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Relative abundance of insect pollinators and their correlation with important abiotic factors on almond

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Abstract
Studies on relative abundance of various insect pollinators on almond crop were carried out at three districts *viz.* Srinigar, Budgam and Pulwama of Kashmir valley. Insect diversity studies showed that almond flowers were visited by 12 species of insect pollinators belonging to 6 families and three orders Hymenoptera, Diptera and Lepidoptera. Foraging populations of honeybees responded differently to abiotic factors. Peak activity hymenopteran and lepidopteran was observed between 1200-1400 pm, however peak activity of dipterans was observed between 0800-0900am. Hymenopterans, *Apis mellifera* (*0.836) Apis cerana* (*0.699*) *Lasioglossum* spp. (0.893) *Xylocopa* spp (0.724) *Andrena* spp (*0.884) Bombus tunicatus* (0.601) Lepidopteran (0.469) and Dipterans (-0.580) were positively correlated with temperature and sunshine but negatively correlated with relative humidity except dipterans. Sunshine showed significant positive correlation but rainfall showed negative impact. These results suggested to maintain a natural habitat that is suitable for *Lasioglossum nursei* and other native insect pollinators to ensure successful survival of these important insects in almond orchards which contribute significantly to fruit set. Moreover, pesticide application should be avoided at time of full bloom.

Keywords: Insect pollinator, correlation, abundance, almond bloom

1. Introduction

Pollination is required for the production of a wide range of fruit crops [13]. Almond requires insect pollination to set fruit and has extremely high pollination requirements for commercial production [17]. Most almond growers rely on rented honeybee (*Apis mellifera* L.) hives as the sole source of pollination [4]. Good pollination improves both fruit size and yield [9]. Ecosystem services and their economic value have often been used as an incentive for conservation, although it is sometimes difficult to characterize and quantify them. Wild and managed pollinators have been reported to be threatened in several regions around the world, and there is concern about the effect of pollination deficit may have on crop production. Different crops and cultivars have different levels of dependence on insect pollination due to a combination of biological, physical and management factors. Even though managed honeybees are the major pollinator of crops globally [23]. Wild pollinators are particularly important for less intensively farmed crops with ample resources for these pollinators [10,11]. The degree to which different crops and cultivars depend on pollinators for fruit set, size or quality can vary greatly from one to the other [8]. Insect's attraction for pollination depends upon qualities like bright colour of its petals, attractive scent, presence of nectar gland, edible pollens. The numerous peculiarities of structure and physiology of flowers are obviously related to certain morphology and physiology of insect that pollinate them [7]. Differences in land-use practice, pollinator species and their indigenousness to an area or not, will all add to regional dissimilarities of pollination systems. Therefore, studies on pollination services need to be more focused in regional terms [5] as well as on specific crops and cultivars [2]. It is not only self-sterile varieties which require cross pollination but self-fertile forms also produce better yield, if cross pollinated.

Different kinds of insects such as bees, flies, beetles, butterflies, moths and wasps are important pollinators of many crops. Among insects, bees are more effective pollinators than other insects, their body hairs help in transfer of 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. However, we lack a clear understanding of the importance of native bees in almond pollination and fruit growers are not aware of the potential value of native bees in almond pollination and production.

2. Materials and methods

2.1 Experimental site

Two sites from each district namely Dalgate and Badamvari from Srinagar; Central Institute of Temperate Horticulture (CITH) and K.D. Farm from Budgam and Barsu and Lethipora from Pulwama, respectively, were surveyed for collection and identification of pollinators foraging on almond in the year 2013-14. Each site was visited thrice during period of investigation. Insect pollinators visiting almond blossom between 8 am to 3 pm were collected randomly in the month of March with insect aerial net.

2.2 Specimen collection and identification

The collected specimens were killed in ethyl acetate jars and stored in paper envelopes, such specimens were pinned and then stretched and pinned with the help of the entomological pins and were stored in the collection boxes. Each specimen was marked with the collection date and name of the locality. Taxonomic classification of specimens were done into groups with the help of the key given up to species level except one species (genera level) [19].The genera *Scathophaga* could not be identified, whereas other specimens were identified upto the species level with the help of the relevant literature in the laboratory of Research Training Centre for Pollinator, Pollinizer and Pollination Management (RTCPPPM) SKUAST-Kashmir, Shalimar. Those species that were not identified upto the species level were sent Punjab Agriculture University (PAU), Ludhiana and University of Agricultural Sciences, Dhaward, Karnataka to the workers in India for their proper identification.

2.3 Statical analysis

For recording insect pollinator abundance visiting almond, one meter length on each of the five trees selected per location was marked and numbers of such insects foraging on these branches were counted in the beginning of each hour for 15 min as per the metholodogy of [25]. For recording insect pollinator diversity of hourly count of each insect foraging on almond blossoms was made for entire flowering period. Data pertaining to temperature, sunshine, rainfall and relative humidity were collected from Agro-meteorology Division, SKUAST-Kashmir (Srinigar). Simple correlations were estimated for average hourly count of insect pollinator population and abiotic factors as per method proposed by proposed by [26].

3. Results and Discussion

3.1 Abundance of insect pollinators on almond

Almond flowers attracted insect pollinators belonging to the orders hymenoptera, lepidoptera and diptera. The hymenopterous insects *viz*. *Lasioglossum* spp. were more abundant followed by, *A. cerana* almond blossoms, as soil dwelling bees remain high during spring because of their adaptation to temperature and soil acts as a shield to the soil dwelling bees against habitat destruction and pesticide sprays so population of bees remain high during the spring.

Conclusion drawn from the studies of [20] indicated that honey bees were the most abundant pollinators on apple blossoms. The butterflies belonging to order lepidoptera, *Scathophaga* sp. and Syrphid flies from order diptera were observed in low numbers and are not regarded as effective pollinators. Hymenopterans (78.89%) were found 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 [14]. Abundance, richness and evenness of the hymenopterous pollinator were found at peak during the successional flowering time in the orchards of both pome and stone fruits in various localities. In the present study, maximum abundance was shown by *L. nursie* (Halictidae, Hymenoptera). The higher values of rank abundance of these species can be attributed to the fact that these species are supposed to have a greater adaptability to local environmental conditions [15, 16].

Table 1: Relative abundance of insect pollinators visiting almond during bloom period

Species	Mean no of insect pollinators/meter/branch length/15 minutes		
	Srinagar	Budgam	Pulwama
Apis cerana	6.89	4.45	4.12
Apis mellifera	1.34	1.08	0.93
Lasioglossum	12.77	10.32	9.32
Andrena floridula	0.66	0.54	0.00
Andrena patella	0.00	0.00	1.08
Andrena cineraria	0.00	0.00	1.067
Bombus tunicatus	0.19	0.00	0.00
Xylocopa valga	0.70	0.42	0.69
Xylocopa violacea	0.00	0.00	0.39
Papilio machaon	0.233	0.00	0.00
Eoseristalis cerealis	0.00	0.52	0.00
Scathophaga spp.	0.00	0.32	0.00

Figures are mean of 5 observations

Table 2: Correlation coefficient between different weather parameters and insect pollinators on almond bloom

Pollinators	Environmental factors			
	Temperature	Relative humidity	Sunshine hours	Rainfall
Apis meliffera	0.836**	-0.652*	0.843**	-0.590*
Apis cerana	0.699**	-0.522*	0.740**	-0.441*
Lasioglossum spp.	0.893**	-0.518*	0.653**	-0.553*
Xylocopa spp.	0.724**	-0.537*	0.356**	- 0.634*
Andrena spp.	0.884**	-0.347*	0.778**	-0.510*
Bombus tunicatus	0.601**	-0.421*	0.382**	-0.429*
Lepidopterans	0.469**	-0.421*	0.399**	-0.525*
Dipterans	-0.580**	0.555**	0.858**	-0.678*

P Value < 0.05

* = Slightly significant

** = Highly significant

Table 3: Relative abundance of insect pollinators at different hours of the day at Budgam on almond bloom

Insect pollinators	Mean number of insect pollinators/minute branch/15minutes and ±SEm						
	0800-0900	0900-0100	0100-1100	1100-1200	1200-1300	1300-1400	1400-1500
Apis cerana	3.2 ±0.38	3.4 ±0.52	3.8 ±0.59	4.0 ±0.54	4.2 ±0.37	5.0 ±0.32	4.8 ±0.36
Apis mellifera	2.8 ±0.73	3.0 ±0.49	3.4 ±0.34	3.8 ±0.82	4.0 ±0.32	4.8 ±0.37	4.2 ±0.37
Lasiogolossum nursei	3.6 ±0.92	3.8 ±0.48	4.2 ±0.79	4.4 ±0.51	5.2 ±0.37	6.2 ±0.37	6.0 ±0.44
Xylocopa spp.	2.0 ±0.20	2.4 ±0.40	3.0 ±0.28	1.8 ±0.28	1.6 ±0.14	1.2 ±0.20	1.4 ±0.22
Andrena spp.	2.4 ±0.22	2.8 ±0.28	3.4 ±0.39	3.6 ±0.57	3.8 ±0.28	4.2 ±0.42	4.0 ±0.35
Dipterans	3.0 ±0.44	2.48 ±0.24	1.6 ±0.31	1.8 ±0.73	1.6 ±0.24	1.2 ±0.48	1.4 ±0.39

Mean of 5 replications

Table 4: Relative abundance of insect pollinators at different hours of the day at Srinagar on almond bloom

Insect pollinators	Mean number of insect pollinators/minute branch/15minutes and ±SEm						
	0800-0900	0900-0100	0100-1100	1100-1200	1200-1300	1300-1400	1400-1500
Apis cerana	3.0 ±0.37	3.4 ±0.68	3.6 ±0.79	3.8 ±0.86	4.2 ±0.67	4.6 ±0.54	4.4 ±0.89
Apis mellifera	2.8 ±0.28	3.0 ±0.35	3.6 ±0.39	3.8 ±0.46	4.0 ±0.35	4.6 ±0.67	4.2 ±0.53
Lasiogolossum spp.	4.2 ±0.60	4.4 ±0.39	4.6 ±0.59	4.8 ±0.17	5.0 ±0.53	5.6 ±0.64	5.2 ±0.49
Xylocopa spp.	0.8 ±0.14	1.0 ±0.17	1.6 ±0.23	1.2 ±0.28	0.8 ±0.14	1.4 ±0.20	1.2 ±0.22
Andrena spp.	2.0 ±0.14	2.2 ±0.12	2.4 ±0.39	2.6 ±0.22	2.8 ±0.14	3.2 ±0.35	3.0 ±0.28
Bombus tunicatus	0.0 ±0.00	0.2 ±0.19	0.4 ±0.24	0.6 ±0.23	0.8 ±0.19	1.0 ±0.31	1.4 ±0.31
Lepidopterans	0.0 ±0.00	0.2 ±0.14	0.2 ±0.15	0.4 ±0.22	0.8 ±0.28	0.2 ±0.40	1.2 ±0.32

Mean of 5 replications.

Similar results revelations confirmed that 9 species of insects in five genera belonged to order hymenoptera as per rank abundances [12].

3.2 Trends in foraging activity of insect pollinators in relation to environmental factors

Each bee pollinator has specific ecological threshold for foraging activity which differ inter and intra specifically depending upon the level of adaptation of a given species in an environment [3]. hymenopteran and lepidopteran pollinators increased with increase in temperature and sunshine and had negative relationship with relative humidity and rainfall. Our results were in accordance with the reports that the bee activity increased with temperature [1]. In case of *A. mellifera,* morning activity was related to nectar flow it was correlated with the photoperiod [21].

Daily variations in temperature, solar radiation, wind and humidity are reported to influence when an insect should be active and what it should be doing at any given point of time [22]. In particular, daily variations of temperature and light strongly influence the habitat selection and activity patterns due to their surface area to mass ratio [18].

3.3 Foraging behaviour of different pollinators in relation to different hours of the day

Hourly observations of insect visiting almond flowers revealed that maximum population of Hymenopterans was observed between 1200-1400 hour. In case of Dipterans the maximum activity was recorded during earlier hours of the day, and more number of Dipterans visited when relative humidity was more, similar results were reported by [6] who reported that foraging activity of Dipteran flies were significantly and positively correlated with relative humidity. In general suitability of conditions for maximum bee activity vary from season to season, depending upon the level of adaptability of bee species. The conditions of optimum bee activity may also vary, depending upon geographical regions, time of the year and insect pollinators.

Our results were in collabration with [24] who reported that no butterfly species was observed at 6:00 a.m. in the morning, while they started appearing slowly and increased in number during later periods. The maximum abundance was observed at 12:00 p.m.

Analysis of data on relative abundance of insect pollinators visiting almond bloom per 15 minutes/branch/tree in all the three districts namely Srinagar, Budgam and Pulwama are recorded in the Table-1. Analysis of data on relative abundance of different insect pollinators revealed that *L. nursei* was most abundant insect visitor to almond blossom in all the three locations i.e. Srinagar, Budgam and Pulawama. Other important hymenopterans at the three sites were *A. cerana*, *Andrena* sp., *A. mellifera* and *B. tunicatus*. Among dipterans, *E. cerealis* and *Scathopha* sp. were the most important pollinators at Budgam district. The relationship of foraging population and various environmental variables was computed through estimation of simple correlation. The data given in the Table-2 revealed that field abundance of hymenopteran and lepidopteran pollinators increased with increase in temperature while, dipterans were negatively correlated with temperature and positively correlated with relative humidity. However, hymenopterans and lepidopteran pollinators have negative correlation with relative humidity. The relationship between insect pollinator was found to be positively correlated with sunshine, and showed negative relationship with rainfall. The result presented in the Tables-2, 3and 4 indicated that bee population reached its peak between 1200-1400 p.m., but peak activity of dipterans was found early in the morning (0800-0900 am), and declined at noon and further declined in afternoon, and the lepidopterans (butterflies) were found in low numbers at morning hours and their peak activity was observed at noon. In general, field activity of foraging population of insect pollinators increased with increase in temperature, sunshine hours and decreased with increase in relative humidity and rainfall, except Dipterans which had negative correlation with temperature and rainfall, while positive and significant correlation with relative humidity and sunshine hours. All the pollinators belonging to order Hymenoptera were found to be in few numbers in early hours and showed peak activity at 1200-1400 hours. Maximum population of dipterans were observed early in the morning 0800-0900 a.m. and decline in after noon, however lepidopterans showed their peak activity at 1200-1400 hours, they showed positively significant correlation with temperature and sunshine, while negatively correlation with relative humidity and rainfall. The present investigation implies that native insect pollinators frequently

visiting almond blossom viz. *L. nursei*, *Xylocopa* sp., *Andrena* sp., Syrphid flies *and E. cerealis* besides honey bees need to be exploited for future pollination services, and their breeding techniques and mass rearing should be standardized and synchronized with bloom period.

4. References

1. Abrol DP, Kapil RP. Factors affecting pollination activity of Megachile lanata. Proceedings of Indian Academy of Science (Animal Science) 1986; 95:757-769.
2. Allsopp MH, Lange De Abrol DP. Environmental factors influencing pollination activity of *Apis mellifera* on Brassica compestris. Journal of Indian Institue of Sciences 68: 49-52, W.J. and Veldtman, R. 2008. Valuing insect pollination services with the cost of replacement. Plos one. 1988; 3:3128.
3. Burill RM, Dietz A. The response of honeybees to variations in solar radiation and temperature. Apidologie. 1981; 12:319-328.
4. Delaplane KS, Mayer DF. *Crop* Pollination by Bees. CABI Publishing, New York, 2000.
5. Donaldson JS. Pollination in agricultural landscapes, a South African perspective. In: Pollinating Bees-The Conservation Link Between Agriculture and Nature. (Eds. P. Kevan and F.V.L. Imperatriz), Ministry of Environment, Brasilia, 97-104. Available online at [http://www.webbee.org.br/ bpi/pdfs/livro_02_donaldson.pdf] 2002.
6. Dashad SS. Pollination studies on apple (Malusdomestica Borckh) with particular reference to the role of honey bees. Ph.D. Thesis, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan, H.P. India 1989, 129.
7. Dutta AC. Botany for Degree Student, Oxford University Press, New York, 1970.
8. Free JB. Insect Pollination of Crops. Academic Press, London. 1993, 684.
9. Gautier-Hion A, Maisels F. Mutualism between a leguminous tree and large African monkeys as pollinators. Behavioural Ecology and Sociobiology. 1993; 34:203-210.
10. Ghazoul J. Buzziness as usual? Questioning the global pollination crisis. Trends in Ecology and Evolution. 2005a; 20:367-373.
11. Ghazoul J. Response to Steffan-Dewenter Questioning the global pollination crisis. Trends in Ecology and Evolution. 2005b; 20:652-653.
12. Hussain AK, Rahim M, Ghffar A, Alia H, Jamil A. The hymenopterous pollinators of Himalayan foot hills of Pakistan (distributional diversity). African Journal of Biotechnology. 2012; 11(28):7263-7269.
13. Klein AM, Vaissiere BE, Cane JH, Steffan DI, Cunningham SA, Kremen C *et al*. Importance of pollinators in changing landscapes for world crops. Proceedings of the Royal Society London, Series B 2007; 274:303-31
14. Kumar D. Bioecology of *Apis* and its mite pests in relation to almond and peach pollination. Ph.D. Thesis, Himachal Pradesh University, Shimla, India, 1995, 16-43.
15. Jasara AW, Rafi MA. Pollination management of apricot as alivelihood source in northern areas. Pakistan Journal of Agriculture Agricultural Engineering and Veterinary Science. 2008; 24:34-40.
16. Jasara AW, Ashfaq S, Kasi AM. Apple pollination in Balochistan, Pakistan. National Arid land Development and Research Institute, Ministry of Food, Agricultural and Livestock, Islamabad, 2000, 33.
17. Lumkin D. Overcoming obstacles during 2005 almond pollination. American Bee Journal. 2005; 145:290-294.
18. May M. Insect thermoregulation. Annual Review of Entomology. 1979; 24:313-349.
19. Michener CD. The bees of the world. 2nd ed. Johns Hopkins University Press, Baltimore, 2007.
20. Mishra RC, Dogra GS, Gupta PR. Some observations on insect pollinators of apple. Indian Bee Journal. 1976; 38:20-22.
21. Nunez JA. Nectar flow by melliferous flora and gathering flow by *Apis mellifera* L. Journal of Insect Physiology. 1977; 23:265.
22. Piexoto PE, Benson W. Daily activity patterns of two co-occuring tropical Satyrine butterflies. Journal of International Science. 2009; 9:54.276.
23. Richards AJ. Does low biodiversity resulting from modern agricultural practice affect crop pollination and yield? Annals of Botany 2001; 88:165-172.
24. Ruchi N, Nirjara G, Sujatha P. Abundance of four butterfly species and their correlations with ecological parameters-A short term study at Bioresearch Bulletin, 2013, 42-49.
25. Sihag RC, Abrol DP. Correlation and path coefficient analysis of environmental factors influencing flight activity of *Apis florae* F. Journal of Apiculture Research. 1986; 25:202-208.
26. Snedecor GW, Cockran WG. Statistical methods Oxford and IBH Publishing Co London, 1967.