International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(3): 3658-3661

Received: 23-03-2018
Accepted: 28-04-2018

Bharat Lal
JNKVV, College of Agriculture, Tikamgarh, Madhya Pradesh, India

MK Nayak
JNKVV, College of Agriculture, Tikamgarh, Madhya Pradesh, India

AK Srivastava
JNKVV, College of Agriculture, Tikamgarh, Madhya Pradesh, India

DS Tomar
JNKVV, College of Agriculture, Tikamgarh, Madhya Pradesh, India

Correspondence
Bharat Lal
JNKVV, College of Agriculture, Tikamgarh, Madhya Pradesh, India

Seasonal incidence of major insect pests of mustard and their natural enemies

Bharat Lal, MK Nayak, AK Srivastava and DS Tomar

Abstract
A field experiment was conducted at research farm of College of Agriculture, Tikamgarh to assess the seasonal incidence of major insect pests of mustard crop and their natural enemies and its correlation with weather parameters. The incidence of mustard aphid, painted bug and flea beetle were started during 47th SMW and attained their peaks during 5th, 8th and 52nd SMW respectively. While the activity of *C. septumpunctata* and *D. rapae* were started from 4th SMW and reached its peak during 9th SMW respectively. Correlation studies revealed that aphid population was positive correlated with morning and evening relative humidity (r = 0.49, 0.44 respectively) and negatively correlated with maximum and minimum temperature, while significant and positive correlation was observed between population buildup of painted bug and maximum and minimum temperature (r =0.48 and 0.61). Whereas the flea beetle population exhibited significant positive correlation (r = 0.35 respectively) with maximum temperature and negatively correlated with morning and evening relative humidity to the level of significance. The correlation study between natural enemies and weather parameters revealed that the maximum temperature was significantly positive correlated (r = 0.76,) with *Coccinella* beetle population while morning and evening relative humidity were found to be negatively correlated (r = -0.92, -0.90 respectively). The *Diaeretiella rapae* population showed significant positive correlation with maximum, minimum temperature and rainfall (r = 0.42, 0.40, and 0.26 respectively), while morning and evening relative humidity were found to be negatively correlated (r = -0.11, -0.28 respectively).

Keywords: mustard aphid, painted bug, flea beetle, incidence, weather factors

Introduction
Oilseeds have been the backbone of agricultural economy of India since long. India accounts for 14.8 % of rapeseed mustard production at global level and occupies prime position in the World (Singh, 2014) [14]. Rapeseed-mustard (*Brassica spp.*) are the major *Rabi* oilseed crops, grown over an area of 6.34 million hectare with a production of 7.82 million tones and productivity of 1234 kg/ha in 2012-13 in India (Thomas *et al*., 2014) [17]. In Madhya Pradesh mustard crop is cultivated in area about 7.79 lakh ha with the production of 6.63 lakh tones and productivity of 851 Kg/ha (Anonymous, 2015) [2].

More than 43 species of insect pests have been reported to infest rapeseed-mustard crop in India, of which sawfly (*Athalia lugens proxima*), aphid (*Lipaphis erysimi*), painted bug (*Bagrada hilaris*) and leaf miner (*Phytomyza horticola*) are the important ones (Singh *et. al*. 2009) [16]. Among these, mustard aphid, *L. erysimi* (Hemiptera: Aphididae) is the major limiting factor causing up to 96 per cent yield losses and 5-6 per cent reduction in oil content (Shylesha *et al*., 2006) [13]. Both nymph and adult stages of this pest cause economic damage by sucking the cell sap from leaves, petioles, tender, stems, inflorescence and pods. Biological control provides an alternative to pesticide use in pest management. Biological control is not only effective in regulating pest populations, but is also considered as a sustainable, eco-friendly pest management tool which can improve ecological system by minimizing pesticide use. Parasitoids are fascinating insects that by eggs in or on the body of the hosts where parasitic immature grow and develop by exploiting the fixed resources available in a host. The Lady Birds (*Coccinella septempunctata)* is the important entomophagous predators against many species of aphids and observed as an efficient and mightiest predator of *L. erysimi* in field conditions (Singh and Singh, 2013) [15]. Generally, the aphid appears at its peak at flowering stage of crop, which is synchronized with the activities of predatory beetle, *Coccinella septempunctata* and braconid parasitoid, *Diaeretiella rapae*. The role of biotic and

abiotic factors for reducing the pest population is one of the methods of IPM. Therefore, the study was undertaken to study the impact of weather parameters on major insect pests of mustard and their natural enemies.

Materials and Methods

The field experiment was conducted at Research Farm, College of Agriculture, Tikamgarh (M.P.), India, during the *Rabi* season of 2016-2017. *Brassica juncea* cultivar "Pusa Bold" was sown on 22nd October with row to row and plant to plant distance as 30 cm and 15 cm respectively. An experiment was conducted in a randomized block design with 3 replication. All the agronomical practices were followed to raise a crop except the plant protection measures. Observation on incidence of mustard aphid and its parasitoids *Diaeretiella rapae* was recorded on central apical twigs (10 cm) at weekly interval by selecting 10 rows and from each row 5 plants were selected randomly after first appearance on the crop to the maturity.

The population counts of painted bug were made once a week, which started one week after germination and continued till the maturity of the crop. As painted bug appeared on both sides of the leaves, stem and flowering shoot, the counting was made on the both sides of the leaves. The population of flea beetle (top, middle and bottom leaves) were recorded at weekly interval by selecting 5 plants starting from the first appearance of pest at seedling stage till harvest of the crop. The population of *Coccinella septumpunctata* was also recorded on terminal twigs each of 10 cm selected 5 plants at weekly interval starting from the first appearance of pest and continued till harvest of the crop. The Pearson's correlation coefficients between weekly meteorological parameters and pest population were calculated.

Results and Discussion

Seasonal activity of major insect pests of mustard and their natural enemies:

Mustard aphid, *Lipaphis erysimi* (Kalt.)

During *rabi* 2016-17, seasonal activity of mustard aphid, *Lipaphis erysimi* (Kalt.) was observed on mustard *B. juncea* crop variety "Pusa Bold" and sowing was done during October 2016. The middle and third week of December 2016 could see only nymph forms of aphid seen on mustard crop. Countable number of aphid could be observed only from third week of December (51st SMW). Aphid activity was observed right from vegetative stage to podding stage during December 2016 to February 2017. At the beginning of season, number of aphids per plant varied from 2.6 aphids per 10 cm central terminal twig to 86.4 aphid/10 cm central terminal twig per plant. Aphid peak was observed during the 5th SMW on 60-65 days old crop of *B. juncea* with 85.4 aphids/10 cm central terminal twig. During the peak activity of aphid population the maximum and minimum temperature were 31.1 ^{0}C and 10.3 ^{0}C respectively, and maximum and minimum relative humidity were 88.0 and 30.0% respectively, whereas rainfall was recorded to zero. Thereafter, the declined trend of aphid population was observed and reached its lowest level in the 9th SMW (13.4 aphid/10 cm central terminal twig per plant). This finding is in confirmation with Malik and Sachan (2013) [8] they reported that the incidence of mustard aphid started during 51st standard week and reached its peak level in 5th SMW and 8th SMW. However, Sahoo (2012) [11] and Sarkar *et al.*, (2008) [12] reported slightly different findings that mustard aphid, *Lipaphis erysimi* (Kalt.) observed from 52nd SMW, with the peak population on 6th standard week, while Sarkar *et al.*, (2008) [12] reported that aphid population was most abundant during 3rd and 4th week of January when the temperature ranged from 7.9 to 25.5 °C respectively.

Painted bug, *Bagrada hilaris* (Burm.)

The activity of painted bug was started from 47th SMW and continued up to 9th SMW during the study period. The pest population ranged from 0.2 to 1.5 nymphs per plants. The peak population of painted bug (1.5 adult per plant) was during 8th SMW (25 to 03 February), when the maximum and minimum temperature were 29.4 ^{0}C and 8.4 ^{0}C, respectively and morning and evening relative humidity were 82.0 and 24.06% respectively. The present finding concord with the findings of Bhati *et al*. (2015) [3] observed that the insect was recorded from 49th SMW to 3rd SMW during first phase of occurrence, whereas in second phase, this insect was found infesting the crop from 8th to 12th SMW. Ishwarbhai (2015) [6] reported slightly different findings that the population of painted bug (0.33 nymph and adult/plant) first appeared on the crop during 50th SMW which gradually increased and reached to peak (1.67) in the third week of January.

Flea beetle, *Phyllotreta cruciferae* (Goeze)

The first appearance of flea beetle was recorded during 47th SMW (19 November to 25 November) with the population of flea beetles 0.8 per 3 leaves/plant, which reached at its peak (1.2 beetles per 3 leaves/plant) during 52nd SMW and during the peak period the maximum and minimum temperature were 25.1^{0}C and 7.4 ^{0}C, respectively and morning and evening relative humidity were 86.0 and 44.0% respectively.

Lady bird beetle (*Coccinella septempunctata)*

The *Coccinella* beetle was first recorded in the 4th SMW (21 January to 27 January) with the population of *Coccinella* beetle 0.4 beetles/10 cm apical twig, which reached at its peak (3.2 beetles/10 cm apical twig) during 9th SMW (25 February to 28February). During the peak period of *Coccinella* beetle population the maximum and minimum temperature were 29.4 ^{0}C and 8.4 ^{0}C, respectively and morning and evening relative humidity were 82.0 and 24.0% respectively. The observation were more or less identical to those of Varmora *et al*. (2010) who reported that the activity of *Coccinellids* initiated from 1st week of January (0.22 beetle/plant) and reached to its peak (1.20 beetle/plant) in 2nd SMW.

Diaeretiella rapae (MacIntosh) (Mummified aphids)

The first appearance of *D. rapae* was recorded during 5th SMW (28 January to 03 February) with the population of *D. rapae* 1.4 mummified aphids/10 cm main apical twig, which reached at its peak (8.2 mummified aphids/10 cm main apical twig) during 8th SMW (18 February to 24 February). During the peak period of *D. rapae* population, the maximum and minimum temperature were 30.1 ^{0}C and 10.3 ^{0}C, respectively and morning and evening relative humidity were 88.0 and 30.0% respectively. These findings are in support of the studies made by Dhiman (2007) [4] reported that maximum adult population of *D. rapae* was observed during morning (up to 10 a.m.) and evening hours (3 to 6 p.m.), however maximum mummies were observed on the ventral side of the leaves and inflorescence. Population density of both adult and mummified aphid was minimum during December-January and maximum in February to April on mustard. *D. rapae* parasitizing aphid, *L. erysimi* on mustard was 75.46 and 68.96 per cent. Kulkarni and Patel (2001) [7] also reported that *D.rapae* was found during the 1st week of February where in

11.27 per cent parasitism was observed and then gradually increased until the 4th week (43.68 percent parasitism) of February. Panda *et al*. (2000) [10] studied on the natural enemies like *D. rapae* influenced with the mustard aphid, *L. erysimi* population during their activity period (January to February) on rapeseed in Madhya Pradesh.

Correlation studies between major insect pests of mustard with weather parameters

Correlation studies revealed that morning and evening relative humidity were found to be significantly positive correlated (r = 0.49, 0.44 respectively) while negative correlation was observed between population buildup of mustard aphid population and maximum and minimum temperature. Gour and Pareek (2003) [5], Nayak (2010) [9] were also reported that the mustard aphid population was negative correlation with maximum and minimum temperature and positive with morning and evening relative humidity with aphid population infesting mustard.

Significant and positive correlation was observed between population buildup of painted bug and maximum and minimum temperature (r =0.48 and 0.61). Whereas morning relative humidity were found to be positively correlated (r = 0.03 respectively) but non significant. While, evening relative humidity observed negatively but significant correlation. Tiwari and Sarvanan (2009) [18] also found that the mustard painted bug population exhibited significant positive correlation with maximum and minimum relative temperature, rainfall and morning relative humidity.

Correlation studies revealed that maximum temperature showed significant positive correlation (r = 0.35) with flea beetle population, while morning and evening relative humidity and minimum temperature were found to be negatively correlated (r = -0.72, -0.55 and -0.09 respectively) with the flea beetle population. Nayak (2010) [9] also supported with the present finding that the flea beetle population was negatively correlated with relative humidity and positively correlated with maximum and minimum temperatures respectively.

Correlation studies between natural enemies of mustard aphid with weather parameters

Correlation studies revealed that maximum temperature was significantly positive correlated (r = 0.76,) with *Coccinella* beetle population while morning and evening relative humidity were found to be negatively correlated (r = -0.92, -0.90 respectively) with *Coccinella* beetle population. Whereas minimum temperature and rainfall observed positive correlated (r = 0.03 and 0.02 respectively) to non-significant level. Ishwarbhai (2015) [6] was also agree with that the aphid population increased, the natural enemies population was also increased and visa-versa.

Correlation studies revealed that maximum and minimum temperature and rainfall showed significant positive correlation (r = 0.42, 0.40, and 0.26 respectively) with *Diaeretiella rapae* **(**mummified aphids) population. While morning and evening relative humidity were found to be negatively correlated (r = -0.11, -0.28 respectively) with *D. rapae* population to the level of non-significant. Earlier workers Ishwarbhai (2015) [6] has also reported that morning relative humidity (-0.77*) was significantly negative correlated with the parasitism of *D. rapae*. While Achintya *et al.* (2012) [1] revealed that the *D. rapae* a parasitoid was positively correlated with maximum and minimum temperature.

Conclusions

It may be concluded from the results that Peak activity of mustard aphid, painted bug and flee beetle population were observed during 5th, 8th and 52nd SMW respectively. The parasitoids *Diaeretiella rapae* population did not synchronize with the peak population of mustard aphid, therefore artificial rearing may be recommended and release it with the peak activity of mustard aphid. Population of aphid was positively correlated with morning and evening relative humidity and negatively correlated with maximum and minimum temperature. While significant and positive correlation was observed between population buildup of painted bug and maximum and minimum temperature. Whereas the flea beetle population showed significant positive correlation with maximum temperature and negatively correlated with morning and evening relative humidity. The correlation study between natural enemies and weather parameters revealed that the maximum temperature was significantly positive correlated with *Coccinella* beetle population while morning and evening relative humidity were found to be negatively correlated. The *Diaeretiella rapae* population showed significant positive correlation with maximum, minimum temperature and rainfall, while morning and evening relative humidity were found to be negatively correlated.

Table 1: Seasonal incidence of major insect pests of mustard and their natural enemies during 2016-17.

SMW	Major insect of mustard			Natural enemies	
	Aphid	Painted bug	Flea beetle	*Coccinella spp*	*D. rapae*
47	0.0	0.2	0.8	-	-
48	0.0	0.2	0.6	-	-
49	0.0	0.4	0.6	-	-
50	0.0	0.2	0.8	-	-
51	2.6	0.0	1.0	-	-
52	5.6	0.0	1.2	-	-
01	10.6	0.0	0.6	-	-
02	65.0	0.0	0.4	-	-
03	67.8	0.0	0.4	-	-
04	76.4	0.0	0.2	0.4	0.0
05	85.4	0.1	0.0	0.6	1.4
06	83.6	0.2	0.0	1.4	5.4
07	74.0	0.5	0.0	1.6	5.4
08	46.4	1.5	0.0	2.2	8.2
09	13.4	0.4	0.0	3.2	2.2

Table 3: Correlation coefficient (r) of major insect pest of mustard and their natural enemies with different weather factors.

Insect pests	Temperature (^{0}C)		Relative humidity (%)		Rainfall
	Maximum	Minimum	Morning	Evening	
Mustard Aphid	-0.51*	-0.25	0.49*	0.44*	0.00
Painted bug	0.48*	0.61*	0.03	-0.24	0.00
Flea Beetle	0.35	-0.09	-0.72*	-0.55*	0.00
Coccinella spp.	0.76*	0.03	-0.92*	-0.90*	0.02
D. rapae	0.42	0.40	-0.11	-0.28	0.26

***** Significant at 5% level

References

1. Achintya PA, Debjani D, Kumar AD. Redescription of *Diaeretiella rapae* (McIntosh) with emphasis on morphometrics, J Ent. Res. 2012; 36(1):77-82.
2. Anonymous. Area, production and productivity of mustard, 2015. www.mpkrishi.org
3. Bhati R, Sharma RC, Singh R. Studies on occurrence of insect- pests of different *Brassica species*. International Journal of Current Science. 2015; 14:E125-132.
4. Dhiman SC. Population dynamics of *Diaeretiella rapae* (MacIntosh): a parasitoid of mustard aphid, *Lipaphis erysimi* (Kalt). J Appl. Zoo. Res. 2007; 18(2):117-120.
5. Gour IS, Pareek BL. Seasonal incidence of major insect-pests of mustard crop and their correlation with abiotic factors under semiarid region of Rajasthan, J Insect Sci. 2003; 37(3):37-39.
6. Ishwarbhai CR. Insect pests succession and management of aphid, *Lipaphis erysimi* (Kaltenbach) infesting mustard, *Brassica juncea* (L.) Czern and Coss. M. Sc. (Agri.) thesis submitted to Anand Agricultural University, Anand, 2015.
7. Kulkarni AI, Patel IS. Seasonal abundance of mustard aphid *(Lipaphis erysimi)* and associated bio-agent in Indian mustard crop. Indian J Agric. Sci. 2001; 7(10):681-682.
8. Malik R, Sachan SK. Population buildup of mustard, *Lipaphis erysimi* (Kalt.), on Indian mustard in relation to some abiotic factors. Progressive Agriculture. 2013; 13(1):153-157.
9. Nayak MK. Population dynamics of major insect species of mustard (*Brassica Compstris sariah*) towards weather parameters. Journal of Rural and Agricultural Research. 2010; 10(1):19-21.
10. Panda D, Thakur BS, Patro B. Population dynamics of *Lipaphis erysimi* Kalt. On *Brassica juncea* L. at Raipur, Madhya Pradesh. Plant Prot. Bull. 2000; 52(3+4):28-29.
11. Sahoo SK. Incidence and management of mustard aphid (*Lipaphis erysimi* Kaltenbach) in West Bengal. The Journal of Plant Protection Sciences. 2012; 4(1):20-26.
12. Sarkar A, Konar A, Hazra S, Choudhuri S. Incidence and chemical control of mustard aphid, *Lipaphis erysimi* (Kalt.) on mustard in new alluvial zone of West Bengal. J Ent. Res. 2008; 32(1):41-43
13. Shylesha AN, Thakur Azad NS, Pathak KA, Rao KR, Saikia K, Surose S *et al*. Integrated management of insect pest of crops in north eastern hill region. Technical Bulletin No. 19. ICAR for NEH Region, Umiam, 2006, 50.
14. Singh D. Genetic enhancement of mustard for seed yield and its sustainability. Paper presented in 2nd National *Brassica* Conference held at PAU Ludhiana, 2014, 14-16.
15. Singh K, Singh NN. Preying capacity of different established predators of the aphid, *Lipaphis erysimi* (Kalt.) infesting rapeseed-mustard crop in laboratory conditions. Plant Protect. Sci. 2013; 49:84-88.
16. Singh RK, Rajak SK, Verma RA. Influence of abiotic factors on population of *Lipaphis erysimi* Kalt. J Ent. Res. 2009; 33(2):129-131.
17. Thomas L, Sharma AK, Singh D. Strategies for enhancing rapeseed mustard production in Rajasthan. Directorate of rapeseed-mustard research, Sewar, Bharatpur 3213003, Rajasthan, India. 2014, 44.
18. Tiwari SK, Saravanan L. Life history and seasonal activity of Painted Bug, (*Bagrada hilaris*) (Burm.), Infecting Mustard in Allahabad Uttar Pradesh. Pestology. 2009; 33(2):21-23.