Seasonal Incidence of Major Pests of Ash Gourd, *Benincasa hispida* Thunb. in Relation to Weather Parameters

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Received:- 10 October 2024/ Revised:- 17 October 2024/ Accepted:- 22 October 2024/ Published: 31-10-2024

Abstract— *Studies on seasonal occurrence of major pests of ash gourd, Benincasa hispida Thunb. revealed that the incidence of Liriomyza trifolii Burgess and aphid, Myzus persicae Sulzer were highest during first week of October 2018 (SW 40) and first week of February 2019 (SW 05) respectively. Red pumpkin beetle, Aulacophora foveicollis Lucas and Pumpkin caterpillar, Diaphania indica Saunders were highest during second week of October 2018 (SW 41). The correlation and regression analyses showed that weather parameters significantly influenced the incidence of M. persicae, L. trifolli, A. foveicollis and D. indica as 38.34, 23.50, 19.88 and 31.23 per cent of total variation, respectively.*

Keywords— Ash Gourd, Correlation, Insect Pests, Seasonal Incidence, Weather Parameters.

I. INTRODUCTION

Ash gourd, *Benincasa hispida* Thunb is one of the most important vegetable crops, being cultivated throughout the humid tropical and sub tropical regions. It is also known as tallow gourd, Chinese preserving melon, Chinese water melon, white gourd and wax gourd which is originated in the Asian subtropics. Ash gourd is mainly grown in India, China, Malaysia, Bangladesh, Indonesia, Philippines, Taiwan and the Caribbean Islands for vegetable and medicinal purposes. The immature fruits are used as vegetable and mature fruits are used for preparing candy, sweets and also some ayurvedic medicines (Tindall, 1986).

Ash gourd is attacked by wide range of insect pests *viz.*, aphids, *Aphis gossypii* Glover and *Myzus persicae* Sulzer (Aphididae: Hemiptera), whitefly, *Bemisia tabaci* Gennadius (Aleyrodidae: Hemiptera), leafhopper, *Amrasca devastans* Distant (Cicadellidae: Hemiptera), thrips, *Scirtothrips dorsalis* Hood (Thripidae: Thysanoptera), Serpentine leaf miner, *Liriomyzat rifolii* Burgess (Agromyzidae: Diptera), Pumpkin caterpillar, *Diaphania indica* Saunders (Crambidae: Lepidoptera), Red pumpkin beetle, *Aulacophora foveicollis* Lucas (Chrysomelidae: Coleoptera) and Melon fruit fly, *Bactrocera cucurbitae* Coquillett (Tephritidae: Diptera) (Atwal, 1993; Dhillon *et al.* 2005; Tamilnayagan *et al.* 2017a and Tamilnayagan *et al.* 2017b).

Incidence of insects can change over time due to varied reasons including macroclimatic and microclimatic changes and variation in the availability of food resources (Wolda, 1988). The present study is undertaken to study the seasonal incidence of major pests of ash gourd, *B. hispida* which in turns helps in developing timely management practices.

II. MATERIALS AND METHODS

Studies on the seasonal incidence of major pests of ash gourd were carried out under field conditions at Department of Agricultural Entomology, Agricultural College and Research Institute, Killikulam, Thoothukudi district, Tamil Nadu, India during August 2018 to August 2019. Ash gourd seeds (F_1 hybrid MAH 1) were sown at 10 days interval in micro plots. The incidence of major pests *viz.*, aphid (*M. persicae*), serpentine leaf miner (*L. trifolii*), red pumpkin beetle (*A. foveicollis*) and pumpkin caterpillar (*D. indica*) was recorded at weekly intervals during August 2018 to August 2019 on five randomly selected plants and correlated with weather parameters. The data on weather parameters *viz*., maximum and minimum temperature (°C),

relative humidity (%), sunshine hours, total rainfall (mm) and wind velocity (km per hour) during the study period was obtained from the Meteorological Observatory of Agricultural College and Research Institute, Killikulam.

III. RESULTS

3.1 Incidence of major pests of ash gourd:

3.1.1 Aphids, *M. persicae:*

The incidence of *M. persicae* ranged from 0.00 to 8.20 aphids per plant during the entire study period. During the standard weeks (SW) 35, 37, 40, 42, 43, 44 of 2018 and 16, 29, 30, 31, 32, 33, 34 of 2019 there was no incidence of *M. persicae* and the highest incidence (8.20 aphids per plant) was recorded during first week of February 2019 (SW 05) (Fig. 1).

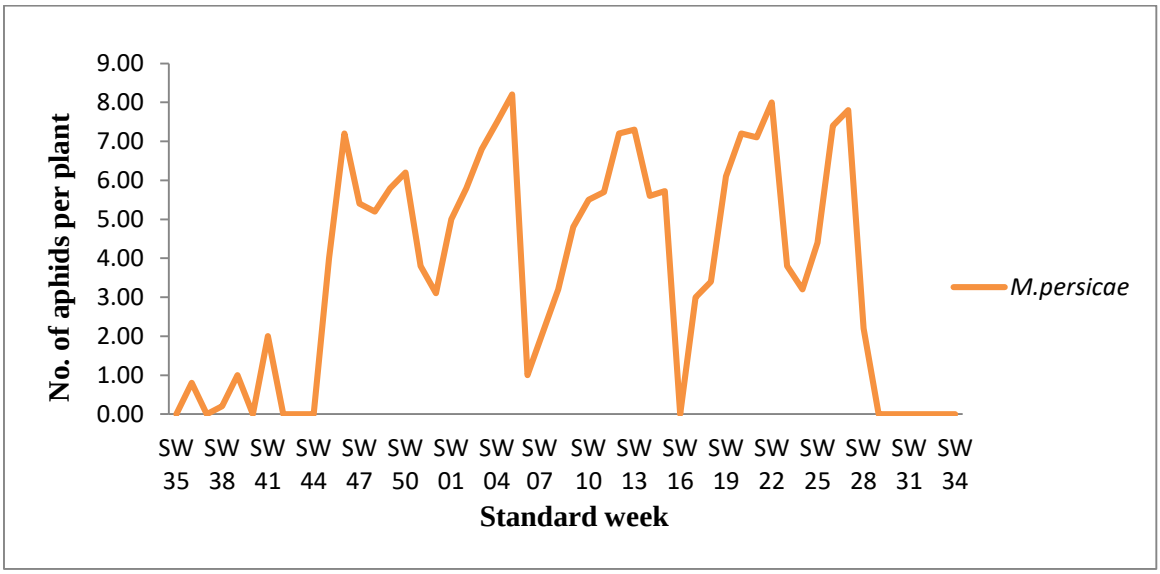

FIGURE 1: Seasonal incidence of *M. persicae* during August 2018 - August 2019

3.1.2 Serpentine leaf miner, *L. trifolii*

The per cent leaf damage of serpentine leaf miner, *L. trifolii* ranged from 3.08 to 24.30 per cent per plant during the entire study period. The incidence of *L. trifolii* was highest (24.30 per cent leaf damage) during first week of October 2018 (SW 40) and minimum (3.08 per cent) during first week of November 2018 (SW 44) (Fig. 2).

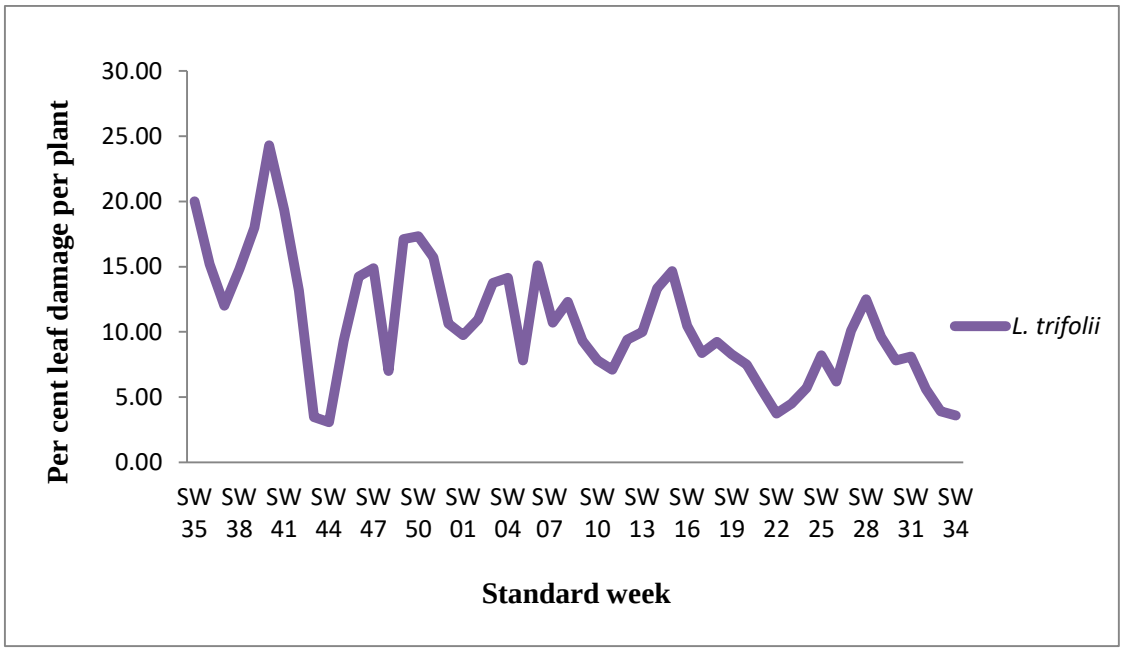

FIGURE 2: Seasonal incidence of *L. trifolii* during August 2018 - August 2019

3.1.3 Red Pumpkin beetle, *A. foveicollis:*

The incidence of *A. foveicollis* ranged from 0.00 to 1.40 beetles per plant during the entire study period and the highest incidence (1.40 beetles per plant) was recorded during second week of October 2018 (SW 41). There was no incidence of *A. foveicollis* during the standard weeks 37, 38, 42, 43, 44, 45, 46 of 2018 and 10 to 25 and 28, 31 of 2019 (Fig. 3).

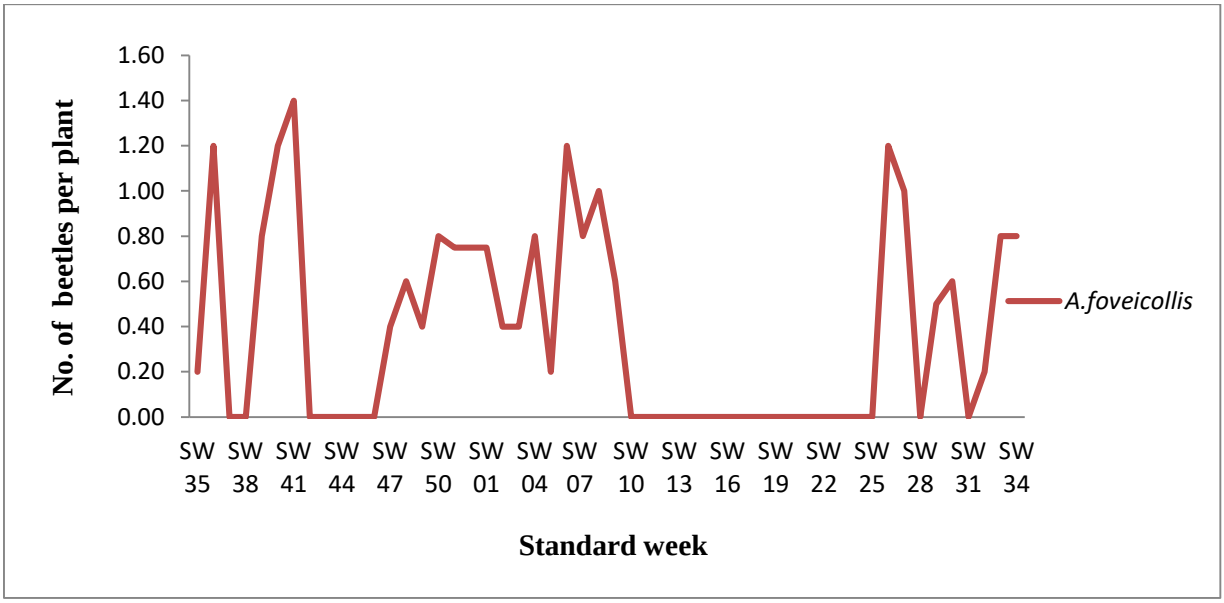

FIGURE 3: Seasonal incidence of *A. foveicollis* during August 2018 - August 2019

3.1.4 Pumpkin caterpillar, *D. indica*:

The incidence of *D. indica* ranged from 0.00 to 1.80 larvae per plant during the entire study period. The highest population of *D. indica* (1.80 larvae per plant) was recorded during second week of October 2018 (SW 41) and no incidence was recorded in the standard weeks 35, 36, 39, 40, 44, 46, 47 of 2018 and 05, 06 and 10 to 31 of 2019 (Fig 4).

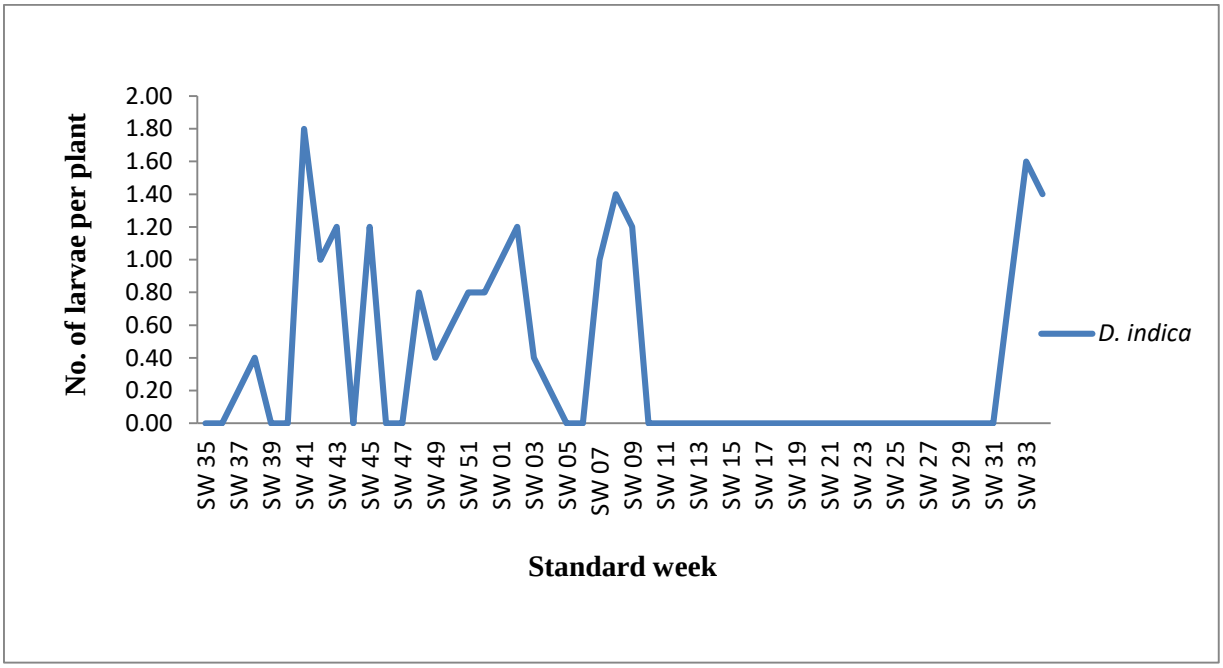

FIGURE 4: Seasonal incidence of *D. indica* during August 2018 - August 2019

3.2 Correlation and regression between incidence of major pests of ash gourd and weather parameters:

Seasonal incidence of major pests of ash gourd during August 2018 - August 2019 was correlated with the weather parameters through simple correlation, simple and multiple regression analyses.

3.2.1 Simple correlation studies on major pests of ash gourd:

3.2.1.1 Aphids, *M. persicae:*

The incidence of *M. persicae* was significantly and positively correlated with the sunshine (r= 0.447**) whereas, rainfall (r= -0.437**) had significant negative correlation. However, the correlation of maximum temperature (r= 0.130), minimum temperature (r= -0.115), relative humidity (r= -0.110) and wind velocity (r= -0.009) was non-significant with the incidence of *M. persicae* (Table 1).

3.2.1.2 Serpentine leaf miner, *L. trifolii:*

The relative humidity (r= 0.408**) had significant positive correlation with the incidence of *L. trifolii* whereas, maximum temperature (r= -0.355**) and minimum temperature (r= -0.422**) had significant negative correlation. However, rainfall (r= 0.099), sun shine (r= -0.179) and wind velocity (r= -0.271) had non-significant correlation with the incidence of *L. trifolii* (Table 1).

TABLE 1
CORRELATION ANALYSIS BETWEEN WEATHER PARAMETERS ON SEASONAL INCIDENCE OF MAJOR PESTS OF ASH GOURD DURING 2018-2019

Variables	*Myzus persicae*	*Liriomyza trifolii*	*Aulacophora foveicollis*	*Diaphania indica*
Maximum temperature (T_{max}) (^{o}C)	0.13	-0.355**	-0.335*	-0.509**
Minimum temperature (T_{min}) (^{o}C)	-0.115	-0.422**	-0.227	-0.393**
Relative humidity (%)	-0.11	0.408**	0.159	0.157
Rainfall (mm)	-0.437**	0.099	0.011	0.16
Sun shine (hours)	0.447**	-0.179	-0.131	-0.249
Wind velocity (km/hr)	-0.009	-0.271	0.17	-0.007

**** Correlation coefficient significant at 1% level***
*****Correlation coefficient significant at 5% level***

3.2.1.3 Red Pumpkin beetle, *A. foveicollis*:

The maximum temperature (r= -0.335*) had significant negative correlation with the incidence of *A. foveicollis* whereas, minimum temperature (r= -0.227), relative humidity (r= 0.159), rainfall (r= 0.011), sun shine (r= -0.131) and wind velocity (r= 0.170) had non-significant correlation (Table 1).

3.2.1.4 Pumpkin caterpillar, *D. indica:*

The incidence of *D. indica* had significant negative correlation with the maximum temperature (r= -0.509**) and minimum temperature (r= -0.393**) whereas, the correlation with relative humidity (r= 0.157), rainfall (r= 0.160), sun shine (r= -0.249) and wind velocity (r= -0.007) were non-significant (Table 1).

3.2.2 Simple linear regression studies on major pests of ash gourd:

3.2.2.1 Aphids, *M. persicae*:

The influence of different weather parameters on the incidence of *M. persicae* has been worked out with simple linear regression analysis (Table 2) and the equations are presented below:

Y_1= -0.670+0.122 X_1 which indicate that for every unit increase in maximum temperature *M. persicae* incidence increased by 0.122.

Y_1= 6.048-0.104 X_2 which indicate that for every unit increase in minimum temperature *M. persicae* incidence decreased by 0.104.

Y_1= 6.966-0.046 X_3 which indicate that for every unit increase in relative humidity *M. persicae* incidence decreased by 0.046.

Y_1= 4.176-0.074 X_4 which indicate that for every unit increase in rainfall *M. persicae* incidence decreased by 0.074.

Y_1= -0.922+0.666 X_5 which indicate that for every unit increase in sun shine *M. persicae* incidence increased by 0.666.

Y_1= 3.736-0.014 X_6 which indicate that for every unit increase in wind velocity *M. persicae* incidence decreased by 0.014.

TABLE 2

SIMPLE REGRESSION ANALYSIS ON THE INCIDENCE OF MAJOR PESTS OF ASH GOURD DURING 2018-2019

Variables	*Myzus persicae* (Y_1)		*Liriomyza trifolii* (Y_2)		*Aulacophora foveicollis* (Y_3)		*Diaphania indica* (Y_4)	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Maximum temperature (T_{max}) (^oC) (X_1)	-0.67	0.122	30.05	-0.549	2.081	-0.048	3.535	-0.089
Minimum temperature (T_{min}) (^oC) (X_2)	6.048	-0.104	25.094	-0.626	1.099	-0.031	1.9	-0.066
Relative humidity (%) (X_3)	6.966	-0.046	-9.545	0.285	-0.349	-0.01	-0.514	0.012
Rainfall (mm) (X_4)	4.176	-0.074	10.47	0.027	0.377	0	0.333	0.005
Sun shine (hours) (X_5)	-0.922	0.666	13.679	-0.439	0.585	-0.029	0.85	-0.069
Wind velocity (km/hr) (X_6)	3.736	-0.014	14.663	-0.679	0.147	0.039	0.384	-0.002

a = Intercept and b = Slope

3.2.2.2 Serpentine leaf miner, *L. trifolii*:

The influence of different weather parameters on the incidence of *L. trifolii* has been worked out with simple linear regression analysis and the equations are presented below.

Y_2= 30.050-0.549 X_1 which indicate that for every unit increase in maximum temperature *L. trifolii* incidence decreased by 0.549.

Y_2= 25.094-0.626 X_2 which indicate that for every unit increase in minimum temperature *L. trifolii* incidence decreased by 0.626.

Y_2= -9.545+0.285 X_3 which indicate that for every unit increase in relative humidity *L. trifolii* incidence increased by 0.285.

Y_2= 10.470+0.027 X_4 which indicate that for every unit increase in rainfall *L. trifolii*incidence increased by 0.027.

Y_2= 13.679-0.439 X_5 which indicate that for every unit increase in sun shine *L. trifolii* incidence decreased by 0.439.

Y_2= 14.663-0.679 X_6 which indicate that for every unit increase in wind velocity *L. trifolii* incidence decreased by 0.679.

3.2.2.3 Red Pumpkin beetle, *A. foveicollis*:

The influence of different weather parameters on the incidence of *A. foveicollis* has been worked out with simple linear regression analysis and the equations are presented below.

Y_3= 2.081-0.048 X_1 which indicate that for every unit increase in maximum temperature *A. foveicollis* incidence decreased by 0.048.

Y_3= 1.099 -0.031 X_2 which indicate that for every unit increase in minimum temperature *A. foveicollis* incidence decreased by 0.031.

Y_3= -0.349-0.010 X_3 which indicate that for every unit increase in relative humidity *A. foveicollis* incidence decreased by 0.010.

Y_3= 0.377+0.000 X_4 which indicate that for every unit increase in rainfall *A. foveicollis* incidence increased by 0.000.

Y_3= 0.585-0.029 X_5 which indicate that for every unit increase in sun shine *A. foveicollis* incidence decreased by 0.029.

Y_3= 0.147+0.039 X_6 which indicate that for every unit increase in wind velocity *A. foveicollis* incidence decreased by 0.039.

3.2.2.4 Pumpkin caterpillar, *D. indica*:

The influence of different weather parameters on the incidence of *D. indica* has been worked out with simple linear regression analysis and the equations are presented below.

Y_4= 3.535-0.089 X_1 which indicate that for every unit increase in maximum temperature *D. indica* incidence decreased by 0.089.

Y_4= 1.900-0.066 X_2 which indicate that for every unit increase in minimum temperature *D. indica* incidence decreased by 0.066.

Y_4= -0.514+0.012 X_3 which indicate that for every unit increase in relative humidity *D. indica* incidence increased by 0.012.

Y_4= 0.333+0.005 X_4 which indicate that for every unit increase in rainfall *D. indica* incidence increased by 0.005.

Y_4= 0.850-0.069 X_5 which indicate that for every unit increase in sun shine *D. indica* incidence decreased by 0.069.

Y_4= 0.384-0.002 X_6 which indicate that for every unit increase in wind velocity *D. indica* incidence decreased by 0.002.

3.2.3 Multiple regression studies on major pests of ash gourd:

The multiple regression coefficients for different weather parameters and incidence of *M. persicae*, *L. trifolii*, *A. foveicollis* and *D. indica* were worked out and presented in Table 3. The results showed that the incidence of *M. persicae*, *L. trifolii*, *A. foveicollis* and *D. indica* on ash gourd was significantly influenced by the weather during the study period.

TABLE 3

MULTIPLE REGRESSION ANALYSIS ON THE INCIDENCE OF MAJOR PESTS OF ASH GOURD DURING 2018-2019

Variables	*Myzus persicae*	*Liriomyza trifolii*	*Aulacophora foveicollis*	*Diaphania indica*
	(Y_1)	**(Y_2)**	**(Y_3)**	**(Y_4)**
Maximum temperature (T_{max}) (^oC) (X_1)	-0.098	-0.026	-0.084	-0.123*
Minimum temperature (T_{min}) (^oC) (X_2)	-0.121	-0.396	0.034	-0.001
Relative humidity (%)(X_3)	0.027	0.165	0.012	-0.024
Rainfall (mm) (X_4)	-0.067**	-0.031	-0.001	0.002
Sun shine (hours) (X_5)	0.714**	0.074	0.003	0.012
Wind velocity (km/hr) (X_6)	-0.392	-0.333	0.063	-0.001
Coefficient of determination (R^2)	0.383	0.235	0.198	0.312

***Regression coefficient significant at 5% level*

**Regression coefficient significant at 1% level*

3.2.3.1 Aphids, *M. persicae:*

The multiple regression equation fitted with weather parameters in order to predict *M. persicae* incidence on ash gourd is furnished below.

Y_1= 5.829 – 0.098 $\mathbf{X_1}$ – 0.121 $\mathbf{X_2}$+ 0.027 $\mathbf{X_3}$ – 0.067 $\mathbf{X_4}$ + 0.714 $\mathbf{X_5}$ – 0.392 $\mathbf{X_6}$ with coefficient of determination (R^2 = 0.383).

The present investigations showed that the weather parameters contributed for 38.34 per cent of total variation in the incidence of *M. persicae* on ash gourd during August 2018 - August 2019.

3.2.3.2 Serpentine leaf miner, *L. trifolii*:

The multiple regression equation fitted with weather parameters in order to predict *L. trifolii* incidence on ash gourd is furnished below.

$Y_2 = 10.717 - 0.026\ \mathbf{X_1} - 0.396\ \mathbf{X_2} + 0.165\ \mathbf{X_3} - 0.031\ \mathbf{X_4} + 0.074\ \mathbf{X_5} - 0.333\ \mathbf{X_6}$ with coefficient of determination ($R^2 = 0.235$).

The present investigations showed that the weather parameters contributed for 23.50 per cent of total variation in the incidence of *L. trifolii* on ash gourd during August 2018 - August 2019.

3.2.3.3 Red Pumpkin beetle, *A. foveicollis*:

The multiple regression equation fitted with weather parameters in order to predict *A. foveicollis* incidence on ash gourd is furnished below.

$Y_3 = 1.100 - 0.084\ \mathbf{X_1} + 0.034\ \mathbf{X_2} + 0.012\ \mathbf{X_3} - 0.001\ \mathbf{X_4} + 0.031\ \mathbf{X_5} + 0.063\ \mathbf{X_6}$ with coefficient of determination ($R^2 = 0.198$).

The present investigations showed that the weather parameters contributed for 19.88 percent of total variation in the incidence of *A. foveicollis* on ash gourd during August 2018 - August 2019.

3.2.3.4 Pumpkin caterpillar, *D. indica*:

The multiple regression equation fitted with weather parameters in order to predict *D. indica* incidence on ash gourd is furnished below.

$Y_4 = 6.398 - 0.123\ \mathbf{X_1} - 0.001\ \mathbf{X_2} - 0.024\ \mathbf{X_3} + 0.002\ \mathbf{X_4} + 0.012\ \mathbf{X_5} - 0.000\ \mathbf{X_6}$ with coefficient of determination ($R^2 = 0.312$).

The present investigations showed that the weather parameters contributed for 31.23 per cent of total variation in the incidence of *D. indica* on ash gourd during August 2018 - August 2019.

Where:

Y_1 = *M. persicae* incidence	X_1 = Maximum temperature
Y_2 = *L. trifolii*incidence	X_2 = Minimum temperature
Y_3 = *A. foveicollis*incidence	X_3 = Relative humidity
Y_4 = *D. indica*incidence	X_4 = Rainfall
R^2 = Coefficient of determination	X_5 = Sun shine
	X_6 = Wind velocity

IV. DISCUSSION

The incidence of *M. persicae* was highest during the first week of February 2019 in the Standard Week 05 and it had significant positive correlation with the sunshine and significant negative correlation with the rainfall. These results are in line with the Tamilnayagan *et al.* (2017a) who also stated that sunshine had a positive correlation with the incidence of *M. persicae.*

The highest per cent leaf damage of *L. trifolii* was recorded during first week of October 2018 (SW 40) and it was positively correlated with the relative humidity and negatively correlated with the maximum and minimum temperature. Chaudhari and Senapati (2004) also reported that relative humidity had positive correlation with the *L. trifolii.*

The population of *A. foveicollis* was higher (1.40 beetles per plant) during second week of October 2018 (SW 41) and it had significant negative correlation with the maximum temperature in accordance with Boopathi *et al.* (2017) and Kumar and Saini (2018) who also recorded the highest population of *A. foveicollis* during October 2012, 2013 and 2014.

The incidence of *D. indica* was also higher (1.80 larvae per plant) during second week of October 2018 (SW 41) and it was negatively correlated with the maximum and minimum temperature in accordance with the Barma and Jha (2014) who reported that maximum and minimum temperature had significant negative correlation with the population of *D. indica*.

V. CONCLUSION

The results of the study indicate that the incidence of *L. trifolii* and *M. persicae* were highest during SW 40 and SW 05, respectively and the incidence of *A. foveicollis* and *D. indica* were highest during SW 41. The correlation and regression analyses showed that the weather parameters significantly influenced the incidence of insect pests. The findings of the study can be helpful for the timely management of insect pests of ash gourd.

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