REDVET - Revista electrónica de Veterinaria - ISSN 1695-7504
Vol 25, No. 1S (2024)
http://www.veterinaria.org
Article received- 05/09/24 Revised-20/09/24 Accepted-03/10/24
DOI: https://doi.org/10.69980/redvet.v25i1S.1098

Influence Of Meteorological Factors On The Population Dynamics Of *Aulocophora foveicollis* Lucas On Pumpkin Crops

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ABSTRACT
Pumpkin is an important crop cultivated across Tamil Nadu, India. It is a versatile, nutrient rich vegetable, known for its medicinal properties. One of the primary obstacles faced by pumpkin cultivators is the detrimental effects of insect pest *Aulocophora foveicollis* Lucas (*Coleoptera- Chrysomelidae*) which causes damage to the crop up-to 100%. In this study, the incidence of red pumpkin beetle (*A. foveicollis* Lucas) from July 2023 to June 2024 is recorded and correlated with the climatic variables like temperature, relative humidity and pressure. The pest population reached peak by the second week of September, fourth week of January and second week of May with an average population of 3.68, 1.26, 3.96 beetles/ plant respectively. The infestation of red pumpkin beetle on leaves and flowers of pumpkin crops throughout the year ranged between 9.14%- 68.83% and 17.00%- 100% respectively. Correlation studies revealed that there is a significant relationship between the incidence of red pumpkin beetle and climatic variables.

Keywords: Red Pumpkin Beetle, *Aulocophora foveicollis* Lucas, Weather parameters, Pumpkin crops, Meteorological Factors.

INTRODUCTION

Pumpkin, (Family: *Cucurbitaceae*) an adaptable, nutrient rich vegetable that has gained considerable attention in recent years (El Khatib & Muhieddine, 2020). It is a substantial source of protein, vitamins like A, B, C, dietary fibre, and minerals like iron, phosphorous, calcium (Dhiman *et. al*., 2020 , P. Jansirani *et. al*., 2017, Muralidhara *et.al*., 2014). It is also medicinally valuable due to the presence of carotenoids, zeaxanthin, ascorbic acid, phytosterols, and linoleic acid (Dhiman *et. al*., 2020, Dutta *et. al.,* 2006). Pumpkins are cultivated worldwide across 3 million hectares approximately, with the yield of 27.832 million tons. India contributes 20% of global production of pumpkin, according to FAOSTAT statistical database 2017 (Hosen *et. al*., 2021). One of the main challenges faced by pumpkin farmers in India is the harmful impacts of insect pests. Among them, *Aulocophora foveicollis* Lucas (Red Pumpkin Beetle) (*Coleoptera-Chrysomelidae*) is an important pest of cucurbits, inflicting considerable amount of damage to crops from seedling stage to harvest. It is a polyphagous pest, that feeds voraciously on leaves, flowers and fruits, causing yield loss from 30% to 100% (Atwal *et. al.,* 2015, Rashid *et.al.,* 2014, Dhillon *et. al.,* 2005). It is extensively distributed all over India and occurs throughout the year with its detrimental effects being particularly pronounced during the early stages of crop growth (Chandra Rajak, 2001, Butani & Jatwani 1984).

The intensity and frequency of pest attack differs from region to region based on the meteorological conditions. Abiotic factors like temperature, relative humidity, pressure considerably affects the growth of insect pests (Ajij *et.al*., 2009). Therefore, it is crucial to understand the influence of weather parameters on the population dynamics of insect pests, in order to develop effective pest management strategies. Research on the incidence of red pumpkin beetle on pumpkin crops in relation to climatic variables is scanty. Consequently, this study focuses on population dynamics of the adult *Aulocophora foveicollis* Lucas from July 2023 to June 2024, its relation to temperature, relative humidity and pressure and its infestation range on pumpkin crops.

MATERIALS AND METHODS

The study on the population dynamics of adult beetle, *Aulocophora foveicollis* Lucas*,* on pumpkin crops, in relation to weather parameters was conducted in the farm areas of Lakshmipuram village, Theni district, Tamil Nadu which is located at 10.0854 N latitude and 77.5087 E longitude at an elevation of 283.23m above the sea level from the month of July 2023 to June 2024. F1 Hybrid pumpkin seeds were sown on 23rd July 2023 in the field area of 38 x 19m^2 and at a distance of 1.5m between each plant. The field was divided into five equal plots with an area of 7.6 x 9m^2 for each plot. The crops were grown without the application of pesticides. The observations on adult beetle population were recorded at weekly intervals from each plot during morning hours. Percentage leaf infestation and Percentage flower infestation of adult red pumpkin beetle on pumpkin plants was also recorded using the following formula,

% Leaf Infestation = (No. of Infested leaves/ Total No. of leaves) x 100

% Flower Infestation = (No. of Infested flowers/ Total No. of flowers) x 100

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DOI: XYZ

The data on weather parameters like temperature, relative humidity, pressure was obtained on a weekly basis and correlation coefficient was carried out between the population of adult red pumpkin beetle and weather parameters using SPSS software version 24.

RESULTS AND DISCUSSION

In the first season of one year study from July 2023 to October 2023 (Table 1), the occurrence of red pumpkin beetle (*Aulocophora foveicollis* Lucas) on pumpkin crops was initially observed during the first week of August (SMW 32) with an average pest population of 0.08 beetles/ plant. The population gradually increased and reached its peak during second week of September (SMW 37) with an average pest population of 3.68 beetles/ plant. However, the population declined subsequently in the month of October. This result supports the conclusion drawn by Kumar *et. al.,* 2018, in which population of red pumpkin beetle decreased in the month of October. The pest also caused significant amount of leaf damage and flower damage between 9.14%- 33.74% and 19.50%- 87.12% respectively (Fig. a). In correlation study between adult red pumpkin beetle and weather parameters like temperature, relative humidity and pressure, the pest population shows significant negative correlation with temperature while with relative humidity and pressure, it shows significant positive correlation and non-significant negative correlation respectively. This finding is more or less similar with the results of Dubale *et. al.,* 2018, wherein he reported that during kharif there was negative correlation existed between maximum temperature and the population of red pumpkin beetle. This also agrees with the study conducted by Sharath *et. al.,* 2021 in which the pest incidence was negatively correlated with maximum and minimum temperature.

During second season from November 2023 to February 2024 (Table 2), the pest infestation on pumpkin crops was initially observed in the second week of December (SMW 50) with an average population of 0.04 beetles/ plant. With 1.26 beetles/ plant, the population gradually increased by fourth week of January (SMW 04). Thereafter, the population shows a decline by third week of February (SMW 07). This result is consistent with the findings of Tushar M. Ghule *et. al.,* 2014, where the population of red pumpkin beetle was found to be highest in the fourth week of January. The pest seriously infested the leaves and flowers of the crop, ranging between 40.39%- 68.83% and 17.00%- 86.00% respectively (Fig. b). The adult beetle population on pumpkin crops showed a non-significant positive correlation with temperature as reported by Kumar *et. al.,* 2018, a significant negative correlation with relative humidity, which partially agrees the findings of Boopathi *et. al.,* 2017, in which the population of red pumpkin beetle was found to be negatively correlated with morning relative humidity and a significant positive correlation with pressure, according to the study conducted from November 2023 to February 2024 (Table 4).

S.No.	Date	SMW	Mean Population	% Leaf Infestation	% Flower infestation	Weather Parameters		
						Temperature (°C)	Relative Humidity (%)	Pressure (mb)
01.	23/07/2023	30	0.00	0.00	0.00	29.52	57.00	1009.09
02.	30/07/2023	31	0.00	0.00	0.00	29.01	57.31	1010.02
03.	06/08/2023	32	0.08	0.00	0.00	29.70	57.83	1010.66
04.	13/08/2023	33	0.56	9.14	0.00	29.37	59.87	1009.67
05.	20/08/2023	34	1.22	30.11	0.00	29.70	57.04	1008.50
06.	27/08/2023	35	1.50	22.10	0.00	29.79	60.62	1010.20
07.	03/09/2023	36	2.68	16.47	19.50	26.62	77.04	1008.34
08.	10/09/2023	37	3.68	13.10	60.53	27.00	74.29	1008.91
09.	17/09/2023	38	3.36	18.51	75.57	26.87	76.66	1009.29
10.	24/09/2023	39	2.80	13.60	87.12	27.12	75.58	1010.08
11.	01/10/2023	40	1.60	14.91	75.09	29.33	75.45	1010.33
12.	08/10/2023	41	1.80	15.91	53.50	29.41	73.25	1011.34
13.	15/10/2023	42	0.46	33.74	27.66	26.70	73.70	1011.91

Table 1: Data of Population, Percentage Leaf Infestation and Percentage Flower Infestation of Adult Red Pumpkin Beetle (*Aulocophora foveicollis* Lucas) on Pumpkin crops and Weather parameters during the period of July 2023 to October 2023.

S.No.	Date	SMW	Mean Population	% Leaf Infestation	% Flower infestation	Weather Parameters		
						Temperature (°C)	Relative Humidity (%)	Pressure (mb)
01.	26/11/2023	48	0.00	0.00	0.00	26.09	84.02	1011.00
02.	03/12/2023	49	0.00	0.00	0.00	27.12	83.72	1012.36
03.	10/12/2023	50	0.04	68.83	0.00	27.41	84.16	1012.75
04.	17/12/2023	51	0.08	59.33	0.00	24.87	91.62	1012.79

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Article received- 05/09/24 Revised-20/09/24 Accepted-03/10/24
DOI: XYZ

05.	24/12/2023	52	0.22	57.39	0.00	25.16	71.33	1015.95
06.	31/12/2023	52	0.10	48.67	0.00	26.58	74.75	1014.08
07.	07/01/2024	01	0.90	40.39	17.00	25.00	91.16	1014.00
08.	14/01/2024	02	0.52	44.18	63.33	25.58	69.29	1014.33
09.	21/01/2024	03	1.00	41.63	80.00	27.00	65.91	1014.00
10.	28/01/2024	04	1.26	42.26	86.00	27.37	64.91	1015.00
11.	04/02/2024	05	1.14	41.06	82.00	27.45	52.50	1016.08
12.	11/02/2024	06	0.92	45.30	82.00	28.37	49.75	1015.95
13.	18/02/2024	07	0.66	51.22	34.00	28.50	49.41	1016.20

Table 2: Data of Population, Percentage Leaf Infestation and Percentage Flower Infestation of Adult Red Pumpkin Beetle (*Aulocophora foveicollis* Lucas) on Pumpkin crops and Weather parameters during the period of November 2023 to February 2024.

S.No.	Date	SMW	Mean Population	% Leaf Infestation	% Flower infestation	Weather Parameters		
						Temperature (°C)	Relative Humidity (%)	Pressure (mb)
01.	17/03/2024	11	0.00	0.00	0.00	32.01	49.00	1008.41
02.	24/03/2024	12	0.00	0.00	0.00	31.92	48.72	1009.56
03.	31/03/2024	13	1.42	64.00	0.00	32.54	48.45	1009.41
04.	07/04/2024	14	0.90	61.30	0.00	32.04	51.79	1010.20
05.	14/04/2024	15	0.66	61.83	0.00	29.20	70.45	1011.58
06.	21/04/2024	16	0.96	43.13	0.00	28.00	70.37	1011.25
07.	28/04/2024	17	0.94	32.35	0.00	28.58	73.37	1011.12
08.	05/05/2024	18	1.80	33.67	52.00	27.16	72.87	1010.50
09.	12/05/2024	19	3.96	31.18	83.66	24.54	92.75	1005.16
10.	19/05/2024	20	3.20	31.70	100.00	27.20	89.66	1005.45
11.	26/05/2024	21	2.88	37.10	80.00	28.37	88.41	1005.95
12.	02/06/2024	22	1.82	42.17	100.00	29.29	87.41	1005.58
13.	09/06/2024	23	1.20	59.01	30.00	27.62	91.83	1005.54

Table 3: Data of Population, Percentage Leaf Infestation and Percentage Flower Infestation of Adult Red Pumpkin Beetle (*Aulocophora foveicollis* Lucas) on Pumpkin crops and Weather parameters during the period of March 2024 to June 2024.

The occurrence of pest on pumpkin crops was observed in fourth week of March (SMW 13), during third season of one year study, from March 2024 to June 2024 with an average population of 1.42 beetles/ Plant (Table 3). With an average of 3.96 beetles/ plant, the pest population reached its peak by second week of May (SMW 19) and the population declined gradually with 1.20 beetles/ plant by second week of June (SMW 23). This result is more or less in conformity with Rathod *et.al.,* 2010, Ghule & Jha, 2015, Saha *et. al.,* 2018, P B Shinde *et.al.,* 2018 in which it is reported that the population of red pumpkin beetle reaches maximum by the month of May. The leaves and flowers of pumpkin crops ranging between 31.18%- 64.00% and 30.00%- 100% respectively were severely infested by the pest (Fig. c). The correlation study (Table 4) exhibited that there is a significant negative correlation between pest population and temperature which agrees with the results of Dubale *et. al.,* 2018, Sharath *et.al*., 2021, a significant positive correlation with relative humidity that aligns with the findings of Bhowmik & Saha, 2017, in which there is a positive correlation of the pest population with maximum relative humidity and moderate negative correlation with pressure.

Duration	Temperature	Relative Humidity	Pressure
July 2023 to October 2023.	-0.636 *	0.762**	-0.363
November 2023 to February 2024.	0.351	-0.620*	0.645*
March 2024 to June 2024.	-0.733**	0.744**	-0.670*

Table 4: Correlation between Population of Adult Red Pumpkin Beetle (*Aulocophora foveicollis Lucas*) on pumpkin crops and Weather parameters.

*Correlation is significant at 0.05 level.
**Correlation is significant at 0.01 level.

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DOI: XYZ

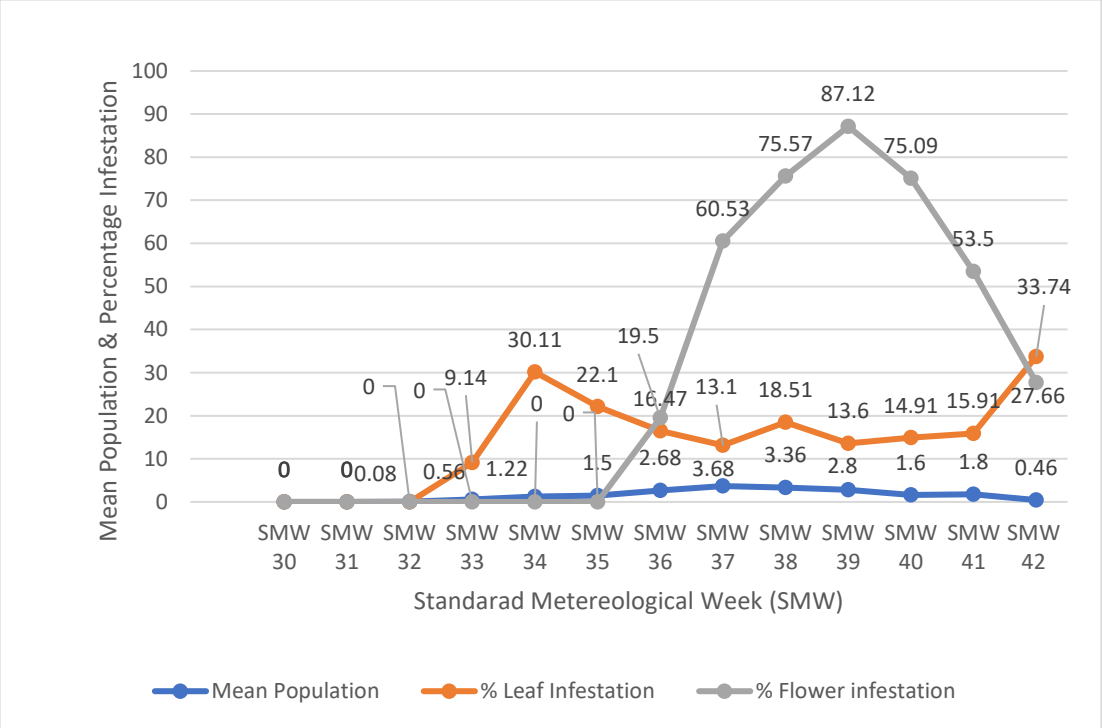

Fig. a: Mean population, Percentage Leaf and Percentage Flower Infestation of Adult Red pumpkin beetle (*Aulocophora foveicollis* Lucas) during the period of July 2023 to October 2023.

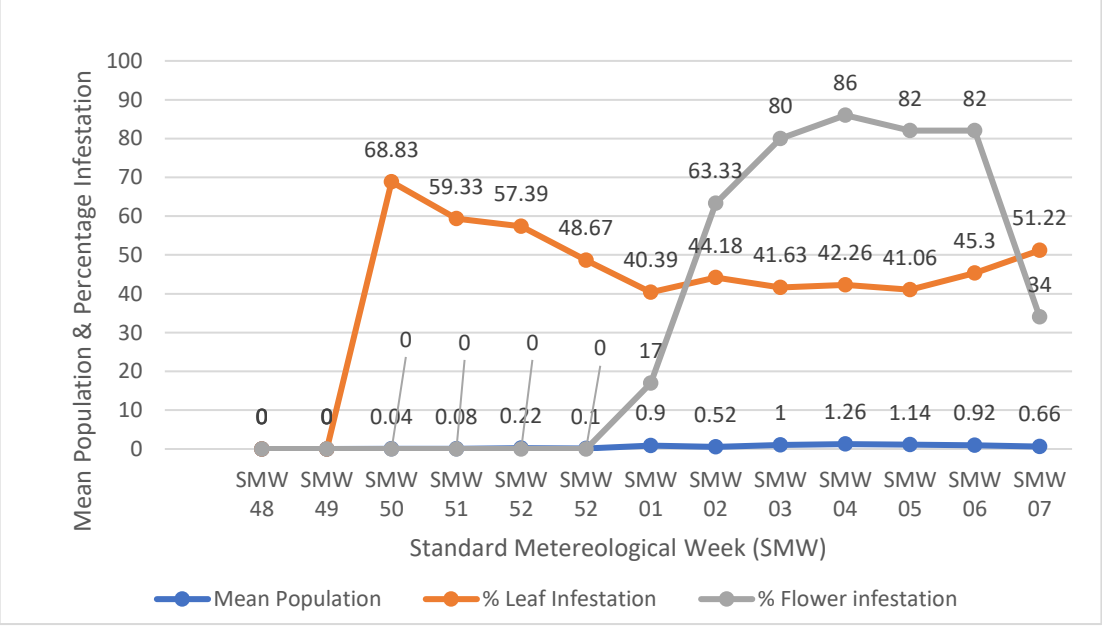

Fig. b: Mean population, Percentage Leaf and Percentage Flower Infestation of Adult Red pumpkin beetle (*Aulocophora foveicollis* Lucas) during the period of November 2023 to February 2024.

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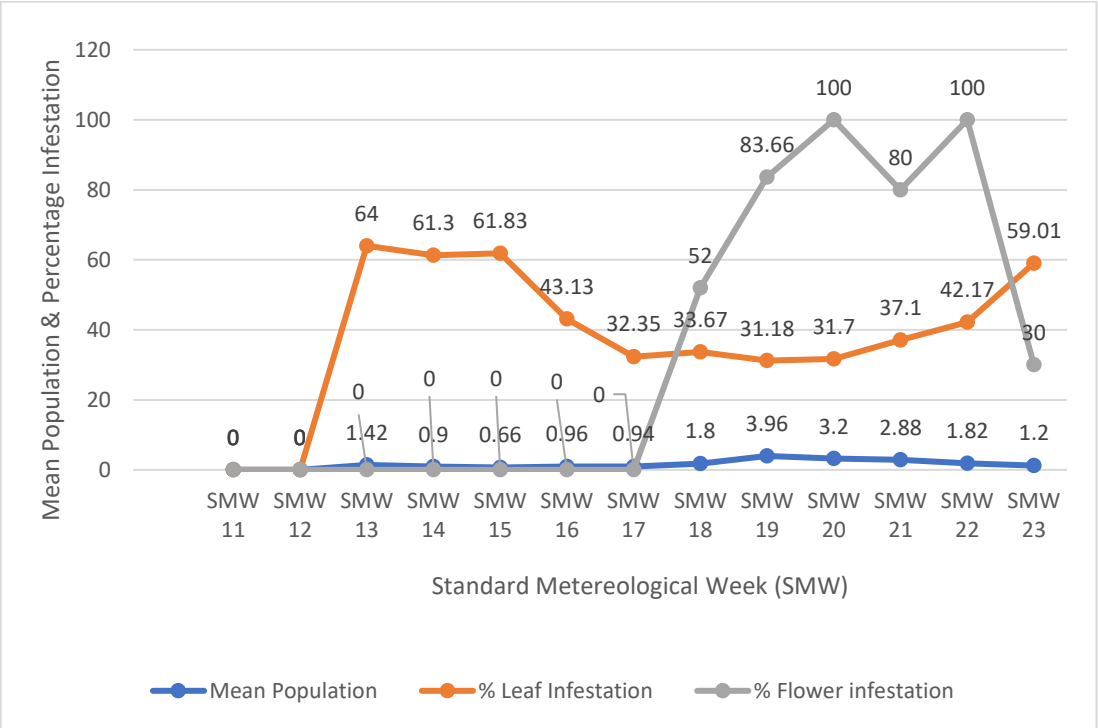

Fig. c: Mean population, Percentage Leaf and Percentage Flower Infestation of Adult Red pumpkin beetle (*Aulocophora foveicollis* Lucas) during the period of March 2024 to June 2024.

Fig. d. *Aulocophora foveicollis* Lucas feeding on Pumpkin leaves.

Fig. e. *Aulocophora foveicollis* Lucas feeding on Pumpkin flower.

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DOI: XYZ

Fig. f. Pumpkin crop heavily infested by *Aulocophora foveicollis* Lucas.

CONCLUSION

This study highlights the influence of meteorological factors on the incidence of red pumpkin beetle (*Aulocophora foveicollis* Lucas) and its infestation range on pumpkin crops, which is one of the primary vegetable crops cultivated in Tamil Nadu. From the results it is evident that the abiotic factors like temperature, relative humidity and pressure are one of the key factors affecting the pest population dynamics. These understandings are essential for developing effective pest management strategies. Integrating meteorological data into pest control strategies help cultivators to anticipate and mitigate pest outbreaks, ensuring better crop protection and yield. Future research should continue to explore these relationships across different geographical and climatic conditions.

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