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Studies diversity, distribution and relative abundance of insect pollinators of *Punica granatum* L. from different areas of Himachal Pradesh

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Abstract
The present studies were conducted on diversity, distribution and relative abundance of insect pollinators of wild pomegranate from eight localities of Himachal Pradesh *viz* Darlaghat (1563m), Jatoli (1464m), Kotla Panjola (1190m), Chandol (1418m), Dhar (1360 m), Aalsindi (1132 m), Jubbad (2050 m) and Potters hill (1887 m). Insect diversity studies showed a total of 25 species of insect pollinators belonging to 4 orders and 11 families of class Insecta. Of these, 13 species belonged to Order Hymenoptera, 6 to Diptera, 2 to Lepidoptera and 1 to Coleoptera. Analysis of data on relative abundance of different insect pollinators revealed that hymenopterans were the most prominent insect visitors of *Punica* flowers in all the localities i.e Darlaghat (86.89%), Jatoli (85.78%), Kotla Panjola (83.64%), Chandol (74.40%), Dhar (89.04%), Aalsindi (92.61%), Jubbad (80.39%) and Potters hill (72.58%). *Apis cerana* was the most abundant insect visitor to *Punica* flowers in all the experimental localities i.e. Darlaghat (29.51±1.10, 29.53%), Jatoli (18.95±3.14, 19.26%), Kotla Panjola (17.75±2.70, 19.05%,) Chandol (21.77±1.17, 22.01%), Dhar (89.04%), Aalsindi (92.61), Jubbad (80.39) and Potters hill (72.58%). Other important hymenopteran pollinators of *Punica* were *Apis mellifera*, *Apis dorsata*, *Bombus haemorrhoidalis* and *Halictus* sp. Besides hymenopterans, dipterans (*Episyrphus balteatus*, *Eristalis tenax*, *Eristalis cerealis* and *Epistalinus paria*) also constituted an important group of insect pollinators followed by Lepidoptera (*Gonepteryx rhamni neplensis* and *Papileo* sp.) and Coleopteran (Buprestinae).

Keywords: diversity, distribution, relative abundance, insect pollinators, *Punica granatum* L

Introduction

Pollination is an essential ecosystem service that helps to the maintenance and preservation of biodiversity. It is an interconnected system that connects the earth's vegetation, animals, and human well-being. (Kevan and Menzel, 2012) [16]. Pollinators also increase quality of fruits, nuts, oilseeds, vegetables, etc. thus, help to improve the economic value of crop production (Nagar and Chaudhary, 2006, Klatt *et al*., 2013, Garratt *et al*., 2014) [28, 19, 8]. There are approximately 3,50,000 different species of animals i.e. birds, bats, butterflies, moths, flies, beetles, wasps, small mammals and insects, thought to act as pollinators. Of all these, Insect pollinators are extremely important in pollinating wild plants and a variety of agricultural crop species. Insect pollinators mainly belong to orders Hymenoptera (wasps, bees, ants, sawflies), Diptera (flies), Lepidoptera (butterflies and moths) and Coleoptera (beetles). Among insect pollinators, honeybees are primary pollinators for the majority of the world's angiosperms, pollinating about 66% of the world's 1500 crop species, accounting for 15-30% of food production (Ollerton *et al*., 2011) [31] and also proved to be effective pollinators of most of the crops including horticultural crops, oilseeds, forage crops, fibre crops and cereal crops (Rahman, 2006) [35].

Wild bees such as flies, beetles, moths and butterflies are equally important as that of honey bees for the production of some crops and raise the commercial value of some crops (Kendall and Solomon, 1973; Jarlan *et al*., 1997; Larson *et al*., 2001; Blanche and Cunningham, 2005; Jauker and Wolters, 2008; Rader *et al*., 2009; Kleijn, *et al*., 2015; Kendall and Solomon, 1973; Larson *et al*., 2001) [15, 11, 22, 3, 12, 34, 15, 22]. The diversity and abundance of both wild and managed insect pollinators are declining globally and locally due to habitat destruction, use of pesticides, pollution problem, parasites, pathogens and predators, posing a threat to the stability of ecosystem service's (Biesmeijer *et al*., 2006; Potts *et al*., 2010a; Potts *et al*., 2010b; Jamwal and Thakur, 2019) [2, 32, 33]. Cross-pollination is not only essential for healthy fruits and seed production but it also promotes the genetic variation and ability of plant species to adapt to new and changing environments (Jump and Penuelas, 2005, Morran *et al*., 2009) [13, 27]. So, it is very important to study the diversity and abundance of insect pollinators.

Wild pomegranate (*Punica granatum* L.) is medicinally and economically very important wild fruit crop species that is native to the region of Northern India to Iran (Mortan, 1987). It is found in vast tract of outer Himalaya at elevation of 900 to 1800m above sea level covering the hill slopes of Jammu and Kashmir and Himachal Pradesh in India. It is commonly called Daru, Dalim and Daran. Wild pomegranate is in heavy demand from recent years because it is great source of natural antioxidants and health promoting constituents like organic acids, anthocyanins, phenolics, vitamins and minerals (Thakur *et al*., 2010; Thakur *et al*., 2011) [40, 41]. Phyto-nutrients obtained from pomegranate fruits provide the best protection against many diseases (Jyotsana and Maity, 2010) [14]. Flower buds of this plant has properties of astringent and given to patients who suffered from chronic

diarrhea and dysentery. The fruit is helpful in curing vomiting, sore throat, brain diseases, spleen complaints, chest troubles, scabies, bronchitis, liver and kidney disorders (Kirtikar and Basu, 1935) [18]. Wild pomegranate fruits are also used for the preparation of "anardana", in Asian countries which is good source of anthocyanins (Jaiswal *et al*., 2010) [9]. Due to medicinal properties, wild pomegranate germplasm eroding fast due to human incursion (Rana *et al*., 2012; Khan *et al*., 2014) [36, 17].

Review indicates that various investigators worked on the insect pollinators of *Punica granatum*. According to Morton (1987), Pomegranate can be self-pollinated or cross-pollinated by insects. Cross-pollination in pomegranate was reported by Gammie and Patwardhan (1929) [7] and Nalwadi *et al*. (1973) [29]. According to Melgarejo *et al*. (2000) [26], pollination in pomegranate is primarily affected by insects. Derin and Eti (2001) [6] studied the effects of cross pollination on fruit quality of pomegranate and reported that the cross pollination help to improve the quality of fruit quality than self and open pollination. Similarly, Adhikari and Adhikari (2010) [1] found that the most effective pollinator of *Punica granatum* was *Apis cerana* along with *A. mellifera*.

Himachal Pradesh is also one of the most diverse regions of the country and well known for the richest floral and faunal biodiversity. So, many workers studied the diversity and abundance of insect pollinators of different fruit crops such as Verma and Chauhan (1985) [43] observed the diversity of insect pollinators of apple crops in Shimla hills and found that *A. cerana* was the most predominant species visiting apple crop in Shimla hills. Singh and Mishra (1986) [37] also studied the abundance of various insect pollinators on the temperate fruit crops under different agro-climatic conditions of Himachal Pradesh. *Apis cerana* was observed to be the most abundant insect visitor followed by *Musca* sp. and *Eristalis* sp.

Similar studies on diversity, distribution and relative abundance of insect pollinators in twenty orchards of apple located at different landscapes of Kullu hills of the Northwest Himalayas (Mattu and Bhagat, 2015) [23] and on litchi flowers (Jamwal and Thakur, 2019; Chauhan and Thakur, 2021) [10, 5] were conducted, it was also observed that *Apis mellifera* was the most abundant insect visitor to these plants. In Himachal Pradesh, most of the focus has given to the insect pollinators of horticultural crops but wild fruit crops are neglected. So, the present study focuses on the diversity, distribution and relative abundance of insect pollinators of wild pomegranate (*Punica granatum* L.) from different areas of Himachal Pradesh.

Methodology

Studies on diversity, distribution and relative abundance of various insect pollinators of wild pomegranate were made by collecting the insect pollinators of *Punica* flowers from different areas *viz*. Darlaghat (1563m), Jatoli (1464m), Kotla Panjola (1190m), Chandol (1418m), Dhar (1360 m), Aalsindi (1132 m), Jubbad (2050 m) and Potters hill (1887 m) of Himachal Pradesh during April-May from 2018 to 2021. Studies on relative abundance of various insect visitors were made by selecting plant at random on the basis of their size, age, flowering stage and number of branches, it was determined in terms of their visit per 500 flowers/10 minutes (Verma and Chauhan, 1985) [43]. The observation was recorded at regular intervals during 0900-1700 hours of a day and average count at these hours gave abundance of insect pollinators for that particular day (Southwood, 1978) [39].

The species diversity and relative abundance was analyzed statistically from the collected data (Snedcor and Cochran, 1993) [38]. Similarly family number, family percentage, order number and order percentage were calculated for all the sites of insect collection and the results were tabulated. The relative abundance of different species of pollinators was calculated by using the following formula and expressed in percent

$$\text{Relative Abundance of Species} = \frac{\text{Total number of individuals of species A}}{\text{Total number of individuals of all species}} \times 100$$

Results and Discussion

Present diversity and distribution studies which were conducted on the insect pollinators of *Punica granatum* revealed a total of 25 species from different areas of Himachal Pradesh. These 25 species belonged to four orders *viz*. Hymenoptera, Diptera, Lepidoptera and Coleoptera. Of these 25 species, 16 belonged to order Hymenoptera, 6 to Diptera, 2 to Lepidoptera and 1 to Coleoptera. Of these, Hymenoptera was the most dominating order represented by 6 families *viz*., Apidae, Halictidae, Megachilidae, Vespidae, Colletidae and Andrinidae with species like *Apis cerana, Apis dorsata, A. mellifera, Bombus haemorrhoidalis, B. tunicatus, Bombus trifaciatus, Ceratina* sp., *Lasioglossum calceatum, Halictus* sp., *Megachile rotundata, Eumenes attrophicus, Seladonia vicina*, *Polistes* sp., *Hylaeus* sp., *Amegilla* sp. and *Andrena* sp. Among the six dipteran species, four species i.e. *Episyrphus balteatus, Eristalis tenax, Eristalis cerealis, Epistalinus paria* belongs to family Syrphidae and other two species i.e *Tachina saeontala* and *Servillia sobria* of family Tachinidae were found to visit pomegranate flowers. However, Lepidopterans were represented by only 2 species i.e. *Gonepteryx rhamni neplensis* (Doubleday) and *Papileo* sp. belonging to families Pieridae and Papilionidae respectively. Order Coleoptera was represented by only one insect pollinator of Buprestidae family recorded as pollinator of *Punica granatum*. Among all these, hymenopterans were the most abundant pollinators comprising 16 species visiting *Punica granatum* (L.) (Table I).

Different investigators have reported different number of pollinators on fruit crops in Himachal Pradesh. Kumar (1995) [20] reported thirty species of insect pollinators on almond bloom in Shimla hills which belonged to 5 orders and 17 families of class Insecta. Relative abundance studies on almond indicated that *Apis cerana* was the most abundant species followed by *A. mellifera* and *Halictus dasygaster*. Whereas, Kumar (1997) [21] recorded that apple flowers were visited by 49 insect species in the Himalayan belt. Similarly, Mattu and Niral (2016) [25] studied that apple flowers were visited by 41 species of insect pollinators in Shimla hills which belonging to 5 orders and 16 families of class insecta. Similarly, Chauhan *et al*. (2021) [5] recorded 23 species of insect pollinators of mango from Kyarda Doon valley of district Sirmaur, Himachal Pradesh. Of these, 11 species belonged to Diptera, 6 to Coleoptera, 4 to Hymenoptera and 2 to Hemiptera.

During relative abundance studies, it was found that hymenoptera were the most prominent insect visitors on pomegranate plant in all the localities i.e. Darlaghat (86.89%), Jatoli (85.78%), Kotla Panjola (83.64%), Chandol (75.40%), Dhar (89.04%), Aalsindi (92.61%), Jubbad (80.39%) and Potters hill (72.58%) followed by Diptera, Coleopteran and Lepidoptera. During this period, 13 species of hymenopterans were recorded of which, 6 species

belonged to family Apidae, 2 to Halictidae and 1 each to Megachilidae, Collitidae and Andrinidae. Insect pollinators belonging to family Apidae were the most common in all the localities i.e. Darlaghat (65.54%), Jatoli (54.93%), Kotla Panjola (59.78%), Chandol (56.25%), Dhar (62.33%), Aalsindi (64.21%), Jubbad (61.65%) and Potters hill (Shimla) (49.28%) followed by family Vespidae, Halictidae, Megachilidae, Collidae and Andrenidae (Table II,III,IV,V).

Study revealed that maximum abundance of hymenopterans was observed in Aalsindi (92.61%) followed by Dhar (89.04%), Darlaghat 86.89% Jatoli (85.78%), Kotla Panjola (83.64%), Jubbad (80.39%), Chandol (75.40%) and Potters hill (72.58%). Similarly, maximum number of insect pollinators belonging to family apidae was also observed in Darlaghat (65.54%) (Table II, III, IV, V).

Among all the insect pollinators, *Apis cerana* was the most abundant insect visitor on pomegranate flowers in all the localities i.e. Darlaghat (29.51±1.10, 29.53%). Jatoli (18.95±3.14, 19.26%), Kotla Panjola (17.75±2.70, 19.05%), Chandol (21.77±1.17, 22.01%), Dhar (24.17±1.70, 24.17%), Aalsindi (26.16± 2.12, 28.69%), Jubbad (30.06±2.12, 31.23%) and Potters hill (22.09±1.66, 23.36%) (Table II, III, IV, V).

Other important hymenoptera pollinators of *Punica granatum* at Darlaghat, Jatoli, Kotla Panjola, Chandol, Dhar, Aalsindi, Jubbad and Potters hill were *Apis dorsata* (15.73%, 9.19%, 9.92%, 8.36%, 11.36%, 10.03%, 11.51%, 8.64%), *Apis mellifera* (7.70, 10.72, 17.42, 9.41, 11.19, 11.99, 7.40, 7.92), *Bombus haemorrhoidalis* (4.47%, 5.39%, 7.30%, 7.17%, 2.81%, 10.20%, 4.45%, 4.11%), *Bombus trifaciatus* (3.85%, 3.41%, 3.65%, 4.31%, 2.47%, 6.38%, 3.69%, 3.39%), *Ceratina* species (3.85%, 6.91%, 2.42%, 6.97%, 4.27%, 4.12%, 3.34%, 1.85%), *Lassioglossum* (5.43%, 8.44%, 8.15%, 5.94%, 5.33%, 5.25%, 5.17%, 7.92%), *Halictus* sp. (2.55%, 8.86%, 8.26%, 3.71%, 2.47%, 4.46%, 2.94, 3.39%), *Megachile* sp.(4.81%, 5.20%, 3.65%, 4.93%, 4.61%, 5.04%, 3.64%, 6.01%), *Hyleaus* sp. (4.17%, 9.57%, 1.19%, 2.02%, 8.51%, 2.61%, 3.34%, 2.98%) and *Andrena* sp. (3.21%, 2.21%, 2.14%, 3.47%, 3.20%, 4.12%, 2.58%, 2.98%) respectively (Table II, III, IV, V).

Among dipterans, three species were also recorded from Darlaghat, Jatoli, Kotla Panjola, Chandol, Dhar, Aalsindi, Jubbad and Potters hill *viz*. *Erystalsis balteatus* (3.50±0.64, 3.50%, 4.25±0.95, 4.32%, 3.01±1.17, 3.23%, 4.66±0.90, 4.70%, 1.75±0.49,1.75%, 2.46±0.86, 2.69%, 3.90±0.75, 4.05%, 4.28±0.91, 4.52%), *Eristalinus paria* (2.89±0.59, 2.90%, 3.72±1.08, 3.78% 2.83±0.72, 3.03%, 3.07±1.38, 3.10%, 1.40±0.50,1.40%, 2.72±0.74, 2.98%, 3.22±0.59, 3.34%, 6.03±1.03, 6.37%) and *Eristalis tenax* (3.19±0.69, 3.19%, 2.65±0.62, 2.69%, 2.44±0.64, 2.61%, 2.27±1.23, 2.29%, 2.13±0.46, 2.13%, 1.12±0.04,1.22%, 4.63±0.95, 4.81%, 3.89±0.64, 4.11%) respectively. *Buprestinae* sp. (5.12%, 3.65%, 4.03%, 2.22%, 4.61%, 3.15%, 7.04%, 5.65%) was the only coleopteran pollinator recorded at all the eight localities (Table II, III, IV, V).

Based on present studies it is suggested that hymenopterans were most abundant insect pollinators on *Punica granatum* from different localities of Himachal Pradesh and *Apis cerana* was the most abundant pollinator among all. These results are in conformity with the observations of Nath and Randhawa (1959) [30] who reported that pollination in pomegranate is both self and cross-pollinated and the principal insect pollinators are honey bees (*Apis* sp.). Similarly, Adhikari and Adhikari (2010) [1] reported that honeybees constituted a major proportion of insect pollinators on *Punica granatum* (L.). Present results are also support the recent findings of Mattu and Mattu (2007) [24] who also found hymenopterans (78.89%) the most important insect pollinators on almond bloom, whereas, hymenopterans (44.50%) and dipterans (49.37%) were almost equally abundant on peach bloom in Shimla and Solan hills respectively.

Table 1: Systematic list of insect pollinators of *Punica granatum* L. from different areas of Himachal Pradesh

Order	Family	Fauna/ Insect species
Hymenoptera	Apidae	*Apis cerana* Fabricius
		Apis dorsata Fabricius
		Apis mellifera Linnaeus
		Bombus haemorrhoidalis(Smith)
		Bombus trifaciatus
		Bombus tunicatus Smith
		Ceratina sp.
	Halictidae	*Lasioglossum calceatum*
		Halictus sp.
	Megachilidae	*Megachile rotundata* Fabricius
	Vespidae	*Eumenes attrophicus* (Fabricius)
		Seladonia vicina
		Polistes sp.
	Colletidae	*Hylaeus* sp.
		Amegilla sp.
	Andrenidae	*Andrena* sp.
Diptera	Syrphidae	*Episyrphus balteatus* (De Geer)
		Eristalis tenax (Linnaeus)
		Eristalis cerealis (Fabricius)
		Epistalinus paria (Bigot)
	Tachinidae	*Tachina saeontala* Walker
		Servillia sobria Walker
Lepidoptera	Pieridae	*Gonepteryx rhamni neplensis* (Doubleday)
	Papilionidae	*Papileo* sp.
Coleoptera	Buprestidae	*Buprestinae* sp.

Table 2: Relative abundance of insect pollinators of *Punica granatum* from Darlaghat and Jatoli Localities of district Solan, Himachal Pradesh.

Order	Family		Locality: Darlaghat				Locality: Jatoli			
		Genus/species	Mean±S.E	Percent population	Family percent	Order percent	Mean±S.E	Percent population	Family percent	Order percent
Hymenoptera	Apidae	*Apis cerana*	29.51* ±1.10	29.53	65.54	86.89	18.95*± 3.14	19.26	54.93	85.78
		Apis dorsata	15.72±1.29	15.73			9.04±2.12	9.19		
		Apis mellifera	7.70±1.11	7.70			10.55±2.92	10.72		
		Bombus haemorrhoidalis	4.47±0.79	4.47			5.31±1.11	5.41		
		Bombus trifaciatus	3.85±0.70	3.85			3.36±1.18	3.41		
		Ceratina sp.	3.85±0.70	3.85			6.80±2.10	6.91		
	Halictidae	*Lasioglossum calceatum*	5.43±1.25	5.43	9.03		8.31±2.40	8.86	18.33	
		Halictus sp.	2.54±0.62	2.54			8.72±2.40	8.86		
	Megachilidae	*Megachile*	4.81±0.92	4.81	4.84		5.12±1.03	5.20	5.20	
	Colletidae	*Hyleaus* sp.	4.16±0.62	4.17	4.19		9.57±2.69	9.73	9.73	
	Andrenidae	*Andrena* sp.	3.19±0.68	3.21	3.21		2.09±0.43	2.21	2.21	
Diptera	Syrphidae	*Episyrphus balteatus*	3.50±0.64	3.50	9.65	9.23	4.25±0.95	4.32	10.79	10.65
		Epistalinus paria	2.89±0.59	2.90			3.72±1.08	3.78		
		Eristalis tenax	3.19±0.69	3.19			2.65±0.62	2.69		
Coleoptera		*Buprestinae* sp.	5.12±1.02	5.12	5.15	5.12	3.59±1.14	3.65	3.65	3.62

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

Table 3: Relative abundance of insect pollinators of *Punica granatum* from Kotla Panjola and Chandol localities of district Sirmour, Himachal Pradesh.

Order	Family		Locality: Kotla Panjola				Locality: Chandol			
		Genus/species	Mean±S.E	Percent population	Family percent	Order percent	Mean±S.E	Percent population	Family percent	Order percent
Hymenoptera	Apidae	*Apis cerana*	17.75*± 2.70	19.05	59.78	83.64	21.77* ±1.17	22.01	55.25	74.40
		Apis dorsata	9.24±2.46	9.92			8.20 ±2.28	8.36		
		Apis mellifera	16.23±1.64	17.42			9.23± 0.91	9.41		
		Bombus haemorrhoidalis	6.80±1.00	7.30			7.10 ±0.89	7.17		
		Bombus trifaciatus	3.40±0.76	3.65			4.27 ±0.92	4.31		
		Ceratina sp.	2.26±0.70	2.42			6.90 ±1.08	6.97		
	Halictidae	*Lasioglossum calceatum*	7.93±1.65	8.15	16.78		5.88 ±1.10	5.94	9.59	
		Halictus sp.	7.70±2.87	8.26			3.71 ±1.11	3.74		
	Megachilidae	*Megachile*	3.40±1.51	3.65	3.65		4.88 ±0.98	4.93	4.69	
	Colletidae	*Hyleaus* sp.	1.19±1.03	1.27	1.27		2.00±1.14	2.02	1.92	
	Andrenidae	*Andrena*	2.00± 0.62	2.14	2.14		3.44 ±1.18	3.47	3.30	
Diptera	Syrphidae	*Episyrphus balteatus*	3.01±1.17	3.23	8.87	12.31	4.66 ±0.90	4.70	13.47	22.45
		Epistalinus paria	2.83±0.72	3.03			3.07 ±1.38	3.10		
		Eristalis tenax	2.44±0.64	2.61			2.27±1.23	2.29		
Coleoptera	Buprestinae	*Buprestinae* sp.	3.76±1.02	4.03	4.03	4.03	2.22±0.64	2.24	2.13	2.08

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

Table 4: Relative abundance of insect pollinators of *Punica granatum* from Dhar and Alsindi localities of district Mandi, Himachal Pradesh.

Order	Family		Locality: Dhar				Locality: Alsindi			
		Genus/species	Mean±S.E.	Percent population	Family percent	Order percent	Mean±S.E	Percent population	Family percent	Order percent
Hymenoptera	Apidae	*Apis cerana*	24.17*±1.70	24.17	62.33	89.04	26.16* ±2.12	28.69	64.21	92.61
		Apis dorsata	11.36±0.94	11.36			9.08±1.18	10.03		
		Apis mellifera	11.19±1.16	11.19			10.23±1.70	11.99		
		Bombus haemorrhoidalis	2.81±0.64	2.81			9.30±1.29	10.20		
		Bombus trifaciatus	2.47±0.64	2.47			5.82±0.95	6.38		
		Ceratina sp.	4.27±0.81	4.27			3.76±0.64	4.12		
	Halictidae	*Lasioglossum calceatum*	5.33±0.82	5.33	7.80		4.79±0.68	5.25	12.53	
		Halictus sp.	2.47±0.64	2.47			3.76±0.64	4.12		
	Megachilidae	*Megachile*	4.61±0.86	4.61	5.09		4.46±0.75	4.89	4.67	
	Colletidae	*Hyleaus* sp.	8.51±1.25	8.51	9.42		2.39±0.49	2.61	2.43	
	Andrenidae	*Andrena*	3.20±0.72	3.20	3.20		3.76±0.57	4.12	3.82	
Diptera	Syrphidae	*Episyrphus balteatus*	1.75±0.49	1.75	5.84	5.84	2.46±0.86	2.69	6.41	6.41
		Epistalinus paria	1.40±0.50	1.40			2.72±0.74	2.98		
		Eristalis tenax	2.13±0.46	2.13			1.12±0.04	1.22		
Coleopteran		*Buprestinae* sp.	4.61±0.75	4.61	5.10	5.10	2.88±1.01	3.15	2.93	2.93

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

Table 5: Relative abundance of insect pollinators of *Punica granatum* from Jubbad and Pottershill localities of district Shimla, Himachal Pradesh.

Order	Family	Genus/species	Locality: Jubbad				Locality: Pottershill			
			Mean±S.E	Percent population	Family percent	Order percent	Mean±S.E	Percent population	Family percent	Order percent
Hymenoptera	Apidae	*Apis cerana*	30.06*±2.12	31.23	61.65	80.39	22.09* ±1.66	23.36	49.28	72.58
		Apis dorsata	11.08±1.70	11.51			8.17±0.75	8.64		
		Apis mellifera	7.13±1.78	7.40			7.49±0.72	7.92		
		Bombus haemorrhoidalis	4.29±0.70	4.45			3.89±0.64	4.11		
		Bombus trifaciatus	3.56±0.68	3.69			3.21±0.72	3.39		
		Ceratina sp.	3.22	3.34			1.75±0.49	1.85		
	Halictidae	*Lasioglossum calceatum*	4.98±0.75	5.17	8.11		7.49±1.01	7.92	11.31	
		Halictus sp.	2.83±0.72	2.94			3.21±0.61	3.39		
	Megachilidae	*Megachile*	4.85±0.98	5.04	5.04		5.69±1.54	6.01	6.01	
	Colletidae	*Hyleaus* sp.	3.22±0.59	3.34	3.34		2.82±0.62	2.98	2.98	
	Andrenidae	*Andrena*	2.49±0.62	2.58	2.58		2.82±0.74	2.98	2.98	
Diptera	Syrphidae	*Episyrphus balteatus*	3.90±0.75	4.05	12.20	12.20	4.28±0.91	4.52	14.20	15.01
		Epistalinus paria	3.22±0.59	3.34			6.03±1.03	6.37		
		Eristalis tenax	4.63±0.95	4.81			3.89±0.64	4.11		
Coleopteran		*Buprestinae* sp.	6.78±1.03	7.04	7.04	7.04	5.35±0.59	5.65	5.65	5.65

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

Conclusion

Wild pomegranate is medicinally very important fruit plant and pollinated by wide variety of insect pollinators. The diversity and abundance of both wild and managed insect pollinators are declining globally. So, the study on diversity and abundance of insect pollinators helps in their conservation for future. In the present study, it has been recorded that hymenopterans were the most prominent insect visitors of *Punica* flowers in all the localities. Study revealed the maximum abundance of hymenopterans in Aalsindi (Mandi) (92.61%) followed by Dhar (Mandi) (89.04%), Darlaghat (Solan) 86.89%, Jatoli (Solan) (85.78%), Kotla Panjola (Sirmour) (83.64%), Jubbad (Shimla) (80.39%), Chandol (Sirmour) (75.40%) and Potters hill (Shimla) (72.58%). Among all the insect pollinators, *Apis cerana* was the most abundant insect visitor to *Punica* flowers from all the localities. Besides hymenopterans, dipterans also constituted an important group of insect pollinators followed by coleoptera and lepidoptera.

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