

Solitary Bees Pollination Studies on *Cassia Fistula* Plant in Himachal Pradesh, India



Zoology

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ABSTRACT

Pollination studies have been conducted on *Cassia fistula* plant located at Nahan (933 m) in Sirmour hills and Arki (1104 m) in Solan hills of Himachal Pradesh, during the years from 2012-2016. *Cassia* flowers were visited by 16 species of solitary bees belonging to 4 families of order Hymenoptera of class Insecta. Of these, 7 belonged to Apidae, 5 to Megachilidae, 3 to Halictidae and 1 to Andrenidae family. Diversity and relative abundance data on *Cassia* bloom showed that *Xylocopa fenestrata* was the most dominant bee pollinator at both Nahan (31.65%) and Arki (27.05%). Besides this, other effective solitary bee pollinators were: *Ceratina gigantea* (22.84%, 21.24%), *Megachile flaviceps* (11.02%, 14.82%), *Halictus* sp. (11.62%, 17.03%) and *Trigona iridipenis* (5.61%, 4.40%) on *Cassia* flowers respectively.

INTRODUCTION

Himachal Pradesh-North Western Himalayan state is having a rich repository of medicinal wealth and occupies an important place in Vedic treatise. Medicinal plants are viewed as possible bridge between sustainable economic development, affordable health care and conservation of vital biodiversity. These medicinal plants can be grown in areas which have turned unproductive for traditional farming or are in fallow land. WHO is encouraging and promoting the effective use of herbal medicines in developing countries for health care programme. The state govt. of Himachal Pradesh is also taking up the cultivation of medicinal plants on large scale (Sharma and Mudgal, 1997). *Cassia fistula* (family-ceasalpinaceae) commonly known as the Golden Shower Indian Laburnum. It is an Indian medicinal plant distributed throughout India (NICIR, 2007). Pollination is one of the most important mechanisms to promote biodiversity and to sustain life on Earth. Pollination also benefits society by increasing food security and improving livelihoods (Khan and Khan, 2004). Insects are the most commonly occurring pollinators of many agricultural and horticultural crops. Among insects, bees are more effective pollinators than other insects because, their body hairs help transfer pollen from one flower to another; they show flower constancy and move from one flower to another of the same species; and many species can be reared and managed for pollination (Mattu, 2010; Mattu and Bhagat, 2015). Bees are one of the most favourable insects for research purposes, because of their fascinating and varied behavioural characteristics, involving both nest building and flower relationships, which make their visits to obtain the pollen and nectar as incentive for doing the occupation of pollination (Goulet and Huber, 1993). Non-*Apis* solitary bees commonly called as wild bees play an integral role as pollinators of both wild plant species and agricultural crops (Corbet *et al.*, 1991; Klein *et al.*, 2007). Many investigators have studied pollination of different agricultural crops in relation to non-*Apis* solitary bee pollinator in Europe, North America, South America and Australia (McGregor, 1976; Goodman and Fisher, 1991; Gary, 1992; Free, 1993; Morse and Calderone, 2000). But, only a few studies have been conducted regarding the role of solitary bees in pollinating various mountain crops (Mishra *et al.*, 1976; Mattu, 2010; Mattu and Bhagat, 2015). Therefore, present investigation was conducted on the pollination studies of different solitary bee species visiting *Cassia fistula* plant in Sirmour and Solan hills of Himachal Pradesh.

MATERIALS AND METHODS

Solitary bees pollination studies have been conducted on *Cassia fistula* plant located at Nahan (latitude 30° 33' N, longitude 77° 17' E and altitude 933 m) in Sirmour hills and Arki (latitude 31° 09' N, longitude 76° 57' E and altitude 1104 m) in Solan hills of Himachal Pradesh, during the months of March to June of the years 2012-2016, when these plant were in full bloom. Almost equal numbers of working hours were spent in both localities. Diversity and relative abundance, of different solitary bee visitors was determined in terms of their visits per 500 flowers/10 minutes (Verma and Chauhan, 1985). The observations were recorded from 0800 to 1700 hours of a day and average counts at these hours gave abundance of a solitary bee pollinator for that particular day. All solitary bee visitors on *Cassia* flowers were collected, killed and identified. Identification of different insect specimens was done with the help of standard keys.

RESULTS AND DISCUSSION

Solitary bee diversity studies showed that *Cassia* flowers were visited by 16 species of bees belonging to 4 families of order Hymenoptera of class Insecta. Of these, 7 species belonged to Apidae, 5 to Megachilidae, 3 to Halictidae, and 1 to Andrenidae family. These results corroborate the earlier findings of pollinators were selective in their floral visits and are shown to choose flowers which best meet their energetic requirements (Abrol, 1989). Burkill (1909) started that *Xylocopa* sp. was the most important flower visiting insects in India more active than *Apis florea* on many cultivated crops. Batra (1967, 1995), Atwal (1970), Abrol (1986, 1989), Kimball (2008) and Gupta (2013) have described several species of wild solitary bees from different areas of this country. Apidae were represented by species like *Xylocopa fenestrata*, *Xylocopa* sp. *Trigona iridipenis*, *Ceratina gigantea*, *Ceratina* sp., *Anthophora* sp., and *Amegilla* sp. etc. Of the Family Megachilidae was represented by *Megachile flaviceps*, *Megachile lanata*, *Megachile* sp.1 and *Megachile* sp.2 and *Megachile* sp.3. Family Halictidae has species like *Halictus* sp., *Nomia elliotii* and *Nomia* sp. etc. In addition, a single species of *Andrena* belonging to family Andrenidae was also recorded as pollinator of *Cassia fistula* plant in Himachal Pradesh (Table 1). Analyses of data on relative abundance of different solitary bee visitors revealed that *Xylocopa fenestrata* was the most abundant bee visitor to *Cassia fistula* flowers in the two experimental sites i.e. Nahan (15.6±2.1, 31.65%) and Arki (13.5±1.4, 27.05%). Other important solitary bee pollinators at Nahan

and Arki were *Ceratina gigantica* (11.4±1.8, 22.84% and 10.6±1.2, 21.24%), *Halictus* sp. (5.8±2.1, 11.62% and 8.5±1.2, 17.03%), *Megachile flaviceps* (5.5±1.6, 11.02% and 7.4±0.9, 14.82%), *Megachile* sp.1 (3.9±1.0, 7.81% and 3.7±1.0, 7.41%), *Trigona iridipenis* (2.8±1.0, 5.61% and 2.2±0.8, 4.40%), *Anthophora* sp. (2.4±0.4, 4.80% and 1.8±0.5, 3.60%), *Nomia elliotii* (1.7±0.5, 3.40% and 1.2±0.4, 2.40%) and *Andrena* sp. (0.8±0.4, 1.60% and 1.0±0.3, 2.00%) respectively (Table 2-3, figure 1-2). Therefore, present results suggest that family Apidae and Megachilidae were the most abundant bee pollinators of *Cassia fistula* at Nahana (64.09%, 18.83%) and Arki (56.29%, 22.23%) site (Tables 2-3). The higher population of *Xylocopa fenestrata* in experimental sites may be due to its being native species and thus having better adaptability to local environmental conditions. These results are in conformity with the earlier observations of bees in India have been reviewed by Waser and Real (1979), Corbet, et al. (1991), Batra (1995), Banaszak (1996) and Gupta (2003a, 2013). *Cassia* sp. which flowers round the year attracts *Xylocopa* and *Ceratina* species of solitary bees. These bees start to occur early in the year when no other plants are in bloom (Batra, 1967). The carpenter bee *Xylocopa* sp. deposits more pollen on the *Cassia fistula* flower than any other bee. The pollen deposition was very high when flowers were visited by carpenter bees as against other small social bees like *Apis dorsata*, *A. florea* and *A. cerana*, indicating pollinator specificity in *Cassia fistula*. It appears that *Xylocopa* bees are effective pollinators than other bee pollinator to this plant (Murali and Sukumar, 1993).

Table 1: Solitary bee species visiting *Cassia fistula* flowers with their taxonomic status

Family: Apidae	Family: Halictidae	Family: Megachilidae	Family: Andrenidae
1. <i>Xylocopa fenestrata</i>	1. <i>Halictus</i> sp.	1. <i>Megachile flaviceps</i>	1. <i>Andrena</i> sp.
2. <i>Xylocopa</i> sp.	2. <i>Nomia elliotii</i>	2. <i>Megachile lanata</i>	
3. <i>Trigona iridipenis</i>	3. <i>Nomia</i> sp.	3. <i>Megachile</i> sp.1	
4. <i>Ceratina gigantica</i>		4. <i>Megachile</i> sp.2	
5. <i>Ceratina</i> sp.		5. <i>Megachile</i> sp.3	
6. <i>Anthophora</i> sp.			
7. <i>Amegilla</i> sp.			

Table 2: Relative abundance of solitary bees pollinator visiting *Cassia fistula* bloom at Nahana. No. of bees/500 flowers/10 minutes

Family	Genus/Species	Mean±S.E.	Percentage Population	Family Percentage
Apidae	<i>Xylocopa fenestrata</i>	15.6*±2.1	31.65	64.09
	<i>Ceratina gigantica</i>	11.4±1.8	22.84	
	<i>Trigona iridipenis</i>	2.8±1.0	5.61	
	<i>Anthophora</i> sp.	2.4±0.4	4.80	
Halictidae	<i>Halictus</i> sp.	5.8±2.1	11.62	15.03
	<i>Nomia elliotii</i>	1.7±0.5	3.40	
Megachilidae	<i>Megachile flaviceps</i>	5.5±1.6	11.02	18.83
	<i>Megachile</i> sp.1	3.9±1.0	7.81	
Andrenidae	<i>Andrena</i> sp.	0.8±0.4	1.60	1.60

*Each value is an overall average for bee species
S.E. = Standard error about mean

Table 3: Relative abundance of solitary bees pollinator visiting *Cassia fistula* bloom at Arki. No. of bees/500 flowers/10 minutes

Family	Genus/Species	Mean±S.E.	Percentage Population	Family Percentage
Apidae	<i>Xylocopa fenestrata</i>	13.5*±1.4	27.05	56.29
	<i>Ceratina gigantica</i>	10.6±1.2	21.24	
	<i>Trigona iridipenis</i>	2.2±0.8	4.40	
	<i>Anthophora</i> sp.	1.8±0.5	3.60	
Halictidae	<i>Halictus</i> sp.	8.5±1.2	17.03	19.43
	<i>Nomia elliotii</i>	1.2±0.4	2.40	
Megachilidae	<i>Megachile flaviceps</i>	7.4±0.9	14.82	22.23
	<i>Megachile</i> sp.1	3.7±1.0	7.41	
Andrenidae	<i>Andrena</i> sp.	1.0±0.3	2.00	2.00

*Each value is an overall average for bee species

S.E. = Standard error about mean

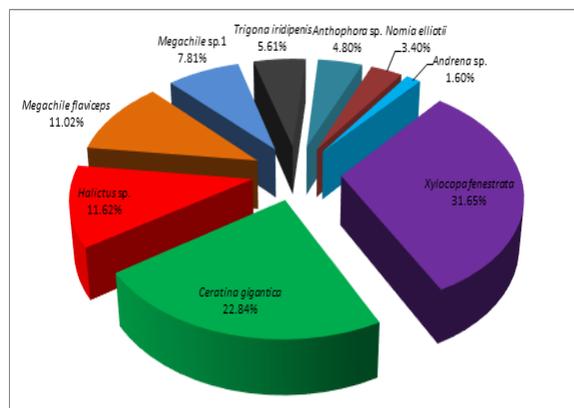


Figure 1: Relative abundance of solitary bees pollinator visiting *Cassia fistula* bloom at Nahana of Sirmour hills.

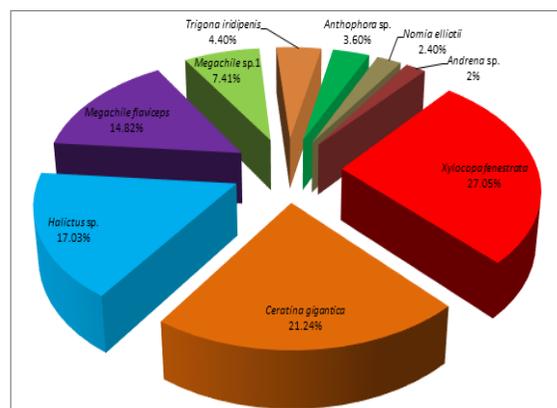


Figure 2: Relative abundance of solitary bees pollinator visiting *Cassia fistula* bloom at Arki of Solan hills.

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