

FLORAL BIOLOGY OF ADAPATHIYAN (*HOLOSTEMMA ADAKODIENSCHULT*)

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Abstract: An investigation on the floral biology of adapathiyana (*Holostemma adakodien* Schult.) was undertaken at the college of Horticulture, Thrissur during the period 1995-1997. The inflorescence is axillary and cymose with bisexual flowers. Flowers open 25 to 28 days after bud initiation and passes through 12 different developmental phases before anthesis. Anthesis commences at 8.30 a.m. and extends up to 10.00 a.m. Anther dehiscence occurs on the fourth day of flower opening from 9.30 a.m. to 1 p.m. The maximum stigma receptivity was observed on the first day of flower opening. Size of the pollen grains ranged from 50 to 75 μm with 90-100 % fertility in Brewbaker and Kwack's medium.

Key words: Anthesis, anther dehiscence, pollen viability, stigma receptivity.

INTRODUCTION

Holostemma adakodien Schult. known in vernacular as adapathiyana belongs to the family Asclepiadaceae. This is the accepted source of *Jivanti*, reckoned as an important *rasayana* drug capable of maintaining youthful vigour and strength. Roots are used as remedy for various ailments like scalding in gonorrhoea, ophthalmia, diabetes, cough, orchitis and leucoderma. The cultivation is highly remunerative and this is one among the few medical plants which is domesticated at present. In commercial cultivation, availability of propagules is important. Seedlings are rated as the best planting material in comparison with vegetative propagules like stem cutting (Meera, 1994). Similar to other Asclepiads, fruit set in adapathiyana also is very rare and this becomes a major constraint for the large-scale cultivation of this species. To unravel the reason for low fruit set and to formulate suitable breeding programme, knowledge about floral biology is essential. The present study is an attempt to study the flowering behaviour and floral biology of adapathiyana.

MATERIALS AND METHODS

The study was undertaken at the College of Horticulture, Vellanikkara, Thrissur during 1995- 1997. Local collection of adapathiyana maintained in the fields of the Department of Plantation Crops and Spices were used for the study.

To study the floral characters, 50 flower buds were tagged randomly at the time of their initiation. The flower bud development

stages observed as change in morphology and colour till anthesis were divided into 12 arbitrary stages. The duration of each stage was also recorded. Morphology of flower was also studied and figures were drawn. Anthesis time was observed daily from 8.00 a.m. to 10.00 a.m. at 30 min interval on flower buds tagged one day prior. Anther dehiscence was observed on flowers collected each day and observed under microscope. Size of pollen was measured using ocular micrometer. Pollen production per pollinia was attempted using a haemocytometer. Pollen viability was determined by Alexander's stainability test (Viswanathan and Lakshmanan, 1984). The pollen germination was studied with fresh pollinia using different media like distilled water, distilled water + sucrose and Brewbaker and Kwack's medium (Brewbaker and Kwack, 1963). Stigma receptivity was assessed visually with hand lens, from one day prior to anthesis to two days after anthesis and later confirmed by hand pollination of emasculated flowers. Fruit set was observed after five days to ascertain receptivity.

RESULTS AND DISCUSSION

Inflorescence is an umbellate cyme arising from leaf axil. The number of flowers per inflorescence varied from 2 to 20 and each plant produced 10-64 inflorescences. Complete opening of one inflorescence occurred in 4 to 15 days. Flowers are bracteate, pedicellate, complete, actinomorphic, bisexual, hypogynous and pentamerous.

The flower buds passed through a series of morphological changes to reach the anthesis

stage following visual emergence. The whole period of flower bud development was divided into 12 approximate stages.

Table 1. Period of anthesis in adapathiyian

Time, hour	No. of flowers observed	No. of (lowers opened	% of total
08.00-08.30	25	0	0.0
08.30-09.00	25	3	13.2
09.00-09.30	25	14	54.4
09.30-10.00	25	7	26.8
10.00-10.30	25	2	6.0

Table 2. Period of anther dehiscence in adapathiyian

Time	No of flowers observed	No. dehiscd	Dehiscence %
On the day of anthesis	25	0	0
Second day of anthesis	25	0	0
Third day of anthesis	25	0	0
Fourth day (09.00 to 11.00)	25	2	8
Fourth day (t 1.00 to 13.00)	25	23	92

Table 3. Pollen fertility

Days of flower opening	No. of pollen grains observed	No. of fertile pollen grains	% pollen fertility
Day of anthesis	20	19	95.0
Second day	18	17	94.4
Third day	15	13	86.7
Fourth day	7	5	71.4
Fifth day	7	4	57.1

Stage 1: Tiny compact mass with very small pedicel and covered with purple coloured sepals and clear bracts.

Stage 2: Bud appeared fully with light purplish cream colour and covered with sepals.

Stage 3: Bud size increased, sepals green, bracts started yellowing.

Stage 4: The head of the bud became globular

Table 4. Period of stigma receptivity in adapathiyian

Pollination time	No. of flowers pollinated	No. of fruits set	% fruit set
24 h before anthesis	20	0	0
18 h before anthesis	20	0	0
2 h before anthesis	20	0	0
At the time of anthesis	20	2	10
2 h after anthesis	20	1	5
6 h after anthesis	20	0	0
24 h after anthesis	20	0	0
48 h after anthesis	20	0	0

colour turned cream tinged with purple. Bracts dropped down.

Stage 5: The globular head and basal part equal in length with prominent pedicel.

Stage 6: Calyx tip became more pointed and fleshy.

Stage 7: Calyx restricted to the bottom portion, making the bud fully exposed.

Stage 8: Pedicel length increased. Demarcation of petals became distinct

Stage 9: Purple coloured buds with nearly triangular petals

State 10: Basal portion became more swollen and tip flattened slightly.

Stage 11: Tip became more flat and basal part of petals start separating.

Stage 12: Anthesis occurred with stigma exposed first.

Calyx is deeply 5-partite with broadly ovate, obtuse and veined sepals. Corolla is gamopetalous, subrotate and divided about 2/3 of the way down and petals overlap to the right.

Corona arises from the base of the staminal column. Stamens are five in number and seen adnate to the base of the corolla tube and filaments cohere in five winged stigma to form the gynostegium. Pollen grains at

maturity are seen as pendulous mass called **pollinium**. Each stamen bear two **pollinia** united by **caudicles** to form translator. Pistil is **bicarpellary**, **apocarpous** and **enclosed** by the **staminal tube**. Two styles are free but united at the **stigmatic head**. Fruit consist of two distinct **follicles** diverging from the base (Sivarajan and Balachandran, 1994). Floral biology is shown in Fig 1.

Anthesis: Commenced at 8.30 a.m. and continued up to 10.00 a.m. The data presented in Table 1 revealed that maximum **anthesis** (54%) was observed between 9.00 a.m. and 9.30 a.m.

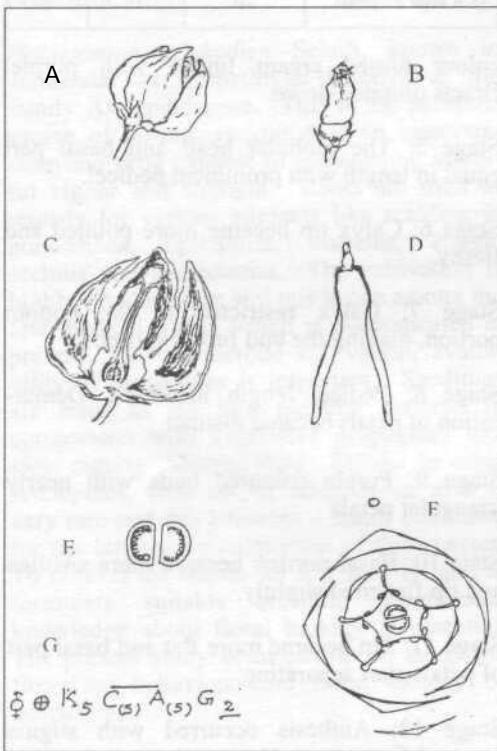


Fig 1. Floral biology of adapathiyam (A. Open flower, B. Gynostegium, C. LS gf flower, D. Pollinia, E, TS of ovary, F. Floral diagram. G. Floral formula)

Anther dehiscence

The data regarding anther dehiscence is given Table 2. Anther dehiscence occurred in flowers on the fourth day of opening. At this

time flowers were in the wilting stage with petals almost closed. Anther dehiscence started from 9.00 a.m. onwards and maximum dehiscence (92%) was noted from 11.00 a.m. to 1.00 p.m.

Pollen studies

Pollen grains were agglutinated in clavate shaped, slightly curved **pollinia**. Pollen grains were more or less **circular** or **oval** in shape without **exine**. Individual pollen had a diameter of 59.4 μm with a range of 50-75 μm . Pollen production per pollinium could not be estimated by **haemocytometer** method. The suspension of pollinia in water + extran was very turbid and even dispersion could not be obtained. This may be due to the **sticky** nature of pollen grains inside the pollinia.

The pollen viability examined by Alexander's **stainability** test revealed that higher values were observed on the first and second day of flower opening (95.0 and 94.4% respectively). Viability decreased thereafter and on fifth day only 57.1 per cent was recorded (Table 3). Proper staining was obtained only after dehiscing the pollinia by keeping in distilled water for one to two hours.

Pollen germination studies were conducted with intact pollinia. Line of dehiscence was noted in all pollinia when placed in distilled water and distilled water + sucrose. But consistent results were obtained in Brewbaker and Kwack's medium alone. Pollen tube emanation was observed from the **convex** side of the pollinia, (Sreedevi and Namboodiri, 1982). Pollen germination at different intervals could not be recorded since separation of pollen grains was difficult due to the sticky nature and also **teased out** pollen grains from the pollinia could not be germinated. No difference in germination was noted among pollinia collected from first, second and third day of flower opening, but only sparse germination was noted in pollinia collected from fourth and fifth day opened flowers,

Stigma receptivity

Shiny surface, light cream colour, fresh appearance and **nectariferous** surface indicate

receptive stigma. Lateral sides of the stigma were found to be receptive which is covered by a tight membrane. After the first day of the flower opening, stigma gradually lost the fresh colour, appeared dried and turned light brown. The data regarding stigma receptivity presented in Table 4 showed that the maximum fruit set of 10 % was recorded when pollination was done at anthesis. After two hours of anthesis, pollination of flowers gave only 5 per cent fruit set. Thus the study indicated that the stigma receptivity was very short and lasted only for two hours after anthesis.

Pollination

In Adapathiyan, the flowers appear to be protogynous with a distinct lag between the male and female phases. The pollination was strictly entomophilous with carpenter bees (*Xylocopaspp.*) as the major pollinators.

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