

Diversity and Foraging Behaviour of Insect Pollinators on *Murraya koenigii* (L.) (Rutaceae)

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ABSTRACT

The present studies on diversity and foraging behaviour of insect pollinators on *Murraya koenigii* (L.) was carried out during March - April 2019 at Akot town situated in Akola district of Maharashtra. Ten insect species visited *Murraya koenigii* flowers viz. Five hymenopterans and five lepidopterans. This study revealed that hymenopterans were found to be the most dominant (97.5%) flower visitors, followed by lepidopteron insects (2.5%). Among these *Apis florea*, *Apis cerana indica*, and *Apis dorsata* were found to be the most frequent pollinators. The result on foraging behaviour of bees *Apis florea* started visiting *Murraya koenigii* flowers in early morning at 06.00 hrs, *Apis cerana indica* at 6.30 hrs and ceased their activity later in the evening. *Apis mellifera* and *Apis dorsata*, they started visiting the flowers from 7.00hrs. Maximum foraging was by *Apis florea* (12 flowers/minute) followed by *Apis cerana indica* (10 flowers/minute) and *Apis dorsata* (9-10 flowers/minute). Time spent per flower was the maximum with lepidopteron (25 sec./flower) followed by Moth (15 sec./flower)

Keywords : *Murraya Koenigii*, Insect, Foraging Behaviour, *Apis Florea*

I. INTRODUCTION

Pollination plays an important role in the reproduction and fruit set of flowering plants (Corbet *et al* 1991, Buchmann and Nabhan 1996). Many agricultural crops and natural plant population are dependent on pollination and offer on the services provided by wild, unmanaged, pollinator communities (Free, 1993, Kluser and Peduzzi, 2007). Insect pollinators especially honeybees play an important role in pollination of many wild and cultivated plants. These helps in increasing the quality and quantity of agricultural produce (Sihag, 1986)

Murraya koenigii (L.) belongs to the family Rutaceae and is a native of India, Srilanka and other south Asia countries. It is more or less deciduous shrub or small tree. It is aromatic in nature. Flowers are produced in

terminal cymes, each bearing 50-65 flowers. Flowers, ebracteate, white, sweet scented, fragrant, bisexual, complete, actinomorphic and hypogynous.

Murraya koenigii is a potential medicinal plant highly valued for its characteristic aroma and bioactive compounds. *Murraya koenigii* has diverse role in traditional medicine and is known for its stomachic properties. Leaves are often used in curries for flavouring and seasoning due to their aromatic nature. The bioactive compound possess antioxidant, antimicrobial, anthelmintic, analgesic, anti-inflammatory, antidiarrhal properties (Gahlawat *et al* 2014).

By keeping this view, the present study was carried out to record the different insect pollinators and foraging behaviour of honeybees visiting *Murraya koenigii* flowers.

II. MATERIAL AND METHODS

The study was carried out in Akot situated in Akola district of Maharashtra during March-April 2019. Akot town lies between latitude 21. 06 N and longitude 77. 06 E in the northern most of the Akola district of Maharashtra.

Observations on the insect pollinators visiting the flowers of *Murraya koenigii* was recorded during the peak flowering period . The number of flowers visited by visitors was recorded at 2 hrs intervals between 06. 00 hrs - 18. 00 hrs. The photographs of selected visitors were also taken. The foraging rate of different types of insect visitors was recorded in terms of the number of flowers visited per minute . The foraging speed of bees was recorded in terms of the time spent by each species on a flower. The observations on foraging behaviour of insect visitors were undertaken consecutively for 15 days.

III. RESULTS AND DISCUSSION

Flowering period of *Murraya koenigii* was started from first week of March and lasted till end of April. The peak period of flowering in *Murraya koenigii* was observed to be the last week of March to second week of April. Flowers were borne in terminal cymes , white in colour and sweet scented. During the observation 10 insect species belonging to seven families of two orders, Hymenoptera and Lepidoptera (Table 1) were recorded during the peak flowering period of *Murraya koenigii* plants. Among all , major floral visitors were the hymenopterans comprising of six species viz. *Apis florea*, *Apis cerana indica*, *Apis mellifera* *Apis dorsata*, Moth and five species from Lepidoptera viz. *Barbo cinnara* , *Catopsilla pyranthe* , *Pachliopta aristolochiae*, *Hypolimnas bolina* and unidentified butterfly. The bees *Apis cerana indica*, *Apis florea* and *Apis dorsata* were found to be major and frequently observed visitors. Butterflies *Barbo*

cinnara, *Catopsilla pyranthe*, *Pachliopta aristolochiae* , *Hypolimnas bolina*, unidentified butterfly and Moth were the occasional visitors (Table1). Among the different insect pollinators, *Apis florea* was the predominant species found to visit the inflorescence during the entire flowering period. Results showed that *Apis florea* commenced its foraging activity very early in the morning 6. 00hrs and peaked during 09. 00-15. 00 hrs declined at 17. 00 hrs and was very low at 18. 00 hrs. *Apis cerana indica* began foraging after half an hour of *Apis florea* at 6. 30 hrs, peaked during 1100-1300hrs. The bees *Apis florea* and *Apis cerana indica* after landing on the inflorescence walked on the same and collected pollen and nectar from flowers. *Apis dorsata* started foraging at 6. 30 hrs, peaked during 10. 00 -13. 00 hrs declined in the afternoon and was not recorded at 18. 00 hrs. Of all the insect visitors , *Apis florea*, *Apis cerana indica* and *Apis dorsata* were the most abundant visitors. *Apis mellifera* was found to be the least abundant among order hymenoptera. Foraging speed of different honeybees in terms of time spent by each species on a flower is presented in (Table 2). Among the honeybees, the mean foraging speed throughout the day period were found to be maximum for *Apis florea* (4. 31sec.) followed by *Apis cerana indica* (3. 64 sec) *Apis mellifera* (3. 05 sec)and *Apis dorsata* (2. 86 sec.)

Foraging rate of different honeybees in terms of number of flowers visited per minute per forager is presented in Table 3. Among the four honeybees *Apis florea* having the highest mean foraging rate (11. 1) which was followed by *Apis cerana indica* (10. 91), *Apis dorsata*(10. 73) and *Apis mellifera* (10. 11). It was observed that maximum numbers of flowers visited at 10. 00-12. 00 hrs and 12. 00-14. 00 hrs. The bees spent more time in single flower , visited less number of flowers. During study, it was observed that *Apis dorsata* spent more time in single flower and visited less number of flowers. Butterflies visited during 08. 00 hrs to 12. 00 noon. They fed on nectar

and their stay on the flower varied from 20-25 sec. Moth visited 2-3 flowers per bout and stayed for 60-90 sec. and collect the pollen grains. Butterflies and Moth visited flowers very occasionally.

The visits of insect visitors were low at the time of commencement and cessation of flowering period but these remained high during mid flowering period. The differences may be due to variation in the floral density during the span of blooming of tree . Similar findings were reported by Kendell and Smith (1975);Wilson and Price (1977);Schaffer and Schaffer (1979);Schemske (1980);Dhaliwal and Atwal (1985) who stated that at the peak flowering, number of flowers was more and these were visited by larger number of pollinators. Another important factor for attraction of more visitors is found to be presence of aggregated/massed flowers is preferred by flower visitors. Faegri and Van der Pijl(1979) also support that aggregated massed flowers are preferred by flower visitors. Proctor *et al* (1996) reported that massing together of flowers in inflorescences enhances the floral display to attract pollinators.



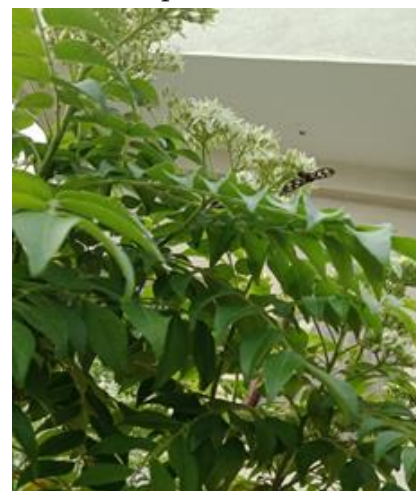
Apis florea, Apis dorsata, Apis cerana indica



Apis dorsata



Apis florea



Moth

Table 1. Diversity of different insect species on *Murraya koenigii* species

Name of species	Order	Family	Foraging Type	Visitors Frequency
<i>Apis florea</i>	Hymenoptera	Apidae	P,N	VF
<i>Apis cerana indica</i>	Hymenoptera	Apidae	P,N	VF
<i>Apis dorsata</i>	Hymenoptera	Apidae	P,N	VF
<i>Apis mellifera</i>	Hymenoptera	Apidae	P,	VF
Moth unidentified	Hymenoptera	unidentified	Pollen	VO
<i>Barbo cinnara</i>	Lepidoptera	Hesperiidae	N	VO
<i>Catopsilla pyranthe</i>	Lepidoptera	Pieridae	N	VO
<i>Hypolimnas bolina</i>	Lepidoptera	Nymphalidae	N	VO
<i>Pachliopta aristolochiae</i>	Lepidoptera	Papilionidae	N	VO
Unidentified Butterfly	Lepidoptera	Unidentified	N	VO

Table 2 : Foraging speed of insect pollinators on *Murraya koenigii* flowers (time spent in second per flower per forager)

Time	<i>Apis florea</i>	<i>Apis cerana indica</i>	<i>Apis dorsata</i>	<i>Apis mellifera</i>
600-800	4.33	3.53	3.23	00
800-1000	4.46	4.13	3.53	3.73
1000-1200	5.20	4.60	3.40	3.53
1200-1400	5.06	4.46	2.53	2.86
1400-1600	3.73	2.73	2.33	2.60
1600-1800	3.13	2.40	00	00
Total	25.91	21.85	17.18	18.31
Mean	4.31	3.64	2.86	3.05

Table 3 : Foraging rate of insect visitors on *Murraya koenigii* flowers (number of flowers visited per minute per forager)

Time	<i>Apis florea</i>	<i>Apis cerana indica</i>	<i>Apis dorsata</i>	<i>Apis mellifera</i>
600-800	10.43	9.62	9.45	8.56
800-1000	11.05	11.89	10.41	9.67
1000-1200	12.04	12.02	11.67	11.17
1200-1400	12.31	12.13	12.04	11.67
1400-1600	11.14	10.24	11.21	10.12
1600-1800	9.63	9.56	9.63	9.52
Total	66.6	65.46	64.41	60.71
Mean	11.1	10.91	10.73	10.11

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