton the opening of flower and dehiscence of anthers were markedly influenced by the atmospheric temperature and humidity. The influence of low temperature and high humidity delayed the process. Similar results were reported by Hassan and Srivastava (1966) in ground-nut and Pal and Singh (1943) in egg plant.

Morphology of pollen grains : The dehisced pollen grains were fine yellowish white powdery mass. The shape and size of the pollen grains were influenced by different environmental conditions. The fresh individual pollens were blackish brown to yellow in colour, oval, elliptical and circular in shape and monocorporate with the average size of 25.6 to 30.7 μ in dry conditions under high magnifications (Plate I). The exine could be clearly distinguished in wet condition by its fairly thick circular brown smooth wall. The entine could be seen bulging out through the germ-pore with yellowish



Plate—1-3.

1. Fresh Pollens of Bhalia
2. Sterile Pollens of Bhalia
3. Germinated Pollens of Bhalia

white outline. The viable pollens were turgid, round and an average diameter of 35.9 μ whereas non-viable or sterile pollens were shrivelled and elliptical in shape (Plate II), Similar variations in size and shape were also reported by Mishra (1962) in brinjal and sexine as thick as nexine by Saoji (1975) in *Momordica charantia* L.

Pollen viability : The pollens collected within 2 to 3 hr after dehiscence showed 95% average viability in 0.5% acetocarmine at room temperature 26°C ± 1 and 85% RH.

The viability of pollens was determined by pollen germination method also. The data presented in Table 3, showed that the pollen germination was maximum (68 5%) *in vitro* in 45% sucrose solution and 1% agar-agar medium (Plate III). On an average 23 8, 37.1, 41.1, 46.7, 52.5, 68.5 and 60 3 per cent pollen germination was recorded in 15, 25, 30, 35, 40, 45 and 50 per cent sucrose solution and 1 per cent agar-agar media respectively at room temperature from 22.2 to 27.7°C and RH from 76 to 97 per cent. Similar behaviour was also reported by Vasil (1960) while studying the pollen germination of certain cucurbitaceous plants.

Storage of pollen grains : The pollen germination was also studied in relation to the period of anthesis (Table 4). The pollen germination was noted to start after 3 hr of anthesis and was maximum 69.2% with a 133.1 μ of tube length when collected after 4½ to 5 hr of anthesis. Pollens collected after 3½, 4, 4½, 5 and 5½ hr of anthesis showed the pollen germination as 36.4, 47 6, 60.7, 69.2 and 24.7 per cent respectively and their pollen tube length measured from 110 to 133.1 μ at the temperature between 25 to 31°C and RH 67 to 80 per cent. It was clear from the above observations that the pollen collected after 4½ to 5 hr of dehiscence were physiologically active and could be used in crossing.

Table 3. Germination percentage of pollens of *bhalia* in various concentration of sucrose solution and one per-cent agar–agar media

Temperature °C Maximum	Minimum	Relative Humicity (per cent)	Av rage Germination Percentage (in per cent) and 1 per cent agar-agar media Sucrose solution						
			15	25	30	35	40	45	50
25 5	25.5	76	23.5	26.1	50 0	50.0	57.1	75.0	60.0
27.7	26.7	60	29.4	58.3	52.2	50.0	57.1	77.8	75.6
26.7	25.5	96	25.0	36.4	42.9	50.0	55.0	70.0	55.6
24.4	22.2	97	18.8	33.3	38.5	33.3	42.8	62.5	57.1
25.5	22.2	97	22.2	31.2	22.2	50.0	50.0	57.0	53.8
		Average	23.8	37.1	41.1	46.7	52.5	68.5	60.3

Table 4. Germination percentage of pollens of *bhalia* collected at different hours after dehiscence of anther using most standardized medium of 45 per-cent sucrose solution and 1 per-cent agar-agar

Temperature °C Maximum	Minimum	Relative Humidity (per cent)	Collection hours after dehiscence 3 1/2 Germination (per-cent)	3 1/2 Pollen tube length (μ)	4 Germination (per-cent)	4 Pollen tube length (μ)	4 1/2 Germination (per-cent)	4 1/2 Pollen tube length (μ)	5 Germination (per-cent)	5 Pollen tube length (μ)	5 /12 Germination (per-cent)	5 /12 Pollen tube length (μ)
27.5	27.0	78.0	36.7	95.0	44.0	105.0	47.6	112.6	79.2	160.0	26.1	194.6
27.5	27.0	76.0	39.5	100.0	52.0	105.0	75.0	112.6	59.2	100.0	21.8	102.4
31.0	25.0	79.0	47 0	125.0	45.8	115.0	54.5	102.0	66.7	120.0	25.0	112.6
28.3	26.6	78.0	35.2	150 0	50.0	125.0	62.7	184.3	68.2	95.0	22.7	102.4
27.5	26.6	80.0	33.3	155.0	46.4	100.0	63.8	153.6	72.7	150.0	28.1	102.4
			36.4	125.0	47.6	110.0	60.7	133.1	69.2	125.0	24.7	122.9

The data presented in Table 1 revealed that the pollen viability decreased with increased storage. The pollen stored at room temperature 24.4 to 27.7°C and RH between 58 to 74 per cent remained viable up to 75 hr whereas that stored at frigidaire temperature 9.4°C and RH 21.1 per cent remained viable upto 140 hr. Saoji (1975) also recorded that the pollens of *Momordica charantia* L. were viable upto 5 days at 9°C and 4% RH.

Receptivity of stigma and pollen germination test in vivo : No work has been reported so far on the period of receptivity of stigma and pollen germination test *in vivo* in case of *bhalia*. The present studies reveal that stigma becomes receptive 38-40 hr before anthesis and persists upto only 2-4 hr after anthesis (Table 1). Thus the total period for receptivity of stigma has been found to be upto 42-44 hr.

It is apparent from Table 1 that about 40-60 per cent pod formation occurred after artificial pollination of the emasculated flowers which however, confirmed that pollens were quite viable *in vivo*. The best pollination period was observed between 7.30 to 9.30 hr.

Acknowledgements

The authors are grateful to Dr. T.P.S. Tectia, Director and Sri B.K. Purkayastha for the facilities and encouragement.

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