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Diversity and abundance of insect visitors of karonda (*Carissa carandas*) flowers under Hisar conditions

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ABSTRACT

Studies conducted during 2014-15 revealed that karonda (*Carissa carandas* L.)flowers attracted wide variety of insect species belonging to 4 orders, 8 families, 12 genera and 15 species. Among them eight belonging to order Hymenoptera, four to Lepidoptera, two to Diptera and one to Coleoptera. Among all these insects, *Papilio demoleus, Helicoverpa armigera, Apis florea* and *Polistes olivaceus* were the dominant flower visitors. The other important insects visiting karonda flowers were *Delta esuriens* and *Eurema hecabe,* the latter group of insects mostly visited flowers at interrupted hours and not considered as the reliable pollinators. Peak abundance of major insect visitors recorded during mid - day hours as compared to morning and evening hours.

Key words: Abundance, Diversity, Insect visitor, Pollination, Pollinators

Karonda or Christ's thorn (*Carissa carandas* L.) belongs to the family Apocynaceae and native of India. Karonda has little potential for cultivation as food crop. It is a very hardy evergreen shrub and can tolerate drought and diverse soil conditions. It is suitable for arid tropics and sub tropics. Fruits are edible and attractive. Leaves are dark green and ovate. It possesses strong axillary spikes, which are often forked. The flowers are white and fragrant and are borne in clusters of two or three. Fruit is an ellipsoid berry and has 2-8 flat brown seeds. On ripening, the fruit turns from green to white or pink and later black (Verheij and Coronel 1991). Fruit is astringent, antiscorbutic and is used as a remedy for biliousness. Over 75 % of world's most commonly cultivated crops and 80 % of all flowering plant species rely on animal pollinators, mostly insects for pollination (Nabhan and Buchmann 1997). Pollination is the greatest gift of nature that enables the transfer of pollen between plants leads to fertilization and sexual reproduction. The implementation of best management practices in agriculture can provide improved crop yields, and at the same time, improved conditions for pollinator species. Lot of work has been done in India and abroad on commercial fruit crops as bee forage but scanty information is available on potential fruit and medicinal plants. The

Table 1 Diversity of insect visitors/pollinators of *Carissa carandas* (Karonda)

Order	Family	Insect species	IP/IV	Working behaviour
Hymenoptera	Apidae	*Apis florea* Fabricius	IP	T
		Apis dorsata Fabricius	IP	T
		Apis cerana Fabricius	IP	T
		Apis mellifera Linnaeus	IP	T
		Xylocopa fenestrata Fabricius	IV	T
	Vespidae	*Allorhynchium metallicum* (Saussure)	IP	T
		Polistes olivaceus De Geer	IP	T and S
		Delta esuriens (Fabricius)	IV	S
Lepidoptera	Papilionidae	*Papilio demoleus* Linnaeus	IP	T and S
	Noctuidae	*Helicoverpa armigera* Hubner	IV	T and S

Contd.

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Table 1 (*Concluded*)

Order	Family	Insect species	IP/IV	Working behaviour
	Pieridae	*Eurema hecabe* Linnaeus	IP	T and S
	Hesperiidae	*Pelopidas* sp.	IV	T and S
Coleoptera	Coccinellidae	*Coccinella septempunctata* Linnaeus	IV	T
Diptera	Syrphidae	*Sphaerophoria* sp.	IV	S
		Episyrphus sp.	IV	S

*IP –Insect pollinator, IV – Insect visitor. T – Top worker and S – Side worker

information on these plants as bee forage is need of the hour as in some areas they serve as good source of nectar and/or pollen. Keeping in this view, present experiment was conducted to determine the diversity and abundance of insect visitors of karonda.

MATERIALS AND METHODS

Sweeps were made with the hand net throughout flowering period of the crop at two hourly intervals from the morning to the evening to observe the species diversity visiting the flowers. The abundance was recorded at two hourly intervals, starting from commencement to the cessation of insect activity and repeated at weekly intervals. Abundance of different insect visitors/pollinators, number of visitors/m^2 branch of a tree/5 min was recorded from five randomly selected branches. The recorded data were analyzed in randomized block design (Snedecor and Cochran 1989) and the results were compared.

RESULTS AND DISCUSSION

Diversity of insect visitors/pollinators of karonda

Karonda flowers attracted wide variety of insect species belonging to 4 orders, 8 families, 12 genera and 15 species (Table 1). Among them eight belonging to order Hymenoptera, four to Lepidoptera, one to Coleoptera and one to Diptera. The lepidopterans were the major floral visitors comprising from three families, viz. Papilionidae (*Papilio demoleus*), Noctuidae (*Helicoverpa armigera*), Pieridae (*Eurema hecabe*) and Hesperiidae (*Pelopidas* sp.). They were followed in order of diversity by hymenopterans from two families, viz. Apidae (*Apis florea, Apis dorsata, Apis cerana*, *Apis mellifera and Xylocopa fenestrata*) and Vespidae (*Allorhynchium metallicum*, *Polistes olivaceus* and *Delta esuriens*). Coleopteran to Coccinellidae (*Coccinella septempunctata*) and Dipteran to Syrphidae (*Sphaerophoria* sp. and *Episyrphus* sp.) were also observed. Only Lepidopterans and *P. olivaceus* were side foragers. Literature directly related to the entomophily of karonda was unavailable, so pollination studies in related crops/ plants have been discussed with present research findings. Kumar and Bharti (2015) studied diversity of insect visitors on *Butea monosperma* and reported that out of nine insect species, majority belongs to Hymenoptera (6), followed by Lepidoptera (2) while one belonged to Coleoptera. Similarly, Manzoor-ul-haq and Inayatullah (1979) also found 27 species of Hymenoptera, Lepdoptera and Diptera visiting phalsa flowers. *Apis florea* and several species of *Halictus* (Halictidae) and *Andrena* (Andrenidae) were the most common visitors.

Abundance of insect visitors/pollinators of karonda

Abundance of major insect pollinators on karonda flowers at different day hours of the day during April 2014 and 2015 revealed that the abundance at different weeks and day hours differed significantly with insect pollinators. During 2014 and 2015, highest pooled mean abundance (3.35 and 3.60 insects/m^2 branch/5 min) was recorded in *P. demoleus* followed by *H. armigera* (2.23 and 2.41 insects/m^2 branch/5 min), *A. florea* (1.45 and 1.45 bees/m^2 branch/5 min), *P. olivaceus* (1.40 and 1.61 insects/m^2 branch/5 min) and *E. hecabe* (0.92 and 0.87 insect/m^2 branch/5 min). Lowest pooled mean abundance was recorded in *D. esuriens* (0.87 and 1.10 insects/m^2 branch/5 min). From the present pollination study, it is evident that Hymenopteran and Lepidopteran insects were more abundant insect pollinators on karonda flowers (Table 2 and 3). Irrespective of different day hours, significantly maximum number of *P. demoleus* was recorded from karonda flowers followed by *H. armigera*, *A. florea, P. olivaceus, E. hecabe* and *D. esuriens.* Peak activity of *P. demoleus* was recorded between 1000 h -1200 h during full bloom of crop. Peak abundance of all Hymenopterans was recorded at 1000-1200 h and minimum abundance was recorded at 0600 h -0800 h and 1600 h-1800 h irrespective of weeks. Minimum abundance of all Lepidopteran species was recorded at 0600 h -0800 h and 1600 h - 1800 h. Peak abundance was recorded at 1000 h -1400 h irrespective of weeks. Parmar (1976) also observed that hymenopterans were the most abundant visitors, and pollinated the flowers of phalsa.

There was abundance of insect visitors and pollinators in karonda flowers which is a underutilized crop plant. Due to scanty literature availabile on pollination studies of underutilized crops, this study will set benchmark in understanding range of insect pollinators and their importance in fruit setting.

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Table 2 Abundance of insect visitors/pollinators on karonda flowers during 2014

Insect visitors	Number of insect visitors/m^2 branch of a tree/5 min																				
	21/4/14						Overall mean	28/4/14						Overall mean	5/5/14						Overall mean	Pooled mean
	0600h-0800h	0800-1000h	1000h-1200h	1200h-1400h	1400h-1600h	1600h-1800h		0600h-0800h	0800-1000h	1000h-1200h	1200h-1400h	1400h-1600h	1600h-1800h		0600h-0800h	0800-1000h	1000h-1200h	1200h-1400h	1400h-1600h	1600h-1800h		
Papilio demoleus	0.60 (1.24)	3.20 (2.04)	6.00 2.64)	4.40 (2.32)	2.20 (1.78)	2.40 (1.83)	3.13 (1.98)	2.20 (1.77)	5.40 (2.52)	9.20 (3.19)	5.40 (2.52)	3.40 (2.09)	2.60 (1.89)	4.70 (2.33)	1.00 (1.39)	1.80 (1.65)	4.00 (2.22)	2.60 (1.89)	2.60 (1.88)	1.40 (1.54)	2.23 (1.76)	3.35 (2.02)
Helicoverpa armigera	0.60 (1.24)	2.40 (1.83)	3.80 (2.18)	3.60 (2.14)	2.20 (1.77)	1.00 (1.39)	2.26 (1.76)	2.20 (1.77)	4.40 (2.31)	6.20 (2.68)	3.00 (1.99)	1.80 (1.65)	1.20 (1.45)	3.13 (1.98)	0.40 (1.16)	1.40 (1.54)	2.40 (1.82)	1.60 (1.59)	1.40 (1.54)	0.60 (1.24)	1.30 (1.48)	2.23 (1.74)
Apis florea	0.20 (1.08)	1.40 (1.54)	3.40 (2.09)	2.00 (1.72)	1.80 (1.65)	0.20 (1.08)	1.50 (1.53)	0.40 (1.16)	1.80 (1.66)	3.00 (1.99)	3.40 (2.09)	2.00 (1.72)	0.40 (1.16)	1.83 (1.63)	0.20 (1.08)	0.60 (1.24)	2.20 (1.77)	1.20 (1.45)	1.80 (1.65)	0.20 (1.08)	1.03 (1.38)	1.45 (1.51)
Polistes olivaceus	0.00 (1.00)	0.80 (1.31)	2.00 (1.72)	1.40 (1.54)	2.40 (1.83)	1.60 (1.60)	1.36 (1.50)	0.20 (1.08)	1.20 (1.47)	1.80 (1.65)	2.20 (1.76)	3.20 (2.03)	2.20 (1.77)	1.80 (1.63)	0.00 (1.00)	0.80 (1.33)	0.60 (1.24)	1.00 (1.37)	2.60 (1.88)	1.20 (1.47)	1.03 (1.38)	1.40 (1.50)
Delta esuriens	0.00 (1.00)	0.20 (1.08)	1.40 (1.54)	1.60 (1.60)	1.60 (1.60)	0.40 (1.14)	0.86 (1.33)	0.20 (1.08)	0.20 (1.08)	0.80 (1.31)	3.00 (1.98)	2.00 (1.72)	0.80 (1.31)	1.16 (1.41)	0.00 (1.00)	0.40 (1.16)	0.80 (1.31)	0.60 (1.22)	1.40 (1.54)	0.40 (1.16)	0.60 (1.23)	0.87 (1.32)
Eurema hecabe	0.40 (1.16)	0.80 (1.33)	2.60 (1.89)	1.60 (1.59)	1.20 (1.45)	0.40 (1.16)	1.16 (1.43)	0.60 (1.24)	1.00 (1.37)	2.20 (1.77)	0.80 (1.31)	1.20 (1.45)	0.60 (1.24)	1.06 (1.40)	0.40 (1.16)	0.40 (1.16)	1.20 (1.45)	0.20 (1.08)	0.60 (1.24)	0.40 (1.16)	0.53 (1.21)	0.92 (1.35)
Mean	0.30 (1.12)	1.46 (1.52)	3.20 (2.01)	2.43 (1.82)	1.90 (1.68)	1.00 (1.37)	1.71 (1.59)	0.96 (1.35)	2.33 (1.74)	3.86 (2.10)	2.96 (1.94)	2.26 (1.78)	1.30 (1.47)	2.28 (1.73)	0.33 (1.13)	0.90 (1.35)	1.86 (1.64)	1.20 (1.43)	1.73 (1.62)	0.70 (1.28)	1.12 (1.41)	1.70 (1.57)

Factor	*SE m (±)*	*CD*
Insect visitors	0.02	0.06
Week	0.01	0.04
Time	0.02	0.06
Insect × Week	0.04	0.11
Insect visitors × Time	0.05	0.15
Week × Time	0.04	0.11
Insect visitors × Week Time	0.09	0.27

*Figures in parentheses are square root transformed values. Each value represents mean of 5 observations.

Table 3 Abundance of insect visitors/pollinators on karonda flowers during 2015

Insect visitors	Number of insect visitors/m^2branch of a tree/5 min																				
	17/4/15						Overall mean	24/4/15						Overall mean	1/5/15						Overall mean	Pooled mean
	0600h-0800h	0800-1000h	1000h-1200h	1200h-1400h	1400h-1600h	1600h-1800h		0600h-0800h	0800-1000h	1000h-1200h	1200h-1400h	1400h-1600h	1600h-1800h		0600h-0800h	0800-1000h	1000h-1200h	1200h-1400h	1400h-1600h	1600h-1800h		
Papilio demoleus	1.00 (1.39)	4.60 (2.36)	6.60 2.75)	5.00 (2.44)	3.20 (2.04)	2.00 (1.72)	3.73 (2.11)	1.80 (1.65)	6.20 (2.68)	8.60 (3.09)	5.60 (2.56)	4.00 (2.22)	2.60 (1.88)	4.80 (2.35)	0.80 (1.33)	2.40 (1.83)	4.60 (2.36)	3.40 (2.09)	1.80 (1.65)	0.60 (1.22)	2.26 (1.75)	3.60 (2.07)
Helicoverpa armigera	0.60 (1.24)	3.20 (2.04)	4.80 (2.40)	3.00 (1.99)	1.80 (1.65)	0.80 (1.33)	2.36 (1.77)	1.60 (1.57)	5.00 (2.44)	6.00 (2.64)	3.60 (2.14)	2.60 (1.89)	1.40 (1.54)	3.36 (2.04)	0.20 (1.08)	2.20 (1.77)	3.20 (2.04)	2.00 (1.72)	1.00 (1.37)	0.40 (1.16)	1.50 (1.52)	2.41 (1.78)
Apis florea	0.00 (1.00)	1.20 (1.47)	3.00 (1.99)	2.40 (1.83)	2.00 (1.71)	0.40 (1.16)	1.50 (1.53)	0.20 (1.08)	2.20 (1.77)	3.60 (2.14)	3.40 (2.09)	2.60 (1.89)	0.20 (1.08)	2.03 (1.67)	0.00 (1.00)	0.00 (1.00)	2.40 (1.83)	1.40 (1.54)	1.00 (1.39)	0.20 (1.08)	0.83 (1.31)	1.45 (1.50)
Polistes olivaceus	0.00 (1.00)	0.80 (1.33)	2.00 (1.72)	2.40 (1.82)	3.00 (1.99)	1.40 (1.54)	1.60 (1.57)	0.20 (1.08)	1.20 (1.47)	2.60 (1.89)	2.60 (1.89)	3.60 (2.14)	2.40 (1.83)	2.10 (1.72)	0.00 (1.00)	0.80 (1.33)	1.00 (1.39)	1.40 (1.54)	2.00 (1.72)	1.60 (1.59)	1.13 (1.43)	1.61 (1.57)
Delta esuriens	0.00 (1.00)	0.40 (1.16)	1.80 (1.65)	2.80 (1.94)	2.00 (1.71)	0.40 (1.16)	1.23 (1.44)	0.00 (1.00)	0.40 (1.16)	2.20 (1.77)	3.40 (2.08)	2.40 (1.83)	0.60 (1.24)	1.50 (1.52)	0.00 (1.00)	0.40 (1.16)	0.60 (1.24)	0.80 (1.31)	0.80 (1.31)	0.80 (1.31)	0.56 (1.22)	1.10 (1.39)
Eurema hecabe	0.60 (1.24)	0.80 (1.33)	3.20 (2.04)	1.60 (1.60)	1.00 (1.39)	0.20 (1.08)	1.23 (1.45)	1.20 (1.47)	1.40 (1.54)	2.80 (1.94)	1.40 (1.54)	1.40 (1.54)	1.40 (1.16)	1.43 (1.53)	0.20 (1.08)	0.40 (1.16)	1.60 (1.60)	0.40 (1.16)	0.40 (1.16)	0.60 (1.24)	0.60 (1.23)	1.08 (1.40)
Mean	0.36 (1.14)	1.83 (1.61)	3.56 (2.09)	2.86 (1.94)	2.16 (1.75)	0.86 (1.33)	1.94 (1.64)	0.83 (1.31)	2.73 (1.84)	4.30 (2.24)	3.33 (2.05)	2.76 (1.92)	1.26 (1.46)	2.53 (1.80)	0.20 (1.08)	1.03 (1.38)	2.23 (1.74)	1.56 (1.56)	1.16 (1.43)	0.70 (1.27)	1.15 (1.41)	1.87 (1.61)

Factor	*SEm (±)*	*CD*
Insect visitors	0.02	0.05
Week	0.01	0.04
Time	0.02	0.05
Insect × Week	0.03	0.10
Insect visitors × Time	0.05	0.14
Week × Time	0.03	0.10
Insect visitors × Week Time	0.09	0.25

*Figures in parentheses are square root transformed values. Each value represents mean of 5 observations.

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