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EFFECTS OF WEATHER ON THE ABUNDANCE AND INFESTATION OF MAJOR INSECT PESTS OF SWEET GOURD IN GAZIPUR

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Abstract: The study was to assess the infestation of red pumpkin beetle, epilachna beetle and fruit fly on 12 germplasm of sweet gourd *Cucurbita moschata*. The study also investigated the effect of weather parameters on the abundance of the insects. Red pumpkin beetle, epilachna beetle and fruit fly showed the highest level of infestation during 3rd week of December, 3rd week of January and 4th week of February, respectively. All the insects revealed the lowest level of infestation on BD274 and BD277 germplasm. Relative humidity had insignificant positive correlation with all the insects. Red pumpkin beetle showed significant positive correlation with temperature. Epilachna beetle exerted significant positive correlation with rainfall. The weather parameters jointly contributed 35.2% abundance of red pumpkin beetle and temperature individually depicted the highest effect (18.9%). Rainfall revealed the highest contribution (44.4%) on the abundance of epilachna beetle and the combined effect of the weather parameters was 66.5%. Temperature, relative humidity and rainfall showed 43.2% contribution on fruit fly abundance and the individual effect of relative humidity was the highest (27.0%).

***Key words*:** *Cucurbita moschata,* fruit fly, epilachna beetle, red pumpkin beetle, meteorological factors

INTRODUCTION

Sweet gourd *Cucurbita moschata* Duch is one of the most popular vegetables among the 118 genera and 825 species of the family Cucurbitaceae (Rai and Kumar 2008). The immature fruit is consumed as a vegetable, while the mature fruit is used for the purpose of making curry, confectionery and beverage.

The fruit contains carbohydrates, vitamins and minerals with higher amount of β-carotene (Yadav *et al.* 2010). Incidence of red pumpkin beetle, fruit fly and epilachna beetle is the major constraint of cucurbits like sweet gourd (Asafuddaullah *et al*. 2015).

Red pumpkin beetle *Aulacophora foveicollis* Lucas is responsible to cause foliage damage to the crop starting from seedling to harvest of the crop (Rahman

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2013). Its infestation may cause 75.0% losses at seedling stage (Kamal *et al*. 2014). Epilachna beetle *Epilachna dodecastigma* Fabricius causes damage to the Solanaceous and Cucurbitaceous crops and damage may reach up to 80.0% of the host plants depending on location and season (Asafuddaullah *et al*. 2015). Fruit flies *Bactrocera cucurbitae* Coquillett attacks the fruits of crop and the extent of losses caused by them varied from 30.0 to 100.0% depending on cucurbit species and season (Gazmer *et al.* 2017).

Meteorological parameters exerted significant influences on the growth and development of the pest population which ultimately results in differential levels of infestation. Bhowmik and Saha (2017) found that rainfall had non-significant negative correlation with the abundance of red pumpkin beetle. Ghule *et al.* (2015) reported that rainfall positively influenced the population of fruit fly infesting ridge gourd. Maximum temperature had negative correlation whereas evening relative humidity had positive correlation with fruit flies infestation (Shinde *et al.* 2018). The incidence of epilachna beetle showed negative correlation with maximum relative humidity but expressed insignificant positive correlation with minimum relative humidity (Haseeb *et al*. 2009). Thus the population of insect pest is directly associated with the weather factors. Different germplasm of a crop show varied responses in their growth, development and characteristics in relation to weather conditions which lead to different levels of infestation by the insect pests. Considering the above points, the objectives of the current study were to find out the relationship of the abundance of red pumpkin beetle, epilachna beetle and fruit fly with different weather parameters, and to assess the varying infestation level of the insectson 12 germplasm of sweet gourd.

MATERIAL AND METHODS

The study was conducted during November, 2018 to March, 2019 in the field of the Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur, Bangladesh. The site is located at 25°25′ North latitude and 89°5′ East longitude.

The seeds of 12 sweet gourd germplasm, namely BARI Mistikumra1, BARI Mistikumra 2, BD 264, BD 265, BD 266, BD 268, BD 269, BD 274, BD 275, BD 277, Gazipur local line and China line were collected from Bangladesh Agricultural Research Institute, local market of Gazipur and Department of Entomology, BSMRAU, and sown in polybags on November 14, 2018 to raise seedlings.

The germplasm were cultivated in the experimental field following randomized complete block design with three replications having plot size 4.0 m × 3.0 m. The spacing between block to block and plot to plot was 1.0 m in both cases. Seedlings were transplanted to the field on December 4, 2018. All the intercultural operations except insect pest management were done whenever necessary and fertilizers were applied according to Fertilizer Recommendation Guide (FRG, 2018).

Systemic sampling following five replications was employed to collect data. Observations were made at weekly interval to count the total number of leaf and number of infested leaf (by red pumpkin beetle and epilachna beetle), and total number of fruit and number of infested fruit by fruit fly. Numbers of leaf and fruit infested data were converted into per cent level of infestation. Daily mean temperature, relative humidity and rainfall data were collected from the weather station of BSMRAU.

Correlation coefficients and Multiple Linear Regression Models were used to determine the relationship and contribution of weather parameters to the abundance of the insects. All the analyses were performed using IBM SPSS 21.0.

RESULTS AND DISCUSSION

The relationship between weather parameters and the abundance of the studied insects is presented in Table 1. Temperature had significant negative and rainfall had insignificant negative correlation, whereas relative humidity had insignificant positive correlation with the abundance of red pumpkin beetle ($F_{1,14}$ = 6.0, $p < 0.05$, $F_{1,14}$ = 1.7, $p = 0.216$, $F_{1,14}$ = 1.1, $p = 0.308$, respectively). The present findings showed agreement with Bhowmik and Saha (2017) who reported non-significant negative correlation between rainfall and the abundance of red pumpkin beetle. The abundance of epilachna beetle was positively correlated with weather parameters and among the parameters only rainfall showed significant result (Temperature: $F_{1,10}$ = 1.3, $p = 0.280$, relative hiumidity: $F_{1,10}$ = 1.6, $p = 0.243$, rainfall: $F_{1,10}$ = 12.4, $p < 0.001$, respectively). Kalaiyarasi *et al.* (2017) observed positive correlation between temperature and population of epilachna beetle. Fruit fly showed insignificant negative correlation with temperature ($F_{1,7}$ = 0.8, $p = 0.403$), insignificant positive correlation with relative humidity ($F_{1,7}$ = 1.0, $p = 0.372$) and rainfall ($F_{1,7}$ = 3.6, $p = 0.100$). Shinde *et al.* (2018) reported negative correlation of the infestation of fruit fly with temperature and relative humidity ($r = -0.189$ and -0.356). Rainfall had significant positive correlation with the abundance of adult fruit fly (Ghule *et al.* 2015).

Table 1. Correlation coefficients (r values) of the abundance of red pumpkin beetle, epilachna beetle and fruit fly with weather parameters

Abundance of adults	Temperature (°C)	Relative humidity (%)	Rainfall (mm)
Red pumpkin beetle	−0.546*	0.272 NS	−0.327 NS
Epilachna beetle	0.340 NS	0.372 NS	0.744**
Fruit fly	−0.319 NS	0.339 NS	0.583 NS

NS - Non-significant ($p \geq 0.05$), *Significant ($p < 0.05$), **Highly significant ($p < 0.01$).

Red pumpkin beetle exerted varied level of leaf infestation among the tested germplasm during the study. Per cent leaf infestation was the maximum during the early periods and declined with the advent of plant growth. The highest mean infestation of the germplasm was observed during 3rd week of December. Among the germplasm, BD 274 and BD 277 depicted the lowest level of infestation (8.5 and 9.7%, respectively). Rahaman and Prodhan (2007) found 35.0 to 75.0% infestation at the seedling stage. In the present study, population decreased from 4th week of January at the flowering stage of the plant (Fig.1).

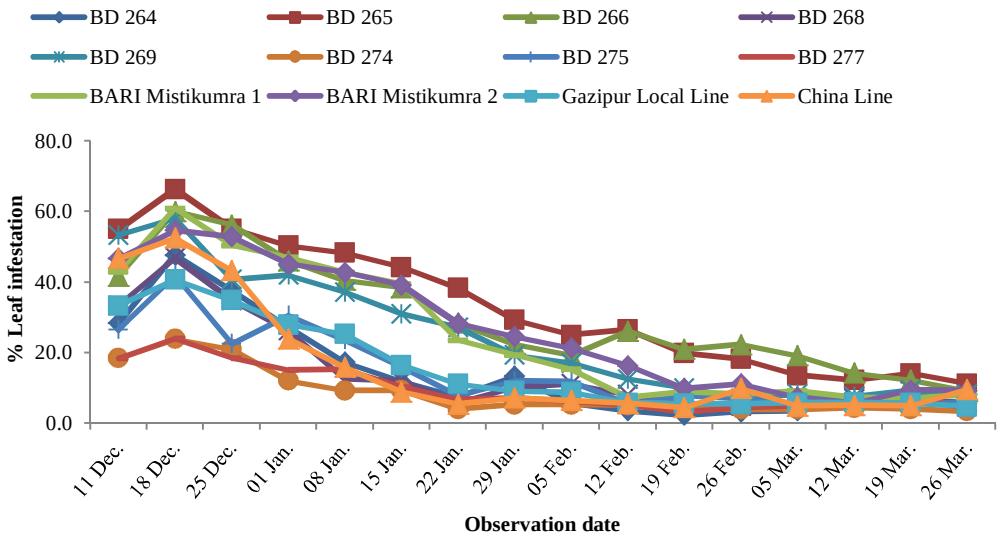

Fig. 1. Infestation level of red pumpkin beetle on leaf of 12 sweet gourd germplasm during December, 2018 to March, 2019.

The temperature individually contributed 18.9% abundance on red pumpkin beetle. Temperature along with relative humidity revealed 22.7% contribution where individual contribution of relative humidity was 3.8%. The individual contribution of rainfall was 12.5% and the combined effect of temperature, relative humidity and rainfall was 35.2%. None of the results were statistically significant (Table 2).

Table 2. Multiple regression models along with coefficients of determination (R^2) regarding the effect of weather parameters on the abundance of red pumpkin beetle during December, 2018 to March, 2019

Regression equation	R^2	100 R^2	Role of individual factor (%)	F statistic F and p value
$Y = 2.671 - 0.067\ X_1$	0.189	18.9	18.9	$F_{1,14} = 3.3$, $p = 0.092$
$Y = 1.571 - 0.066X_1 + 0.013X_2$	0.227	22.7	3.8	$F_{2,13} = 1.9$, $p = 0.187$
$Y = 0.802 - 0.062X_1 + 0.021X_2 - 0.029X_3$	0.352	35.2	12.5	$F_{3,13} = 2.2$, $p = 0.145$

Y - red pumpkin beetle/3 leaves; X_1 - temperature (°C); X_2 - relative humidity (%); X_3 - rainfall (mm).

Epilachna beetle showed infestation from 2nd week of January to 4th week of March. The beetle exerted the highest level of mean infestation of the germplasm during 3rd week of January. Among the germplasm, BD 277 had the lowest level of infestation (3.3%) (Fig. 2). Uikey *et al*. (2016) reported that the epilachna beetle started infestation on bottle gourd from 2nd week of February and reached to the peak (14.92%) in the 3rd week of March.

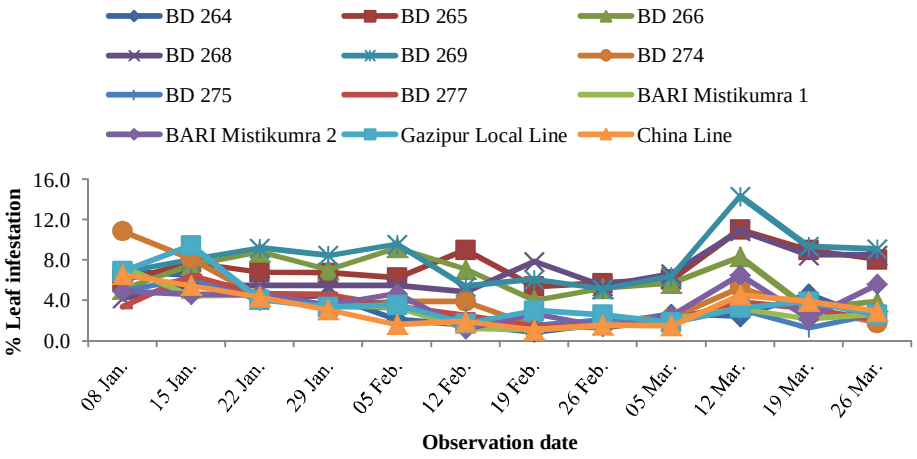

Fig. 2. Infestation level of epilachna beetle on leaf of 12 sweet gourd germplasm during December, 2018 to March, 2019.

The individual effect of temperature on the abundance of epilachna beetle was 11.6% (Table 3). Temperature and relative humidity together showed 21.9% effect and relative humidity individually contributed 10.3%. All the weather parameters jointly showed 66.3% contribution, and rainfall had the highest (44.4%) contribution which was statistically significant.

Fruit fly revealed infestation from 5th week of January to 4th week of March and showed fluctuations among the germplasm. Infestation level increased with the advent of time and the highest mean infestation was recorded during 4th

week of February (Fig. 3). Among the germplasm, BD 274 and BD 277 depicted the lowest level of infestation (19.7 and 19.3%, respectively). The result of the present study is in accordance with Gazmer *et al.* (2017) who reported the higher level of infestation (20.0 to 61.0%) at maturity stage.

Table 3. Multiple regression models along with coefficients of determination (R^2) regarding the effect of weather parameters on the abundance of epilachna beetle during December, 2018 to March, 2019

Regression equation	R^2	100 R^2	Role of individual factor (%)	F statistic F and p value
$Y = 1.104 + 0.044X_1$	0.116	11.6	11.6	$F_{1,10} = 1.3$, $p = 0.280$
$Y = -0.366 + 0.037X_1 + 0.018X_2$	0.219	21.9	10.3	$F_{2,9} = 1.3$, $p = 0.329$
$Y = 0.868 + 0.042X_1 + 0.001X_2 + 0.047X_3$	0.663	66.3	44.4	$F_{3,8} = 5.3$, $p < 0.05$

Y - epilachna beetle/3 leaves, X_1 - temperature (°C), X_2 - relative humidity (%), X_3 - rainfall (mm).

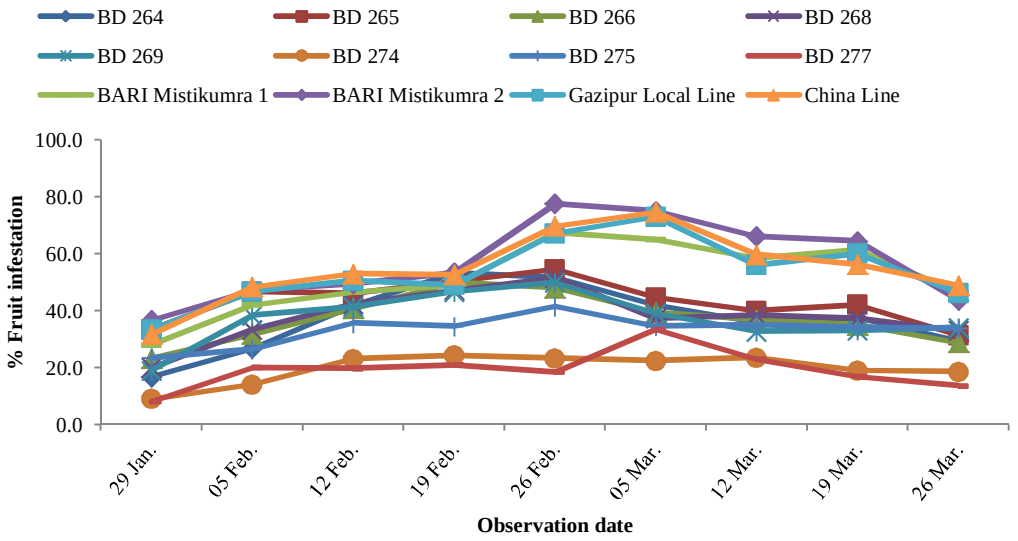

Fig. 3. Infestation level of cucurbit fruit fly on fruit of 12 sweet gourd germplasm during December, 2018 to March, 2019.

Table 4. Multiple regression models along with coefficients of determination (R^2) regarding the effect of weather parameters on the abundance of fruit fly during December, 2018 to March, 2019

Regression equation	R^2	100 R^2	Role of individual factor (%)	F statistic F and p value
$Y = 3.142 - 0.056X_1$	0.102	10.2	10.2	$F_{1,7} = 0.8$, $p = 0.402$
$Y = 0.764 - 0.099X_1 + 0.040X_2$	0.372	37.2	27.0	$F_{2,6} = 1.8$, $p = 0.247$
$Y = 1.542 - 0.069X_1 + 0.022X_2 + 0.026X_3$	0.432	43.2	6.0	$F_{3,5} = 1.3$, $p = 0.379$

Y - fruit fly/plant, X_1 - temperature (°C), X_2 - relative humidity (%), X_3 - rainfall (mm).

The effect of temperature and relative humidity on fruit fly abundance was 10.2 and 27.0%, respectively. The joint effect of temperature and relative humidity was 37.2%. Temperature, relative humidity and rainfall showed 43.2% contribution and the individual effect of rainfall was 6.0% on the abundance of fruit (Table 4).

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