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Study of Population Dynamics of Syrphid Fly (Order- Diptera, Family- Syrphidae) in ITM University Gwalior, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An intriguing ecological interaction can exist between aphids and Syrphid flies, particularly in the setting of millet crops. Aphids (Order Hemiptera: Family Aphididae) are a problem variety of crops, including all types of millets. Syrphid flies (Order Diptera: Family Syrphidae) naturally prey on aphids when they are in their larval stage. Syrphid fly larvae are referred to as "aphid lions" or "hoverfly larvae." Aphids are the main source of food for these larvae, and they manage the aphid population in millet crops. Therefore, Syrphids are used as natural enemies and biological control

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agents and syrphid flies are advantageous insects in agriculture. The present study was conducted in the month of August 2021 to March 2022 (summer and winter season) to find out the population dynamic of syrphid flies in agricultural farms and the campus of ITM University. The target crops like maize, sorghum, pearl millets, okra, mustard crop, cabbage cauliflower, marigold and brinjal were tagged and marked and Syrphid fly larvae and pupa were counted four times in a month. The larvae and pupa were also collected and kept for adult emergence. The maximum number of larvae were collected from the Turari campus and were as a minimum found in CRC 2. The other predator like lady bird beetles were also observed but their population was very minor. The population of syrphid flies and larvae depends on the climatic conditions and the availability of foods and their prey.

Keywords: Syrphid fly; biodiversity Pearson's correlation; population dynamics.

1. INTRODUCTION

"Flower flies (Diptera: Syrphidae) are a large and diverse group of insects. Many species are important pollinators of flowering plants. In addition, the immatures of numerous species are predators of destructive aphids and other pests" [1]. "The syrphid flies are large and diverse group of insects and the larvae of the most of the species are predator of aphids and used as biological control aphids" [2]. "These flies are expert fliers and can hover or fly backward, ability possessed by few insects other than syrphid flies. The adults mainly feed on nectar and pollen. The females must consume pollen since they need the proteins and amino acids of the pollen for maturation of their eggs. Nectar has only a small amount of these substances but much sugar. It is the fuel for the flies, enabling them to fly and hover actively" [3-5]. "Being regular visitors of flowers, hoverflies are important pollinators of various plants including vegetables and fruit trees (e.g. Asteraceae, Brassicaceae, Rosaceae) and select the flowers mainly by their colours. Compared with the adults, the larvae are important predators, feeding primarily on aphids that attack citrus, subtropical fruit trees, grains, corn, alfalfa, cotton, grapes, lettuce and other vegetables, ornamentals, and many wild host plants of the aphids. Three large ecological groups can be distinguished: predators, miners and decomposers (living on dead organic material - saprophagous larvae). All species of the subfamily of Syrphinae have zoophagous larvae. Their main preys are aphids (greenflies). The larvae of Microdontinae are associated with hymenopterans" [5]. "The Microdontinae larvae are supposed to be zoophagous living in ant nests. Eumerus and Merodon larvae are plant eating (phytophagous) but miners in nature. The larvae of the remaining Eristaline species are saprophagous organisms; they live in various habitats (running or stagnant water, mud, compost heaps, rotten wood etc.) feeding on dead organic substances. Hoverflies can be found in every biotope but not in deserts. Each species tends to prefer a certain type of habitat and is limited to a distinct range within the country. In general, within a genus the needs and behavior of the species are similar. As a result, one tends to associate certain genera with particular habitats. For example Chrysogaster, Eristalinus, and Mesembrius (all with aquatic or semi-aquatic larvae) are typical found in wetlands, many tiny Paragus species live in grassland whereas species of Baccha, Melanostoma and Xylota prefer woodlands. Within a given habitat the hoverflies have an irregular distribution. Some prefer the low vegetation (like Melanostoma and Paragus), others can be observed in the tree canopies (like Mallota and Spheginobaccha). There are also differences in the horizontal distribution of the adults at a site since important structural components like certain flowers or egg laying sites cannot be found everywhere within a habitat" [6]. The hoverflies can be efficient predators in cereal crops such as wheat, rice and corn.

"Aphids alone cause tens of millions of Dollars of damage to crops worldwide every year; because of this aphid-eating hover flies are being recognized as important natural enemies of pests, and potential agents for use in biological control some adult syrphid flies are important pollinators. Flies that visit or hover on flowers are not all referable to flower flies or hover flies, but those that do it usually by hovering for some time with a shrill hum are regarded flower flies or hover flies or Syrphidae" [7]. "The family includes small to rather large (3-18 mm), bristle less, brightly coloured flies, may be striped, banded or spotted yellow on a blue, black or metallic ground colour. Head variable, usually as broad as or a little broader than the thorax, thorax rather large and robust, moderately arched, rarely with bristles, abdomen variable in shape, composed of five or six visible segments, rarely four, wings comparatively large, most of which have a false or spurious vein, extending longitudinally and slightly diagonally between the third (R4+5) and (M1+2) longitudinal veins. The systematic study of the family Syrphidae has gradually progressed from the 17th century and presently 6,107 species under 209 genera reported from the world" [8,9]. In India, 357 species under 14 tribes of three subfamilies are reported [10]. This study thus may provide an insight into the pollination biology of this important group in future as well as modern taxonomic approach may serve as important tool for their easy identification.

2. MATERIALS AND METHODOLGY

2.1 Study Selection

The study was conducted in ITM University Gwalior. ITM University Gwalior is located 6 kms from Gwalior city at Jhansi highway NH 75. The altitude of the study area is about 197m above sea level and its position is 26º to 14º N latitude and 78º to 18º E longitudes Annual rainfall of 664.4 mm, with temperature varies from 5 to 45ºc.

2.2 Methodology

2.2.1 Collection of samples

Larvae of syrphyid fly were collected from Sithuli campus, SRC1 SRC 2 and Turai campus. Sample were collected from available crops and its was different from season to season. In winter season the syrphid fly was on mustard crop, cabbage cauliflower, marigold and in rainy and summer season it was collected from maize, sorghum and other vegetables. The sample plants were tagged and larvae pupas were counted and weekly basis. The larvae and pupa were collected and kept in laboratory for emergence of adult syrphid fly.

2.2.2 Methods employed

The sample collected from tagged plants/crops was maintained in the Entomology laboratory School of Agriculture ITM university Gwalior. The plant samples were placed in sample container containing Aphid colony and available Syrphid larvae, both Aphid and Syrphid larvae counted at each three replication of individual host plant samples. The sample container were covered with muslin cloth and tied with plastic rubber to provide aeration to the emerging insects. On the second day of collection aphid colony was provided and continued until pupation. Pupa were separated till the adult emerge. Finally labeling was done such as date of collection with the name of the host sample.

2.2.3 Statistical analysis

The data were analyzed statistically using Pearson's correlation coefficient to measure the strength of linear relationship of biotic (host plants) and a-biotic (temperature, humidity, rainfall and cloudiness) factors with the abundance of hoverflies through SPSS 22 version software.

2.2.4 Data of climatic factors

The data of weather variables i.e. Temperature, humidity, of studied localities were collected from the Department of Land resources and environment.

3. RESULTS AND DISCUSSION

3.1 Syrphid Flies Population

The larvae of syrphid fly were collected and counted from from different localities of Gwalior like Sithuli campus, CRC1, CRC2 and The population mean was recorded monthly with average minimum and maximum temperatures in degree centigrade and average relative humidity. The data were placed on Table 1. The population was recorded from available crops collected at the month of maximum December, January and February.

Temperature is main driving force for availability of sphid fly in different months. And different type cropping pattern also type vegetation that attract the aphids on which syrphid fly fees on it.

Pearson`s correlation coefficient analysis revealed that negative but not significant correlation i.e with minimum and maximum tempetrure for all experimental site. Sithuli (r=0.078) (p=0.922), duranta (r=-0.111) (p=0.889) but positive and not significant correlation for cowpea i.e(r=0.373) (p=0.627) for the month of October. On November according to pearson`s correlation it was positive and not significant correlation i.e sorghum(r=0.607) (p=0.393) of temperature and relative humidity

Table 1. Population of syrphid fly on different

Month	*Sithuli* campus	CRC 1	CRC 2	Turari campus	Methrology		
					Ave T° min	Ave T° max	RH
Aug	8.07	7.75	10.5	10.6	22.20	37.5	81.23
Sep	7.33	6.15	12.25	13.12	21.50	34.5	79.93
Oct	10.33	8.2	12.6	13.1	21.5	32.5	76.50
Nov	13.75	12.1	13.2	14.5	18.5	27.5	75.63
Dem	15.25	13.2	14.1	16.5	10.5	24.5	84.86
Jan	10.15	14.1	12.75	13.5	8.5	20.5	67.39
Feb	15.5	14.75	13.12	14.5	13.5	25.5	60.5
March	8.4	6.2	3.5	4.5	16.5	35.5	61.25
April	2.2	1.1	1.5	2.5	24.5	41.5	62.5
Correlation with average temperature							
r	**-0.761**	**-0.914**	**-0.627**	**-0.672**			
P0.5	0.0172	0.0003	0.07	0 .047			
Covariance	-19.84	-25.4	15.25	-19.6			
r	**0.2204**	**0.1242**	**0.5778**	**0.568**			
P0.5	0.5688	5.3167	0.1032	0.1106			
Covariance	8.8486	5.3167	24.98	25.512			

with abundance of hover flies. While on December temperature with abundance population correlated strong positive and not significant i.e (r=0.961) (p=0.069) but negatively correlated in okra(r=-0.052) (p=0.948). In the month of January overall population of syrphid fly was negative and not significantly correlated. While positive Pearson's correlation for sorghum and mustard on February. For the month of March result revealed negative, positive for duranta and not significant correlated for the available host range. Adults of syrphid flies act as pollinators of different crops [11]. According Shivani Palial [12] In summary, syrphid fly population abundance tends to increase with moderate to high temperatures and humidity, while extremes in these environmental factors can have adverse effects. Understanding these correlations helps in predicting syrphid fly population dynamics and their role in ecosystems, particularly in agricultural settings where they are important biological control agents.

According to present study the relation between pollinators (including hoverflies) and climatic factors usually vary with geographical distribution, Carvolho et al. [13] also reported a positive correlation between temperature and number of syrphids in tropics,while in sub-tropical areas of world this relation could be negative as reported by [14]. Our result was also in accordance with the findings of [14] and climatic factors (temperature, relative humidity) were negatively correlated with hoverfly abundance.

Table 2. Pearson correlation of average population of syrphid larvae on different host plants with Temperature and Relative humidity

	Ave Temp	Ave RH
AP Okra	0.103	0.213
AP Duranta	0.524	0.251
AP Sorghum	0.283	-0.169
AP Bean	-0.548	0.530
AP Cabbage	0.273	-0.617
AP Cowpea	0.418	-0.252
AP Cauliflower	-0.240	-0.704
AP Maize	0.486	-0.166
AP Mustard	-0.240	-0.708

- Sign indicates negative correlation

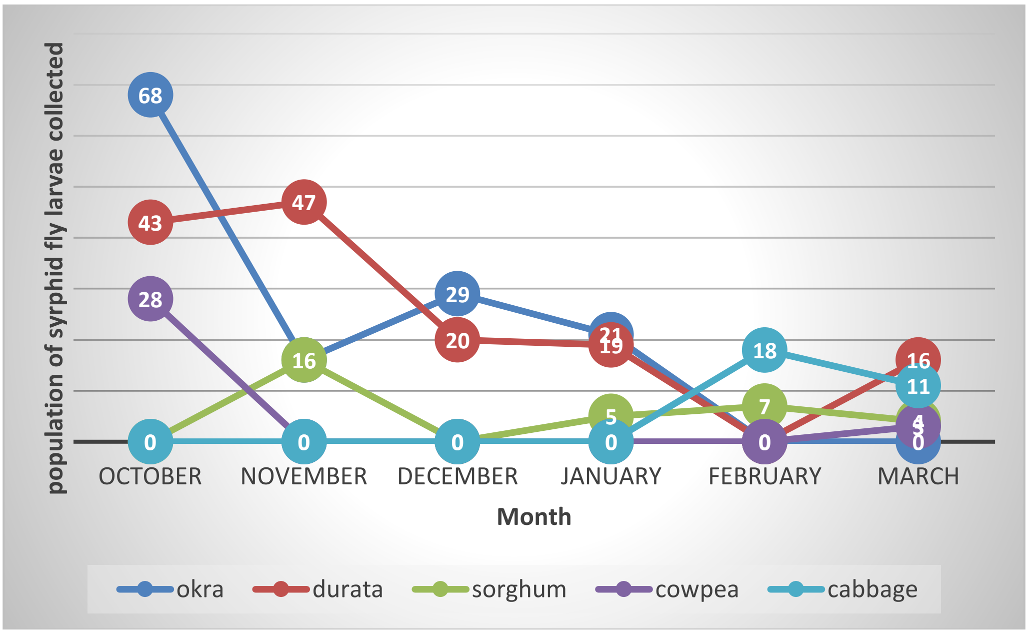

Fig. 1. Syrphid fly population of different crops from October 2018 up to March 2019

4. CONCLUSION AND RECOMMENDATION

The present studies were concluded that population dynamics of syrphid flies on ITM university area farm. In research domain no previous study on syrphid fly in Gwalior were found. During the study period of six months (October 2018 up to March 2019), the population was high during month of October on plants of okra, duranta According to present the temperatures were correlate positively with the population of syrphid flies. And the abundance of syrphid population dramatically affected with the season vegetation cover around the farm. The population richness of syrphid flies is expressively prejudiced by the seasonal changes in vegetation cover around farms. The typically in spring and summer, there is an abundance of nectar and pollen sources which are essential for adult syrphid flies. This leads to higher reproductive success and increased larval food sources, as syrphid larvae primarily feed on aphids which thrive in these conditions. Conversely, in fall and winter, when vegetation cover is sparse and food resources are limited, syrphid fly populations tend to decline. This seasonal fluctuation in vegetation not only affects the availability of food but also influences the microhabitats that provide shelter and breeding sites for syrphid flies, thereby driving their population dynamics around farms.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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