



Diversity and foraging dynamics of insect pollinators on rambutan (*Nephelium lappacum* L.)

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ABSTRACT: Studies were conducted to document and understand the pollinator diversity and foraging behavior of major insect pollinators on rambutan (*Nephelium lappacum* L., Family: Sapindaceae) during 2008-10 at Central Horticultural Experiment Station (CHES), Chettalli, Kodagu, Karnataka, India. Stingless bee, *Trigona iridipennis* and Indian honeybee, *Apis cerana* were the most dominant foragers with a mean visitation of 3.81 and 3.54/panicle/10 minutes. Other species included *A. florea*, *A. dorsata*, an unidentified wasp and calliphorid flies. Peak activity of all foragers was recorded between 10.00-11.00 AM. The extent of fruit set in open pollinated panicles was 29.35fruits/panicle while bagged flowers completely failed to set fruits. The studies established the role of pollinators in rambutan fruit set and hence it is recommended to conserve natural populations or to augment them through placing honeybee colonies to realize maximum fruit set in rambutan.

Keywords: Bees, fruit set, pollination, rambutan

INTRODUCTION

Rambutan (*Nephelium lappacum* L., Family: Sapindaceae), a native of Indonesia and Malaysia, is one of the important underutilized fruit crops with a high potential for commercial cultivation. It is a crop of humid tropics. The fruit has translucent pulp of sweet or sub-acid taste with refreshing flavour and is a good source of vitamin C. A project has been initiated at Central Horticultural Experiment Station (CHES), Chettalli, Kodagu, Karnataka, India, for collection and demonstration of potential underutilized fruit crops suitable for the Western Ghat region. Under this programme, forty seedlings of rambutan were grown at CHES farm. Rambutan is a cross pollinated crop and depends on insects for pollination and fruit set. Aromatic rambutan flowers are very attractive to insects. There is no information on the species diversity and foraging behavior of major pollinators under Indian humid tropic conditions. Since the crop is also a recent introduction, it is felt essential to study and document pollinators for further evaluation and recommendation as a part of crop production technology. Poor fruit set and development of fruits that lack an aril have been reported as recurring problems in many rambutan orchards in Hawaii and studies in affected orchards showed that insufficient pollination was the cause of the problem. This was also confirmed by excluding bees during anthesis time (Nagao *et al.*, 2002). Hence pollinator management plays a

significant role in rambutan production and in order to address this issue, the present study was conducted.

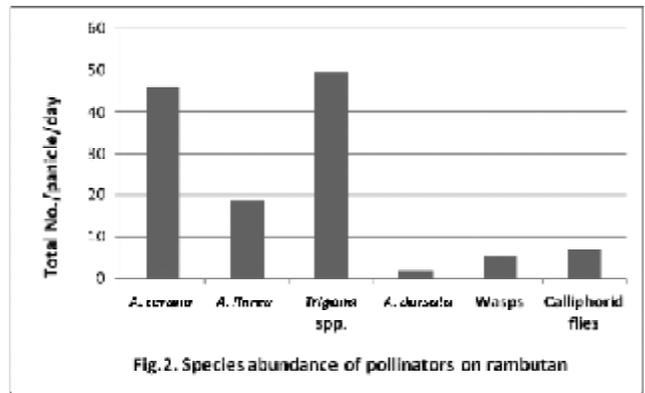
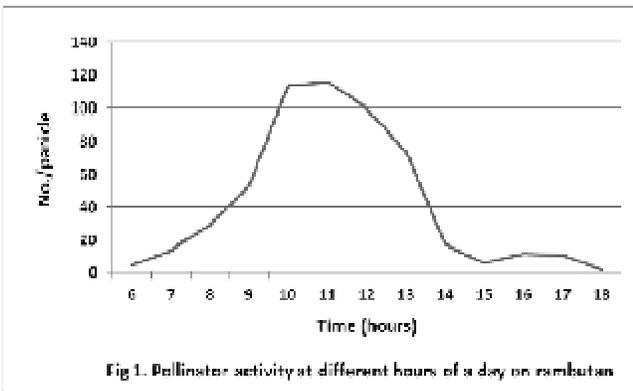
MATERIALS AND METHODS

Field experiments were carried out at CHES, Chettalli, Kodagu, Karnataka, India during 2008-10 to document pollinator diversity along with floral biology of rambutan. Experimental field had 40 open pollinated rambutan trees of 5-6 years old collected from parts of Karnataka, Kerala and Tamil Nadu and planted at a spacing of 6 x 6 m in an area of about 1200 m². Observations were recorded during peak flowering period (March) from 50 randomly selected panicles on five trees. Each tree constituted one replication for data analysis purpose. Data on the species and number of insects foraging per 10 minutes were recorded at hourly interval from 6-00 AM to 6-00 PM. Wherever same insect visited same flower, it was considered as an additional forager. Values were averaged to obtain mean number of pollinators per panicle per 10 minutes. A six frame strength colony of *Apis cerana* was maintained in the field during blossom period. In order to confirm the role of pollinators in fruit set, fifty panicles were covered with nylon mesh bags just before blossoming to exclude pollinators. Bags were removed after fruit set. The extent of fruit set in the covered panicles was compared with open pollinated panicles.

Table 1. Diversity of pollinating insects and diurnal variations in their activity on rambutan (mean of three year data)

Time	No./panicle/10 min at different hours						Total
	<i>A. cerana</i>	<i>A. florea</i>	<i>Trigona iridipennis</i>	<i>A. dorsata</i>	Wasps	Calliphorid flies	
6 AM	4.44 (2.33)	0.62 (1.27)	0.84 (1.36)	0.00 (1.00)	0.00 (1.00)	0.82(1.35)	6.72(2.78)
7 AM	5.16 (2.48)	0.82 (1.35)	0.72 (1.31)	0.00 (1.00)	0.03 (1.01)	0.21(1.10)	6.94 (2.82)
8 AM	3.32 (2.08)	0.50 (1.22)	2.82 (1.95)	0.38 (1.17)	1.14 (1.46)	0.20 (1.10)	8.36 (3.06)
9 AM	4.32 (2.31)	0.64 (1.28)	10.85 (3.44)	0.10 (1.05)	0.84 (1.36)	0.90 (1.38)	17.65 (4.32)
10 AM	10.50 (3.39)	2.52 (1.88)	15.14 (4.02)	1.20 (1.48)	2.12 (1.77)	2.50 (1.87)	33.98 (5.91)
11 AM	9.12 (3.18)	4.14 (2.27)	8.42 (3.07)	0.00 (1.00)	1.40 (1.55)	0.45 (1.20)	23.53 (4.95)
12 Noon	3.24 (2.06)	5.60 (2.57)	4.14 (2.27)	0.00 (1.00)	0.02 (1.01)	0.62 (1.27)	13.62 (3.82)
1 PM	1.22 (1.49)	1.36 (1.54)	1.38 (1.54)	0.00 (1.00)	0.00 (1.00)	0.30 (1.14)	4.26 (2.37)
2 PM	0.00 (1.00)	0.68 (1.30)	0.55 (1.24)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	1.23 (1.49)
3 PM	0.00 (1.00)	0.00 (1.00)	0.32 (1.15)	0.00 (1.00)	0.02 (1.01)	0.20 (1.10)	0.54 (1.24)
4 PM	1.14 (1.46)	0.62 (1.27)	1.54 (1.59)	0.00 (1.00)	0.00 (1.00)	0.64 (1.28)	3.94 (2.22)
5 PM	2.96 (1.99)	1.00 (1.41)	2.42 (1.85)	0.20 (1.10)	0.00 (1.00)	0.00(1.00)	6.58 (2.75)
6 PM	0.60 (1.26)	0.20 (1.10)	0.40 (1.18)	0.00 (1.00)	0.00 (1.00)	0.20 (1.10)	1.40 (1.55)
C.D. (p=0.05)	0.51	0.28	0.52	0.47	0.32	0.08	0.85

Values in parantheses are $\sqrt{x+1}$ transformed.



RESULTS AND DISCUSSION

Flowering period of rambutan started from February and lasted till April with peak during the month of March. Each shoot produced about 10 panicles and flowers were white in colour. Female flower was

receptive between 5.00 AM to 8.00 AM. Peak anthesis was recorded between 5.00 AM and 6.00 AM. Rambutan trees produce three types of flowers viz., staminate (M) hermaphrodite functional female (HFF) and hermaphrodite functional male (HFM) (Tindall *et al.*,

1994; Valmayor *et al.*, 1970). In the HFF type, bifid stigma split opened during anthesis exposing the stigmatic surface to pollination but the stamens remained closely oppressed to the sepals and the anthers never dehisced. In the HFM type flower, the stamens were erect at anthesis and the anthers dehisced viable pollen but the stigma of the rudimentary pistil did not open. Hence, cross pollination is essential for fruit set and depends on insects for pollination. We recorded about 95 percent of HFF flowers in a panicle.

Data revealed that insects visiting rambutan flowers belonged to two orders *viz.*, Hymenoptera and Diptera. Among hymenopterans were four honey bee species *viz.*, *Apis cerana*, *A. dorsata*, *A. florea* and *Trigona iridipennis* and some unidentified ants and wasps. Since the role of ants in pollination is not clear, they were not reflected in results. Calliphorid flies were another group which were found in considerable numbers (Table 1.) Of different species, *T. iridipennis* was the most dominant forager (49.54) followed by *A. cerana* (46.02). Both the species followed more or less similar trend of diurnal activity but *A. cerana* numbers were significantly more than that of *T. iridipennis* between 6-00 AM and 8-00 AM. Considering the fact that stigma receptivity and anthesis coincide with this time, availability of pollinators is crucial. Hence, the Indian honeybee, *A. cerana* is of more importance as rambutan pollinator than *T. iridipennis*, though the latter was found to be more abundant. Foraging activity of these insects showed significant diurnal variability with maximum activity in the morning hours with a peak activity at 10-00 to 11-00 AM (22.14/panicle/10 minutes) (Fig.1). This observation helps in deciding the time of plant protection chemicals to minimize loss to pollinators.

The experiment on the effect of pollinators on fruit set clearly established that without pollinators, there will be no fruit set in rambutan. The extent of fruit set in open pollinated panicles was 29.35 fruits/panicle while bagged flowers completely failed to set fruits. Similar results were reported by Lim (1984) and Nagao *et al.* (2002) from Malaysia and Hawaii, thus emphasizing the importance of pollinators. From these results, it can be summarized that honeybees, especially *A. cerana* and *T. iridipennis* are major pollinators of rambutan and it is essential to conserve or augment them to realize maximum fruit set in rambutan.

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