

Original Research Article

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Species Richness and Abundance of Major Insect Pollinators on Aonla, (*Phyllanthus emblica* L.)

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ABSTRACT

Aonla blossoms attracted total twelve insect species belonged to 5 orders, 7 families and 9 genera. Out of these, Diptera was most diversified and consists of major floral visitors followed by Hymenoptera, Coleoptera, Hemiptera and Lepidoptera. Irrespective of different day hours, significantly maximum abundance recorded by *Episyrphus* sp. followed by *Sphaerophora* sp. and *A. florea*. Peak abundance of *Episyrphus* sp. and *A. florea* were recorded between 1000h-1200h during full bloom of crop. Minimum abundance was recorded at 0600h-0800h irrespective of weeks. Present research findings helpful in identification of insects which are helpful in pollination. Farmers will be saved from misconception of every insect is a pest and helpful in reducing pesticide use and maintaining pollinators diversity and also provided lead for future research for exploitation of underutilized fruit crops. Integration of indigenous underutilized fruits could be one of the appropriate facets to enhance overall horticultural production in the region. Being tolerant to biotic and abiotic stresses, these fruit species are suitable for growing in the disaster- and drought-prone areas. Diversification of agriculture by utilizing these underutilized fruits is a key to doubling farmer's income by providing extra income as their availability is low.

Keywords

Diversity, Diptera,
Episyrphus, *Apis*
florea, Pollination

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Introduction

Potential (Underutilized) plant species are only different from other crops because these crops needs to be acknowledged employed and explored for today's and future generations. A large number of underutilized edible fruits exist in tropic and subtropics of the world. They have been used in Indian system of medicine such as Ayurvedic and Unani since time immemorial. Pollination

research based on several fruit crops revealed that management of pollinators had a significant effect in improvement of the qualitative as well as quantitative parameters of all cultivars. An effective pollinator makes sequential visits to the flowers, carries pollen and transfers them to stigma during a visit (Corbet *et al.*, 1991). The utilisation of pollinators especially honeybees is considered as one of the cheapest eco-friendly approaches in maximising the yield of the cross-pollinated

crops. Lot of work has been done in India and abroad on commercial fruit crops as bee forage but scanty information is available on underutilized fruit and medicinal plants such as *Phyllanthus emblica* L. (Aonla).

Aonla (*Phyllanthus emblica* L.), also known as Indian gooseberry, Amla or Emblic, belongs to the family Euphorbiaceae and is native of tropical south eastern Asia. It is grown commercially in India particularly in Uttar Pradesh (FAO, 1982). Fruits are generally used in cooking, preserves, sauce, pickles, jams and jellies, etc. The fruits are very rich in vitamin C (500-600 mg/100g pulp) and have great importance in Ayurvedic medicine (Ghosal *et al.*, 1996) having antiscorbutic properties and used in treatment of ailments associated with digestive system. Aonla is a highly branched monoecious shrub or tree growing up to 9-18 m high. Leaves are linear-oblong, obtuse, nearly sessile distichously branched on slender branchlets. Small greenish yellow flowers are borne in compact clusters in the axils of the lower leaves. The male flowers are present usually at the lower end of branchlets with female flowers above them. Occasionally, the trees are dioecious. Fruit is a hard berry, round, indented at base and smooth obscurely 6 lobed. The stone contains 6 small seeds (Brun *et al.*, 1987). Present studies were conducted with the objectives to know about species richness and abundance of insect visitors of aonla.

Materials and Methods

Species richness of insect visitors/pollinators of aonla

Present studies on aonla (*Phyllanthus emblica* L.) were conducted during 2014 and 2015 at Research Farm of the Department of Horticulture, CCS Haryana Agricultural University, Hisar, India. To record the species

richness of insect visitors and pollinators of *Phyllanthus emblica* L. were collected by sweep net during their blooming period i.e., March –April 2014 and 2015. Sweeps were made at two hourly intervals from the morning to the evening throughout flowering period of the crop (0600h-1600h).

Abundance of insect visitors/pollinators of aonla

Abundance of different insect visitors/pollinators, number of visitors/m² branch of a tree/5minutes was recorded from five randomly selected branches at two hourly intervals, starting from commencement to the cessation of insect activity and repeated at weekly intervals during blooming period.

Recorded data were analyzed in Randomized Block Design (Snedecor and Cochran, 1989) and the results were compared.

Results and Discussion

Species richness of insect visitors/pollinators of aonla

Aonla blossoms attracted insects belonging to 5 orders, 7 families, 9 genera and 12 species. Of all these insects, four belongs to order Hymenoptera, two to Coleoptera, four to Diptera, one to Hemiptera and one to Lepidoptera. Among these, Dipterans were the major floral visitors comprising of three families viz., Syrphidae (*Sphaerophoria* sp. and *Episyrphus* sp.), Sarcophagidae (*Sarcophaga* sp.) and Muscidae (*Musca domestica*). They were followed in order of diversity by hymenopterans from one family viz., Apidae (*Apis florea*, *A. dorsata*, *A. cerana* and *A. mellifera*). Coleopterans belong to family, Coccinellidae (*Coccinella septempunctata* and *Chilomenes sexmaculata*), Hemipteran to Scutellaridae (*Chrysocoris stolli*) and one Lepidopteran to Arctiidae

(*Amata* sp.). Out of 12 insects, all were top foragers except *Amata* sp. which was side forager also.

Abundance of major insect visitors/pollinators of aonla

During 2014, three species of flower visiting insects belonging to two orders, namely Hymenoptera (1), and Diptera (2) were collected from the aonla flowers (Table 2). The majority belonged to Diptera comprising syrphid flies (*Episyrphus* sp. and *Sphaerophoria* sp.). Among Dipterans, maximum mean population of *Episyrphus* sp. (8.57 flies/m² branch/5min) followed by that of *Sphaerophoria* sp. (4.47 flies/m² branch/5 min) (Table 2). In Hymenoptera, *Apis florea* was recorded with mean population of 3.53 bees/m² branch/5min. Similar trend followed during 2015, Among Dipterans, maximum mean population of *Episyrphus* sp. (8.56 flies/m² branch/5min) followed by that of *Sphaerophoria* sp. (3.54 flies/m² branch/5

min) (Table 3). In Hymenoptera, mean population of *Apis florea* was 5.70 bees/m² branch/5min.

Present pollination study revealed that Dipteran insect species were most abundant insect pollinators on aonla flowers. Irrespective of different day hours, significantly maximum number of *Episyrphus* sp. was recorded from aonla flowers followed by *Sphaerophoria* sp. and *A. florea*. Peak abundance of *Episyrphus* sp. was recorded between 1000h-1200h during full bloom of crop. Maximum abundance of *A. florea* was recorded at 1000h-1200h and minimum abundance was recorded at 0600h-0800h irrespective of weeks. During 2014 and 2015, highest pooled mean of abundance (8.79 and 8.56 flies/m² branch/5min) was recorded in *Episyrphus* sp. followed by *A. florea* (5.40 and 5.70 bees/m² branch/5min), while lowest pooled mean of abundance was recorded in *Sphaerophoria* sp. (3.62 and 3.54 flies/m² branch/5min) (Table 1–3).

Table.1 Diversity of Insect visitors/pollinators of Aonla

Order	Family	Insect Species	IP/IV*	Working Behaviour
Hymenoptera	Apidae	<i>Apis florea</i> Fabricius	IP	T
		<i>Apis dorsata</i> Fabricius	IP	T
		<i>Apis cerana</i> Fabricius	IP	T
		<i>Apis mellifera</i> Linnaeus	IP	T
Coleoptera	Coccinellidae	<i>Coccinella septempunctata</i> Linnaeus	IV	T
		<i>Chilomenes sexmaculata</i> Fabricius	IV	T
Diptera	Syrphidae	<i>Sphaerophoria</i> sp.	IP	T
		<i>Episyrphus</i> sp.	IP	T
	Sarcophagidae	<i>Sarcophaga</i> sp.	IV	T
	Muscidae	<i>Musca domestica</i> Linnaeus	IV	T
Hemiptera	Scutellaridae	<i>Chrysocoris stollii</i> Wolff	IV	T
Lepidoptera	Arctiidae	<i>Amata</i> sp.	IV	T and S

*IP –Insect Pollinator and IV – Insect Visitor

*T – Top worker and S- Side worker

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

S. No.	Insect visitors																							
		25/3/14						Over all mean	1/4/14						Over all mean	8/4/14						Over all 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			
1	<i>Episyrrhus</i> sp.	9.40 (3.22)	9.40 (3.21)	12.40 (3.65)	9.20 (3.19)	7.40 (2.89)	3.60 (2.14)	8.57 (3.05)	13.00 (3.74)	12.40 (3.65)	14.00 (3.87)	7.40 (2.89)	10.40 (3.37)	5.00 (2.44)	10.37 (3.33)	12.40 (3.65)	7.80 (2.96)	7.80 (2.96)	5.80 (2.60)	8.40 (3.06)	2.40 (1.83)	7.43 (2.84)	8.79 (3.07)	
2	<i>Apis florea</i>	0.00 (1.00)	5.00 (2.44)	8.80 (3.12)	4.20 (2.27)	3.20 (2.04)	0.00 (1.00)	3.53 (1.98)	0.40 (1.16)	5.20 (2.47)	12.80 (3.71)	10.20 (3.34)	4.60 (2.36)	0.40 (1.14)	5.60 (2.36)	0.00 (1.00)	9.20 (3.18)	13.80 (3.84)	12.00 (3.60)	7.20 (2.86)	0.20 (1.08)	7.07 (2.59)	5.40 (2.31)	
3	<i>Sphaerophoria</i> sp.	7.60 (2.93)	3.80 (2.18)	5.80 (2.60)	3.20 (2.04)	4.20 (2.27)	2.20 (1.77)	4.47 (2.30)	4.20 (2.27)	4.80 (2.40)	7.00 (2.82)	5.00 (2.43)	3.20 (2.04)	1.80 (1.65)	4.33 (2.27)	1.80 (1.65)	4.40 (2.31)	3.00 (1.99)	1.60 (1.59)	1.00 (1.39)	0.60 (1.24)	2.07 (1.70)	3.62 (2.09)	
	Mean	5.67 (2.38)	6.07 (2.61)	9.00 (3.12)	5.53 (2.50)	4.93 (2.40)	1.93 (1.63)	5.52 (2.44)	5.87 (2.39)	7.47 (2.84)	11.27 (3.46)	7.53 (2.89)	6.07 (2.59)	2.40 (1.74)	6.77 (2.65)	4.73 (2.10)	7.13 (2.82)	8.20 (2.93)	6.47 (2.60)	5.53 (2.44)	1.07 (1.39)	5.52 (2.38)	5.94 (2.49)	

Each value represents mean of 5 observations

*Figures in parentheses are square root transformed values

Factor	SEm (±)	C.D.
Insect visitors	0.02	0.05
Week	0.02	0.05
Time	0.02	0.07
Insect X Week	0.03	0.09
Insect visitors X Time	0.04	0.13
Week X Time	0.04	0.13
Insect visitors x Week Time	0.08	0.23

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

S. No.	Insect visitors	Number of insect visitors/m ² branch of a tree/5minutes																						
		27/3/15						Overall mean	3/4/15						Overall mean		11/4/15						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				
1	<i>Episyrrhus</i> sp.	10.80 (3.43)	4.40 (2.31)	12.40 (3.65)	7.00 (2.82)	8.00 (2.99)	3.80 (2.18)	7.73 (2.90)	8.00 (2.99)	13.40 (3.79)	14.80 (3.97)	7.80 (2.96)	9.00 (3.16)	4.80 (2.40)	9.63 (3.21)	13.00 (3.73)	9.20 (3.19)	9.00 (3.15)	6.00 (2.64)	9.60 (3.25)	3.20 (2.04)	8.33 (3.00)	8.56 (3.03)	
2	<i>Apis florea</i>	0.00 (1.00)	8.00 (2.99)	6.80 (2.79)	2.00 (1.71)	2.60 (1.89)	0.20 (1.08)	3.26 (1.91)	0.40 (1.16)	6.20 (2.68)	12.80 (3.71)	11.20 (3.48)	4.00 (2.22)	0.40 (1.16)	5.83 (2.40)	0.20 (1.08)	11.80 (3.57)	14.80 (3.97)	13.20 (3.76)	8.00 (2.99)	0.20 (1.08)	8.03 (2.74)	5.70 (2.35)	
3	<i>Sphaerophoria</i> sp.	9.80 (3.28)	4.60 (2.35)	5.20 (2.48)	2.60 (1.89)	3.20 (2.04)	1.60 (1.60)	4.50 (2.27)	1.40 (1.54)	4.40 (2.31)	7.20 (2.86)	4.00 (2.23)	4.20 (2.27)	2.60 (1.89)	3.96 (2.18)	1.40 (1.54)	4.20 (2.27)	3.80 (2.18)	2.20 (1.77)	1.00 (1.39)	0.40 (1.16)	2.16 (1.72)	3.54 (2.06)	
	Mean	6.86 (2.38)	5.66 (2.61)	8.13 (3.12)	3.86 (2.50)	4.60 (2.40)	1.86 (1.63)	5.16 (2.36)	3.26 (2.39)	8.00 (2.84)	11.60 (3.46)	7.66 (2.89)	5.73 (2.59)	2.60 (1.74)	6.47 (2.60)	4.86 (2.10)	8.40 (2.82)	9.20 (2.93)	7.13 (2.60)	6.20 (2.44)	1.26 (1.39)	6.17 (2.49)	5.93 (2.48)	

Each value represents mean of 5 observations

*Figures in parentheses are square root transformed values

Factor	SEm (±)	C.D.
Insect visitors	0.02	0.05
Week	0.02	0.05
Time	0.02	0.07
Insect X Week	0.03	0.09
Insect visitors X Time	0.04	0.13
Week X Time	0.04	0.13
Insect visitors x Week Time	0.08	0.23



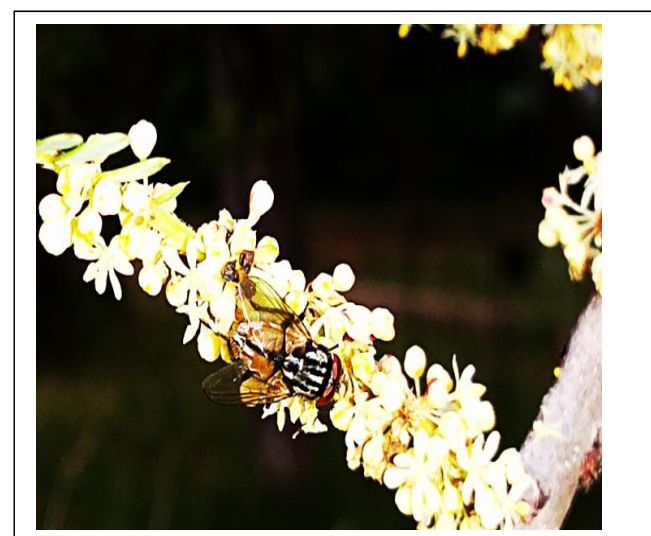
I. BLOSSOMS OF *PHYLLANTHUS EMBLICA* L.



II. *SPHAEROPHORIA* SP.



III. *APIS MELLIFERA*



IV. *MUSCA* SP.



V. *APIS FLOREA*



VI. *EPISYRPHUS SP.*



VII. *COCCINELLA SEPTEMPUNCTATA*



viii. *CHRYSOCORIS STOLLI*

The results pertaining to the species richness of insect visitors/pollinators on aonla during March -April 2014 and 2015 revealed that Dipterans were the major floral visitors followed by Hymenoptera, Coleoptera, Hemiptera and Lepidoptera. Similar findings were reported in aonla by Saini (2011) and stated that majority of insect visitors belonged to Diptera followed by Hymenoptera and Lepidoptera. Dipteran insect species were most abundant insect pollinators on aonla flowers. Peak abundance of *Episyrrhus* sp. was recorded between 1000h -1200h during full bloom of crop. Maximum abundance of *A. florea* was recorded at 1000-1200h and minimum abundance was recorded at 0600h - 0800h irrespective of weeks. Irrespective of different day hours, significantly maximum number of *Episyrrhus* sp. was recorded from aonla flowers followed by *Sphaerophora* sp. and *A. florea*. Present findings are contradictory with the studies reported by Saini (2011) found that hymenopterans are more abundant followed by dipterans in amla.

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