

Arthropod Pests of Pear (*Pyrus pyrifolia*, Nakai) in Central Horticulture Centre, Kirtipur, Kathmandu, Nepal

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Abstract

Arthropod pests cause serious threats to pear orchards, resulting heavy reduction in their yield. The present study focused on the arthropod pests of Pear (*Pyrus pyrifolia*, Nakai), in the Pear orchard of Central Horticulture Centre, Kirtipur, Kathmandu. It was carried out in two seasons: Spring and Summer of 2012. The pests were collected through different methods such as hand picking, knock down process, beating process, sweeping and use of aspirator, depending upon the size of pests. The statistical analyses were performed at 95% confidence level in R-Software (R-Console version 2.15.2).

Altogether, 12 species of pests belonging to 11 families were observed during the study. The results showed that the pest's population was independent to months ($X^2=7.663$, $df=5$, $P=0.175$), seasons ($X^2=0.188$, $df=1$, $P=0.664$), and sites ($F=0.446$, $df=2$, $P=0.652$), however, population density of pests was higher in June (409) and summer (966). Spider mite (*Tetranychus* spp.), Aphids (*Aphis* spp.), Thrips (*Scirtothrips* spp.) Tortoise beetle (*Metrona* spp.) and Fruitfly (*Dacus* spp.) were the common pest species and the most dominant one was the Spider mite (*Tetranychus* spp.), occurring almost in all months, seasons and sites. The overall diversity index of pear pests was high, i.e. 0.800, however regarding individual species diversity index and dominance index, Spider mite (*Tetranychus* spp.) had higher diversity indices, followed by Tortoise beetle (*Metrona* spp.), Fruit fly (*Dacus* spp.) and the least was observed in Click Beetle (*Agriotes* spp.). Although the pest population is independent to months and seasons, the present study showed that pear plants were more affected by pests during hot and warm season.

Keywords: Click beetle, Fruit fly, Pear orchard, Spider mite, Tortoise beetle

Introduction

Pear is commonly a medium sized tree or shrub of genus *Pyrus* (Riegel 2006), which generally reaches height of 10 m to 17 m. The leaves of this plant are alternately arranged, simple and are 2- 12 cm long. The flowers are white, rarely tinted yellow or pink and 2-4 cm in diameter and have five petals. The inflorescence is corymbose with five to seven flowers (Riegel 2006). It is one of the very important deciduous fruit plants of Nepal (Devkota 1999) which is also named as Pomaceous fruit. There are over 5,000 varieties of pears cultivated in temperate climate worldwide (Herbst 2001), of which the most important species for commercial production are European Pear (*Pyrus communis*) and Asian Pear (*Pyrus pyrifolia*), which is also known as Japanese pear or Oriental Pear (Beutel 1990 and Riegel 2006).

In Nepal two kinds of pears are grown: Asian pear (*Pyrus pyrifolia*) and European pear (*Pyrus communis*) (Devkota 1990), former is also called oriental pear which is locally named as Naspatti. Asian pears have a distinct pear like taste and a crisp texture. These pears ripen on the trees and they do not need cold storage period while European Pear are not rounder in shape and less crunchier than Asian Pear (Beutel 1990). The Asian Pear includes Japanese Pears, Chinese Pears, etc. The Japanese Pear includes different varieties like Shinsu, Shunko, Kosui, Hosui, etc. while European Pears are Barlett and Comice.

There are many threats in the cultivation of Pears. Generally, Pears are attacked by various kinds of pests such as Mites, Aphids, Thrips and Scale insects (CHC Annual Report 2011/12). Mites are known to migrate from host plants to other plants and vice-versa (Banerjee 1971) and are known as an important vector of plant viruses too (Gupta 1985, 1990). They may cause various types of direct damages to plants such as loss of chlorophyll, stunted growth, burnt appearance of leaves, heavy leaf fall and reduction in yield (Dhooria 1999). Generally, the Spider mite (*Tetranychus*) is susceptible to orchard plants. They suck sap from leaves, flowers and buds resulting in discoloration, appearance of silvery patches and drying of affected plants (Banerjee 1971).

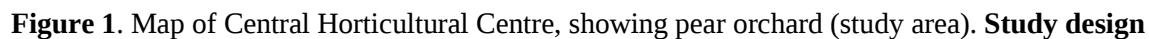
Aphids are another recognized pests of Pear, which are sap sucking in nature (Sharma 2000). They are found in flowers, leaves and stem of Pear and are known to have transmitted more than 100 plant viruses (Sharma 2005). Similarly, Pear thrips and Scale insects are other common pests of Pear plant. Young thrips feed almost entirely on tender foliage and fruits (Daniel 1904), while scale insects make small, narrow or circular flat holes on stem and fruits of Pear (Evans 1984).

Materials and Methods

Study area

Central Horticulture Centre lies in Kirtipur Municipality, Kathmandu, which is 5 km south from Kathmandu valley. Geographically, it lies between 27° 30' N latitude to 85° 15' E longitude, at an altitude of 1,320 m asl (CHC Annual Report 2011/12).

The station has mild temperature reaches up to 32° C during summer and falls below -3° C during winter. The average rainfall during monsoon season is 1,025 ml (CHC Annual Report 2011/12).



Pest collection and preservation

The general objective of this research was to study the arthropod pests of Pear (*Pyrus pyrifolia*, Nakai) in Central Horticulture Centre, Kirtipur.

One-way Analysis of Variance (ANOVA) was used to test the significant difference in number of pests observed in different sites. But, to test the significant difference in pest's number due to

months and seasons, Kruskal-Wallis Rank Sum test was used. It is a non parametric test which is alternative to ANOVA. Since the data was not found normal, hence this test was performed. The statistical analyses were performed at 95% confidence level in R-Software (R-Console version 2.15.2).

On the other hand, the Shanon diversity index ($\bar{H}$) was calculated by using the formula
Shanon index of diversity ($\bar{H}$) = $-\sum(n_i/N)\log(n_i/N)$ (Odum 1996)

Where, n_i = Importance value for each species

N = Total of importance value

Similarly, the index of dominance (c) was calculated as

Index of dominance (c) = $\sum(n_i/N)^2$ (Odum 1996)

Where, n_i = Importance value for each species

N = Total of importance value

Results

Pests of pear

Altogether 12 species of pear pests belonging to 11 families were observed in the Central Horticulture Centre, Kirtipur during the study. Among them, Family Chrysomelidae was represented by two species, whereas other families by single species (Table 1). The classification is based on Borror and DeLong (1971).

Table 1. Pest species with their families

S.N	Pests	Family	Scientific Name
1	Aphid	Aphidae	<i>Aphis</i> spp.
2	Roaches	Blattodae	Unidentified
3	Tortoise Beetle	Chrysomelidae	<i>Mettriona</i> spp.
4	Leaf Beetle	Chrysomelidae	<i>Basilepta</i> spp.
5	Snout Beetle	Curculionidae	Unidentified
6	San Jose Scale	Diaspididae	<i>Quadraspidiotus</i> spp.
7	Click Beetle	Elatridae	<i>Agriotes</i> spp.
8	Brown Marmorated Stink Bug	Pentatomidae	<i>Halyomorpha</i> spp.
9	Fruit fly	Tephritidae	<i>Dacus</i> spp.
10	Spider mite	Tetranychidae	<i>Tetranychus</i> spp.
11	Thrips	Thripidae	<i>Scirtothrips</i> spp.
12	Hornet	Vespidae	<i>Vespa</i> spp.

4.2 Species diversity of pests

Altogether 1,652 individuals of pests belonging to 12 species were observed during the study. Among them, Spider mite (*Tetranychus* spp.) was the most common pest of Pear. Similarly, the other frequently

occurring pests were Aphids (*Aphis* spp.), Thrips (*Scirtothrips* spp.), Tortoise Beetle (*Metriona* spp.) and fruitfly (*Dacus* spp.) (Figure 2). Click Beetle (*Agriotes* spp.) was the least common species in Pear Orchard of CHC during the study.

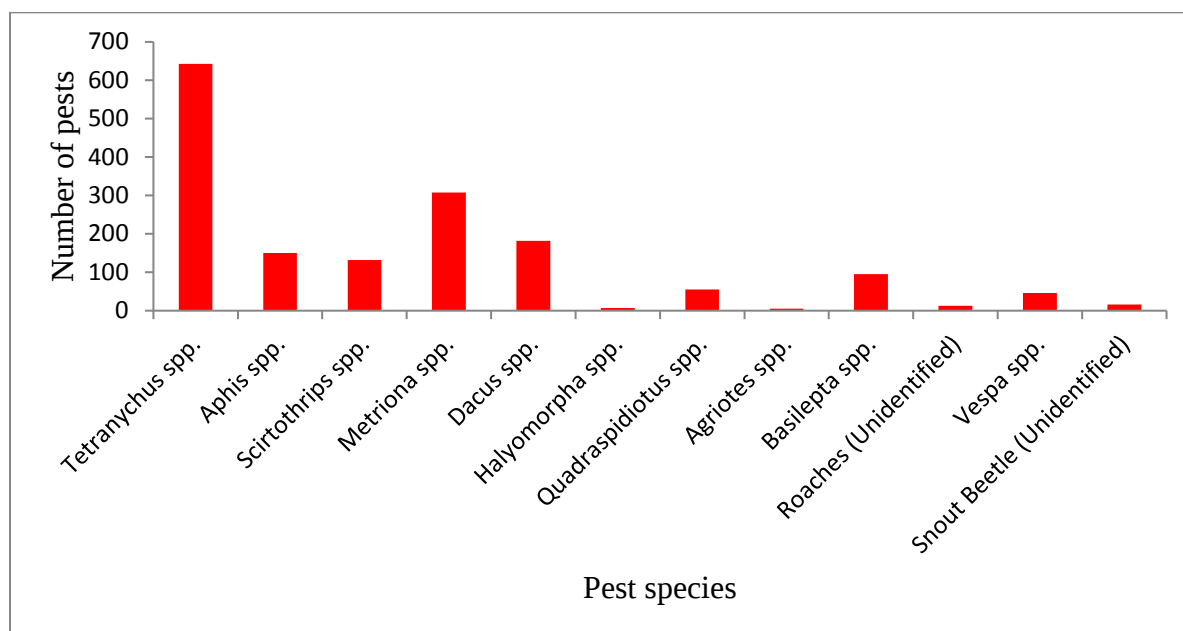


Figure 2. Pest species and their number.

Table 2. Species diversity of pests

S.N	Pests	ni	ni/N	log ni/N	Shanon Index $\sum -ni/N \log ni/N$	Species Dominance $\sum (ni/N)^2$
1	<i>Tetranychus</i> spp.	643	0.389225	-0.4097991	0.159504117	0.151496242
2	<i>Aphis</i> spp.	150	0.090799	-1.0419188	0.094605216	0.008244464
3	<i>Scirtothrips</i> spp.	132	0.079903	-1.0974361	0.0876886	0.006384513
4	<i>Metriona</i> spp.	308	0.186441	-0.7294593	0.136000891	0.034760126
5	<i>Dacus</i> spp.	182	0.110169	-0.9579387	0.105535615	0.012137317
6	<i>Halyomorpha</i> spp.	7	0.004237	-2.372912	0.010054712	1.79546E-05
7	<i>Quadraspidiotus</i> spp.	55	0.033293	-1.4776474	0.049195281	0.001108422
8	<i>Agriotes</i> spp.	5	0.003027	-2.51904	0.007624213	9.16052E-06
9	<i>Basilepta</i> spp.	95	0.057506	-1.2402864	0.071323978	0.003306946
10	Roaches (Unidentified)	13	0.007869	-2.1040667	0.016557426	6.19251E-05
11	<i>Vespa</i> spp.	46	0.027845	-1.5552522	0.043306054	0.000775346
12	Snout Beetle (Unidentified)	16	0.009685	-2.0138901	0.019504988	9.38037E-05
	Total	1652			0.800901092	

The overall diversity index of pear pests was high, i.e., 0.800, however, regarding individual species diversity index, Spider mite (*Tetranychus* spp.) had higher diversity index (0.1595), followed by Tortoise Beetle (*Mettriona* spp.), Fruitfly (*Dacus* spp.) and so on. Among 12 species of Pear pests, Click Beetle (*Agriotes* spp.) had the lowest diversity index (0.0076). Similarly, the index of dominance was also higher in Spider mite (*Tetranychus* spp.), which is 0.1514, followed by Tortoise beetle (*Mettriona* spp.), Fruitfly (*Dacus* spp.) and so on. The Click Beetle (*Agriotes* spp.) was the lowest dominant pest species having index of dominance only 9.16052E-06 (Table 2).

4.3 Monthly variation in number of pests

Kruskal Wallis test revealed that there was no significant difference ($X^2=7.666$, $df=5$, $P=0.175$) in pest number due to different months. However, their number gradually increases from March to June, peaked on this month and then decreasing onwards in the subsequent months. Clearly, the highest number of pests was observed in June (409) and the lowest in March (94) (Figure 2). Similarly, species richness was also high in June and also in July too. Out of 12 species recorded, the same number of species, i.e. 11 was found in June and July, which was the highest number of species recorded among six months (Figure 2). Regarding specific pests, Aphids (*Aphis* spp.) and Thrips (*Scirtothrips* spp.) were dominant in March and April, whereas, Spider mite was the most dominant pest species in the subsequent months; in fact, there was more or less same number of Spider mite (*Tetranychus* spp.) and Tortoise beetle (*Mettriona* spp.) in July (Figure 3). In May and June, Spider mite (*Tetranychus* spp.) alone damaged more than 50 per cent of total damage, done by overall pests in Pear orchard of CHC.

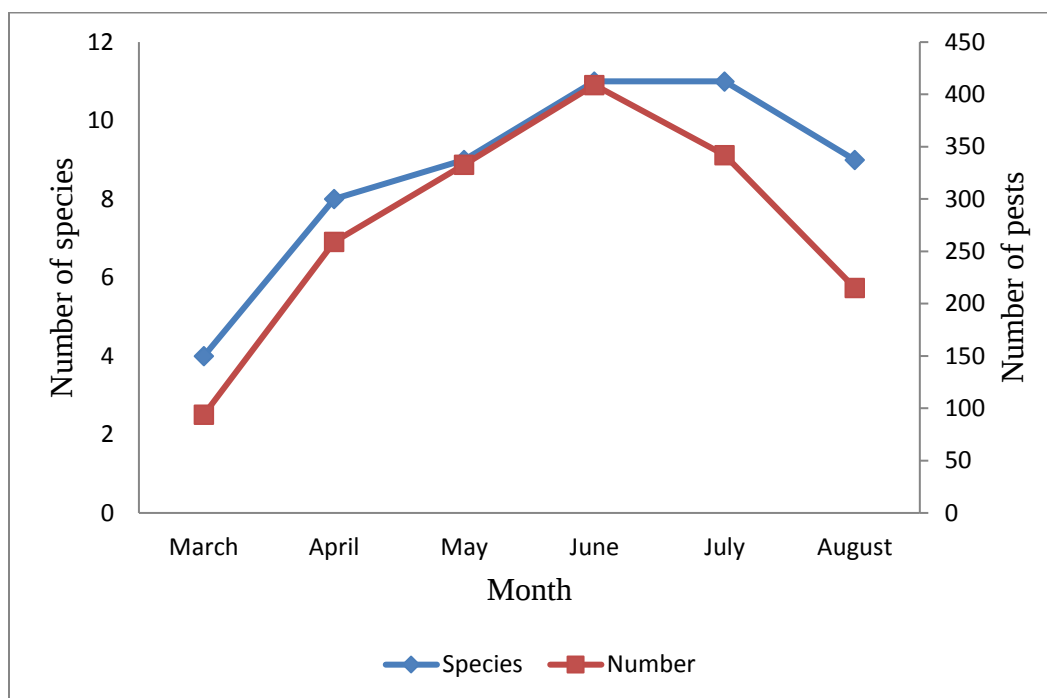


Figure 3. Monthly variation in species and number of pests.

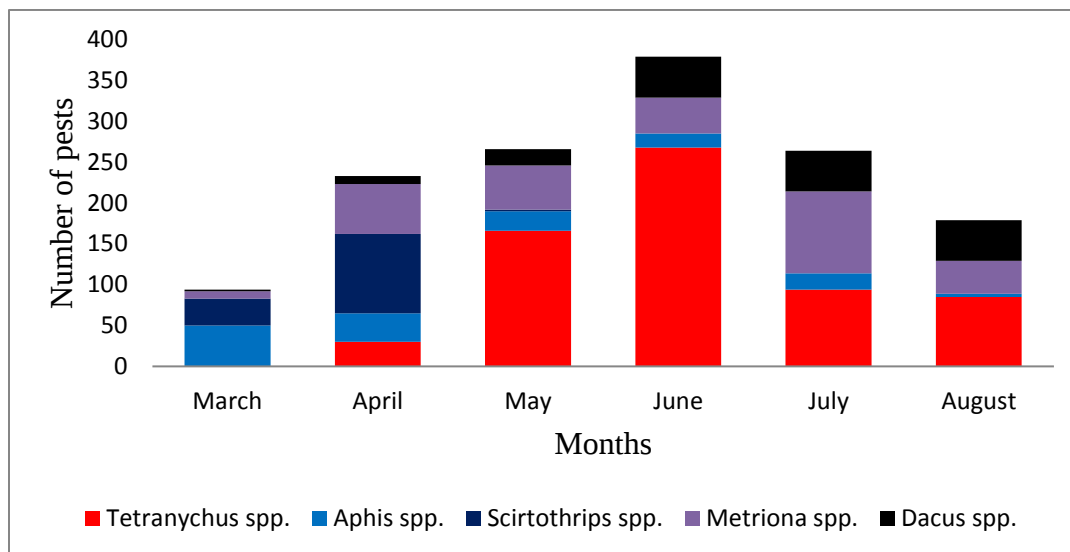


Figure 4. Monthly variation and species dominance.

4.4 Seasonal variation and number of pests

With variation in seasons, the number of Pear pests did not vary. Kruskal Wallis test showed that there was no significant difference ($X^2=0.188$, $df=1$, $P=0.664$) in number of pests in Pear plants due to different seasons. However, summer (966) had higher number of pests than the spring (686) (Table 3). But, among 12 pear pests recorded, summer had more number of species (11) than spring (9). Click Beetle (*Agriotes* spp.), Roaches (Unidentified) and Hornet (*Vespa* spp.) were absent in spring whereas, Thrips (*Scirtothrips* spp.) was not observed in summer during the study. In overall, Spider mite (*Tetranychus* spp.) was the most dominant pest species in both seasons.

Table 3. Pests of Pear in two seasons

SN	Pests	Season		Total
		Spring	Summer	
1	Spider mite (<i>Tetranychus</i> spp.)	196	447	643
2	Aphids (<i>Aphis</i> spp.)	109	41	150
3	Thrips (<i>Scirtothrips</i> spp.)	132	0	132
4	Tortoise Beetle (<i>Metriona</i> spp.)	124	184	308
5	Fruitfly (<i>Dacus</i> spp.)	32	150	182
6	Brown Marmorated Stink Bug (<i>Halyomorpha</i> spp.)	4	3	7
7	San Jose Scale (<i>Quadraspidotus</i> spp.)	21	34	55
8	Click Beetle (<i>Agriotes</i> spp.)	0	5	5
9	Leaf Beetle (<i>Basilepta</i> spp.)	59	36	95
10	Roaches (Unidentified)	0	13	13
11	Hornet (<i>Vespa</i> spp.)	0	46	46
12	Snout Beetle (Unidentified)	9	7	16
	Total	686	966	1,652

4.5 Variation in number of pests in different sites

There was no variation in number of pests occurring in different sites. One-way ANOVA revealed that there was no significant difference ($F=0.446$, $df=2$, $p=0.652$) between number of pest species and sites. More or less same number of pests was observed in all sites. Spider mite (*Tetranychus* spp.), Aphids (*Aphis* spp.), Thrips (*Scirtothrips* spp.), Tortoise beetle (*Metriona* spp.) and Fruitfly (*Dacus* spp.) were the most common pest species, occurring in all sites. The median value of pest's number was more than 80 in all sites.

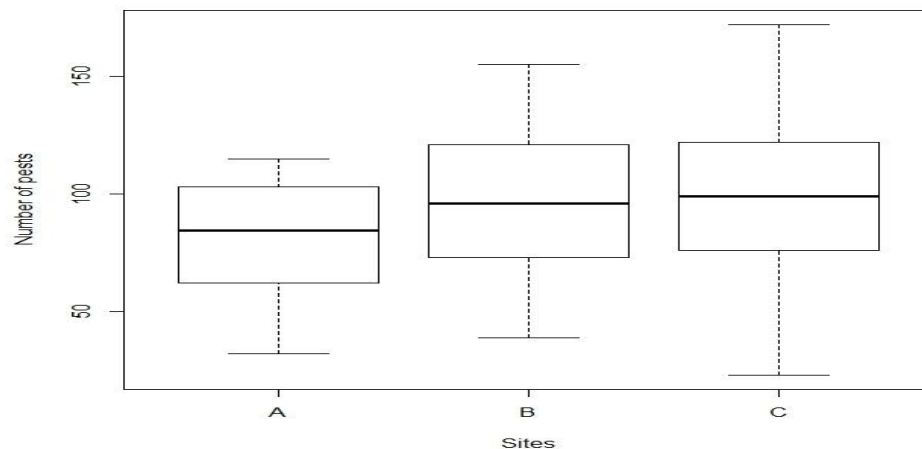


Figure 5. Box plot showing number of pests observed in three different sites (A, B and C). The dark line in the box plot represents the median or mid value and its arm represents the quartile value.

Discussion

Species diversity is the ratio between number of species and “importance values” (number, biomass, productivity, and so on) of individuals (Odum 1996) in which it tends to be low in physically controlled ecosystem and high in biologically controlled ecosystems. Species Diversity Index (SDI) is the most frequently used tool by many scientists for measuring the species diversity (Parrotta et al. 1997, Whitford 1997). It is a numerical measurement of species and can express the diversity within communities and often used to compare the diversity of the species. In Central Horticulture Centre (CHC), the SDI of overall pear pests was high (0.800), which shows stability in pest’s ecosystem. But regarding individual diversity indices, both SDI and index of dominance were high in Spider mite (*Tetranychus* spp.) comprising 0.1595 and 0.1514 respectively (Table 2). On the other hand, Click Beetle (*Agriotes* spp.) was the least dominating pest species having dominance index only 9.16052E-06. As this study was carried out in spring and summer months, this might be cause for high number of Spider mite (*Tetranychus* spp.) during the study because the mite population was positively correlated with high temperature and low relative humidity (Putatunda and Tagore 2000, Mohamed Osman and Mahmoud 2008). Therefore, its SDI and dominance index were relatively high among other pests of pear.

Although the pests’ population was statistically independent to months, however, the high number of pests was observed in June (409). It showed gradual increment from March to June, was peaked on June and their number gradually dwindled in the subsequent months (Figure 3). This result is in agreement with the findings of Dhooria and Bhutani (1983) and Putatunda and Tagore (2000), in which the pest population peaked during May to September and there was negligible population during December to March, as a result, their population was peaked in summer months. As temperature is generally high in summer months (May and June), this might be another cause for high density of pests in these months because the life cycle of most of the insect pests became functional or more active during hotter days (Pedigo 2002). Indeed, eggs overwinter and hatching occurs after onset of spring, i.e. when the environment became warm. Regarding specific pests in the present study, the density of Spider mite (*Tetranychus* spp.) was highest which is followed by Tortoise beetle (*Metritona* spp.), Fruitfly (*Dacus* spp.), Aphids (*Aphis* spp.), Thrips (*Scirtothrips* spp.) and so on (Figure 2). The annual report of CHC Annual Report (2011/12) also mentioned Spider mite (*Tetranychus* spp.) as a pest of pear, including other species such as Hornet (*Vespa* spp.), Thrips (*Scirtothrips* spp.) and Fruitfly (*Dacus* spp.) which resembles with our study.

There was no statistical variation in pest population due to seasons, but more number of pests was observed in summer (966) than in spring (686). Temperature is one of the most important factors that have great effect on pests (insects) developmental rates primarily because of their poikilothermic adaptation. As environmental conditions become more and more warm, their biological processes and hence the life cycle proceeds more well (Pedigo 2002). Therefore, due to higher temperature in summer months, pest population generally becomes higher. This was observed during our study as well. Regarding specific pests, Spider mite (*Tetranychus* spp.) alone dominated the both seasons in present study, but its number was higher in summer which is similar to the study of Portor (2007) and Murray and Alston (2011), where they argued that Spider mites reproduce during hot and dry conditions of summer and thus their density was high in this period. In contrast, Krewer and Bertrand (2012) discussed that Red Spider mites attack pears during bloom in great proportion, i.e. at spring which contradicts with our findings. This may be because we had not gone to species level, as perhaps the species of Spider mites were different.

Similarly, Alston and Reding (2011) revealed that pear is the most sensitive to mite feeding than other stone fruits. Chhillar and Kumar (2000) also argued that phytophagous mites occur almost in all ornamental crops, including pear, reducing sharp decrease in yield and serving as a vector of several plant diseases. The annual report of CHC (2011/12) also mentioned that there was a noticeable decrease in the yield of pear due to damage done by mites. Mite feeding may cause leaf curling, leaf burning and defoliation (Gupta 1990), that lead to decrease in total yields. During our visit too, leaf curling and burning in some pear plants were observed. This was more noticed in June and July; because perhaps their population is at peak in these months which directly correlates to nature of damage.

The study further showed that Thrips (*Scirtothrips* spp.) were more dominant during first two spring months (Table 3). Booth (2007) discussed that pear is one of the host trees of Thrips, in which it overwinters in the soil and the adult Thrips emerge from soil in early spring and begin feeding just as the buds begin to expand, which is similar to our results. Therefore, this might be a cause for high density of Thrips during spring months. Gardescu (2008) also discussed that adult Thrips emerge from their underground cells in spring when soil temperature become warm, therefore, their population seem higher in spring than other season of a year.

On the other hand, there was no significant difference in the number of pests in different sites (Site A, B and C) of pear orchard of CHC (Figure 5). In all sites, Spider mite (*Tetranychus* spp.), Aphids (*Aphis* spp.), Thrips (*Scirtothrips* spp.), Tortoise beetle (*Metriona* spp.) and Fruitfly (*Dacus* spp.) are the common pests that were recorded mostly. The three sites are no more than 20 m from one another, so that any insect pest whether flying or non-flying could easily migrate from one to other. Similarly, the physical location of these sites is also similar; all are facing towards east and somehow sloppy in nature. There did not exist any physical or topographical difference among these sites, though they occupy different area. As a result, the pest composition seemed similar in all sites.

Results showed that some pests such as Fruit fly (*Dacus* spp.), Hornet (*Vespa* spp.) and Tortoise beetle (*Metriona* spp.) were more in number during fruiting season of pear. The annual report of CHC (2011/12) also mentioned Hornet (*Vespa* spp.) and Fruitfly (*Dacus* spp.) as a destructive pests of pear during fruiting period. This study seemed close to this annual report of CHC, where the density of Hornet (*Vespa* spp.), Fruitfly (*Dacus* spp.) and beetles were comparatively high in summer, a fruiting time of pear. As these species prefer fruits than other parts of plants, hence this might be a cause for these species to occur more in fruiting trees of pear.

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