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Vijay Kumar

Assistant Professor, Department of Agriculture, Shivalik Institute of Professional Studies, Dehradun, Uttarakhand, India

Pankaj Kumar

Assistant Professor, Department of Entomology, A.N.D.U.A.&T. Kumarganj, Ayodhya, Uttar Pradesh, India

Umesh Chandra

Assistant Professor, Department of Entomology, A.N.D.U.A.&T. Kumarganj, Ayodhya, Uttar Pradesh, India

Pradij Kumar Patel

Research Scholar, Department of Entomology, A.N.D.U.A.&T. Kumarganj, Ayodhya, Uttar Pradesh, India

Prerna Bhargav

Assistant Professor, Department of Agriculture, Shivalik Institute of Professional Studies, Dehradun, Uttarakhand, India

Seasonal incidence of insect pest on Indian mustard

Vijay Kumar, Pankaj Kumar, Umesh Chandra, Pradij Kumar Patel and Prerna Bhargav

Abstract

Indian mustard is also known as *Brassica juncea* is a versatile, widely cultivated plant species in the Brassicaceae family, native to South Asia. The major insect pests of Indian mustard cause severe damage to the crop. The study was conducted to investigation of seasonal incidence of major insect pests of Indian mustard. The field experiment was carried out in winter season (2017-18) at the SIF farm of the Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya Uttar Pradesh, India. The results showed that the infestation of major insect pests of Indian mustard was higher during the first week of January and lowest first week of March. The results showed that the correlation coefficient between the occurrences of major insect-pests (biotic) with abiotic factors.

Keywords: Indian mustard, seasonal incidence, major pests and abiotic factors

Introduction

India was the 4th largest importing country in 2020-21 and its share in global production of mustard oil in 2021-22 was around 12 percent (Anonymous, 2021) [1]. In Uttar Pradesh the crop was grown on 1262.3 ha with production of 1224 kg/ha. In 2021-22 and productivity of 1331 kg/ha (FAO, 2020). Brassica crops suffer heavy loss in yield due to various biotic and abiotic factors. Among abiotic factors, its environmental sensitivity is considered to be for most i.e. instability of mustard plant under different environmental conditions. Among the biotic constraints the insect pests have the most detrimental effects on the yield of rapeseed-mustard. The total number of insect reported upto 24. A wide gap exists between the potential yield and the yield realized at the farmer's field, which is largely because of number of biotic and abiotic stresses to which the rapeseed-mustard crop is exposed. It has been reported that 15 species of insect-pests cause damage to mustard viz., mustard aphid (*Lipaphis erysimi* Kalt), mustard saw fly (*Athaliaugen sproxima* Klug.), painted bug (*Bargrada cruciferum* Kirk), leaf minor (*Phytomya horticola* Gour.), bihar hairy caterpillar (*Spilarctia (Spilosoma) oblique* Walker), peach aphid (*Myzus persicae* Sulzer), cabbage aphid (*Brevicorynae brassicae* Linn.), cotton aphid (*Aphis gossypii* Walker), cabbage butterfly (*Pieris brassicae* Linn.), diamond back moth (*Plutela xylostella* Linn.), white fly (*Bemisia tabaci* Genn.), cut worm (*Agrotis segatum* Dennis & Schiff) and stem fly (*Melana gromyza cleome* Spencer) are the pests of major importance. Among them mustard aphid (*Lipaphis erysimi* Kalt), Aphididae: Homoptera, is one of the most destructive insect, which is responsible for causing severe reduction in grain yield varying from 15.0 to 73.3%. Therefore it becomes necessary to study the subject to view the seasonal incidence of insect-pests on Indian mustard crops and find out correlation between occurrence of insect-pests on Indian mustard crops & weather factors.

Research Methodology

Indian mustard crop was regularly monitored for occurrence of major insect-pests from germination to pre-harvest stage of the crop at three farmers' field. The occurrence of insect-pests was recorded on ten randomly selected plants from each field. The mode of observations adopted for different insects - pests and natural enemies has been given below.

Corresponding Author:

Vijay Kumar

Assistant Professor, Department of Agriculture, Shivalik Institute of Professional Studies, Dehradun, Uttarakhand, India

Mode of observation for insect- pests and predators

S. No.	Insects- pests	Mode of observation
1	Mustard sawfly	No. of grubs/10 plants/ plot
2	Mustard aphid	No. of aphids/10 cm central twig on 10 plants/plot
3	Painted bug	No. of bugs (nymph+ Adults)/10 plants/ plot.
4	Cabbage butter fly	No. of caterpillar on 10 randomly selected plants/ plot
Natural enemies (Predator)		
5	<i>Coccinellaspp.</i>	No. of grubs and adults/10 plants/ plot

Correlation between populations of major insect-pests in relation to weather factors.

The meteorological data during *Rabi*, 2018-19 was obtained from the Department of Agro-meteorology of the University. The incidence of insect-pests was related with weather conditions prevalent during crop season. The correlation between damaged leaves due to aphid and abiotic factors viz. minimum temperature, maximum temperature, relative humidity and rainfall were worked out by using following formula:

$$r = \frac{\sum dn \cdot dy}{N^n \sqrt{\frac{\sum d^2 xi}{N} \times \frac{\sum d^2 y}{N}}}$$

r = Correlation on coefficient

y = Damaged leaves

x_i = Weather parameters

n = No. of observations

∑ = Summation

Observations recorded

Aphid populations were observed on 10 cm central twig on 5 randomly selected plants /plot at weekly interval starting with flower initiation till pre harvest of the crop in terms of number.

Findings

The results obtained from different studies have been presented under different sections as follows:

The occurrence of major insect-pests of Indian mustard

The weekly observation on major insect-pests of mustard starting from germination to harvest showed that only four insect- pests viz., mustard sawfly (*Athalia lugens proxima* Klug), mustard aphid (*Lipaphis erysimi* Kalt.), painted bug (*Bagrada hilaris* Kirk.), and Cabbage butterfly (*Pieris brassicae* Linn.) caused damage to mustard in this area. One natural enemies the *Coccinella spp.* has also been recorded during the crop period occurrence these insect-pests fluctuated and natural enemies under varying weather conditions. The data recorded on population of these insect-pests during experimental period was analyzed statistically and depicted here as under:

Mustard sawfly

The data presented in (Table-1) revealed that the mustard sawfly appeared at an early stage of crop 46th (SW) to 52th (SW). The initial population of (0.67 grubs/ plant) was recorded during 46th (SW) 2nd week of 2018 which increased to 1.13 grubs/plant during 47th (SW) when minimum temperature 12.7 °C, maximum temperature 28.7 °C, RH 68.3% and rainfall 0.00 mm was recorded. The maximum population of 8.90 grubs/plants was recorded during 49th

(SW) with minimum temperature 11.0 °C, maximum 26.8 °C, RH 70.7%, rainfall 0.00 mm and sunshine 6.7 hours their after, the population of mustard sawfly declined and it was not observed from standard week of 2019 till the harvest of the crop.

Mustard aphid

The incidence of mustard aphid recorded at weekly interval during crop season, revealed that the insect appeared at early stage 49th (SW) of 2018 which continued up to 9th (SW) of 2019 with varying population of ranging from 8.90 to 88.09 aphids/10 cm central twig/plant. The peak population of this insect was observed during 5th (SW) of 2019 at minimum temperature 10.6 °C, maximum 21.1 °C, RH 74.9%, rainfall 0.00 mm and sunshine 4.2 hours minimum population of 0.85 aphids /10 cm central twig /plant was recorded during 9th (SW) with minimum temperature 11.2 °C, maximum temperature 25.3°C, relative humidity 72.7% and sunshine hours 6.9. (Table-1).

Painted bug

The occurrence of painted bug population was stated from 46th (SW) of 2018 and remind up to 1st (SW) of 2019. The bug population ranged from 0.87-8.76 bugs/plant. The peak population was observed during 51th (SW) of 2018 at minimum temperature 7.5°C, maximum temperature 24.2°C, relative humidity 69.0% and sunshine hours 6.1. However, 0.95 bugs/ plant minimum population was recorded during 1st (SW) of 2019 (Table-1).

Cabbage butter fly

The appearance of cabbage butter fly started from 5th (SW) of 2019 and continued up to 9th (SW) of with population varying from 0.65 to 5.89 larvae/caterpillar /plant during different (SW). The maximum population of 5.89 caterpillar/plant during 8th (SW) of 2019. where at minimum temperature 10.5 °C, maximum temperature 21.8 °C, relative humidity 69.1%, rainfall 0.00 mm and sunshine hours 3.6. The minimum population of cabbage butter fly (0.65 caterpillar/plant) record during 5th (SW) of 2019 at minimum temperature 11.2 °C, maximum temperature of 25.3 °C, relative humidity 72.7 and sunshine hours 6.9.(Table-1)

Natural enemy (*Coccinella spp.*)

The incidence of lady bird beetle *Coccinella* species was recorded from 52th (SW) of 2018 to 9th (SW) of 2019. The *Coccinella spp.* population ranged from 0.40 to 12.76 during whole observations period. The population of the predator was initially low (0.40 grubs & adults/ plant) during 52th (SW) of 2018 and maximum population of 12.76 grubs & adults/plant recorded during 7th (SW). There after the population decreased and fell up to 0.98 grubs & adults/plant during 9th (SW) of 2019. (Table-1)

Table 1: Occurrence of major insect-pests of Indian mustard along with weather parameter during *Rabi*, 2018-19.

Calendar Week	Standard Week	Sawfly (No. of grubs/plant)	Mustard aphid (No. of aphids/10 cm central twig/ plant)	Painted bug (No. of bugs/plant)	Cabbage butter fly (No. of caterpillar/ plant)	<i>Coccinella</i> spp. (No. of grubs & adults /plant)	Temperature (°C)		Rainfall (mm)	RH (%)	Sunshine (hrs.)
							Min.	Max.			
10/11/2018	45	0.00	0.00	0.00	0.00	0.00	15.5	31.8	0	69.6	8.7
17/11/2018	46	0.67	0.00	0.00	0.00	0.00	12.7	28.7	0	68.3	7.4
24/11/2018	47	1.13	0.00	0.00	0.00	0.00	13.0	28.7	0	71.2	7.2
01/12/2018	48	2.67	0.00	0.00	0.00	0.00	11.0	27.8	0	67.5	7.0
08/12/2018	49	8.90	8.90	0.00	0.00	0.00	11.0	26.8	0	70.7	6.7
15/12/2018	50	3.13	23.79	0.00	0.00	0.00	8.5	25.2	0	71.0	6.3
22/12/2018	51	0.52	35.08	0.00	0.00	0.00	7.5	24.2	0	69.0	6.1
29/12/2018	52	0.13	44.00	0.00	0.00	0.40	5.0	23.2	0	71.3	6.7
05/01/2019	1	0.00	49.50	0.00	0.00	0.87	3.5	21.1	0	70.8	6.6
12/01/2019	2	0.00	62.02	0.87	0.00	1.79	5.3	22.2	0	72.2	5.5
19/01/2019	3	0.00	68.97	1.90	0.00	2.84	5.7	21.8	0	70.5	6.0
26/01/2019	4	0.00	78.82	2.36	0.00	3.67	5.0	22.5	41	76.1	6.9
02/02/2019	5	0.00	88.09	3.33	0.65	7.89	10.6	21.1	0	74.9	4.2
09/02/2019	6	0.00	53.02	5.79	0.89	6.98	7.1	21.7	41	75.1	7.4
16/02/2019	7	0.00	53.02	8.76	2.45	12.76	8.9	22.3	0	76.6	4.3
23/02/2019	8	0.00	39.25	1.12	5.89	5.68	10.5	21.8	0	69.1	3.6
02/03/2019	9	0.00	0.85	0.95	2.54	0.98	11.2	25.3	0	72.7	6.9
09/03/2019	10	0.00	0.00	0.00	0.00	0.00	10.0	22.9	0	66.9	6.7

Correlation coefficient between the occurrences of major insect- pests (biotic) with abiotic factors:

The occurrence of major insect pests on Indian mustard correlated with abiotic factors by determining correlation coefficients. The fluctuating trend in incidence of insect pests was found mainly due to change in weather conditions describe under following heads: (Table-2).

Correlation between occurrences of mustard sawfly with abiotic factors:

The correlation coefficients determined between the incidences of mustard sawfly on Indian mustard crop with weather parameters revealed that the mustard sawfly populations build up showed non-significant positive correlation with minimum and maximum temperature and sunshine hours, rainfall. While negative correlation was found

with relative humidity during *Rabi* 2018-19 (Table-2).

Mustard aphid with abiotic factors:

The populations build up of mustard aphid showed significant negative correlation with minimum and maximum temperature and sunshine as well as positive correlation with rainfall and non-significant positive correlation with relative humidity. (Table-2)

Correlation between occurrence of painted bug and abiotic factors

The population of painted bug showed non-significant negative correlation with minimum, maximum temperature and sunshine hours. While it was showed non-significant positive correlation with rainfall and while it had significant positive correlation with relative humidity. (Table 2)

Table 2: Correlation coefficient between incidence of insect-pests and weather parameters during *Rabi*, 2018-19

S. No.	Insect- pests	Temperature (°C)		RH (%)	Rainfall(mm)	Sunshine (hrs)
		Min	Max.			
1.	Mustard Sawfly	NS (0.223)	NS (0.344)	NS (-0.158)	NS (0.186)	NS (0.135)
2.	Mustard aphid	-0.691*	-0.793*	NS (0.387)	0.660*	-0.550*
3.	Painted bug	NS (-0.161)	NS (-0.451)	0.768*	NS (0.405)	NS (-0.117)
4.	Cabbage butter fly	NS (0.158)	NS (-0.276)	NS (-0.058)	NS (0.124)	-0.614*
5.	<i>Coccinella</i> spp.	NS (-0.139)	-0.546*	NS (0.288)	0.722*	-0.648*

*Significant at 5% Level of significance

Correlation of Cabbage butterfly with weather variables:

The data presented in (Table-2) revealed that the population of cabbage butterfly showed a non-significant negative correlation with maximum temperature and relative humidity while it was non-significantly positively correlated with minimum temperature and rainfall and significantly negative with sunshine hours during *Rabi* 2018-19.

Correlation of occurrences of *Coccinella* species with weather parameters:

The populations buildup of *Coccinellids* showed non-significant negative correlation with minimum temperature while it had a non-significant positive correlation with relative humidity. These was significantly negative correlation with maximum temperature and sunshine hours and significant positive correlation with rainfall during *Rabi* 2018-19. (Table-

2)

Discussion

Seasonal incidence of major insect-pests of Indian mustard

Seasonal incidence of major insect-pests revealed the association of 5 insects in this crop of which four namely mustard sawfly, mustard aphid, painted bug and cabbage butter fly while the *Coccinellids* recorded the natural enemy during *Rabi* 2018-19. The incidence of insect-pests was observed at weekly interval on mustard starting from germination to harvesting. The mustard sawfly appeared at early stage of crop and its population ranged from 0.67 to 8.90 grubs/plant. This is in partial agreement with the findings of Jagdev Singh Kular *et al.* (2011) who recorded the highest sawfly population of 4.5 larvae/plant and lowest population

0.59 /plant this also in accordance with the findings Kuldeep Singh *et al.*, (2013) ^[13] who found that mustard sawfly attacking the rapeseed mustard crop at an early stage. The present finding is also supported by Sundar Pal *et al.* (2018) ^[11] who recorded the incidence of sawfly ranged 0.3 to 7.3 on *Brassica* oil seed crop.

Occurrence of mustard aphid was recorded 49th (SW) of 2018 which continued 9th (SW) of 2019 with varying aphid population of 8.90 to 88.09 aphids/10 cm twig/ plant. This is an accordance with findings of Srivastava *et al.* (1971) ^[16] who found the aphid appearance in 4th week of January which reached at peak level from 28 January to 4th February. This is also in partial agreement with findings of Rohit Bhati *et al.* (2015) ^[5] who recorded the appearance of aphid from 51th SW of 2013-14 with the peak population during 5th SW.

In the present studies the last aphid appearance was recorded during 9th SW of 2019. The present study is also supported by Kumar (2004) ^[8] who found the incidence of mustard aphid from the last week of December to last week of March.

The occurrence of painted bug was recorded from 46th (SW) of 2018 which continued up to 1st standard week of 2019 and its population ranged from 0.87 to 8.76 bug/plant and the peak population was observed during 51th (SW) of 2018. The present study are in an agreement with findings of Kumar (2004) ^[8] who recoded the incidence of the painted bug on *Brassica* oil seed during same period. The record of the occurrence of painted bug on rapeseed mustard crop by Jat *et al.* (2006) ^[7] during the same period is also in accordance with the present study.

The incidence of cabbage butterfly was recorded from 5th (SW) of 2018 up to 8th (SW) of 2019 and the population ranged from 0.65 to 5.89 caterpillar/plant during different standard week. The maximum population was recorded during 8th (SW) of 2019 the present findings are also accordance with the finding of S.R. Patel *et al.* (2004) and Hakim *et al.* (2016) ^[17] who found cabbage butterfly attacking the mustard crop.

The occurrence of *Coccinella* spp. the was recorded from 52th (SW) of 2018 and 7th (SW) of 2019 and the population ranged from 0.40 to 12.76 grubs/adults/plant during whole observation period. Present findings are in accordance with the findings of Sundar Pal *et al.* (2018) ^[11] who recorded the predator activities on the mustard varieties having maximum pest activities in the starting, when predator population reached the peak level the pest aphid population reduced and predator population showed positive correlation with pest population

Correlation coefficient between the occurrences of insect-pests with abiotic factors

The correlation coefficients determined between the incidence of mustard sawfly and abiotic factor revealed both positive and negative correlations. The mustard sawfly populations build up showed non-significant negative correlation with relative humidity, while positive correlation was found with minimum, maximum temperature, rainfall and sunshine hours. This is a partial agreement with findings of Ansari *et al.* (2007) ^[3] who found no significant positive correlation with any of the abiotic factors except relative humidity which showed positive correlation and negative with sawfly population build up.

This is in contrary with findings of S.K. Mishra *et al.*, (2018) ^[10] who studies on mustard sawfly population showed non-significant negative correlation with temperature, relative

humidity, sunshine hours and rainfall.

The findings observing a negative correlation the maximum and minimum temperature and relative humidity in case of aphid population build up is accordance with the present findings is also supported by M.R. Hasan *et al.*, (2009) ^[6] who found that aphid population had significant negative correlation with minimum temperature, relative humidity. However this finding of positive correlation with maximum temperature and sunshine hours. The present findings also with findings Arshad Ali *et al.*, (2012) ^[2] who found a non-significant positive correlation with maximum, relative humidity, rainfall and sunshine hours and non-significantly negative correlation with minimum temperature.

The present findings is also accordance S.K. Mishra *et al.*, (2018) ^[10] who found significantly positive correlation relative humidity, significantly negative correlation with minimum and maximum temperature.

The population of painted bug showed non-significant negative correlation with minimum, maximum temperature and sunshine hours. While it was showed non-significant positive correlation with rainfall and while it had significant positive correlation with relative humidity. (Table 2) This is also contrary with the findings of Mishra and Kanwat (2003) ^[9] who found significant negative correlation minimum and maximum temperature and significantly positive correlation with relative humidity. The present findings is also accordance of Bharat Lal *et al.*, (2018) ^[4] who found significantly and positive correlation with minimum and maximum temperature and significantly negative correlation with relative humidity.

The population of cabbage butterfly showed a non-significant negative correlation with maximum temperature, relative humidity while it had non-significant positive correlation with minimum temperature and rainfall. These was significantly negative correlation with sunshine hours. The results could not be compared with work with other scientist due to non-availability of literature.

The population's buildup of *Coccinella* spp. showed non-significant negative correlation with minimum temperature, while it had a non-significant positive correlation with relative humidity. These was significant negative correlation with maximum temperature, sunshine hours and significant positive correlation with rainfall.

The present findings in contrary with findings of Bharat Lal *et al.*, (2018) ^[4] who found that the population buildup of *Coccinella* had highly significant positive correlation with minimum and maximum temperature but significantly negative correlation with relative humidity.

Summary and Conclusion

The occurrence of mustard sawfly appear at an early stage of crop growth in 46th (SW) of 2018 and population ranged from 0.67 grubs/ plant to 8.90 grubs/plant. The minimum population was occurred during 52th standard week of 2018 where as the maximum population was record 49th standard week of 2018. The sawfly population showed non-significant negative correlation with relative humidity (-0.158) while non-significant positive correlation with minimum (0.223) and maximum (0.344) temperature, rainfall (0.186) and sunshine hours (0.135) .

The incidence of mustard aphid was first recorded during 49th standard week of 2018 which continuous up to 9th standard week of 2019 with varying population ranging from 8.90 to 88.09 aphids/10 cm central twig/plant. The minimum aphid

population was during 9th standard week of 2019 while the maximum population of aphid in 5th (SW) of 2019. The aphid population build up significantly negative correlated with minimum (-0.691) and maximum (-0.793) temperature, sunshine hours (-0.550) while it had a significant positive correlation with rainfall (0.660) and non-significant positive correlation with relative humidity (0.387).

The occurrence of painted bug population initiated during 46th standard week of 2018 and remained up to 1st standard week of 2019. The bug population ranged from 0.87-8.76 bugs/plant. The minimum population were recorded during 1st (SW) of 2019 and maximum population in 51th (SW) of 2019. The bug population build up showed non-significant negative correlation with minimum temperature (-0.026), relative humidity (-0.211) and rainfall (-0.311) and non-significant positive correlation with maximum temperature (0.205) and sunshine hours.

The incidence of cabbage butterfly made its first appearance during 5th (SW) and continued till 9th (SW) of 2019 with population varying from 0.65-5.89 caterpillar/adult/plant minimum and maximum butterfly caterpillar were recorded during 5th (SW) of 2019 and 8th (SW) of 2019 respectively. The cabbage butterfly population build up showed non-significant negative correlation with maximum temperature (-0.276), and relative humidity (-0.058) while showed non-significant positive correlation with minimum temperature (0.158) and rainfall (0.124) while it had showed significantly negative correlation with sunshine hours (-0.614).

The first appearance of *Coccinella* species was recorded during 52th (SW) of 2018 which continued up to 9th (SW) of 2019 and the population ranged from 0.40-12.76 grubs/adults/plant Minimum *Coccinellids* population was recorded during 52th (SW) of 2018 and maximum during 7th (SW) of 2019. The *Coccinellids* population build showed non-significant negative correlation with minimum temperature (-0.139) and non-significant positive correlation with relative humidity (0.288). It had showed significant negative correlation with maximum temperature (-0.546) and sunshine hours (-0.648), while it showed significant positive correlation with rainfall (0.722).

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