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Floral Phenology of *Delonixregia*(Boj. Ex Hook) Raf. (Family: Caesalpiniaceae)

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ABSTRACT

The various parameters included in the study are blooming phenology at the population, individual and inflorescence levels, floral dynamics like timing of anthesis, and anther dehiscence, floral architecture, mode of pollen presentation, pollen number per anther, pollen-ovule ratio, pollen viability, stigma receptivity, nectar secretion and quantity. Based on the data relating to these parameters of *Delonixregia*(Boj. ex Hook.) Raf. described and discussed. The trees of *D. regia*bloomed after leaf shedding. It flowers during March – September. The period of blooming extended over 128.5 (R = 97 - 158) days. The flowers per raceme were 11-14. They matured intermittently in acropetal succession; the gap was 2-3 days between the maturation of flowers. Flowering life of an inflorescence varied from 16-19 days, with actual flowering occurring on 6-8 days. On any day 1-3 flowers opened, two being more common. Anthesis occurred during 0930-1000 hours. Individual flowers were very striking and prominent with one relatively larger, standard, upright petal marked with white, yellow and red streaks. It acted as a nectar guide and its base concealed the nectar. Its basal part formed a tube-like structure by the incurvation of margins. It functioned for 36 hours. The other four petals were scarlet-red. Flowers were retained for four days. Stigma became receptive at 1430 hours of first day of flower life, while the anthers began to dehisce intermittently during 1530-1830 hours of first day of flower life. Stigma and pollen were functional for 20-24 hours. Pollen remained in clumps.

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Introduction:

Flowers are the organs of sexual reproduction, and the sexual process involves two important events - Pollination and Fertilization, that lead to the formation of fruit and seed. The seed represents the next generation and thus ensuring the continuity of species. The phenology of flowering on an individual plant, and the resulting overall floral display, onset and cessation of flowering, and the number of open flowers at any given time, are determined by the balance between initiation (=birth) and senescence (=death) of individual flower modules. The sexual efficiency of any plant species is dependent upon the interplay of floral morphology, floral phenology (daily and seasonal), vector of pollination and breeding system. The links between and among these parameters are vital for the success of reproduction. The main aim of the study is to examine the efficacy of the logistic model of flower and floral display dynamics on a plant.

Delonixregia(Syn. *Poinciana regia*) of the family Caesalpiniaceae is exotic - grown as an ornamental in India for its large red flowers. It is native to Madagascar. In India it has been successfully used in protecting channels and riverbanks.

A study of the floral phenology of this exotic species *Delonixregia* was undertaken. The different

aspects of the study included seasonal and daily blooming, anthesis and anther dehiscence, pollen production and release, pollen viability, stigma receptivity, nectar quantity and concentration.

Methodology:

The present study on floral biology and pollination ecology of *D. regia* belonging to family *Caesalpiniaceae* was carried out during 2006 -2009. For study the tree of *D. regia* present at different places of Visakhapatnam (17º41'N latitude and 82º18'E longitude) and Narasannapeta, Srikakulam district (18º20'N latitude and 83º50'E longitude), were utilized. These areas receive rainfall in the two monsoons – the North-East monsoon (December–February) and the South-West monsoon (June-September). The months of October and November receive the retreating monsoon rains and unpredictable cyclones. Temperature is highest during May, day temperature ranging between 30-40º C and night temperature between 20-28º C. Rainfall ranges between 100-150 cm per annum.

A brief description of the general distribution of study sites and economic importance of the study species is given in the following. *Delonix*Rafin. is a genus of flowering plants in the family *Caesalpiniaceae.* It contains moderate sized trees native to Madagascar and East Africa. Among the different species of *Delonix*the best known species is *D. regia*. Its common names include gold mohur, peacock flower, royal poinciana etc. derived from its large flame red flowers. It is now wide spread in most tropical and sub-tropical areas of the world and is exotic in India. The plant mainly valued as a decorative tree, often being planted in avenues and gardens. It can also be planted as live fence posts and as shade tree in dairy forms, Tea plantations and compounds. The large pods as well as the wood are used as fuel. The tree yields gum and the seeds contain gum, that may be useful in textile and food industries. Bark has medicinal properties.

Collection of blooming phenological data:

The period from the first opening of the flower buds to the time when the last flower completes its life was taken as the flowering period. After making cursorial observations of the flowering period of the study plant, field trips were undertaken at weekly intervals to different study sites to record the blooming period including the onset, progress and termination of the blooming of selected 25 trees for *D. regia*.

Collection of data on flower dynamics:

Inflorescence phenology:

The nature, morphology and orientation of the inflorescence as well as the morphology, orientation and arrangement of individual flowers on the inflorescence were carefully observed. Six different inflorescences each distributed on a different tree were tagged before the initiation of blooming. They were followed every day to record the number of opened flowers. The opened flowers were removed after counting to avoid their recounting the next day. These inflorescences were continuously observed until they ceased flowering to obtain data on their life span. The daily rate of flower production, and hence the flowering life of each inflorescence was thus assessed.

The nature of inflorescence, the orientation of flowers, their morphology, petal colour, anther dehiscence, pollen morphology, pollen production, pollen viability, stigma receptivity, ovule number and nectar production were recorded.

Timing and rate of anthesis and anther dehiscence:

After preliminary observations on the timing of flower opening, the progress and termination of flower opening or anthesis was followed from close quarters. Simultaneously, the mode of anther dehiscence, and whether the dehiscence occurred in the mature bud stage or after opening of the flowers were noted. The associated ambient air temperature and relative humidity were measured using thermometer, and hygrometer respectively.

Determination of pollen productivity:

A mature but undehisced anther was placed at the center of a clean microscope slide (75 x 23 mm) and dabbed with a needle in a drop of lacto-phenol aniline-blue. Then the anther tissue was examined through the microscope for pollen, if any; if no pollen grains were there, the tissue was removed. The resultant pollen mass was spread into a uniform narrow band and was scanned under compound light microscope (40x objective, 10x eye piece) and the number of pollen grains encountered were counted. This was repeated for 10 anthers collected from different inflorescences of different conspecific plants. From this, the mean number of pollen grains produced per anther was determined. The mean number of pollen produced per flower was arrived at by multiplying the number of anthers by the mean number of pollen grains per anther. Simultaneously, pollen grain size (determined by ocular and stage micrometer), shape, nature, exine pattern were also noted.

Determination of pollen-ovule ratio:

The pollen-ovule ratio of each plant species under study was obtained by dividing the number of pollen grains produced per flower by the number of ovules in a flower (9).

Assessment of pollen viability:

Pollen viability was tested *in vitro* and *in vivo* methods following Dafni (10). For *in vitro* tests fresh pollen was collected in a clean Petri dish and placed in sucrose solutions of different concentrations ranging from 10-80% (together with 5 ppm of detergent) for pollen germination. The cavity slides with the pollen were placed on U-shaped glass rods in the Petri dishes lined with moistened filter paper and incubated at selected time intervals for about 60 hours. They were observed every ½ hour under light microscope for the

germinating pollen which were then counted. For determining the viability of pollen grains *invivo*, the pollen from the freshly dehisced anthers was collected in Petri dishes and then applied with a camel hair brush at different intervals to stigma(s) of the emasculated flowers and enclosed with paper bags prior to anther dehiscence and anthesis. The pollinated flowers were examined for about 10 days for fruit set; depending on the batches of flowers that set fruit, the duration of pollen viability was determined.

Determination of stigma receptivity:

The condition of stigma was observed through a hand lens. The stigma that appeared, viscid and shiny was considered to have attained receptivity, and the loss of receptivity was indicated when the stigmas turned brown or brownish black or withered. The period of stigma receptivity was also determined by hand-pollination tests. Batches of mature flower buds of about the same age were emasculated before anthesis and covered with paper bags. They were hand-pollinated with fresh pollen at selected time intervals and were enclosed in paper bags, and followed for ten days for fruit set. The ability of the stigmas pollinated at different time intervals to produce fruit was taken to indicate their receptivity.

Determination of flower life time:

The interval between the time of mature flower-bud opening and the time of withering and/or dropping of the flower was considered as the life of the flower. For this, mature but unopened flower buds were selected randomly and tagged, and followed from the time of opening up to withering and/or dropping.

Nectar volume determination:

To measure the amount of nectar produced by a flower, some inflorescences of the plants in peak bloom were enclosed in insect proof covers and the accumulated nectar in the flower was removed with the calibrated micropipettes at desired intervals. The concentration of nectar was determined by keeping the nectar onto the prism of refractometer and percentage concentration was noted. For the analysis of sugar types of nectar, paper chromatography method was used (15). Nectar was spotted on Whatman No. 1 filter paper along with standard samples of glucose, fructose and sucrose were spotted separately on the same paper. The paper was arranged descendingly in chromatography chamber and run for 36 hours with a solvent system of butanol-acetone-water (4 : 5 : 1), dried at 105ºC in an oven for 5 minutes and sprayed with aniline-hydrogen-phthalate to develop the nectar spots. The developed nectar spots were compared with spots of the standard sugars and the type (s) of sugar in the nectar recorded.

Results:

Blooming phenology:

Delonixregia tree is deciduous. It bloomed after shedding foliage. Leaf-fall occurred in general during the last week of February and the second week of March. In the following month, leaf initiation and simultaneous flowering began. In some cases leaf shedding and flowering were not uniform in all the branches of a tree. Thus in these cases some branches were in foliage and some were in flower. In general blooming began during the last week of March and first week of April and progressed to a peak between the third week of May and second week of July and began to terminate during the third week of July and first week of September. Thus on the whole, the blooming season was compact with recognizable initial, peak and final phases. The length of flowering period varied from tree to tree (Table-1). On average the flowering period of 25 trees studied at different sites was 128.5 days and the range was 97 – 158 days.

Inflorescence Phenology (Plate 1):

Inflorescences are produced in clusters at the terminal growing branches. Each inflorescence is a raceme with the flowers produced laterally in acropetal order. The main axis is relatively elongated. Depending on the length of the main axis, the number of individual flowers produced varied, though not largely, from inflorescence to inflorescence. Enumeration of the number of flowers on 75 inflorescences distributed on different trees showed the presence of 11 – 14 flowers per inflorescence. Maturation of flowers occurred in acropetal succession a characteristic feature of recemose flowers, i.e. the flowers started maturing from the base of the inflorescence. The sequential maturation of individual flowers on an inflorescence followed for six inflorescences each distributed on a different plant showed that maturation of flowers did not occur on each consecutive day (Fig-1). The gap was 2 – 3 days between the maturation of flowers, and in one case there was a maximum gap of 5 days.

The flowering life of inflorescence varied from 16 – 19 days with actual flowering occurring intermittently on 6 – 8 days. The number of opened flowers varied from 1 - 3, on any day of flowering and the occurrence of two opened flowers being more frequent.

Floral dynamics (table - 2):

On fair weather days the mature flower buds began to open from 0530h onwards (Plate- II A). The flowers were fully open by 0930 – 1000 hours. The prevailing temperature during that period ranged between 28°C – 31°C and relative humidity between 61% - 73%. On rainy day flower opening was delayed. On one such occasion with rain in the morning hours, flower opening or anthesis occurred during 0730 and 1430 hours in other words the opening process was postponed and prolonged by 2 – 3 hours.

The individual flowers are very striking and prominent with scarlet-red or flame-red coloured petals and measured 1.2 - 12.7 cm across. Each flower has four spoon shaped spathulate spreading petals about 6 – 7.5 cm long and 4 - 4.5 cm width. One upright large

petal (the standard petal) is marked with yellow, white and red markings (Plate – II B). The five petals are imbricate in ascending order. The odd standard fifth posterior petal is innermost in bud enclosed by the lateral pair which is again enclosed by the two lowest anterior petals. The upright posterior standard petal also differs from other spreading petals in that it acts as a nectar guide. The basal part of standard petal is relatively broader than the basal part of other petals and forms a tube like structure by the incurvature of the margins which remain overlapping. Any animal visitor seeking nectar at this flower is guided by the odd petal and its folded base. The flower is complete and zygomorphic. Stamens are 10, free, exerted, measuring 3– 4 cm in length. All the ten stamens are fertile and freely exposed. Each stamen bears a bilobed anther which is relatively large, and versatile. The anther dehisces longitudinally exposing the pollen of the sticky mass.

The gynoecium is superior with fertile part measuring 2 cm in length containing the ovules and the style is 2 cm in length. The stigma is simple. The ovary is unilocular with ovules on axile placentation. The number of ovules ranged between 19–32 per ovary, the average being 27± 3.97.

The flower faces side wards. Both androecium and gynoecium are curved, and almost stand opposite to the standard petal (Plate- II F). The flowers are retained for 4 days. The odd posterior standard petal remains functional for 36 hours after anthesis. It then becomes folded inwards by its margins (Plate-II C). The colour of the petals begins to fade away (Plate – II D) and by end of the 4th day of flower life, all the petals drop away.

The flowers are nectariferous. It is concealed at the base of the odd petal (Plate- II E). Nectar is secreted in the flowers for two days of four days life span. At the time of anthesis nectar was absent. It is produced gradually by evening in the tube like structure present, but in traces. By the next day morning (0530 h), 5 µl nectar was produced and two hours later 1 µl, by successive hours its amount was decreasing and it was in traces. By second day evening nectar secretion ceases well before the infolding of the odd petal. Total amount of nectar secreted in flower lifetime is 6 µl. Nectar analysis revealed the presence sucrose, fructose, and glucose, the first being the dominant one. Nectar sugar concentration was 41.7%.

Pollen dynamics:

The average number of pollen grains per anther contained 2760 (range 2530 – 2980) and the number of pollen per flower averaged to 27625 ± 1272 (range 25318 – 29868). The time of anther dehiscence was not simultaneous with flower anthesis. It occurred nearly after 5 ½ hours of anthesis (during 1530 – 1830 h). Also all the ten anthers did not dehisce at a time. Forty five minutes after the dehiscence of first anther, the second anther dehisced. After another 15 minutes the third, fourth and fifth anthers dehisced. After another two hours the remaining five anthers dehisced. Thus anther dehiscence was staggered and pollen presentation was intermittent and took place during a period of three hours. The pollen grains are ellipsoidal sticky and remain adhered firmly. The surface shows depressions that are strikingly uniform and distributed in a systematic fashion.

The pollen grain viability was tested *in vitro* and *in vivo.*The results of both tests showed nearly similar duration of pollen viability. *In vitro*, the fresh pollen grains gave 100% germination in 20% sucrose solution. The grains of later age, showed decreasing percentages of germination for 36 hours. Thus 12 hours-old pollen grains showed 70% germination, 16 hours-old pollen grains showed 65% germination, 20 hours-old pollen grains showed 30% germination, 24 hours-old pollen grains showed 20% germination, 30 hours-old pollen grains showed 10% and 36 hours-old pollen grains showed 5% germination (Fig-2). The pollen grains of later age did not germinate.

In another method (*in vivo)*, the percentage of fruit set in hand pollinations was taken to indicate pollen viability (Table-3). Pollination with fresh pollen gave 88% fruit set, with 6 hours old pollen 68%, with 12 hour old pollen 56%, with 18 hour old pollen 36%, with 24 hour old pollen 20%, with 30 hour old pollen 12 %. The pollen stored further gave no fruit set.

Determination of pollen numbers of the anthers on different days of the flower life indicated that by the first day evening (1600-1900) i.e. just before dehiscence of the anther, the number of pollen grains was (100%) 27460 (Table-4), and morning (0930 h) of the second day 35.6% of the pollen produced was removed, and by the morning (0930 h) of the third day, altogether 69.23% of the total pollen produced was removed, and by the morning of the fourth day altogether 92.9% of the total pollen produced in anther was depleted. The amount of pollen remaining by the evening of second day was about 50% of total pollen production per flower. Since pollen viability lasted for about 24-30 hours of anther dehiscence, only about 50% of the total pollen was removed from the anther by about 24 hours of anther dehiscence. The amount of pollen removed after was equally large and was ineffective in biological function.

The stigma attained the receptivity after five hours of flower opening time (0930 h) that is at about 1430 h the stigmas appeared shiny with freshness and sticky indicating its receptive condition. On the second day morning, pollen grains were found deposited as observed under the light microscope of the pressed stigmas. The number of pollen deposited ranged between 60 – 150 on a stigma. By the evening of the second day of flower life the stigma turned brown. And also stigma receptivity was tested by hand-pollinations. When the stigma is fresh and in receptive condition hand-pollination resulted fruit set 92%, 6 hours old

stigma hand-pollination resulted of fruit set 72%, 12 hours old stigma hand-pollination resulted of fruit set 56%, 18 hours old stigma hand-pollination resulted of fruit set 28%, 24 hours old stigma hand-pollination resulted of fruit set 4% (Table-5), after that old stigma hand-pollination resulted no fruit set. Thus the stigma remained receptive for about 20 hours. Its maturation was about 2 hours ahead of anther dehiscence. On average 1020 pollen grains are produced per ovule.

Discussion:

In the tropics several tree species are reported to bloom in the dry season (22), and the blooming phenology has been considered to have evolved as a result of selective role of pollinators on flowering time (25). Not only flowering times of individual tree species, even at the community level synchronization of flowering has also been explained as a result of pollination selection as shown by Janzen (22) in Central American forests.

However, in Central India four phenological patterns of flowering namely vernal flowering, serotinal flowering, monsoon flowering and post monsoon flowering have been recognized (5). Tree species with vernal flowering come to bloom during spring season or Vasanthritu (February - March). Species under serotinal flowering produce bloom during summer season or Grieshmaritu (April-June). Monsoon flowering occurs during rainy season or Varsharitu (July – September) and post monsoon flowering during Sharadhritu (September – October).

The study area being located at Srikakulam and Visakhapatnam on the east coast of Bay of Bengal and Anatapur located at South – West of Andhra Pradesh, also experiences tropical monsoon type of climate and the year is divisible into four seasons as mentioned below.

1. Winter season (January – February)
2. Summer season (March – Mid June)
3. Rainy season (Southwest Monsoon) (Mid June – September)
4. North-east monsoon (October – December)

Interestingly the blooming season of *D. regia* mostly spreading over the period from April – August, covers the summer and rainy seasons. Thus it could not be categorized solely under the distinct categories of Bhatnagar (5). The blooming season of *D. regia* covers both Grieshma and Varsharitu. Thus in *D. regia*the number of flowering days is about 128 days.

As to the triggering factors of flowering phenology, seasonal variation in water availability is considered to determine the seasonal development in tropical trees. However, many developmental events do not correlate seasonal precipitation patterns as evidenced by the tropical trees frequently flowering during the early dry season after leaf fall. Such dry season flowering is against an attempt to infer causal relation from correlation between tree development and rainfall. Several authors suggest that variation in temperature and photoperiod could be the environmental cues triggering various phases of tree development (28). In the case of *D. regia* with blooming spreading over summer and rainy seasons, the prevailing temperature photoperiod could be the causal factors determining the blooming phenology. The prevailing minimum and maximum temperatures during the study period for *D. regia* was 25°C - 27°C and 30°C – 34°C respectively and the day length was 1333–1412 h.

Duration and pattern of flowering:

The duration of flowering refers to the length of blooming period. This may vary among the species. Also the species may vary with respect to the number of flowers produced per unit of time, based on the length of blooming period and density of flowering. Gentry(13) has described five types of flowering patterns for the family members of Bignoniaceae. The two extreme patterns are (1) mass-flowering pattern and (2) steady state flowering (2,3). The flowering phenology of individual plants of tropical species varies between these two extreme patterns. The individuals displaying mass flowering produce large number of flowers per day and bloom for a few days, those individuals with steady state flowering produce a few flowers per day but bloom for a long period, lasting several weeks to several months. Mass-flowering as a resource is important in shaping foraging behaviour of tropical pollinators (31,37). Such resources attract a high diversity of visitors (18), and can be fiercely contested (26,30). The flowering pattern of *D. regia*with individuals flowering for a period of 3 – 4 months can be designated as steady state flowering. There was asynchrony between different branches of tree and there was intermittent flowering within an inflorescence, but the general appearance of flowering of individual trees gives an impression of mass-flowering syndrome. The behaviour of inflorescence with one or two flowers opening intermittently and the individual blooming for longer period confirm at least to the steady-state flowering pattern in *D. regia*. The mass-flowering effect is caused by the retention of opened flowers for a longer period lasting for four days.

Steady state flowering confers several advantages (3). It allows better control of the relative investment in flowers and fruits, increases individual's chances of fertilizing a large number of mates, enables to receive pollen donors from a large number of genotypes, reduces the level of geitonogamy and forces pollinators to seek rewards from other conspecifics and entails less risk of reproductive failure resulting from bad weather or lack of pollinators.

Flowers and flowering patterns have evolved largely in response to selection for effective transfer of pollen grains to receptive stigmatic surface of a compatible flower. The "most effective pollinator principle" of Stebbins (32) holds that selection should

favour floral traits that attract and maintain only those visitors that provide the best pollination service. In other words, the idea of the most effective pollinator may have an overriding selective influence on floral morphology. Thus a harmony between flower morphology and colour, and the size and behavior of pollinator is expected. In general, flower size is strongly correlated with the pollinator size and the ovule number is a function of the type of pollinator and its out-crossing ability. Accordingly, Proctor and Yeo (27) and, Faegri and Pijl (11) have catalogued and described the vast array of pollination systems and formulated pollination syndrome or packages of characteristics in plants serviced by different groups of pollinators. Variations in the floral traits directly involve with pollinator attraction and efficiency which can result in different reproductive outputs and further selection (19). Facing of variable assemblage of floral displays, pollinators have shown to prefer plants with certain floral traits, such as high number of flowers (4,24), large flowers (7,21), large nectar rewards (12,34), inflorescence architecture (8,14), or particular flowering time (14). Flower colour and shape also influence pollinators (1,6,23,29,33,35,36).

The peacock flower of *D. regia* fits butterfly syndrome or psychophily. The butterfly blossoms are characterized by diurnal anthesis with no closing at night, weak odour, petals vividly coloured including pure red, blossoms erect with flat rim, but often narrow with ample nectar held hidden in narrow tubes and nectar guide simple or mechanical tongue guide is simply a sexual groove. The sexual organs and nectar are well separated by long distance by the flowers of *D. regia*, the anterior and lateral petals are bright scarlet-red and the posterior petal marked with yellow, white and red streaks in the base forming a narrow tube by infolding of its margins. In *D. regia* flowers open during the day and continue in that condition the following night and day evening. The standard petal then becomes folded indicating that nectar is no more available for the pollinator. Strikingly, there is no flat rim because the petals are free and divergent.

One of the possible reasons for short visitation sequences is the availability of nectar in such quantities adequate enough to attract and sustain the pollinator but not so much nectar that the pollinator becomes sedentary (16,17). Though *D. regia* flowers are large the nectar quantity per flower is very small (0.1 – 0.6µl). Consequently, the lepidoptoran pollinators do not remain for longer periods on the same plant characteristically they visited few flowers per foraging bout.

*D. regia*produce bisexual or hermaphordite flowers with both sexual organs functional. Plants with hermaphrodite flowers can contribute genes to the next generation through both male and female function, pollen and seeds respectively. The flowers are nearly homogamous with slightly protogynous nature.

The flowers produce more pollen and pollen viable for one and half day of four days of flower life span. They showed stigma receptivity for 24 hours. Plants could avoid exposure to infectious agents by minimizing stigmatic receptivity (20). Cruden (9) predicted that P/O ratio is indicator of breeding systems. The P/O ratio found in *D.regia* is predicted for facultative xenogamy. Cruden (9) reported that this mating system facilitates out-crossing when pollinators are available and facilitates selfing in their absence. The high P/O ratio seems to be imperative to compensate the pollen loss associated with the pollen collecting behavior of foragers.

There has been a growing concern and commitment for the preservation, improvement and management of biodiversity to ensure the health and stability of the planet earth, and wealth and sustainability of human societies. It is also being increasingly realised that a complete knowledge of sexual and pollinating system is of vital importance in the *in situ* and *ex situ* conservation of plant biodiversity.

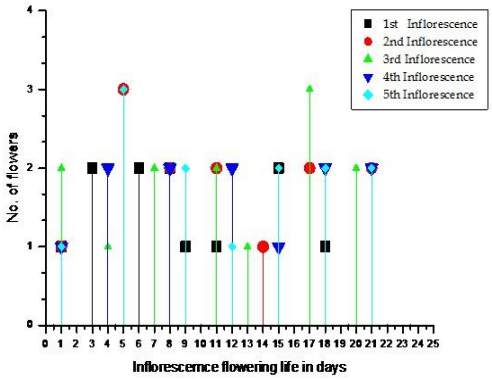


Figure: 1. Pattern of flower production in inflorescence of *Delonix regia*

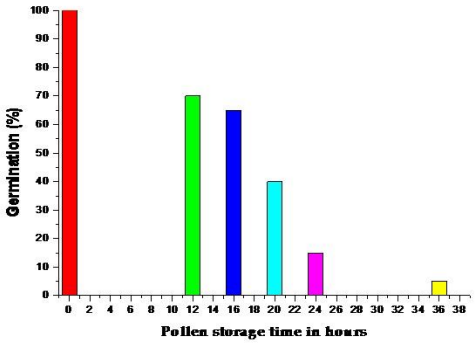


Figure: 2. Pollen germination percentages in *Delonix regia*

Table: 1. Flowering phenology of *Delonixregia*

Study site	No. of plants	Initial	Peak	Final	Total flowering days
Andhra University - Applied Physics Department	2	09 May to 20 May	21 May – 14 July	15 July – 20 August	103
Lawsons Bay Colony Road	4	28 March to 11 May	12 May – 19 July	20 July – 18 August	140
Andhra University - Instrumentation Department	2	08 May to 20 May	21 May – 16 July	17 July – 04 Sept.	116
Andhra University - Out Gate Opposite Road	3	25 April to 18 May	19 May – 20 July	21 July – 7 Sept.	135
Dabagarden Area	3	10 May to 22 May	23 May – 17 July	18 July – 28 August	110
Old C.B.I.	2	18 April – 16 May	17 May – 22 July	23 July – 07 Sept.	142
Andhra University - Post Office Road	3	05 April – 18 May	19 May – 20 July	21 July – 29 August	146
A.U. GMC R.S. Hostel Surroundings	3	12 May – 27 May	28 May – 12 July	13 July – 16 August	97
Municipal Guest House	1	31 March – 16 May	17 May – 15 July	16 July – 06 Sept.	158
East Point Colony Road	2	17 April – 14 May	15 May – 18 July	19 July – 04 Sept.	141

Flowering period in days: Range 97 – 158; Mean ($\overline{X}$) = 128.5 ± 19.57

Table: 2. Chronology of floral events in *Delonixregia*

Day	Time	Floral events
Day1	0530h	Flower initial opening
	1000h	Flower total opening
	1030h	Stigma immature
	1400h	Stigma receptive
	1600h	Anther dehiscence – 1
	1645h	Anther dehiscence – 2
	1700h	Anther dehiscence – 3 ,4,5
	1900h	Anther dehiscence -6,7,8,9,10
Day2	0500h	Stigma receptive
	1100h	Stigma sticky
	1630h	Standard petal folded
Day 3	0500h	Stigma dried
	1100h	Stigma became brown
	1700h	Stigma dropped
Day 4	1100h	All anthers dried
	1700h	Flowers began to fall

Table: 3. Longevity of *Delonixregia* pollen grains as assessed by hand-pollinations with stored pollen grains

Pollen storage Time (h)	No. Of flowers Pollinated	No. Of Flowers Fruit Set	Fruit Set (%)
0000	25	22	88
0600	25	17	68
1200	25	14	56
1800	25	09	36
2400	25	05	20
3000	25	03	12
3600	25	00	00

Table: 4. Loss of pollen grains dehisced from anthers in *Delonixregia*

Days	Time	No. of pollen grainsat flower	Release of pollen grains
Day 1	1830h	27460	0
	0530h	19114	8346
Day 2	0930h	17694	1420
	1330h	16494	1250
	1730h	13748	2716
	0530h	10116	3632
Day 3	0930h	8452	1664
	1330h	6540	1912
	1730h	5115	1425
	0530h	2095	2095
Day 4	0930h	1947	1073
	1330h	820	1127
	1730h	27	793

1830 - 0530h (Night) -30.39%

0530 – 1730h (Day) -19.61%

1730 – 0530h (Night) -13.2%

0530 – 1730h (Day) -18.2%

1730 – 0530h (Night) -7.63%

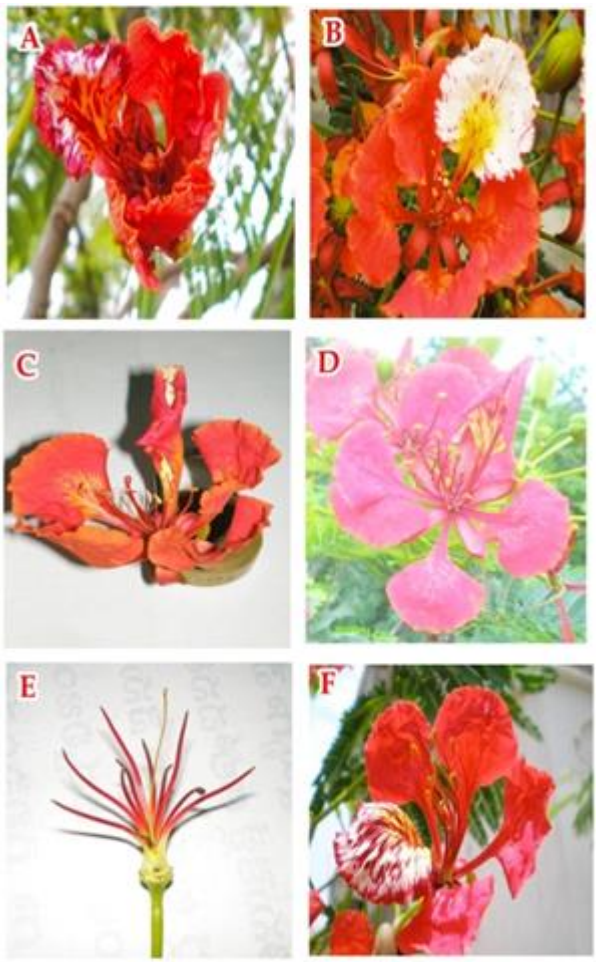
0530 – 1730h (Day) -10.8%

Table: 5. Stigma receptivity *in vivo* in *Delonixregia* as assessed by hand – pollination of stigma same age at six hour interval

Stigma age after anthesis (h)	No. of flowers pollinated	No. of flowers set fruit
00	25	23
06	25	18
12	25	14
18	25	07
24	25	01

Plate: I

Plate: II



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