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A PRELIMINARY STUDY ON INSECT POLLINATORS OF TEMPERATE FRUIT CROPS IN HIMACHAL PRADESH

R.M. Sharma and Bulganin Mitra*

Zoological Survey of India, Western Regional Centre, Pune-411044, Maharashtra

**Zoological Survey of India,*

'M'-Block, New Alipore, Kolkata-700053

INTRODUCTION

Pollination is an ecological process that involves the transfer of pollen from the male to the female part of the flower with the help of abiotic and biotic pollen dispersal agents. It is an essential pre-requisite for fertilization and fruit/seed setting. If there is no pollination, there will be no fertilization and no fruits or seeds will be formed (Free, 1993).

Insects constitute one among the primary groups of pollinating agents (Free, 1993). Various insect groups, which are of prime significance in pollination of agricultural and horticultural crops mainly belong to the orders Hymenoptera (bees, ants and wasps), Diptera (flies, mosquitoes, fungus gnats, midges etc.), Coleoptera (beetles and weevils), Lepidoptera (moths and butterflies), Thysanoptera (thrips), Hemiptera (bugs) and Neuroptera (lace wing flies).

Several workers like Sharma (1961), Mishra *et al* (1976), Bhalla *et al* (1983), Kumar *et al* (1985), Singh and Mishra (1986), Kumar (1988), Thakur (1988), Dashad (1989), Dashad, *et al* (1991), Thakur *et al* (1993) have studied the pollination efficiency of insect visitors, foraging preferences, foraging rate of insect visitors / pollinators of temperate fruit crops in Himachal Pradesh.

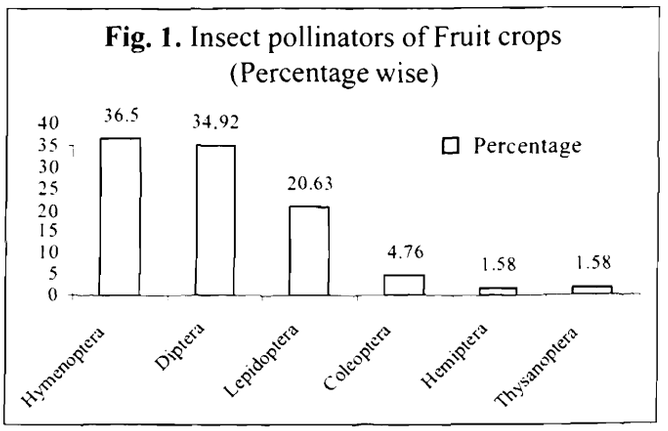
Himachal Pradesh is mainly a hilly state lying between 30°22′ to 33°12′ North latitude and 75°47′ to 79°04′ East longitude in the lap of the northwest Himalaya. The physiography of the state is almost mountainous with elevations ranging from 350 to 6500 meters above mean sea level, and the total area of the state is 55,673 sq km.

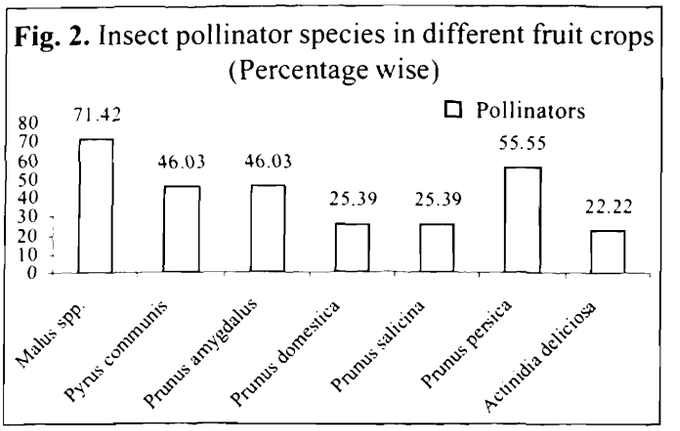
Himachal Pradesh is predominantly a horticultural state of India, having a vast potential for successful cultivation of a wide range of horticultural crops. The important plant genera that constitute temperate fruit crops in the State are *Malus, Prunus, Pyrus, Juglans, Caryo, Corylus, Sorbus, Fragaria, Actinidia, Rubus, Ribes, Crataegus, Cydonia, Docynia, Hippophae, Diospyros and Cotoneaster.* However, Apple is the major fruit of the state accounting for 67 per cent of the total area under fruits and 88 per cent of total fruit production. Besides apple, fruit crops viz.,plum, peach, pear, cherry, and apricot occupy 28 per cent, whereas, other temperate fruits such as Almonds, Walnuts, Pecans, Pistachios, Filberts, Chestnuts, Olives, Strawberries, Currants, Gooseberries, Raspberries, Blueberries, Cranberries and Kiwi occupy 5 per cent of the total area. Among nuts and dry fruits, almonds are most important and have been the monopoly of the cold and dry region of Kinnaur district of Himachal Pradesh (Verma and Jindal, 1997). Therefore, the major economy of this state depends upon the production of temperate fruits.

The present study on insect pollinators of temperate fruit crops of Himachal Pradesh is based on the collection and observations of the pollinating insects made by the authors during the period 2004-2006.

METHODOLOGY

The study was conducted during flowering season of the temperate crops in different orchards of Himachal Pradesh. The observations were made in three consecutive flowering seasons of the years 2004, 2005 and 2006. The collections of insect pollinators were mostly made in the morning and late afternoon by handpicking and aerial sweeping by insect net. All the entomofaunal collections made were identified by the experts of the respective groups from the Zoological Survey of India, Kolkata.





RESULTS

The diversity of insect pollinators in temperate fruit crops is directly linked with the diversity of fruit crops. A preliminary study conducted in Himachal Pradesh by the authors revealed that 63 species under 27 families of 6 insect orders are engaged in the process of pollination of 7 different species of temperate fruit crops in Himachal Pradesh. (Table-1; Plates-I & II). Of these, 23 species belonged to Hymenoptera, 22 species to Diptera, 13 species to Lepidoptera, 3 species to Coleoptera, 1species to Hemiptera and 1 species to Thysanoptera. Of the 23 species of Hymenoptera, 7 species belonged to the family Vespidae, 3 species each to the families Apidae and Bombidae, 2 species each to the families Halictidae and Formicidae. Xylocopidae, Andrenidae, Ichneumonidae Ceretinidae, Tenthridinidae and Scoliidae were represented by 1 species each. Of the 22 species of Diptera, 13 species belonged to the family Syrphidae, 3 species to the family Muscidae, and 2 species to the families Calliphoridae. Dolichopodidae, Scathophagidae, Sepsidae and Asilidae were represented by 1 species each. Of the 13 species of Lepidoptera, 4 species belonged to the family Pieridae, 3 species to the family Nymphalidae, 1species to the family Lycaenidae, and among moths the family Noctuidae was represented by 4 species and the family Zyganidae by 1 species. Of the 3 species of Coleoptera, 2 species each belonged to the families Chrysomelidae and Coccinellidae. One species each of Hemiptera (family Cixiidae) and Thysanoptera were also found to function as pollinators of the temperate fruit crops.

The order Hymenoptera (36.50%) formed the predominant pollinator group of temperate fruit crops followed by the orders Diptera (34.92%), Lepidoptera (20.63%), Coleoptera (4.76%) and, lastly, Hemiptera and Thysanoptera account for 1.58% each (Fig. 1). It is also interesting to note that among the total pollinator species reported from the fruit crops of Himachal Pradesh, the maximum number of pollinator species has been recorded from the *Malus sp.* (71.42%), followed by *Prunus persica* (55.55%), *Pyrus communis* (46.03%), *Prunus amygdalus* (46.03%), *Prunus domestica* (25.39%), *Prunus salicina* (25.39%) and *Actinidia deliciosa* (22.22%) (Fig. 2).

REMARKS

Pollination success depends on several conditions like, the attractiveness of the crop flowers, the use of pesticide in the area, total size of the field, the distance to the natural habitat of the wild pollinators and presence of natural pollinator species in their foraging range. The overall decline in wild and domesticated pollinators is a lesser known crisis but has great potential to cause enormous consequences on fruit production. This decline is largely due to destruction of nesting habitats of wild pollinators, poisoning due to excessive pesticide application and constant alteration in land use practices leading to loss of adult and juvenile food resources for pollinators. However, the preliminary information presented in this report though sketchy is valuable in the sense it can be used in future.

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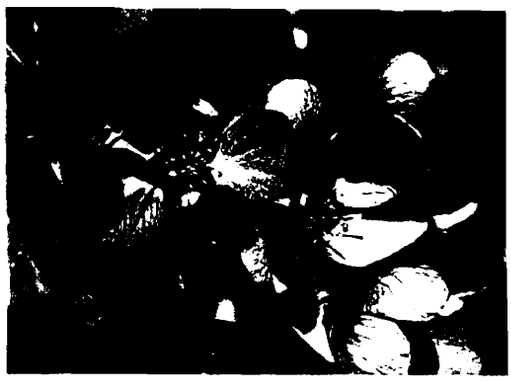
PLATE-I



1. ***Malus* sp.** Common Name : Apple

2. ***Pyrus communis*** Common Name : Pear

3. ***Prunus amygdalus*** Common Name : Almond or Badam

PLATE-II

4. ***Prunus domestica***

5. ***Prunus salicina***

Common Name : **Plum**

6. ***Prunus persica*** Common Name : Peach or Aru

7. ***Actinidia deliciosa*** Common Name : Kiwi

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Table. 1 : Pollinator species and their visited plant species

SL. No.		*Malus spp*	*Pyrus communis*	*Prunus amygdalus*	*Prunus domestica*	*Prunus salicina*	*Prunus persica*	*Actinidia deliciosa*
Order HYMENOPTERA								
	Family APIDAE							
1.	*Apis cerana* Fabricius	+	+	+	+	+	+	+
2.	*Apis mellifera* Linnaeus	+	+	+			+	+
3.	*Apis dorsata* Fabricius			+				+
	Family BOMBIDAE							
4.	*Bombus tunicatus* Smith	+	+	+	+	+	+	+
5.	*Bombus haemorrhoidalis* Smith	+						
6.	*Bombus sp.*	+	+	+	+	+		
	Family VESPIDAE							
7.	*Vespa* (*Vespa*) *magnifica mandarina* Smith	+	+					
8.	*Vespa velutina auraria* Smith	+	+		+	+	+	
9.	*Vespa orientalis* (Linnaeus)				+	+		
10.	*Vespa magnifica* Smith						+	
11.	*Vespa flaviceps* Smith	+		+				
12.	*Polistes maculipennis* Sauss	+	+	+			+	
13.	*Polistes sp.*	+	+				+	
	Family HALICTIDAE							
14.	*Halictus* sp.	+	+		+	+	+	
15.	*Halictus dasygaster* Vachal	+	+	+	+	+	+	
	Family ANDRENIDAE							
16.	*Andrena sp.*	+						
	Family XYLOCOPIDAE							
17.	*Xylocopa fenestrata* (Fabricius)	+	+				+	
	Family ICHNEUMONIDAE							
18.	*Fileantha sp.*						+	

Table. 1 : *Cont'd.*

SL. No.		*Malus spp*	*Pyrus communis*	*Prunus amygdalus*	*Prunus domestica*	*Prunus salicina*	*Prunus persica*	*Actinidia deliciosa*
	Family FORMICIDAE							
19.	*Camponotus sp.*	+	+	+				
20.	*Holcomyrmex sp.*						+	
	Family CERETINIDAE							
21.	*Ceratina hieroglyphica* Smith						+	
	Family TENTHRIDINIDAE							
22.	*Athalia sp.*						+	
23.	*Elis thoracica*			+				
	Order DIPTERA							
	Family SYRPHIDAE							
24.	*Eristalis (Eristalis) tenax* (Linnaeus)	+	+	+			+	
25.	*Eristalis (Eoseristalis) himalayensis* Brunetti	+	+	+				
26.	*Eristalinus (Eristalinus) arvorum* (Fabricus)	+	+					
27.	*Eristalis (Eoseristalis) cerealis* Fabricius	+	+	+			+	+
28.	*Eristalis angustimarginalis* Brunetti	+						
29.	*Episyrphus balteatus* (De Geer)	+						
30.	*Episyrphus* sp.	+						+
31.	*Scaeva opimius* (Walker)		+	+			+	
32.	*Eristalis sp.*				+	+		
33.	*Scaeva sp.*	+						
34.	*Metasyrphus sp.*	+			+	+		+
35.	*Melanostoma sp.*	+						
36.	*Syrphus sp.*		+	+			+	+
	Family MUSCIDAE							
37.	*Musca (Musca) domestica* Linnaeus	+	+	+	+	+		
38.	*Musca* sp.	+			+	+		+

Table. 1 : *Cont'd.*

SL. No.		*Malus spp*	*Pyrus communis*	*Prunus amygdalus*	*Prunus domestica*	*Prunus salicina*	*Prunus persica*	*Actinidia deliciosa*
39.	*Orthellia* sp.	+						
	Family SCATHOPHAGIDAE							
40.	*Scathophaga stereoraria* (Linnaeus)	+		+			+	
	Family CALLIPHORIDAE							
41.	*Lucilia* sp.	+	+	+			+	
42.	*Calliphora vicina* Robineau-Desvoidy	+	+	+			+	
	Family DOLICHOPODIDAE							
43.	*Dolichopus* sp.	+	+	+			+	
	Family SEPSIDAE							
44.	*Sepsis sp.*						+	
	Family ASILIDAE							
45.	*Promachus sp.*			+			+	
	Order LEPIDOPTERA							
	Family PIERIDAE							
46.	*Pieris canidia indica* (Evans)	+	+	+	+	+	+	+
47.	*Pieris sp.*	+	+				+	+
48.	*Delias sp.*	+						
49.	*Gonepteryx rhamni nepalensis* Doubleday			+			+	
	Family NYMPHALIDAE							
50.	*Vanessa indica* (Herbst)	+	+	+			+	
51.	*Vanessa sp.*	+		+	+	+		
52.	*Neptus sp.*	+						
	Family LYCAENIDAE							
53.	*Heliophorus sp.*				+	+	+	
	Family NOCTUIDAE							
54.	*Heliothis sp.*							

Table. 1 : *Cont'd.*

SL. No.		*Malus spp*	*Pyrus communis*	*Prunus amygdalus*	*Prunus domestica*	*Prunus salicina*	*Prunus persica*	*Actinidia deliciosa*
55.	*Plusia sp.*	+			+	+	+	
56.	*Agrotis flammatra* Schiff	+		+				
57.	*Agrotis sp.*	+						
	Family ZYGANIDAE							
58.	*Zyganea sp.*		+				+	
Order COLEOPTERA								
	Family CHRYSOMELIDAE							
59.	*Altica sp.*	+	+	+			+	+
	Family COCCINELLIDAE							
60.	*Coccinella septumpunctata* (Linnaeus)	+	+	+	+	+	+	+
61.	*Coccinella sp.*	+	+	+			+	+
Order HEMIPTERA								
	Family CIXIIDAE							
62.	*Nysius sp.*						+	
Order THYSANOPTERA								
	Family THRIPIDAE							
63.	*Thrips sp.*	+						