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PREVALENCE OF APHIDOPHAGOUS HOVERFLIES (SYRPHIDAE: SYRPHINAE) IN RELATION TO THEIR PREY, GREEN APHIDS (*MYZUS PERSICAE*) ON BRASSICA (*BRASSICA RAPA OLIEFERA)* IN DADU

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ABSTRACT

During current investigation different fields of brassica crop present in district Dadu were explored systematically, from November 2016 to March 2017. The specimens were collected with the help of insect net, malaise trap and hand picking. Total 323 specimens of three species belonging to three different Genera of Aphidophagous Hoverflies were collected from green-peach aphid colonies (*Myzus persicae*) present on Brassica (*brassica rapa oleifera)*. 36.22 % of trapped hover flies were of *Ischiodon scutellaris*, 19.5% of *Eupeodes luniger* and 44.2 % of *Episyrphus balteatus.* In addition to this, 94 larvae of aphidophagous hover flies in the colonies of green peach aphid were also collected. In the current survey it was perceived that occurrence of these species varies from month to month due to significant effect of the ecological factors, with the average number being significantly increased as the temperature increased up to certain limits in winter, which shows positive correlation of hoverflies with temperature 0.444 % (P = 0.454) in winter. The number of syrphid flies was very low in November i.e. 7.4 % which gradually increased as the environment became favorable and the brassica became mature in the march i.e. 34.6 %. The population of syrphid flies was found to be significantly influenced by other ecological factors also. The Pearson correlation revealed strong negative correlation of aphidophagous hoverflies with humidity and wind speed – 0.900 (P=0.038) and -0.835 (P = 0.078) respectively, while these hover flies had strong positive correlation with aphid colonies of *Myzus persicae* 0.975 (P=0.005).

Key Words: Correlation, *Episyrphus balteatus,* Prevalence, *Myzus persicae*, aphidophagous.

INTRODUCTION

More than 4000 species of aphids have been described worldwide, which damage crops, vegetables, fruits and ornamental plants by sucking cell sap (Spiller *et a.,*1990). They are polyphagous in nature, single green aphid (Myzus *persicae*) feeds on more than 400 crops (Blackman and Eastop, 2000),thus causing heavy damage to crops, vegetables, fruits and ornamental plants. Brassica (*Brassica rapa oleifera*) is one of the important cash crops being one of the major source of edible oil grown in Pakistan (Amjad, 2014). Total about 0.646 tons of edible oil is produced in Pakistan which is still 30% of required value; about 70% edible oil is imported by paying up to 207 billion rupees (Amjad, 2014). Brassica crop is short period crop and requires less efforts that's why growers intend to cultivate more crops and also rotate them in order to eliminate the crop pest from the field. Different species of aphids attack brassica (*Brassica rapa oleifera*) crop seriously. Green peach aphid is one of major pest of brassica, the colonies of green peach aphids attack stem, leaves and seed pod, which results in severe damage (Blackman and Eastop, 2000).The hoverflies are one of the important insects in the field of research due to variety of their feeding mode. The larvae of aphidophagous hoverflies are peripatetic and active predator of aphids that's why the female prefer to oviposit near aphid colonies (Sadeghi and Gilbert, 2000). After emergence, these larvae crawl and start feeding over aphid species. Meanwhile, aphidophagous hoverflies feed over specific prey (Malcolm, 1992). Some of them are specialist feeds only over one species of aphids, some are generalist, feeds over four to five aphid species and some along with aphids feeds over other plants pest (Sadeghi and Gilbert, 2000).The dominance of aphidophagous hoverflies is examined over the green aphid (*Myzus persicae*) colonies on brassica crop, viz., the occurrence and abundance of aphidophagous hoverflies is linked with ecological factors and host plants (Barrett and Helenum, 1987).Numerous features govern the process of oviposition and selection of oviposition site i.e. aphid species, aphid colonies and host plants. These variables proved to be significantly affecting reproductive behavior of aphidophagous hover flies (Budenburg and Powell, 1992). The large aphid colonies provide quick and proper nourishment to the larvae of syrphid flies. Furthermore, they save the searching time and increase attacking rate. These natural predators of aphid species have found to suppress the population of these cop pests in natural environment without harming the equilibrium of environment (Ghorpade, 1981). Such natural attachment and feeding habitat of aphidophagous hoverflies with its host plants and food (aphids) can be used to attract hoverflies in

specific field to control the population of plant pest (aphids). In this way, they are considered as major bio control agent for controlling population of aphid colonies (Singh and Mishra, 1988). A very insignificant work on the population of aphidophagous hoverflies have been done from the studied area. Hence, present study was aimed to analyze the relation between aphidophagous hoverflies and green aphid over the brassica, beside this role of ecological factors affecting this correlation between predator and prey such as Effect of temperature, speed of wind, relative humidity, presence of clouds and abundance of host plant and its flowering season including abundance of aphid colonies on brassica crop was also recorded. Therefore the current investigation will provide substantial support in understanding the behavior of aphidophagous hoverflies and also help upcoming researcher in controlling population of aphid colonies by using efficiently these predator biological control agents.

MATERIALS AND METHODS

Study site: In present study, three major cities of district Dadu i.e. Mehar, Khairpur Nathan shah and Dadu itself were explored for the collection of specimens. Total five points from 2 hectaresof brassica crop in each locality were selected for the collection of species. For the best results, visits were made in the morning and evening in addition to collection of specimens, the ecological factors like temperature, humidity and wind speed were recorded during visits (Table 01).

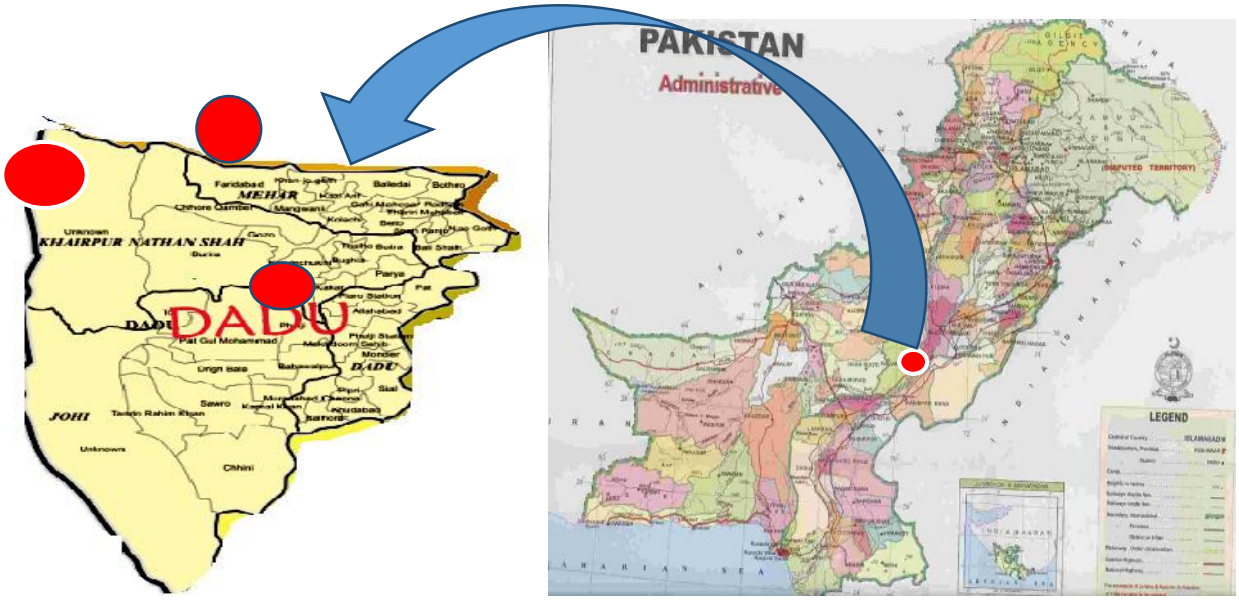


Figure 1. Map of collection site (Dadu, Sindh Pakistan)

Collection method: A sample of total 322 specimens of syrphid flies belonging to three genera and one sub family were collected from aphid colonies present on brassica crops. Specimens were collected with the help of insect net, malaise trap and hand picking. Most of the specimens were collected from shady or covered area. In addition malaise trap yielded highest number of specimens due to availability of trap in field for log time.

Preservation and identification: The collected specimens were kept in bottles and killed by freezing in refrigerator by keeping of couple of hours. After that samples were brought to the entomology lab of pest management where further process of identification and preservation was carried out. Observation was made with the help of binocular microscope. Keys of different authors Coe *et al.,* (1950) were used for the identification. Preservation was made with the help of naphthalene bolls and BHC powder in the insect boxes.

Data analysis: Data were analyzed using SPSS 22.0 software and correlation analysis of aphidophagous hoverflies with humidity, wind speed, temperature fluctuations, number of the aphid colonies and abundance of host plant was also calculated.

Table No 1. Showing environmental factors of winter season of District Dadu.

Month	Temperature C^0	Humidity %	Wind speed m/h
November	30	51	10
December	22	48	7
January	18	50	9
February	25	48	8
March	33	43	6

RESULTS & DISCUSSION

Present study was conducted in the brassica field of Dadu districts, which is one of the major brassica growing areas. We have observed that this rabi cash crop is severally attacked by many pest specially green aphids, which cause severe destruction, thus reducing yield (Fig. 2 a & b). Aphid pests are having the natural enemies in the environment which feeds over them (Fig 2). So as to observe correlation between aphidophagous hoverflies and green aphids different field of brassica crops were surveyed, through observation it was found that open crops were less attractive as compared to covered, shady and mixed crops. In current investigation total 322 specimens of 3 species (*Eupeodes luniger, Ischiodon scutellaris* and *Episyrphus balteatus,*) belonging to genus *Eupeodes, Ischiodon* and *Episyrphus*, family *Syrphinae* were collected from November 2016 to March 2017; 117 specimens of *Ischiodon scutellaris*, 63 *Eupeodes* and 143 Episyrphus *balteatus* (table 1).In addition to this, 94 larvae, 43 of *E. balteatus* and 30 of *I. scutellaris* and 21 of *E. luniger* were also collected from the aphid colonies.

The highest number was recorded in February and March (fig. 06) due to moderate temperature and large aphid colonies of green aphids present on brassica crop, since Khan and Safdar (1997), also reported highest number of aphid colonies in February and March. The abundance of *E. balteatus* was greater than that the *I.scutellaris* and *E. luniger.* Schneinder, (1969) also credited *E. balteatus* one of the most frequent aphidophagous flyfound in aphid infested plants.

(a)
(b)

Figure 2. A & B Syrphinae larvae feeding over aphid colonies on brassica crop

Hovering Performance: Hovering period, response to ecological factors, selection of oviposition site and impact of host plants of these three species was explored in field of brassica crop. *E. balteatus* was found very active and abundant on brassica crop throughout the whole winter season and mostly found hovering in lower parts of crop. Whereas *I.scutellaris* mostly fly near the tip of flowers, while *E. luniger* had strong and durable flight. The all three species were having huge difference of sound produced by the wings during flight that resembles that of wasp species. Rashed (2006) also discovered the mimicry of sound production in hover flies, Furth more he added that such buzzing behavior of hover flies also resemble with bumblebees. Almost same number of specimens were collected from all three localities of district Dadu i.e. Dadu, Mehar and Khairpur Nathan shah except Dadu from where most number of specimens were collected (Table. 2) as there were shady crops and farmers mostly grew there trees and other ornamental plant around the brassica crop. Vanhalen *et al.,* (2001) and Videla *et al.,* (2006) has also found that the physical and chemical characteristics of plants also play key role in the prevalence of these syrphid flies.

Oviposition & Larval performance: The behavior of different instars of syrphid larvae was observed in the crop present in studied area. Total 94 larvae of aphidophagous hoverflies were observed in the field of brassica crop from district Dadu. Female oviposit in response to aphid colonies and sometime species specific. Malcolm (1992) revealed that the larval performance depends upon the type of food and its nutritional value. They are always found to be hovering around the flowers for nectar and pollen whenever they find any aphid colonies they come around and lay eggs. Sadeghi and Gilbert, (2000) has also reported the same pattern of oviposition. It was observed that as soon the larvae emerge it starts searching for food initially it crawl slowly and attack an aphid and hold it for movement and then sucks fluid gradually in this way it become active predator of aphid species. Scholz and Poehling, (2000) also discovered the same pattern of feeding behaviors. Nearly all the aphid-infested brassica plants e.g. leaves, stem, or pods when observed deeply contained at least 2 to 3 larvae, eggs, or the adult hovering around that colony for oviposition. Scholz and Poehling, (2000) has also discovered that Syrphinae flies hardly lays eggs in the absence of aphid colonies.

Episyrphus balteatus (De Geer 1766)

Episyrphus balteatus was recorded in big number which was most common among all (fig. 06). We have observed that whenever the aphid colonies consisting of more than 100 aphids one or more larvae of *Episyrphus balteatus* were there and at the same time adult especially female were found hovering around it for oviposition of eggs Schneider (1969) also credited *Episyrphus balteatus* one of the most frequent visitor of ecosystem. The prevalence of *Episyrphus balteatus* showed that the larvae of *Episyrphus balteatus* were active predator of green aphids feeding voraciously on aphid instars and adults. Irshad (2014) has also observed that *E. balteatus* consume 1005 aphids' species in its larval period of 16 to 20 days. We have the same observation since most of collected larvae from the aphid colonies (more than hundred aphids) when identified in lab were of *Episyrphus balteatus*. (Fig. 02).

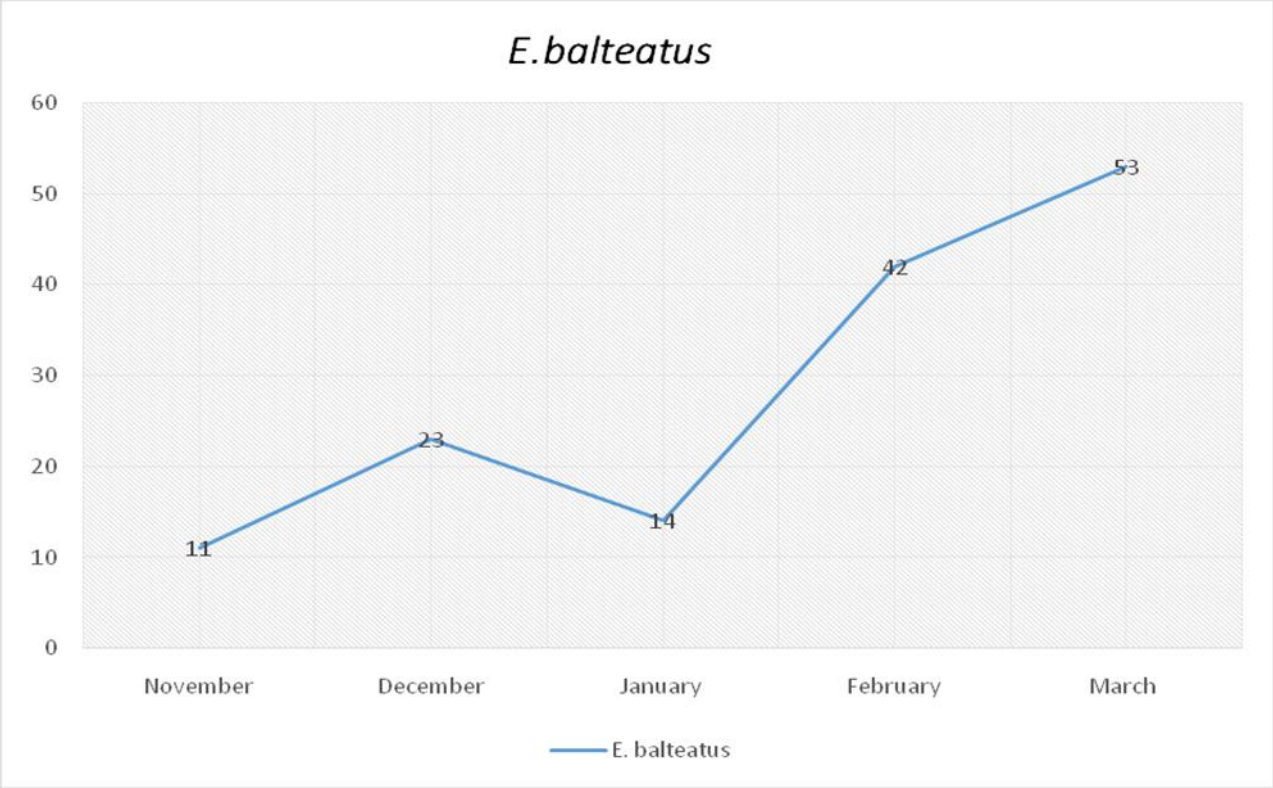


Figure 03. Month wise prevalence of *Episyrphus balteatus*

Ischiodon scutellaris (Fabricius 1805)

Ischiodon scutellaris was second most abundant in proportion, when the weekly collected samples were compared month wise it was found that, in November there was least number of aphids as well as hover flies on brassica crop since the population of both groups is correlated while number increase significantly in February and March because of flowering season of brassica and presence of huge colonies of green aphids (Fig. 04)

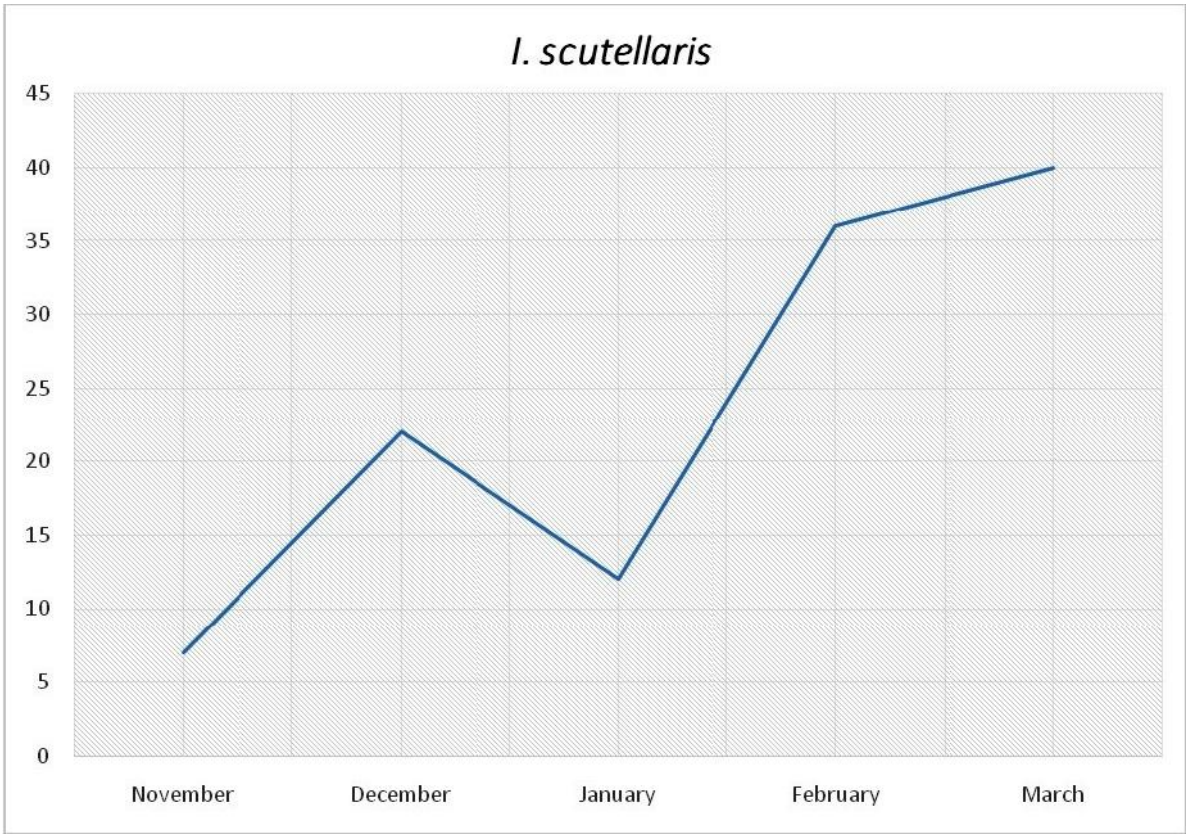


Figure 04. Month wise occurrence of *Ischiodon scutellaris*

Eupeodes luniger (Meigen, 1822)

Eupeodes luniger was least in number from district Dadu, Branquart and Hemptinne, (2000) had also reported the flight period of *E.luniger* is from November to April and we found the same pattern of appearance of *E. luniger* which was low in November and increased significantly in February and march. We have observed that it prefer to fly in shady places surrounded by bushes and shrubs. Its population was also integrated with the aphid colonies and other ecological factors, in hot temperature it was found sitting under shady crops over bushes while in dawn and dusk time it was very active.

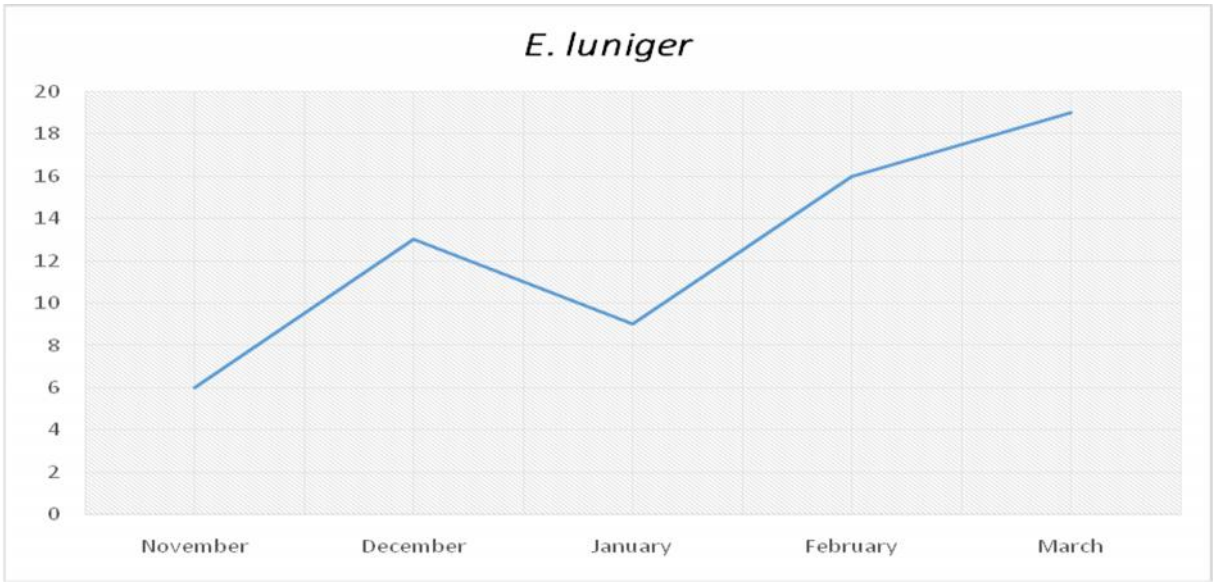
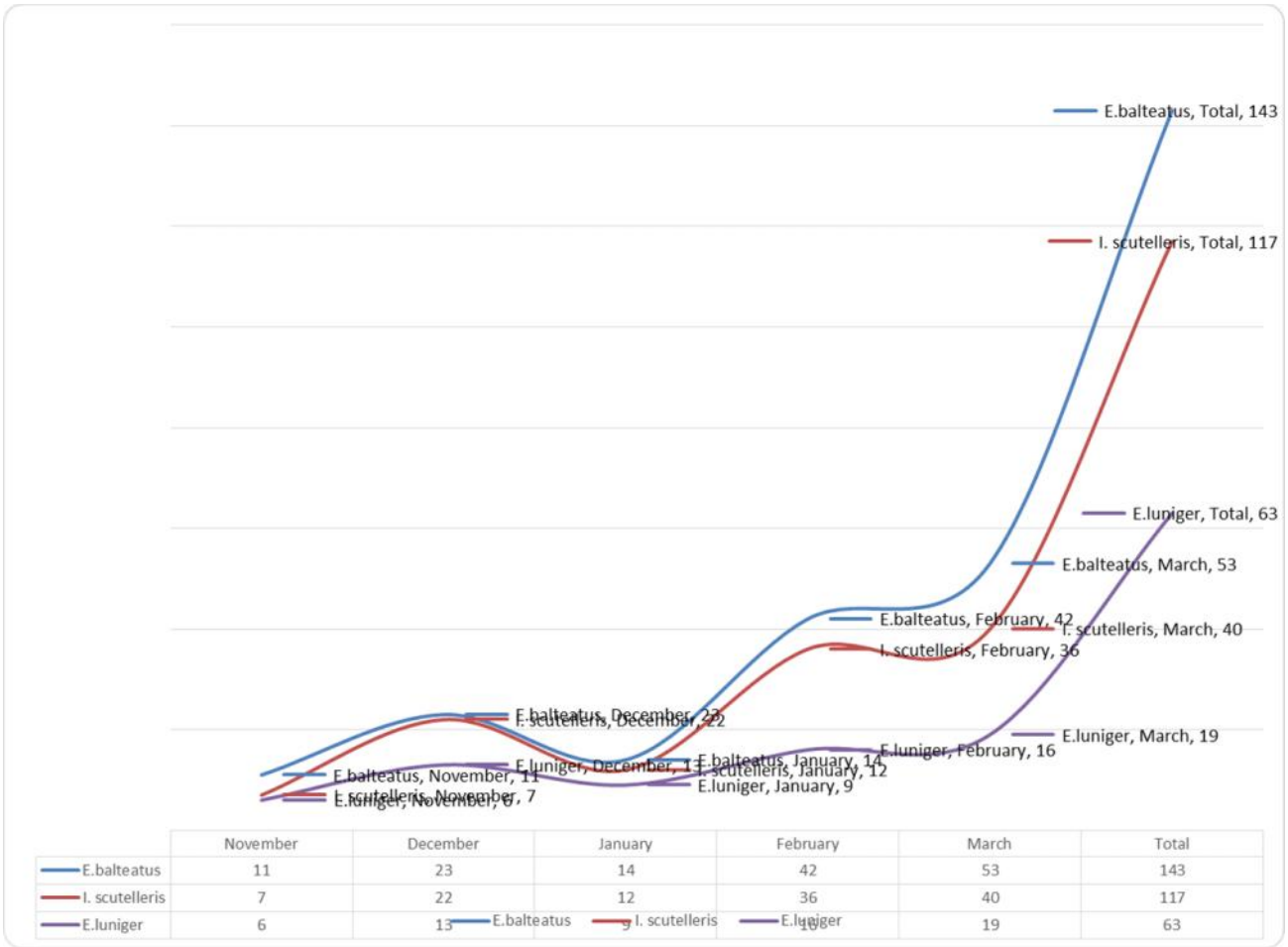


Figure 05. Month wise abundance of *Eupeodes luniger*

Comparative analysis of month wise distribution of three aphidophagous hoverflies species: The results of whole study period displayed that among all the species *Episyrphus balteatus* was the most prevalent species in all localities of Dadu i.e. Mehar, Khairpur Nathan shah and Dadu itself, with highest number of specimens, followed by *Ischiodon scutellaris* on second and *Eupeodes luniger* on third. The maximum collection was made in the month of March due to a number of factors like, Optimum temperature, favorable humidity, plenty of food (aphids colonies) for the larvae of aphidophagous hover flies due to availability of flowering season of brassica crop in the studied area. In contrary to this November was less favorable for the population of syrphid flies of district Dadu owing to immature brassica and harsh environmental conditions.

Table No 2. Month wise distribution of aphidophagous hoverflies (Syrphidae: Syrphinae) in three districts of Dadu

	Dadu			**Mehar**			**Khairpur Nathan Shah**		
Month	*E. balteatus*	*I.scutellaris*	*E.luniger*	*E. balteatus*	*I.scutellaris*	*E.luniger*	*E. balteatus*	*I.scutellaris*	*E.luniger*
November	6	3	3	3	2	2	2	2	1
December	11	9	7	7	7	3	5	6	3
January	5	6	4	5	4	3	4	2	2
February	18	17	8	15	10	5	9	9	3
March	27	23	9	13	10	4	13	7	6



	November	December	January	February	March	Total
E.balteatus	11	23	14	42	53	143
I. scutelleris	7	22	12	36	40	117
E.luniger	6	13	9	16	19	63

Figure 06. Month wise prevalence of aphidophagous hoverflies

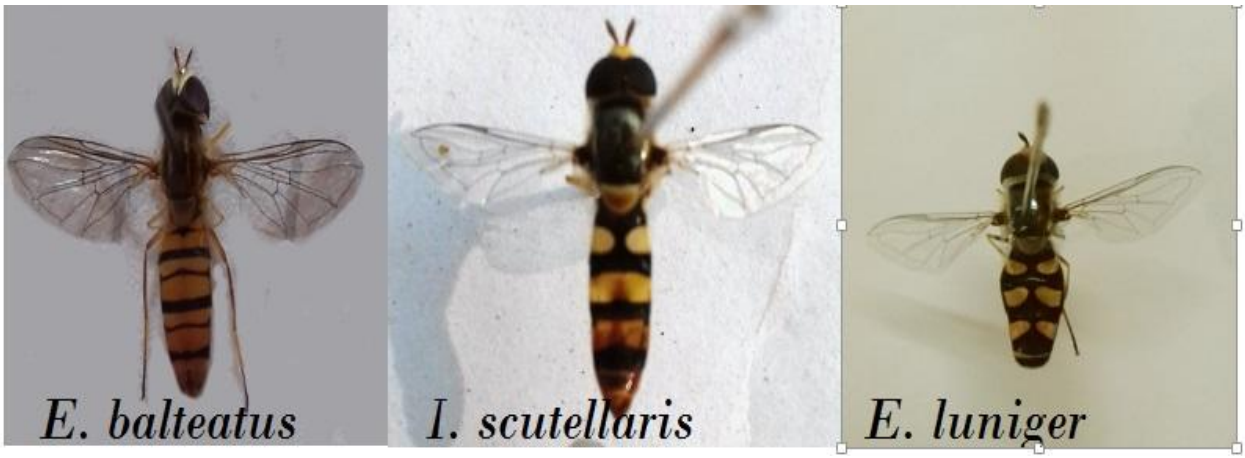


Figure 07. Showing three aphidophagous hover flies

Month wise Correlation of aphidophagous hoverflies with aphids: Our results of current analysis indicate that there is strong positive correlation between population of green peach aphid (*Myzus persicae*) and the number of aphidophagous hoverflies (r = 0.974) and p = 0.00) on brassica crop (Fig. 08), as the number of aphid colonies increase the number of aphidophagous hoverflies also increases. The examination displayed significant positive relationship between the predator syrphid species and prey i.e. green aphids, whereas temperature, relative humidity, and wind speed had negative impact over the hoverflies population in the ecosystem. The population was dramatically influenced by temperature, in the winter increase in temperature up to certain limits encourage the aphidophagous hoverflies, while decrease in temperature below 12 C^0 cause reduction in the appearance of syrphid flies. High temperature at the end of March also caused reduction of aphid colonies so as the syrphid flies, hence the Pearson correlation of temperature revealed positive correlation with appearance of hover flies r = 0.444 and p = 0.454 (Fig. 10). Wind speed had great impact on population of aphidophagous hoverflies which exposed negative correlation r= -0.900 and p= 0.038 with population of aphid colonies. During study we observed that when weather was windy the hover flies population was reduced, when wind speed was high the population of hover flies was almost wiped out (Fig. 11). Humidity also displayed negative correlation with (r= 0.835 and p= 0.078) the prevalence of syrphid flies since in the rainy weather the population was greatly reduced due to increase in humidity because of rainfall (Fig. 10)

Table. No 3. Table showing linear relationship between aphidophagous hoverflies with biotic and abiotic components.

S/No:	Factors	Aphidophagous hover flies	P value
1	Aphid colonies	0.974	.005
2	Temperature	0.444	0.454
3	Wind	0.835	0.078
4	Humidity	-0.900	0.038

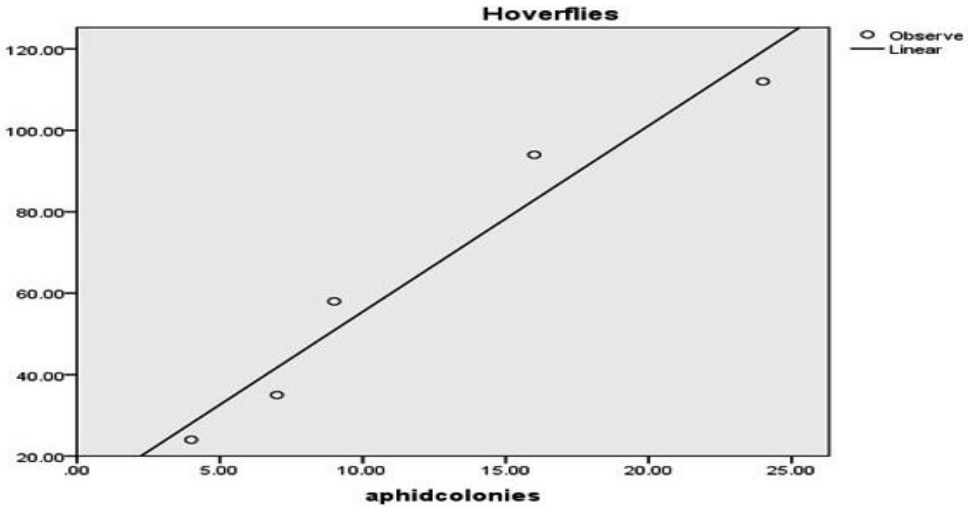


Figure 08. Strong positive correlation of Syrphinae flies with aphid colonies of green peach aphids.

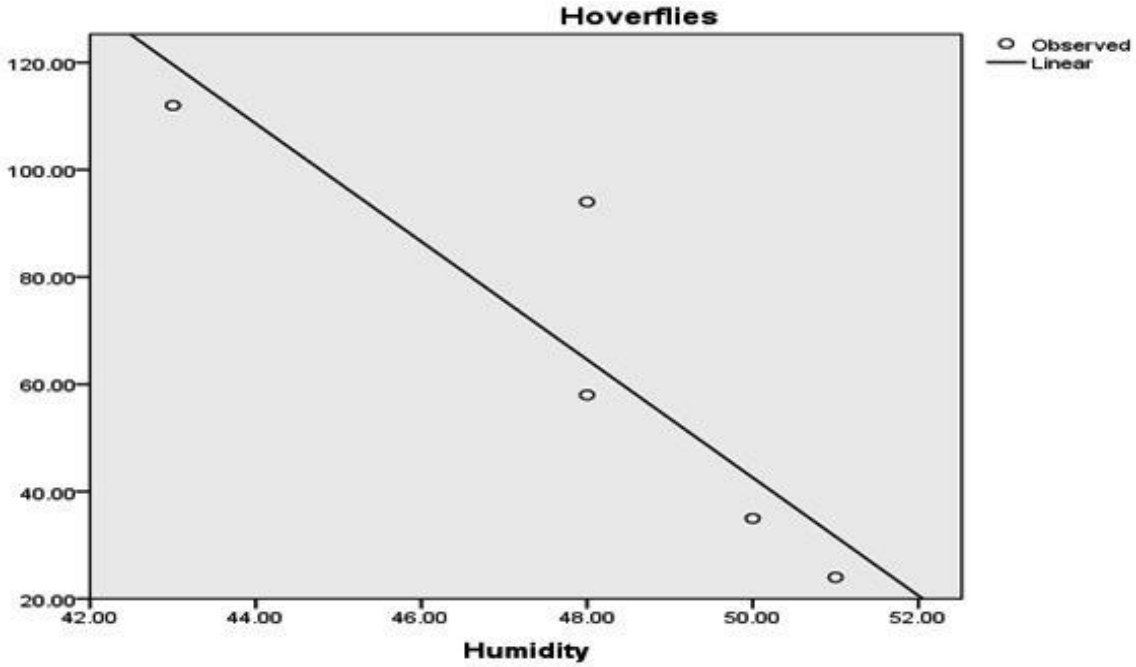


Figure 09. Showing negative correlation of aphidophagous hoverflies with humidity

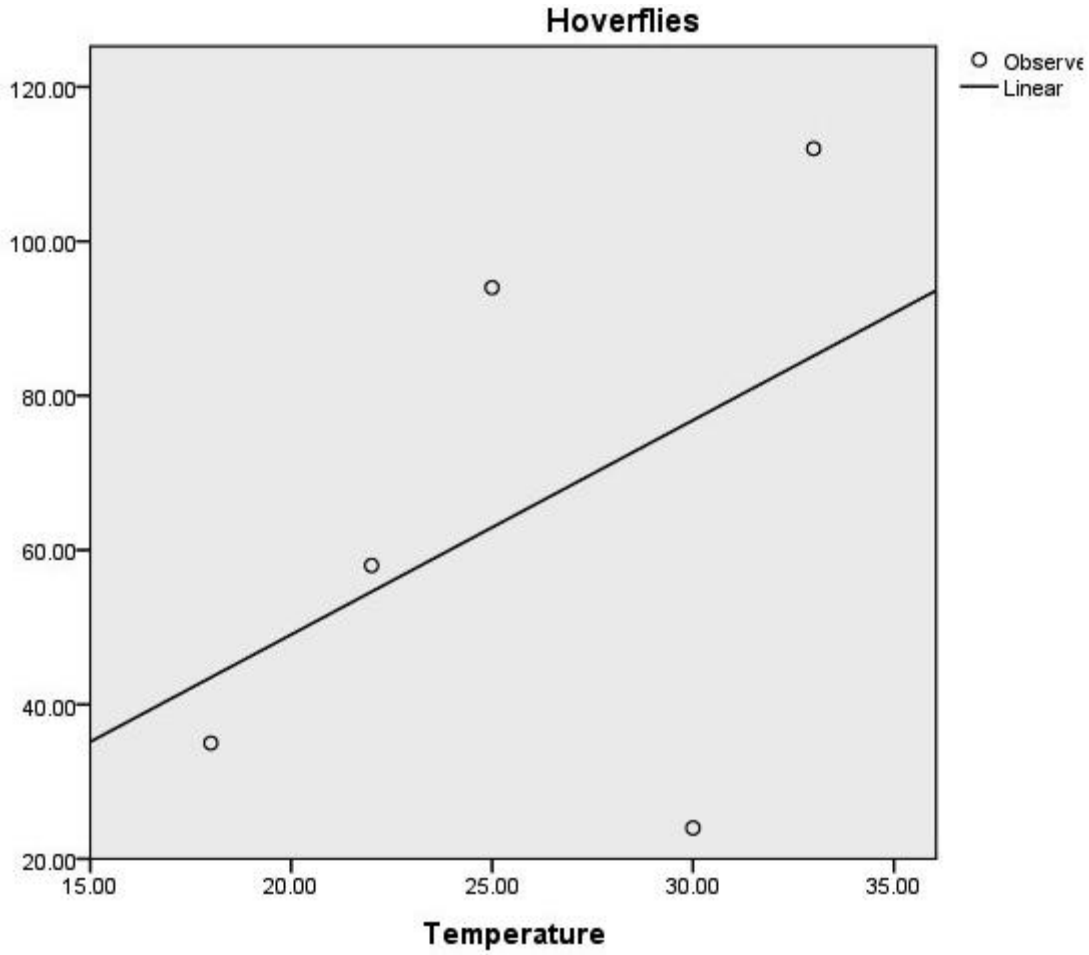


Figure 10. Showing positive correlation of aphidophagous hover flies with temperature

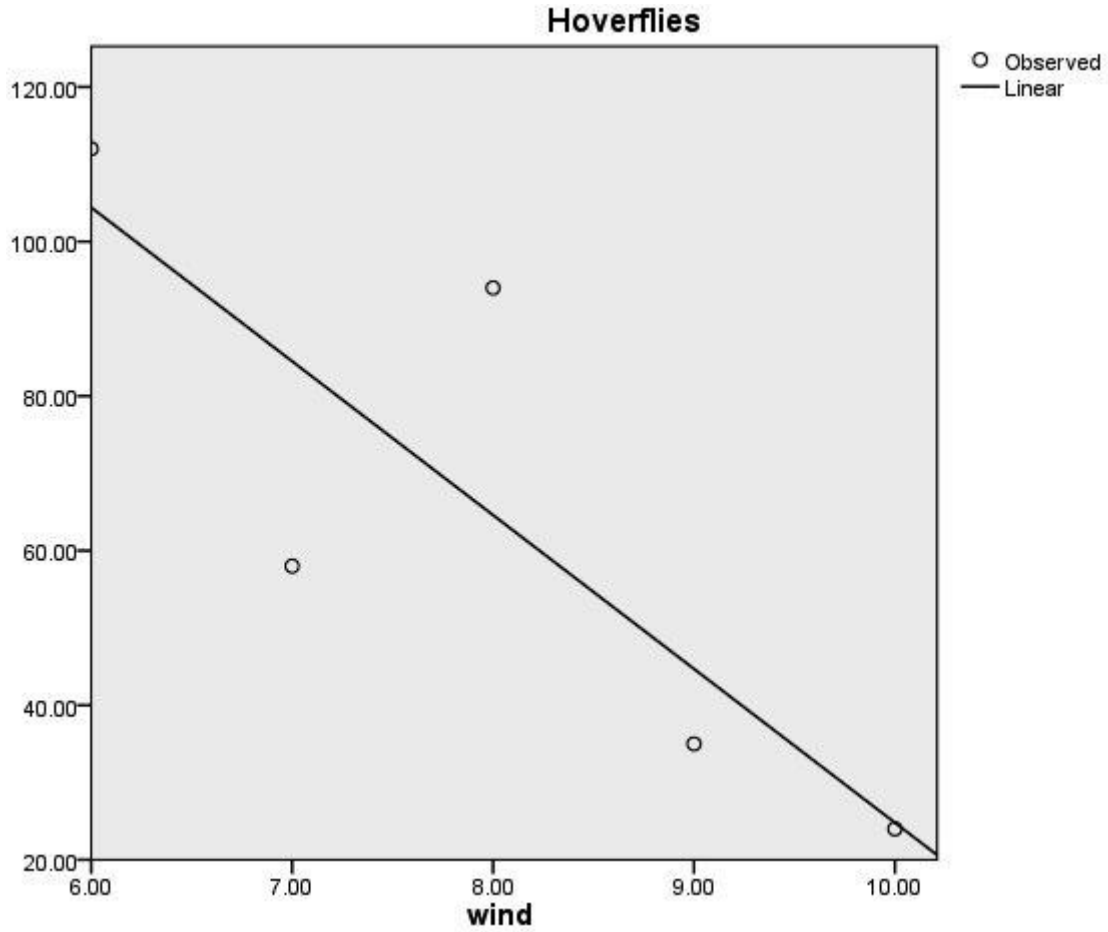


Figure 11. Showing negative correlation of aphidophagous hover flies with wind speed.

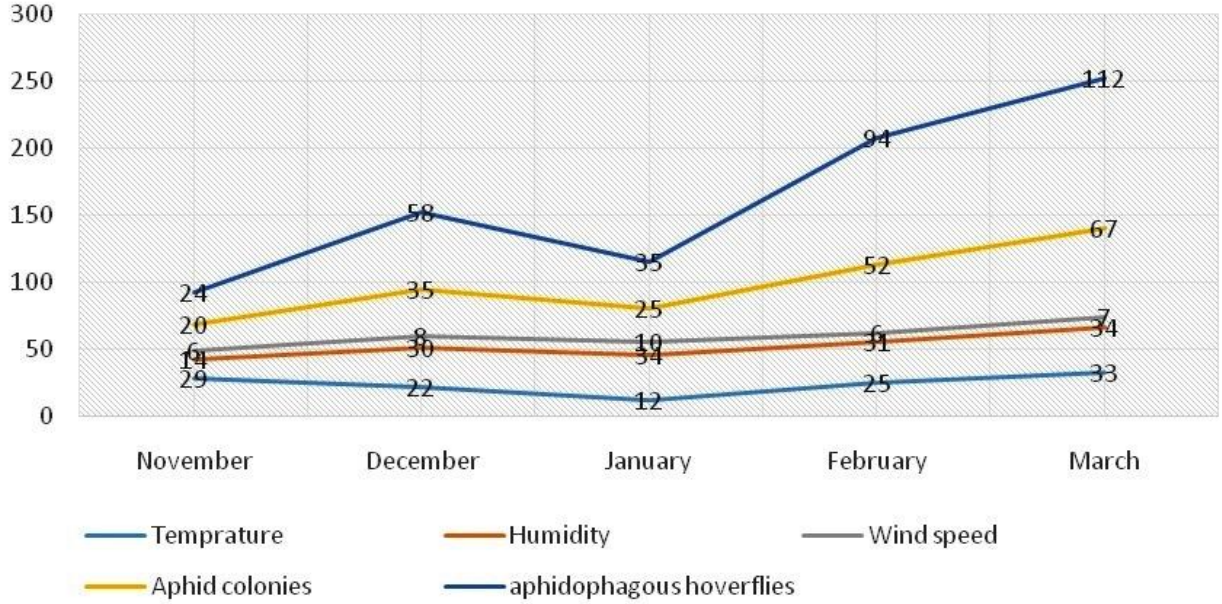


Figure 12. Correlation of syrphid flies with ecological factors (temperature, wind, and humidity), host plants and aphid colonies

Conclusion: The current study of prevalence of aphidophagous hoverflies in relation to green aphids on brassica crop clearly concluded that, the occurrence and abundance of syrphid species is significantly associated with the prevalence of colonies of green aphids (*Myzus persicae*) specially the number of aphid colonies and also the presence of number of aphids in each colony. Beside this some other factors like, temperature, wind speed, humidity and availability of host plants, play vital role in the prevalence of syrphid population. In this way the present analysis indicate that the brassica crop is severally attacked by green aphids and the aphidophagous hoverflies are the active predator of these aphid species. So the inoculation of these aphidophagous hoverflies in natural environment with the help of above mentioned ecological factors the population of destructive pests i.e. aphids can be controlled to achieve good yield of brassica and so many other vegetables thus reducing and finely eliminating the use of chemicals in the crops.

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