RESEARCH ARTICLE

# SEASONAL DYNAMICS OF INSECT PESTS AND NATURAL ENEMIES IN RELATION TO METEOROLOGICAL PARAMETERS ON MUSTARD

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**Abstract:** The present experiment was conducted at Research cum Instructional Farm at Sant Vinoba Bhave College of Agriculture and Research Station, Marra, Patan, Durg, (CG) Indira Gandhi Krishi Vishwavidyalya, Raipur, Chhattisgarh during *rabi* season 2020-21 entitled with "Seasonal dynamics of insect pests and natural enemies in relation to meteorological parameters on mustards" Results of the present investigation showed that, population of aphids attained its peak in 3rd SMW (143.86/ 10 cm apical twig) which was favoured by min. temp. of 11.7°C and max. temp. of 30.0°C with morning 83 % and evening 24 % humidity along with no rainfall. Flea beetle was recorded attained its peak level of 11.5 beetle/plant in 3rd week of January (3rd SMW). The painted bug was observed 3nd week of December and saw fly was recorded from second week December and reached its peak activity 2.5 bug/plant in the 4th week of January (4th SMW) and 1.02 adult per plant in 3rd week of January (3rd SMW). The populations of diamond back moth and leaf webber were commenced on the both insect on crop in the 2nd week of December (50th SMW) and reached to its peak 1.03 larvae per plant in 2nd week of January (2nd SMW) and 4.1 adult /plant in 3rd week of January (3rd SMW). The correlation studies indicated that mustard aphid and flea beetle was negatively correlated with sunshine hours and relative humidity (morning and evening) but only mustard aphid was significantly negative correlation with morning relative humidity. They were positively correlated with maximum temperature and rainfall while minimum temperature was positively correlated with mustard aphid and negatively correlated with flea beetle.

**Keywords:** Mustard aphid, Flea beetle, Painted bug, Sawfly, *C. sexmaculata,* Meteorological parameters

## INTRODUCTION

Oil crops play the most important role in India's agriculture economy. Mustard, *Brassica juncea* L. is one of the earliest domesticated oil crops among all plants in cruciferous family and grows in the *Rabi* season. The name 'mustard' is derived from the Latin word 'Mustum' or must of old wine mixed with crushed seed makes it one of the most important spices in the world (Hemingway, 1976)

Globally, mustard is mainly cultivated in India, Canada, China, Pakistan, Poland, Bangladesh, Sweden and France. About 33.8 percent of the total cultivated area of world is in India with 16 per cent shares in production.

Rapeseed & mustard (*Brassica spp*.) crop in India are grown in diverse agro-climatic conditions ranging from northeast and northwest hilly areas to south, under irrigated and rainfed timely sowing and late sowing, saline soil and as a mixed-cropping, In india, mustard is cultivated in 6.23 million hectares area with a production of 9.34 million tonnes and productivity of 1494 kg $ha^{-1}$ during 2018-19 (Anonymous, 2019).

In Chhattisgarh, Mustard is cultivated over 41.43 thousand hectares area with a production of 18.35 thousand tonnes and productivity of 443 kg $ha^{-1}$ (Anonymous, 2017-18). It is grown in Durg district over an area of about 0.98 thousand hectares with the production of 0.36 thousand tonnes and productivity of 367 kg $ha^{-1}$ (Anonymous, 2017-18)

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Main reason behind the less productivity in Chhattisgarh and especially in district Durg, is infestation of insect pests. More than 43 species of insect pests have been reported to infest mustard crop in India, (Singh *et al*., 2009). Based on their economic importance, the insect pests of mustard crops can be divided into the following key pest: aphid, *Lipaphis erysimi* (Kaltenbach), major pests: sawfly, *Athalia lugens proxima* (Klug), painted bug, *Bagrada cruciferarum* Kirkaldy and leaf miner, *Chromatomyia horticola* Goureau, minor pests: bihar hairy caterpillar, *Spilosoma obliqua* Walker, cabbage butterfly, *Pieris brassicae* Linnaeus, flea beetle, *Phyllotreta Cruciferae* Goeze and green aphid, *Myzus persicae* Sulzer, new pests: leaf webber, *Crocidolomia binotalis* Zeller, borer, *Hellula undalis* Fabricius and whitefly, *Bemisia tabaci* Gennadius (Pal *et al*., 2020).

Mustard aphid a potentially serious key pest of mustard crop has still been taking away of heavy loss of production (Bakhetia and Sidhu, 1983).

Abiotic factors play key role in the influence of aphid infestation due to large variation in the date of aphid infestation and its multiplication. Under suitable climatic conditions, mustard aphids spread very rapidly and cross ETL boundary and reach EIL, frequently, due to grower need to repeatedly use insecticides. Several studies have been carried out to develop correlations between weather parameters and aphid population. They reported that the peak of aphid populations on *B. juncea* varied from end of

January to first week of March. Based on a simple linear regression analysis between the aphid population and the corresponding weather for 3 years (Bishnoi *et al*.,1992).

## MATERIALS AND METHODS

A field experiment was conducted at research station Marra, Patan, (C.G.) during *Rabi* season, 2020-21. *Brassica juncea* cultivar " PM-25" was sown on 10 November with row to row and plant to plant distance as 30 cm and 10 cm respectively. This experiment was conducted in a randomized block design with three replication. The crop was raised after following standard agronomical practices in large plot for recording observations of insect pests and its natural enemies, whole plot was divided into five equal plots The plots were kept free from any insecticidal spray throughout the crop period. The observations recorded at weekly interval soon after their appearance during crop season till harvesting of the crop.

**1. Aphid, *Lipaphis erysimi* (Kalt.)**

Five plants were selected randomly and tagged with label for recording the observation of aphid population at weekly intervals and note the first appearance of aphid on plants from each plot. As the aphid first appeared, the population was recorded from central apical twigs (10 cm). The aphid populations were recorded till the maturity of crop.

**2**. Similarly, to assess the population of **flea beetle, painted bugs, mustard sawfly, diamondback moth, leaf webber as well as natural enemies *viz*., *Cheilomenes sexmaculata*** were recorded at weekly intervals from randomly selected five plants from each plot. Five plots were examined for each observation thus, total twenty five plants were observed to record the population of all insect (Table 01).

**Table 1.** Mode of observation for insect-pests and predators

| S. No. | Insects- pests | Mode of observation |
|---|---|---|
| 1 | Mustard aphid | No. of aphids/10cm apical twig on 5 plants/plot |
| 2 | Flea beetle | No. of beetles/5 plants/ plot |
| 3 | Painted bug | No. of bugs (nymph+ Adults)/5 plants/ plot. |
| 4 | Saw fly | No. of grubs/5 plants/ plot |
| 5 | Diamond back moth | No. of larvae and adult/5 plants/plot |
| 6 | Leaf webber | No. of larvae and adult/5 plants/plot |
| **Natural enemies (Predator)** | | |
| 7 | *Cheilomenes sexmaculata* | No. of grubs and adults/10 plants/ plot |

## RESULT AND DISCUSSION

Insect- pests succession, natural enemies and weather parameters on mustard crop depicted in table 2. and table 3.

**1. Aphid, *Lipaphis erysimi* (Kalt.)**

The data (table 2) revealed that the first appearance of the mustard aphid insect-pest incidence was recorded from the last week of November ($48^{th}$ SMW) with (1.21 aphid per ten cm apical twig/plant) during 2020-21. Its multiplication varies from 1.21 to 143.86 aphid per ten cm apical twig/plant. The nymph and adult population of aphids were found maximum with 143.86 aphid per ten cm apical twig/plant in $3^{rd}$ week of January ($3^{rd}$ SMW) gradually the populations were decline and reach up to 98.43 aphid per ten cm apical twig/plant in last week ($5^{th}$ SMW) of January 2021. Further, the aphid population seems to be declining in subsequent weeks as the crop moved towards maturity. Sahito *et al*., (2010) also found the appearance of aphid from $2^{nd}$ week of November to till harvest of the crop. At initial stage low population was recorded. Thereafter, population increased slowly, gradually and reached its maximum in $2^{nd}$ week of December. Similar results were also reported by the earlier other workers Mandawi *et al*. (2017) and Pradhan *et al*. (2020).

**2. Flea beetle, *Phyllotreta striolata* (Fabricus)**

The (table 2) first appearance of incidence of flea beetle per plant recorded at weekly intervals during rabi 2020-21 on the mustard crop revealed that the population of flea beetle started from last week of November ($48^{th}$ SMW) with 1.2 beetle per plant and continue till $5^{th}$ week of January, 2021 ($5^{th}$ SMW). Flea beetle population ranged from 1.2 to 11.5 beetle per plant and peak during in the $3^{rd}$ week of January ($3^{rd}$ SMW) afterwards the population showed declined trend up to the end of the crop season with the minimum beetle population of 7.3 per plant on last week of January 2021 ($5^{th}$ SMW). Similar results are reported from the earlier workers Sandhya (1995), Ansari *et al*. (2007), Choudhury and Pal (2009) and Pradhan *et al*. (2019).

**3. Painted bug, *Bagrada hilaris* (Kirkaldy)**

The (table 2) painted bug, *Bagrada hilaris* population ranged from 0.19 - 2.5 bugs per plant. Its population was first observed from last week of December ($52^{nd}$ SMW) with 0.19 bugs per plant. Thereafter, slowly increased in population and reached to peak of 2.5 bugs per plant in $4^{th}$ week of

January (4th SMW). Thereafter the population gradually decreased up to 5th week of January.

**4. Saw fly, *Athalia lugens proxima* (Klug)**

The (table 2**)** pest saw fly, did not appeared from last week of November to 2nd week of December. First appearance of incidence of saw fly, *Athalia proxima* occurred from 3rd week of December (51st SMW) to 4th week of January (4th SMW) with the population range from 0.12 to 0.67 larvae per plant, respectively. The larvae incidence slowly increased and reached to peak 1.02 larvae per plant in the 3rd week of January (3rd SMW). Thereafter, larval population showed decreasing trend and showed minimum 0.67 larvae per plant in the 4th week of January, 2021 (4th SMW).

**5. Diamondback moth, *Plutella xylostella* (Linnaeus)**

The (table 2) diamondback moth, *Plutella xylostella* population ranged from 0.10 to 1.03 per plant during 2020-21. Diamondback moth was first appeared in second week of December (50th SMW) with 0.10 larvae per plant. Thereafter, slowly increased in population and reached to maximum of 1.03 adult per plant in first week of January (2nd SMW). Further, the population gradually decreased up to 0.19 adult per plant in forth week of January in (4th SMW) and became 0.00 in the fifth week of January (5th SMW)

**6. Leaf webber**, ***Crocidolomia binotalis* (Zeller)**

The leaf webber, *Crocidolomia binotalis* population ranged from 0.24 to 4.1 per plant during 2020-21 and it was first appeared in second week of December (50th SMW) with 0.24 larvae per plant. Thereafter, slowly increased in population and reached to maximum of 4.1 bug per plant in 3rd week of January (3rd SMW).

**7. Natural enemies, *Cheilomenes sexmaculata***

The first appearance of lady bird beetle, *Cheilomenes sexmaculata* occurred from 3rd week of December (51st SMW) and continue till 5th week of January (5th SMW) and its population ranged from 0.12 to 1.29 per plant and attained highest level of lady bird beetle population (1.29 beetle per plant) in 2nd week of January (3rd SMW). Thereafter, the number of lady bird beetle gradually decreased up to 5th week of January (5th SMW) with 0.65 lady bird beetle per plant.

**Correlation studies between insect pests of mustard with weather parameters.**

**1. Aphid population and meteorological parameters**

The correlation between aphid population and meteorological parameters are presented in **Table 3.** The aphid population exhibit positive correlation with maximum temperature (r = 0.394), minimum temperature (r = 0.078) and rainfall (r = 0.194) while negative relationship with evening relative humidity (r = -0.388) and sunshine hrs. (r = -0.293). But all the correlations were non-significant except the correlation of morning relative humidity with negative significant (r = -0.645*). Ishwarbhai (2015) and Kashyap *et al*. (2018) were also reported aphid population exhibited positive correlation with maximum and minimum temperature and negative correlation with evening relative humidity and rainfall.

The regression equation between aphid and morning relative humidity (**Y** = -9.809x + 889.2, $\mathbf{R^2}$ = 0.401) shows that for every unit increase in relative humidity, the infestation level decrease by 9.809. (table 4) (fig. 1)

**2. Flea beetle population and meteorological parameter**

The correlation between painted bug and meteorological parameters are presented in Table 3. The population of flea beetle exhibit positive non-significant correlation with maximum temperature (r = 0.283) and rainfall (r = 0.011), whereas, minimum temperature (r = -0.100) morning relative humidity (r = -0.331), evening relative humidity (r = -0.479) and sunshine hrs. (r = -0.412) showed non-significantly negative correlation. Kashyap *et al*. (2018) and Pradhan *et al*. (2019) were also reported the flea beetle population exhibit positive correlation with maximum and minimum temperature and negative correlation with morning and evening RH.

**3. Painted bug population and meteorological parameter**

The correlation between painted bug and meteorological parameter are presented in Table 3. The weather parameters, maximum temperature (r = 0.431), minimum temperature (r = 0.084) and rainfall (r = 0.201) were positively non-significant and morning relative humidity (r = -0.653*) negatively significant correlated with the population of painted bug. Whereas, evening relative humidity (r = -0.207) and sunshine (r = -0.233) were negatively and non-significantly correlated with painted bug population. . Nagar (2011) were reported the painted bug population showed positive correlation with maximum and negatively and non-significantly correlated with RH. Divya *et al*. (2015) also reported that the painted bug population showed positive correlation with maximum and minimum temperature and negative correlation with evening RH, support the present findings.

The regression equation between painted bug and morning relative humidity (**Y** = -0.164x + 14.50, $\mathbf{R^2}$ = 0.426) shows that for every unit increases in relative humidity, the infestation level decreases by 0.164. (table 4) (fig. 2)

**4. Saw fly population and meteorological parameter**

The correlation between painted bug and meteorological parameters are presented in Table 3. The weather parameters, maximum temperature (r = 0.536), minimum temperature (r = 0.232) were positively and non-significantly correlated with saw fly population. Whereas, morning relative humidity (r = -0.476), evening relative humidity (r = -0.205),

rainfall (r = -0.302) and sunshine hrs. (r = -0.368) showed negative non-significant correlation. Patel and Patel (1997), Kashyap *et al*. (2018) and Pradhan *et al*. (2019) also reported the saw fly population showed positive correlation with maximum and minimum temperature and negative correlation with evening RH and sunshine hrs. support the present findings.

**5. Diamondback moth population and meteorological parameter**

The correlation between diamond back moth and meteorological parameters are presented in Table 3. Simple correlation worked out between diamond back moth and weather parameters on mustard crop. The result revealed that there was positive non-significant correlation with maximum temperature (r = 0.210) and minimum temperature (r = 0.113) and negative non-significant correlation with morning relative humidity (r = -0.170), evening relative humidity (r = -0.326), rainfall (r = -0.352) and sunshine hrs. (r = -0.451), respectively.

**6. Leaf webber**, ***Crocidolomia binotalis*** **and meteorological parameter**

The correlation between Leaf webber, *Crocidolomia binotalis* and meteorological parameters are presented in Table 3. The meteorological parameters *viz;* maximum temperature (r = 0.406), minimum temperature (r = 0.049) and rainfall (r = 0.124) were positive and non-significant correlation. Whereas, morning relative humidity (r = -0.619), and evening RH (r = -0.349) and sunshine hrs. (r = -0.225) had negative and non-significant correlation with *Crocidolomia binotalis* population.

**7. Ladybird beetle, *C. sexmaculata* population and meteorological parameters**

The correlation between population of *Cheilomenes sexmaculata* and weather parameters are presented in Table 3. The meteorological parameters *viz;* maximum temperature (r = 0.407), minimum temperature (r = 0.112) and rainfall (r = 0.077) had positive non-significant correlation with *C. sexmaculata*. Whereas, morning relative humidity (r = -0.601), evening relative humidity (r = -0.385) and sunshine hrs. (r = -0.316) had negative non-significant correlation with the population of *C. sexmaculata*.

## CONCLUSION

Aphid was observed to be the most dangerous and significant pest of all mustard pests. The aphid population incidence occurred between November and February, while the plant was in the vegetative, flowering, and podding stages.

Aphid population activity peaked between the 2nd and 4th SMW (Standard meteorological weeks).

Flea beetle population activity peaked between the 52nd and 4th SMW (Standard meteorological weeks).

The aphid population had a positive correlation with maximum temperature (r = 0.394), minimum temperature (r = 0.078), and rainfall (r = 0.194), but a negative relationship with evening RH (r = -0.388) and sunshine (hrs) (r = -0.293) whereas, negative significant correlation with morning RH (r = -0.645*).

**Table 2.** Meteorological parameters and seasonal incidence of insect pest of mustard and their natural enemies during *Rabi*, 2020-21

| SMW | Meteorological parameters | | | | | | Insect pest of mustard | | | | | | Natural enemies |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tem. ($^0$C) | | R.H. (%) | | Rainfall (m.m) | Sunshine (hrs.) | Aphid | Flea beetle | Painted bug | Sawfly | DBM* | Leaf webber | *C. sexmaculata* |
| | Max. | Min. | Mor. | Eve. | | | | | | | | | |
| 48 | 28.6 | 14.7 | 81 | 35 | 0.0 | 6.2 | 1.21 | 1.2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 49 | 30.7 | 11.9 | 89 | 33 | 0.0 | 7.3 | 4.23 | 3.7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 50 | 30.2 | 15.8 | 86 | 37 | 0.0 | 3.7 | 9.04 | 4.6 | 0.00 | 0.00 | 0.10 | 0.24 | 0.00 |
| 51 | 27.7 | 10.3 | 87 | 27 | 0.0 | 5.0 | 15.32 | 6.9 | 0.00 | 0.12 | 0.39 | 0.45 | 0.12 |
| 52 | 28.4 | 10.3 | 87 | 28 | 0.0 | 4.8 | 48.29 | 8.1 | 0.19 | 0.20 | 0.67 | 0.91 | 0.38 |
| 01 | 29.7 | 13.8 | 85 | 32 | 0.0 | 3.2 | 89.52 | 8.7 | 0.72 | 0.51 | 0.89 | 1.4 | 0.87 |
| 02 | 31.2 | 16.3 | 78 | 30 | 0.0 | 3.9 | 127.65 | 10.3 | 1.2 | 0.79 | 1.03 | 2.7 | 1.13 |
| 03 | 30.0 | 11.7 | 83 | 24 | 0.0 | 6.1 | 143.86 | 11.5 | 1.9 | 1.02 | 0.83 | 4.1 | 1.29 |
| 04 | 31.0 | 14.2 | 80 | 36 | 0.0 | 3.3 | 129.76 | 9.7 | 2.5 | 0.67 | 0.19 | 3.7 | 0.96 |
| 05 | 28.2 | 10.3 | 81 | 23 | 4.6 | 6.8 | 98.43 | 7.3 | 1.3 | 0.00 | 0.00 | 2.1 | 0.65 |

DBM* Diamond back moth

**Table 3.** Correlation between insect pest infesting on mustard and weather parameter during *Rabi*, 2020-21.

| Insect pest and natural enemies | Weather parameter | | | | | |
|---|---|---|---|---|---|---|
| | Temprature ($^0$C) | | R.H. (%) | | Rainfall (mm) | Sunshine(hrs) |
| | Max. | Min. | Mor. | Eve. | | |
| Aphid | 0.394 | 0.078 | -0.645* | -0.388 | 0.194 | -0.293 |
| Flea beetle | 0.283 | -0.100 | -0.331 | -0.479 | 0.011 | -0.412 |
| Painted bug | 0.431 | 0.084 | -0.653* | -0.207 | 0.201 | -0.233 |
| Saw fly | 0.536 | 0.232 | -0.476 | -0.205 | -0.302 | -0.368 |
| Diamond back moth | 0.210 | 0.113 | -0.170 | -0.326 | -0.352 | -0.451 |
| Leaf webber | 0.406 | 0.049 | -0.619 | -0.349 | 0.124 | -0.225 |
| *C.sexmaculata* | 0.407 | 0.112 | -0.601 | -0.385 | 0.077 | -0.316 |

*Significant at 5% level of significance

**Table 4.** Correlation (r) and regression (bxy) coefficient between meteorological parameters and population of insect pest of mustard, *Rabi*, 2020-21

| Meteorological parameter | Aphid | | Painted bug | |
|---|---|---|---|---|
| | r | $b_{yx}$ | r | $b_{yx}$ |
| **Morning RH** | -0.645* | -9.8 | -0.653* | **-0.16** |
| **Except all population of insect pest of mustard and meteorological parameters non- significant** | | | | |

*Significant at 5% level of significance

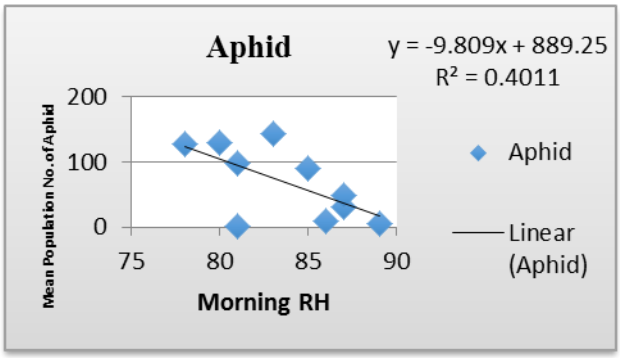


**Fig.1:** Correlation (r) and regression (bxy) coefficient between morning RH and Aphid population of mustard, *Rabi*, 2020-21

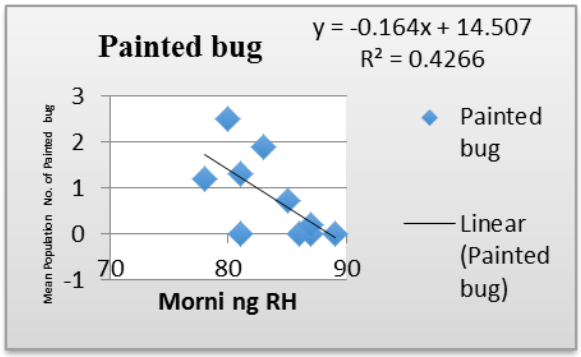


**Fig.2:** Correlation (r) and regression (bxy) coefficient between morning RH and Painted bug population of mustard, *Rabi*, 2020-21

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