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Research Article

Floral biology of *Anisomeles malabarica* R.Br.

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Abstract

The floral biology of *Anisomeles malabarica* R.Br. was revealed by the study of floral morphology, anthesis, anther dehiscence, Pollen numbers, Pollen load, type of nectar, breeding behaviour by autogamy, geitonogamy and xenogamy was tested through controlled pollination, floral visitors and Bud drop. lntensive flowering period was noticed between February and April. Life span of flowers is approximately 15 days and anthesis take place between 1.50 a.m. to 2.05 a.m. The nectar secretion is maximum at 8-10 am at time of flowering and concentrated by fructose, sucrose, and glucose respectively. Approximately 1250 pollen grains per anther were recorded. Pollen viability was about 98% and stigmatic pollen loads was maximum at 8-10 am. The floral forages comprising butterflies like *Danaus genutia, Belenois aurota, Papilio demoleus* and insects such as *Xylocopa* sp. visited intensively during 8-10am. There is a correlation between nectar secretions, forages visitation and stigmatic load have been revealed. In controlled pollination treatments Xenogamy resulted 75% of flowers was fruit set. By this study the life cycle of *Anisomeles malabarica* R.Br. was documented.

INTRODUCTION

Pollination studies have contributed useful information on the degree of mutual dependence between species and reproductive ecology of plant community. Floral morphology is one of the aspects for plant-pollinator interactions. Depending on floral morphology plant species differ in the type of reward offered to the pollinating agent or in the accessibility of this reward to a particular pollinator. Several floral characters such as corolla shape, colour, flowering phenology and quantity of nectar or pollen have been directly associated with the identity of pollinators Kishore *et al*. (2012). pollination is an important factor in the structure and timing of flowering of many plant communities (Pleasants 1983; Rathcke 1983, 1988). Such information is important from both pollination ecology perspectives and in estimating the socioeconomic value of a species.

Anisomeles malabarica R. Br. belongs to the mint family comprising 210 genera and 3500 species is cosmopolitan is distribution. The lower lib is characteristic and responsible for the conserved family name, labiatae. The family is represented in India by 64 genera and 350 species of which 60 species and 5 varieties 18% are strictly endemic to peninsular India. A comprehensive study on phenology, floral biology, nectar dynamics and reproductive biology is scarce in Lamiaceae members at species level. So in this perspective the present study was experimented on *A. malabarica* was assessed.

MATERIALS AND METHODS

Study Area:

The study area was foot hills of Sankari hills, Sankari taluk, Salem district, Tamil Nadu was selected for study. It is situated at 11^0 29'02" N altitudes and 77^0 52'02" longitudes. The vegetation is dry thorny shrub forest and it receives an annual rainfall of 90cm.

Phenology:

Floral morphology was recorded by using flower buds and mature buds, anthesis, and anther dehiscence, evaluation of the intensity of blooming flower structure, size, shape and colour as well as number of flowers per inflorescence, number of opened flowers per day and flower longevity were documented as per Marcia Motta Maues *et al.*(2008)

Pollen count:

A volume of pollen mixture of a flower was placed in a hemocytometer, pollen grains were counted and value was used to estimate the total number of pollen grains per flower. (Etcheverry 2005).

Pollen load:

Pollen load was observed by number of pollen grain deposited on the stigma after pollination. Pollination efficiency was calculated dividing pollen load by the number of pollen grains produced per flower. (Alexader 1987).

Sugar Concentration:

A known volume of collected nectar was immediately loaded on the whattman No.1 chromatographic paper assess the kind of nectar sugar, using n-butanol acetic acid and water(4:5:1) as the running solvent. The different components of sugar were separated on the chromatographics paper and eluted by dissolving the spots in 80% ethanol. The extract was analyzed quantitatively by the colorimetric method of (Yam and Wills 1954).

Controlled pollination:

In controlled pollination treatments 3 types of pollination were examined they are autogamy-self-pollination (flowers are bagged before opening). Hand Self-pollination the pollen grains are artificially dusted on receptive stigma and anthers are emasculated and flowers are bagged to avoid cross pollination. Xenogeny-hand cross pollination the anthers are emasculated before anther dehiscence (the pollen grains artificially dusted on receptive stigma and flowers are bagged) the pollen grains are collected from another flower of different plant of *A.malabarica.* (Solomon Raju *et al.*2004).

Forages:

A floral visitor was observed to settle their potential as pollinators. The behaviour on the flower, flying pattern across inflorescences, time of visit and kind of resource collected. Captured individuals were pinned and identified. The numbers of flowers visited by the insects were counted and the total time spent on these flowers recorded with a stopwatch. From these data, the mean number of flowers visited was calculated.

Bud drop:

Bud drop was evidenced by fifty fallen buds were collected and observed carefully. Solomon (Raju *et al.* 2004).

RESULTS AND DISCUSSION

The intensive flowering of *A.malabarica* was recorded between February to April. The relative intensity of flowering produces about 7 to 190 flowers/plant. This value comprises the total number of flowers produced by each individual during the flowering period. Flowers are bilabitae in shape, corolla purple colour, 0.9cm in breadth, 1.5cm in length. Flowers life span approximately 15 days, after which the corolla deceased together with stamens (fig: 1).

Pollen load ensure pollination, *A.malabarica* stigmas received an approximately 288 pollen grains/per day. In early morning 6.00 am to 8.00 am stigma receives about 0.07% pollen grains. In 8.00 am to 10.00 am stigma receives 0.26 % pollen grains, During 10 am to 12 pm stigma receives 0.04% and 12.00 pm to 2.00 pm stigma receives 0.05% pollen grains and 4.00 pm to 6.00 pm stigma dose not receives pollen grains or least amount of pollen grains (Table:3).

The flower of *A.malabarica* receptive for one day. The anthesis starts between 1.50 am to 2.05 am. Nectar secretion started before flower opening in this species and increased soon after flower opening and continued till early morning. Nectar is secreted by nectar glands inside the corolla tube. The amount and composition of total sugars of nectar varied from hour to hour there are low and high peaks in nectar which is highly enmarked in the species. The mean volume of nectar produced by a flower was 1.5 ± 0.35µl. Sugar analyses has revealed that sucrose, fructose and glucose were the main components in this species. The ratio of fructose & sucrose was maximum at 8-10 am (20.7 ± 0.57µg) and minimum at 6-8 am (2.04 ± 0.065 µg).

Table: 1 Identification of Sugar Composition of Nectar by Chromatograph Method

S.No	Time	Rf Value	Compound
1	6-8 am	0.24	Fructose
2	8-10 am	0.22	Fructose / Glucose

Table: 2 Sugar composition of nectar in the *A.malabarica R.Br*

Time	No.of flowers	Nectar volume per flower(µl)	Percentage of sugar	
			Fructose & sucrose (µg) per flower	Glucose (µg) per flower
6-8 am	30	0.5 ± 0.10	2.043 ± .065	1.828 ± .081
8-10 am	30	1.5 ± 0.35	20.778 ± .57	20.232 ± .65

Table: 3 Stigmatic pollen loads in *A.malabarica R.Br*

Time	Percentage of pollen loads
6-8 am	0.07%
8-10 am	0.26%
10-12 am	0.04%
12-2 pm	0.05%
2-4 pm	0.05%
4-6 pm	No pollen grains found

Table: 4 Insect / Bees Visitors observed feeding on flower nectar of *A.malabarica R.Br*

S.No	Flower visitors	Insect / Bettles Observed from 24.2.11 to 28.4.11				
		No of visit	Frequency of visit in a day			
			6-10 am	10-1 pm	1-4 pm	4-6 pm
1	*Xylocopa latipes*	206	100	26	8	72
2	*Xylocopa aestuaus*	15	14	1	-	-
3	*Xylocopa violacea*	81	53	15	3	10
4	*Mylabris pustulata*	67	67	67	67	67
5	*Dananus genutia*	4	-	1	-	3
6	*Belenois aurota*	2	1	-	1	-
7	*Papilio dmoleus*	18	7	8	2	1

The percentage of the glucose was maximum at 8-10 am (20.2 ± 0.65 µg) and minimum at 6-8 am (1.8 ±0.081µg) (Table: 1 & 2). The most frequent species of flowers are great numbers of beetles, 4 different groups of insects such as *Xylocopa latipes, Xylocopa aestuaus, Xylocopa violacea* and 3 butterflies such as *Dananus genutia, Belenois aurota, Papilio dmoleus* were captured on the flower (Table:4). *Mylabris pustulata* was shown without any activity from 6 am to 9 am in the stem, after while the sunlight was increase the beetle moves gradually towards the inflorescences. In evening time the *Mylabris pustulata* movement looks very active when compared to the morning time. *Xylocopa latipes, Xylocopa aestuaus* and *Xylocopa violacea* beetles were very active during visit to the flowers. In morning hours from 6 am to 10 am *Xylocopa latipes, Xylocopa aestuaus, Xylocopa violacea, Belenois aurota* and *Papilio dmoleus* were visited the flowers frequently.

Xylocopa latipes visited more frequently at 6 am to 10 am, when compared to the other experimental times. *Dananus genutia* visited the flowers from 10 am to 1 pm and 4 am to 6 am and not visited during 6 am to 10 am. *Papilio dmoleus* visited round the day from 6 am to 6 pm, *Belenois aurota* visited during 6 am to 10 am and 1 pm to 4 pm.

In controlled self-pollination. Out of 20 flowers experimented 3 flowers (15%) were fruits set, in controlled hand self-pollination out of 20 flowers, 7 flowers (35%) were fruit set, in controlled cross pollination out of 20 flowers, 15 flowers (75%) were fruits set.

The showy inflorescences of *A.malabarica* at the flowering peak, results in a flowering display which may attract visitors from long distances. Their clumped distribution is very attractive to visitors. Higher inflorescences number provide greater advertising area to the plant and this added to high number of open flowers, simultaneously attract more attention of visitants and potential pollinators.

The low pollen load deposited on the stigmas could be related in the part to relatively of an adequate pollen activity, reduces the total pollen flow. The low pollen load may also due to open-pollinated conditions and time of anther dehiscence. The high pollen load 8.00 am to 10.00 am is evidence due to pollinator activity and anther dehiscence.

Sugar analysis has revealed that sucrose, glucose and fructose were the main component in the species. The nectar composition of *A.malabarica* correlated with study on (Frost and Frost 1980; Gill and Conway 1979) nectar of *Leonotis nepetifolia* and *L .leonursus* and suggested the presence of sucrose, glucose and fructose which was also confirmed by (Vos *et al.* 1994; Dafni *et al.* 1988) for eight species of *Leonotis* and nine species of other Lamiaceae members.

The flower visitor can be categorized into pollinator and non-pollinator, according to analysis of observation of their behaviour as to whether or not take part in the pollination of *A.malabarica* . All the species of *Xylocopa latipes, Xylocopa aestuaus, Xylocopa violacea* are considered legitimate pollinators due to their pollen loads and opportunities to contact stigma. *Myllabris pustulata* is a floral herbivore. Most of the flowers were insect-loving and they emit at night a sweet scent which attracts insects from a distance. When the colour fails the scent is paticularrly useful in directing the insects to the flowers (Axel Ssymmank *et al.*2008), but in *A.malabarica* there is no perceptile smell, so colour may play an important role in attracting visitors.

From geneticist view point geitongamy is similar to self-pollination because all the flowers on a part are normally genetically identical (Hakimeh Olomi and Farkhundeh Rezanejhad 2009). Cross-pollination makes sense only if two different plants, either of an same species or different species are involved in the process (Fatikahriman 2015). However pollination ecologists lead that since geitonogy and xenogamy both require similar ecological factors for pollen transference they should considered under one category (Soloman Raju *et al.* 2004; Kishore *et al*.2012).

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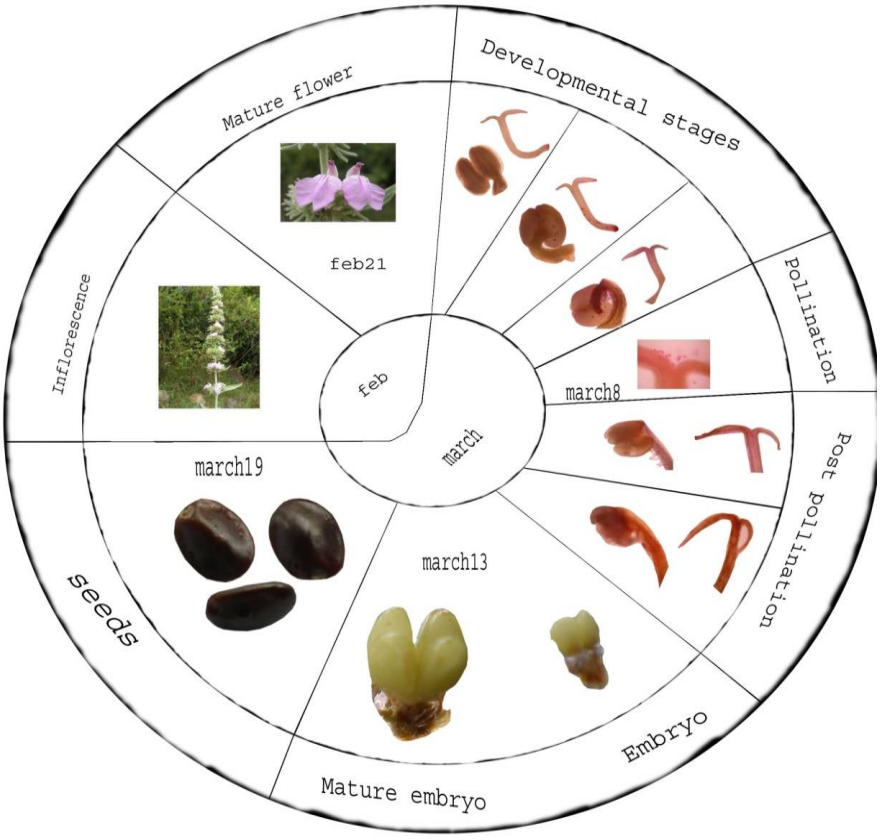

Figure: 1 Reproductive cycle of *A.malabarica*

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