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SHORT COMMUNICATION

ON THE REPRODUCTIVE BIOLOGY OF SALACIA FRUTICOSA WALL. EX M.A. LAWSON - AN ENDEMIC MEDICINAL PLANT OF THE WESTERN GHATS, INDIA

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ON THE REPRODUCTIVE BIOLOGY OF SALACIA FRUTICOSA WALL. EX M.A. LAWSON - AN ENDEMIC MEDICINAL PLANT OF THE WESTERN GHATS, INDIA

K. Subin 1, P.A. Jose 2 & T.V. Sarath 3

1 Sustainable Forest Management Division, Kerala Forest Research Institute, Peechi, Kerala 680653, India
2 subink1993@gmail.com, 3 pajosekfr@gmail.com (corresponding author), sarathtv35@gmail.com

Salacia L. belonging to the family Celastraceae, consists of about 200 species worldwide, distributed in tropical America, Africa and Asia (Mabberley 2008) of which 21 species are reported from India (Ramamurthy & Naithani 2000). Out of this, 15 species are reported from peninsular India and eight species from Kerala itself (Udayan et al. 2012). The true raw drug, Ekanayakam (Malayalam) / Pitika (Sanskrit) is extracted from Salacia reticulata Wight, however, the species is so rare and sparse for raw drug collection in situ. The Salacia oblonga Wall. ex Wight & Arn., S. fruticosa Wall. ex M.A.Lawson and S. chinensis L. are the substitutes used and all of them are overexploited and facing a high threat in their habitats (Chithra et al. 2010).

Salacia fruticosa is a woody climbing shrub, endemic to Western Ghats, distributed in the evergreen and semi evergreen forests and also in the plains. It has anti hyperglycemic properties (Venkateshwarlu et al. 2009). Endemism and fragmented distribution, over exploitation, poor fruit set and seed infestation have led to the study of reproductive biology of the plant in order to understand the reproductive constraints of the species.

MATERIAL AND METHODS

Periodic dynamic changes in reproductive phenological phases of the species Salacia fruticosa were monitored and recorded on a day to day basis at KFRI, Peechi with respect to bud initiation, development, anthesis, pollination behavior etc. as per the methods suggested by different authors (Faegri & Pijl 1979; Armstrong & Drummond 1984; Sreekala et al. 2008;
Jose & Pandurangan 2012, 2013). Stigma receptivity was determined by the physical appearance of stigma such as turgidity, shine and oily appearance and it is confirmed by using hydrogen peroxide ($\text{H}_2\text{O}_2$) (bubble formation). The pollen-ovule ratio was worked out as per the method suggested by Cruden (1977). Pollen fertility test was carried out using Acetocarmine staining method (Sharma & Sharma 1980). Pollen germination was carried out with 15% sucrose solution. Bagging experiment was conducted for evaluating the pollination behavior.

Study area
The study was carried out in a population of $S$. fruticosa growing in the medicinal garden of the Kerala Forest Research Institute, Peechi, situated between 10.529°N & 76.348°E (Fig.1).

Results
In Salacia fruticosa, the flower bud takes one week to reach the full bloom stage. The opening of the flower takes place from 11.00–12.00 hr. The flowers are protandrous as the anther dehisces at 10.00hr while the stigma is receptive only at 11.00hr. The stigma was found to be receptive for about 30 hours. Each flower has three anthers and 3-celled ovaries with 1 (rarely 2) ovules in each cell. Pollen grains are liberated through longitudinal slits of the anther. A single anther contains ~105 pollen grains, thus one flower comprises around ~315 pollen grains. Hence, pollen-ovule ratio was worked out as 105 pollens per ovule (105:1). The pollen grains are globose in nature and having 13µm in diameter. Nearly 92% pollen grains are found viable and 87% pollen germination was recorded at the time of anthesis. The pollen viability and germination was found to decrease and a drastic decline was recorded after three hours from anthesis though the stigma was found receptive for 30 hours. After around one-and-half months the fruits attain maturity and the percentage of fruit set was found to be 25% (detailed floral characters are given in Table 1 & Image 1). The emasculated flowers with artificial pollination as well as flowers which are polybagged (with big holes) were found to be inefficient.

Table 1. Reproductive characters of Salacia fruticosa

| Floral Characters                     | Findings                                           |
|--------------------------------------|----------------------------------------------------|
| Flowering period                     | Throughout the year                                |
| Flower type                          | Pentamerous, bisexual, actinomorphic               |
| Flower colour                        | Yellow                                             |
| Flower opening time (anthesis)       | 11.00–12.00 hr                                     |
| Floral nature                        | Protandrous                                        |
| Anther dehiscence mode               | Longitudinal slit                                  |
| Anther dehiscence time               | 10.00hr                                            |
| Average no. of pollens/ anther       | 105                                                |
| Mean no. of pollen grains/ flower    | 315                                                |
| Mean no. of ovules/flower            | 3                                                  |
| Pollen shape                         | Globular, smooth                                   |
| Stigma receptive time and period     | 11.00hr onwards (up to 30 hours)                   |
| Pollen - Ovule ratio                 | 105:1                                              |
| Pollen diameter                      | 13 µm                                              |
| Pollen fertility                     | 92.3%                                              |
| Fruit development period             | 45 days                                            |
| Percentage of fruit set              | 25%                                                |
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for fruit set, that underlines the autogamous nature of the species. Majority of the fruits on maturity were found to be infested and the seeds were consumed by the caterpillars of the adult butterfly, *Bindahara moorei* Fruhstorfer. About 70–80% matured fruits were infested by this insect.

**Discussion and Conclusion**

Knowledge of reproductive biology particularly the anthesis, pollen and stigma viability, nature of pollination and fruit set are essential to understand the causes of rarity of the species. The dehiscence of anthers and release of pollen grains prior to the receptivity of stigma is considered as an indicator for promoting facultative autogamy in the species. The low number of pollen grains, i.e., 105 pollen/anther was found to promote cross pollination through insects but the incidence of pollinators during blooming time was negligibly sparse. A low count of pollens and a sparse incidence of pollinators are limiting the species from both anemophily and entomophily. According to Cruden (1977), plants with pollen–ovule ratio lying between 31.9 to 396 support facultative autogamy and signifies the above observations in the species.

Depending upon the population history and reproductive features of the species, reduced pollinator service may have several negative impacts on the plant population including reproductive failure (Jennersten 1988) or decreased effective population size through reduced gene flow and increased selfing (Bawa 1990). These altered reproductive patterns may cause less of genetic diversity and/or reduced progeny fitness due to inbreeding depression (Jain 1976; Barrett & Kohn 1991). Self fertile individuals, however, may be at a selective advantage in some particular habitats, if outcrossing is disfavored because plant density is low or if pollinators...
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are scarce or cross pollination is inadequate (Jain 1976; Lloyd 1980).

Even though the stigma receptive for 30 hours, the drastic decline of pollen viability within three hours after anthesis reduces chances for effective pollination. The bagging experiment also underlines the chances for self pollination in the species. The low rate of pollination reduced fruit set to 25% in the species. The insect-pest incidence and its extent of damage on the seed and seedling output accelerate endangerment of the species in the near future.

**References**

Armstrong, E.J. & B.A. Drummond (1984). Floral biology of *Myristica fragrans* Houtt. (*Myristicaceae*) the nutmeg of commerce, *Biotropica* 32–38

Barrett, S.C.H. & J.R. Kohn (1991). Genetic and evolutionary consequences of small population size in plants: implications for conservation. In: Falk, D. & K.E. Holsinger, (eds.), *Genetics and Conservation of Rare Plants*. Oxford University Press, New York. pp. 3–30.

Bawa, K.S. (1990). Plant-pollinator interactions in tropical rain forest. *Annual Reviews of Ecology and Systematics* 21: 399–422.

Chithra, M., P.S. Udayan & I. Balachandran (2010). Systematic study of the genus *Salacia* L. occurring in Kerala, pp. 881–882. In: Nair, C.T.S. (ed.). *Proceedings of the 22nd Kerala Science Congress*, 28–31 January. Kerala Forest Research Institute, Perichi.

Cruden, R.W. (1977). Pollen-ovule ratios- A conservative indicator of breeding system in flowering plants. *Evolution* 31: 32–46.

Faegri, K. & L. Pijl (1979). *The Principles of Pollination Ecology*. Pergamon Press, London, 248pp.

Jain, S.K. (1976). The evolution of inbreeding in plants. *Annual Review of Ecology and Systematics* 10: 469–495.

Jennersten, O. (1988). Pollination in *Dianthus deltoides* (Caryophyllaceae): effects of habitat fragmentation on visitation and seed set. *Conservation Biology* 2: 359–366.

Jose, P.A. & A.G. Pandurangan (2012). Reproductive biology of *Ochreinauclea missionis* (Wall. Ex G. Don) Ridsd. An endemic and vulnerable tree from the Western Ghats, India. *Annals of Forestry* 20(2): 161-167.

Jose, P.A. & A.G. Pandurangan (2013). Reproductive biology of *Gluta travancorica* Bedd.. An endemic and threatened tree from the Southern Western Ghats, India. *Annals of Forestry* 21(2): 165–171.

Lloyd, D.G. (1980). Demographic factors and mating patterns in Angiosperms, pp. 677–688. In: Solbrig, O.T. (ed.) *Demography and Evolution in Plant Populations*. Blackwell, Oxford.

Mabberley, D.J. (2008). *Mabberley’s Plant-Book: A Portable Dictionary of the Vascular Plants, their classification and uses*. Cambridge University Press, 1021pp.

Ramamurthy, K. & B. D. Naithani (2000). Hippocrataceae, pp. 138–162. In: Singh, N.P., J.N., Vohra, P.K. Hajra & D.K. Singh (eds.). *Flora of India* 5. Botanical Survey of India, Calcutta.

Sharma, A. & A. Sharma (1980). *Chromosome techniques – Theory and Practice*. Butterworth & Co. (Pub.) Ltd., London, 724 pp.

Sreekala, A.K., A.G., Pandurangan, R. Ramasubbu & S.K. Kulloli (2008). Reproductive Biology of Impatience coelotropis Fischer, a critically endangered balsam from the Southern Western Ghats. *Current Science* 95: 386–388.

Udayan, P.S., R. Yohannan, M.S. Devipriya, V. Devipriya & A.K. Pradeep (2012). A new species of *Salacia* (Hippocrateaceae) from south India. *Edinburgh Journal of Botany* 69: 255–258.

Venkateshwarlu, E., R. Narisinha, A. Reddy, A.S. Sunder, G. Kiran, J.V. Rao & S. Madhusudhan (2009). Anti-hyperglycemic activity of methanolic extract of *Salacia fruticosa* leaves in alloxan induced diabetic rats. *Drug Invention Today* 1(2): 95–97.
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