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INSECT POLLINTORS VISITING CITRUS (*CITRUS LIMON*) AND AVOCARDO (*PERSEA AMERICANA*) FRUIT TREES

Kashif Mehmood[1], Shahid Hussain[2], Naveed Mustafa[1], Imran Bodlah[1] and Munir Ahmad[1]*
[1]*Non-Apis Bees Laboratory, Department of Entomology, PMAS-Arid Agriculture University Rawalpindi*
[2](*Plant Protection*) *Pest Warning and Quality Control of Pesticides, Bhakkar, Punjab, Pakistan*

ABSTRACT

Insect pollinators community on avocado (*Persea americana*) and citrus (*Citrus limon*) at Horticulture orchard of Arid Agriculture University Rawalpindi, Pakistan was assessed during March-April, 2013. Eight insect pollinator species viz. *Apis florea*, *Xylocopa* sp, *Pieris brassicae*, *Danaus plexippus*, *Papilio demoleus*, *Papilio hyale*, *Eumerus tuberculatus* and *Musca domestica* were observed visiting regularly on fruiting trees. Foraging activity of pollinating insects from Hymenoptera, Lepidoptera and Diptera was observed during flowering season both fruit trees at four time intervals viz., 0800-0900, 1100-1200, 1400-1500 and 1700-1800 hours. Foraging activity of insect pollinators was highest at 0800-0900 and lowest during 1700-1800 hours. Hymenopteran pollinators were higher in numbers (42%) followed by Lepidopterans (33%) and Dipterans (25%). *A. florea*, *E. tuberculatus*, and *P. demoleus* were consistent and frequent visitor on both fruit plants.
Keywords: Avocado, Citrus, Foraging, Hymenoptera, Lepidoptera, Diptera, Pollination

INTRODUCTION

Crop pollination with native and non-native insect pollinators is gaining importance due to decline in pollinator stocks (Dewenter et al. 2005). It is the most beneficial for agricultural crops as more than 65% of the 1500 cultivated plant species are pollinated by animals (Roubik, 1995). Pollination, a transfer of pollen grains, is very important for qualitative and quantitative fruit and seed production especially in cross pollinated plants. Insect pollination plays vital role in determining mating opportunities in plants and improves seed set percentage (Free, 1993). Such mechanism of crossing over in flowers is important not only for the ecosystem sustainability but also for our food needs to fulfil. Large share of animals in pollination contribute for world food production process with insect pollinators as the major contributors (Klein et al. 2007; Morse and Calderone, 2000; Gallai et al. 2009).

Efficiency and importance of insects as plant pollinators provides almost 80-85% share pollination services comprising different hymenopteran, dipteran, coleopteran and lepidopteran insects with major role of the pollen and nectar collecting insects (Free, 1993; McGregor, 1976; Johannsmeier and Mostert, 2001). Nature has granted these insect pollinators with typical physiological and morphological characters to transfer the pollens from one flower to another not only helping their pollination but also to collect these for their young ones and maintaining their colonies development (Jams and Singer, 2008). Hymenopterans being the superior flower visitors contribute more as kept in managed bee apiaries and their movement for crop pollination services leading to other value added products (Shrestha, 2004). Managed apiculture industry is considered to be responsible for 70-80% of all insect pollination to crops (Johannsmeier and Mostert, 2001).

Avocado (*Persea americana*) belongs to family Lauraceae is native to southern Mexico and Central America. Bees, wasps and flies are the frequent visitors of this plant in its native environment (Can-Alonzo et al. 2005). A mature fruit tree may have more than a million blooms even though rate of fruit set is too low (Blumenfeld and Gazit, 1974). Short life span of the pollen make them vulnerable to persist and even hermaphrodite flowers are also produced by the plants but insects as pollinators are required mostly for effective pollination and fruit set Many insects forage on avocado but honey bees are considered as the most reliable ones (Ish-Am and Eisikowitch ,1998). Commercially grown areas of avocado in absence of native pollinators largely depend on honeybees (*Apis mellifera* L.) for efficient fruit setting due to positive correlation in fruit

**Corresponding author:* e-mail: munirahmad@uaar.edu.pk

set and bee visitation (Davenport, 1998; Robbertse et al. 1998).

Different citrus species differ in their pollination needs and even pollinators vary in their choice for different citrus species (Free, 1993; Roubik, 1995). For instance, some sweet orange and citrus varieties are partially or completely self-incompatible which makes them dependent on insect pollinators for pollination services (Sanford, 1992). However, it is confusing for pollination requirements in grapefruit with no insect pollination for fruit set (Roubik, 1995) while others considered them the most important to increase fruit production (Crane and Walker 1984). In Pakistan citriculture is mostly practiced in northwestern regions of the country with large number of insect species as pollinators like honeybees, carpenter bees, butterflies, hoverflies, wasps and ladybird beetles. , However extensive study is required on insect mediated pollination for efficient fruit production and increasing yield. The objective of present study was to assess various insect pollinators visiting citrus and Avocado flowers and their peek foraging time.

MATERIALS AND METHODS

Present study was carried out at horticulture orchard of Arid Agriculture University Rawalpindi during March-April, 2013. Experimental area was consist of six adult plants of avocado and citrus each planted at 5 x 5 m adjacent to each other. At the time of flowering aerial net was used to collect pollinating insects at four different time viz. 0800-0900, 1100-1200, 1400-1500 and 1700-1800 hours. After having the assessment of visiting insects tag insects were made by allotting specific number to particular insect species. Data were recorded by walking along the fruiting plants for 10 mints in each observation period on weekly basis throughout flowering season. The temperature and relative humidity were measured during each census. The collected specimens were killed in killing jar (having potassium cyanide), large specimens were pinned, labelled and preserved in collection box while small insects were mounted, labeled and preserved with other insects. The correlation coefficient of insect pollinators visiting avocado and citrus flowers with temperature and relative humidity was calculated. SPSS statistical programmer ver. 14 was used to analyze the data. Comparisons between means were made using the Least Significant Difference (LSD) at $p< 0.05$.

RESULTS AND DISCUSSION

Investigations made on major insect orders visiting avocado and citrus trees during flowering period lasted during March-April 2013. Pollinator community of avocado and citrus flowers was composed of two bee (Hymenoptera) species, two fly (Diptera) species and four butterfly (Lepidoptera) species. Figure 1 reveled insect pollinators from three major orders viz. Hymenoptera, Lepidoptera and Diptera visited avocado and citrus flowers. Hymenopteran fauna observed on both these fruit plants was higher (42%) followed by Lepidoptera (33%) and Diptera (25%). Result indicated that bees and butterflies are major pollinators of experimental area. These outcomes are in close agreement with findings of Wysoki et al. (2002) observed Hymenoptera as a major pollinating order of Avocado. The comparison among number of different bee species illustrated that insignificant difference exist in number and foraging activity of *Xylocopa* sp. and *Apis florea* during all observations (1100 to 1700 hours) except morning time. Maximum activity of both these bees were recorded during 0800 hours and decreased with time during the day (Figure 2 A), similar to that of Cuevas and Cabezas (2005) concluded bees as efficient pollinators of avocado.

Diurnal dynamic pattern of flies (Figure 2 B) depicted significant difference in number and foraging activity of *Eumerus tuberculatus* and *Musca domestica* during morning as compared to noon and evening time observations. Maximum visits of *E. tuberculatus* and *M. domestica* were recorded during 0800 hours followed by 1100 hours however, there was no variation in visitation of both these flies during 1400 and 1700 hours. These results are in agreement with findings of Vischer and Sherman (1998), stated flies as a frequent visitors of avocado flowers. Balam et al. (2012) found flies as abundant and efficient insect pollinator on avocado. These results advocate previous studies (Ish-am et al., 1999; Vithanage, 1990; Heath, 1982) concluding flies as frequent visitors of avocado. Figure 2 C showed almost similar visitation pattern of Lepidopterus pollinators on Avocado. No

significant variation resulted in number and foraging behavior of *Pieris brassicae*, *Danaus plexippus*, *Papilio demoleus* and *Papilio hyale* on avocado throughout flowering period as suggested the Lepidopteran visitors the second most important and frequent visitors for *Asclepias tuberosa* flowers for nectar collection (Fishbein and Venable 1996). These results are in agreement with findings of Ahmad and Aslam (2002) observed peak activity of Lepidopterans pollinators during 0800-0900 hours on carrot. Our findings are in disagreement with Goyal at al. (1989) concluded peak activity during 1000-1100 hours on carrot, variations in results may be due to amount of nectar production in avocado early morning compared to carrot flower. Abundance of major Hymenopterous pollinators was assessed on citrus plants during flowering period clearly depicted significant difference in numbers of *Apis florea* and *Xylocopa* sp. during 800 and 1100 hours however, non-significant difference prevailed during 1400 and 1700 hours. Figure 3 A showed consistently decreasing trend of numbers of *A. florea* from morning to evening compared to *Xylocopa* sp. which drastically decreased after 1400 hours. These outcomes strongly coincide with results of Chacoff and Aizen (2006) that honeybees are major and active pollinators of grapefruit in Northwestern Argentina. Foraging behavior of *E. tuberculatus* and *M. domestica* significantly varied at all observation times except 1700 hours. Maximum abundance of hoverfly was recorded during 0800 hours followed by 1100 hours remained almost consistent till 1400 hours and declined at 1700 hours however housefly showed constant visitation pattern till 1400 hours and drastically decreased afterwards (Figure 3 B). Figure 3 C illustrated dynamic pattern of butterflies on citrus flowers showed number of *P. brassicae* and *P. demoleus* varied significantly from *D. plexippus* and *P. hyale* during 0800 and 1100 hours compared to rest of observation times. Outcomes of present study are in agreement of Karmakar (2013) found frequent visits of *A. florea* and Diptera during 0900 hours and Lepidoptera during 1000 - 11.30 hours on *Citrus aurantiifolia.* Majority of insect pollinators during morning times may be due to availability of abundant food resources (Nectar) compared to noon and evening.

As number of insect pollinators decreased at evening time, these findings can be helpful to save pollinators by applying pesticides at evening time. By protecting insect pollinators high yield can be ensured.

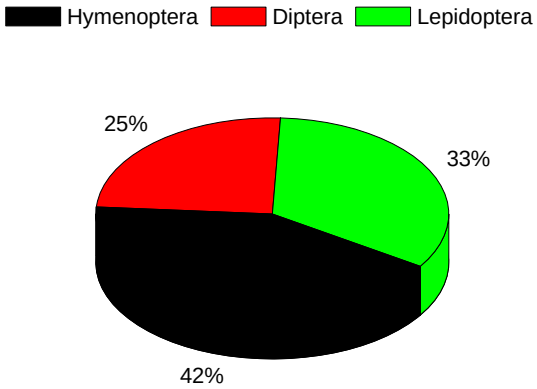

Fig. – 1: Comparative percentage of insect pollinators visiting avocado and citrus during March - April, 2013

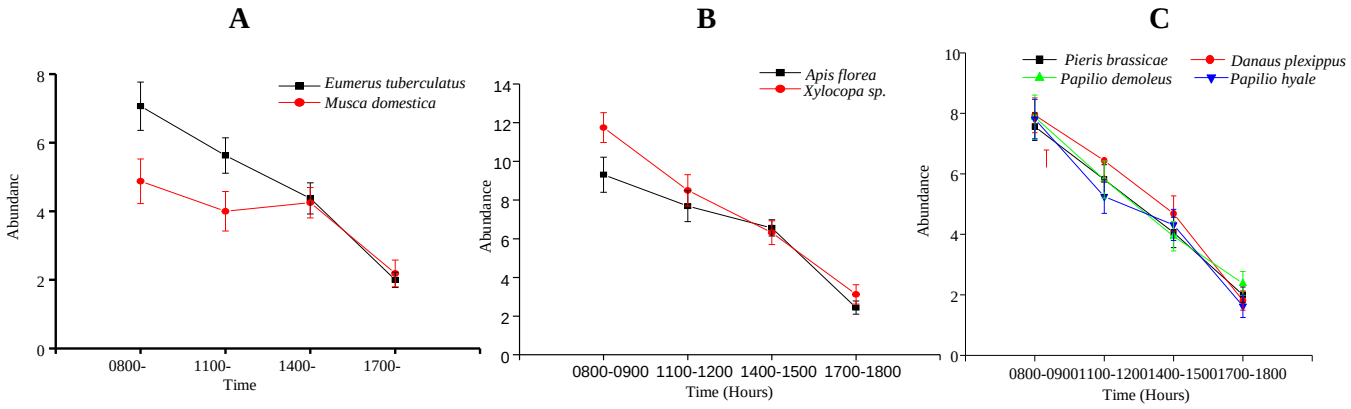

Fig. – 2: Diurnal dynamic pattern of **A** Hymenoptera, **B** Diptera, and **C** Lepidoptera visiting avocado flowers during Mar-Apr, 2013

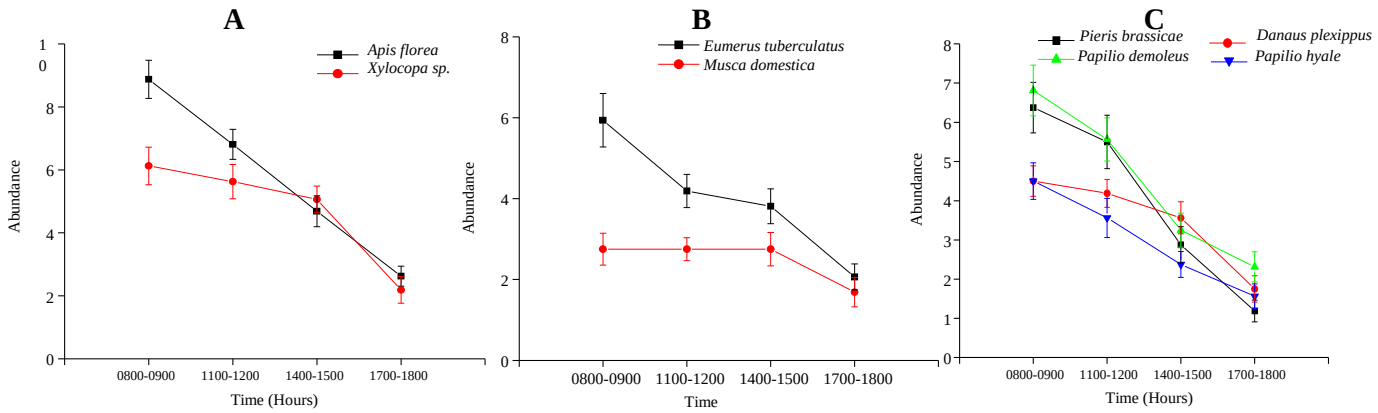
A
Apis florea
Xylocopa sp.
Abundance
0800-0900
1100-1200
1400-1500
1700-1800
Time (Hours)
B
Eumerus tuberculatus
Musca domestica
Abundance
0800-0900
1100-1200
1400-1500
1700-1800
Time
C
Pieris brassicae
Papilio demoleus
Danaus plexippus
Papilio hyale
Abundance
0800-0900
1100-1200
1400-1500
1700-1800
Time (Hours)

Fig. – 3: Diurnal dynamic pattern of **A** Hymenoptera, **B** Diptera, and **C** Lepidoptera visiting citrus flowers during Mar-Apr, 2013

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