

Population dynamics of mustard aphid *Lipaphis erysimi* Kalt. on different varieties of Indian mustard and their relationship with prevailing weather parameters

■ Awaneesh Chandra¹, Y.P. Malik² and Anoop Kumar*²

¹Department of Entomology, C.S.A. University of Agriculture and Technology, **Kanpur (U.P.) India**

²ICAR- National Research Centre for Integrated Pest Management, **New Delhi (India)**

ARTICLE INFO

Received : 16.08.2019
Revised : 10.09.2019
Accepted : 24.09.2019

KEY WORDS :

Population dynamics, *Lipaphis erysimi*,
Brassica juncea, Weather parameters

ABSTRACT

An experiment was conducted during *Rabi* 2008-2009 and 2009-2010. Aphid appeared in first week of January when the maximum temperature was (15.8-16.1°C) and minimum temperature (5.3-8.0°C) along with relative humidity 93.0-95.3 per cent maximum, 66.0-82.9 per cent minimum and wind speed 2.6 km/h during 2008-09 and 2009-10, respectively. The peak intensity of aphids on different varieties of Indian mustard during 7th standard week (Feb., 12-18) in respective years, when the temperature was 23.1-25.1°C maximum and 9.4-12.5°C minimum along with relative humidity maximum 89.0-91.0 per cent and minimum 43.0-69.0 per cent during 2008-09 and 2009-10, respectively. The aphid population was completely wiped out from mustard crop in the last week of February and first week of March, when the crop age was 118 days. At this stage, temperature was 29.7-31.7°C maximum and 12.7-15.7°C minimum along with relative humidity maximum 73.0-78.0 per cent and minimum 34.0-36.0 per cent during 2008-09 and 2009-10, respectively. Simple correlation co-efficient of aphid with weather factors showed a positive relationship with temperature ($r=0.226-0.645$ and $0.900-0.961$) and wind speed ($r=0.434-0.651$ and $0.599-0.684$), while negative impact with relative humidity ($r=-0.579$ to -0.765 and -0.526 to -0.633) during both the years.

How to view point the article : Chandra, Awaneesh, Malik, Y.P. and Kumar, Anoop (2019). Population dynamics of mustard aphid *Lipaphis erysimi* Kalt. on different varieties of Indian mustard and their relationship with prevailing weather parameters. *Internat. J. Plant Protec.*, **12**(2) : 160-165, DOI : 10.15740/HAS/IJPP/12.2/160-165, Copyright@ 2019: Hind Agri-Horticultural Society.

*Corresponding author:

Email : robinca@gmail.com

INTRODUCTION

Indian mustard [*Brassica juncea* (L.) Czern. and Coss] is an important oilseed crop, which is a valuable source of edible oil. Average productivity of rapeseed-

mustard in India is only 1014 kg/ha, which is far below than 1883 kg/ha yield at global level. Major constraints responsible for this low yield level is mustard aphid which is considered as key factor in reducing mustard

production and sometimes it may be so severe that it may cause yield loss upto 90 % (Gupta *et al.*, 2003). The average yield losses in U.P. recorded 27.3-94.5 per cent (Singh and Malik, 1998 and Malik *et al.*, 2003). Number of chemicals has been recommended for the management of this pest by several workers, but their indiscriminate use for suppressing the pest population increases the cost of production, reduced profit, residual hazards to human health, adverse effect on honey bee (Kumar *et al.*, 2010) and development of resistance in the insect pests. Efforts were made to determine the population dynamics of mustard aphid *Lipaphis erysimi* Kalt. on different varieties of Indian mustard *Brassica juncea* L. so that better management decision can be taken.

MATERIAL AND METHODS

The investigation on population dynamics of aphid in relation to prevailing weather parameters on different mustard varieties was carried out in the Insectory of the Department of Entomology of the C.S.A. University of Agriculture and Technology, Kanpur-India during 2008-09 to 2009-10. Mustard varieties Varuna, Vardan, Rohini, Urvashi, Maya and Basanti were sown in the first weeks

on November during both the years 2008-09 and 2009-10. Crop was managed by following usual agronomic practices in plot size of 3.15 x 2.75 m with 45 x 10 cm plant spacing. A uniform recommended dose of fertilizer *i.e.* (80N+40P₂O₅+40K₂O kg/ha) was applied. The half dose of nitrogenous and full dose of phosphatic and potassic fertilizers was applied at the time of the last ploughing. Remaining dose of nitrogenous fertilizer was used as top dressing after first irrigation. The experimental fields were kept moist by providing required irrigation in order to maintain the suitable crop growth. Normal weeding and hoeing practices were adopted to keep the fields free from weeds to increase soil aeration and to conserve the moisture. Field was laid out in RBD with 3 replications. The observations on aphid intensity were recorded at weekly intervals starting from 52nd standard week during both the years. The intensity of the aphid population of mustard aphid was observed on 10 randomly selected plants on 10 cm top shoot/inflorescence of the main shoot as per techniques used by Bakhietia and Ghorkand (1989).

RESULTS AND DISCUSSION

The results (Table 1 and 2) of population dynamics

Table 1 : Weather parameters prevailing during observation period

S.W.	Observation period	Temperature			Relative humidity			Rainfall (mm)	Wind speed (km/h)
		Max. °C	Min °C	Ave. °C	Max.	Min.	Ave.		
2008-2009									
52	Dec.24-31	23.7	6.9	15.3	94.12	41.12	67.62	0.0	1.8
01	Jan. 1-7	16.1	5.3	10.7	93.0	66.0	79.5	0.0	2.6
02	Jan. 8-14	22.6	9.5	16.0	94.0	56.4	75.2	0.0	2.8
03	Jan. 15-21	24.3	10.3	17.3	89.0	46.0	67.5	0.0	4.3
04	Jan. 22-28	25.4	11.3	18.3	91.0	46.0	68.5	0.0	6.0
05	Jan. 29 – Feb.4	24.3	8.0	16.1	89.0	40.0	64.5	0.0	4.1
06	Feb.5-11	26.0	9.2	17.6	89.0	43.0	66.0	0.0	3.4
07	Feb. 12-18	25.1	9.4	17.2	89.0	43.0	66.0	0.0	5.5
08	Feb. 19-25	28.8	12.5	20.6	82.0	37.0	59.5	0.0	6.9
09	Feb. 26-Mar.04	29.7	12.7	21.2	73.0	34.0	53.5	0.0	6.7
2009-2010									
52	Dec.24-31	20.9	6.9	13.9	92.0	52.0	72.0	0.0	1.8
01	Jan. 1-7	15.8	8.0	11.9	95.3	82.9	89.1	0.0	2.6
02	Jan. 8-14	14.8	7.8	11.3	95.0	78.0	86.5	3.2	1.5
03	Jan. 15-21	14.8	8.1	11.4	94.0	76.0	85.0	0.0	2.6
04	Jan. 22-28	19.8	6.7	13.2	94.0	60.0	77.0	0.0	1.2
05	Jan. 29 – Feb.4	24.8	8.3	16.5	91.0	41.0	66.0	0.0	2.4
06	Feb.5-11	25.7	12.7	19.2	91.0	53.0	72.0	4.8	5.3
07	Feb. 12-18	23.1	12.5	17.8	91.0	69.0	80.0	10.2	2.9
08	Feb. 19-25	26.8	11.9	19.3	89.0	47.0	68.0	0.2	3.1
09	Feb. 26-Mar.04	31.7	15.7	23.7	78.0	36.0	57.0	0.0	4.8

of aphid (*Lipaphis erysimi*) on different varieties of Indian mustard based on both the years revealed that the aphid appeared in first week of January at the flowering stage of the crop (On 62 days old crop) with its initial intensity of 20.6, 17.4, 19.5, 17.8, 20.3 and 21.0 aphids/plant in first year on Varuna, Vardan, Rohini, Urvashi, Maya and Basanti varieties of Indian mustard, respectively and 14.1, 16.4, 16.1, 19.6 and 18.4 aphids/plant during second year on respective varieties. Thereafter, the aphid multiplied at faster rate due to conducive weather parameters and succulency of the crop. Maximum intensity of 315.1, 380.5, 323.7, 250.9, 386.7 and 408.6 aphids/plant during first year and 325.1, 377.6, 310.6, 242.6, 371.8 and 400.2 aphids/plant in second year were observed on Varuna, Vardan, Rohini, Urvashi, Maya and Basanti varieties of Indian mustard in 3rd week of February. During this period, the range of average temperature 10.7–17.2°C (maximum temperature 16.1–26.0°C and minimum temperature 5.3–11.3°C), relative humidity 64.5.0–79.5 per cent (maximum relative humidity 89.0–94.0 per cent and minimum relative

humidity 40.0–66.0%), wind speed 2.6–6.0 km/h were found favourable during first year, while average temperature 11.3–19.2°C (maximum temperature 14.8–25.7°C and minimum temperature 6.7–12.7°C), relative humidity 66.0–89.1 per cent (maximum relative humidity 91.0–95.3% and minimum relative humidity 41.0–82.9%), wind speed (1.2–5.3 km/h) and rainfall 3.2–10.2 mm/day were observed beneficial for best multiplication of this aphid in second year. After 3rd week of February in both year, the aphid intensity decreased suddenly which was recorded 212.2, 233.6, 271.1, 156.6, 251.8 and 276.9 aphids/plant on Varuna, Vardan, Rohini, Urvashi, Maya and Basanti varieties in first year, respectively and 220.2, 241.5, 278.8, 176.3, 262.8 and 294.9 aphids/plant in second year on these varieties. This sudden decline in aphid intensity on all the varieties in both years may be due to facing the unfavourable weather coupled with crop succulency. This pest wiped out from the crop in the last week of February at average temperature 21.2 - 23.7°C, relative humidity 53.5–57.0 per cent, wind speed 4.8–6.7 km/h and the crop become harder for piercing it.

Table 2 : Weekly aphid intensity on different varieties of Indian mustard in relation to different weather parameters

S.W.	Observation period	Crop age (days)	Aphid intensity (No./plant)					
			Varuna	Vardan	Rohini	Urvashi	Maya	Basanti
2008-09								
52	Dec. 24-31	55	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
01	Jan. 1-7	62	20.6 (20.6)	17.4 (17.4)	19.5 (19.5)	17.8 (17.8)	20.3 (20.3)	21.0 (21.0)
02	Jan. 8-14	69	49.7 (29.1)	64.9 (47.5)	21.8 (2.3)	33.3 (15.5)	38.8 (18.5)	54.3 (33.3)
03	Jan. 15-21	76	80.5 (30.8)	113.7 (48.8)	63.8 (42.0)	58.9 (25.6)	61.1 (22.3)	71.2 (16.9)
04	Jan. 22-28	83	115.0 (34.5)	168.2 (54.5)	155.7 (91.9)	104.3 (45.4)	105.3 (44.2)	151.4 (80.2)
05	Jan. 29 – Feb.4	90	157.0 (42.0)	223.2 (55.0)	181.3 (25.6)	136.5 (32.2)	156.3 (51.0)	164.1 (12.7)
06	Feb. 5-11	97	283.3 (126.3)	340.7 (117.5)	281.7 (100.4)	181.6 (45.1)	324.1 (167.8)	331.7 (167.6)
07	Feb. 12-18	104	315.1 (31.8)	380.5 (39.8)	323.7 (42.0)	250.9 (69.3)	386.7 (62.6)	408.6 (76.9)
08	Feb. 19-25	111	212.2(-102.8)	233.6(-146.9)	271.1(-52.6)	156.6(-94.3)	251.8(-134.9)	276.9(-131.7)
09	Feb.26 - Mar.04	118	0.0 (-212.2)	0.0 (-233.6)	0.0 (-271.1)	0.0 (-156.6)	0.0 (-251.8)	0.0 (-276.9)
2009-10								
52	Dec. 24-31	55	0.0 (0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
01	Jan. 1-7	62	14.1(14.1)	16.4(16.4)	16.1(16.10)	15.2(15.2)	19.6(19.6)	18.4(18.4)
02	Jan. 8-14	69	16.8(2.7)	23.8(7.4)	18.2(2.1)	17.8(2.6)	20.3(0.7)	20.4(2.0)
03	Jan. 15-21	76	21.6(4.8)	34.8(11)	23.9(5.7)	19.0(1.2)	22.7(2.4)	24.2(3.8)
04	Jan. 22-28	83	34.4(12.8)	39.7(4.9)	35.0(11.1)	35.1(16.1)	44.4(21.7)	31.5(7.3)
05	Jan. 29 – Feb.4	90	141.8(107.4)	152.2(112.5)	148.2(113.2)	127.3(92.2)	181.8(137.4)	151.8(120.3)
06	Feb. 5-11	97	280.7(138.9)	291.6(139.4)	279.8(131.6)	181.1(53.8)	320.9(139.1)	334.8(183.6)
07	Feb. 12-18	104	325.1(44.4)	377.6(86.0)	310.6(30.8)	242.6(61.5)	371.8(50.9)	400.2(65.4)
08	Feb. 19-25	111	220.2(-104.9)	241.5(-136.1)	278.8(-31.8)	176.3(-66.3)	262.8(-109)	294.9(-105.3)
09	Feb.26 - Mar.04	118	0.0(-220)	0.0(-254.5)	0.0(-278.8)	0.0(-176.3)	0.0(-262.8)	0.0(-294.9)

NB: Figures in parentheses are weekly increase in aphid intensity

Table 3 : Relationship of aphid intensity with prevailing weather parameters during

Weather parameters	Aphid intensity (No./plant)						
		Varuna	Vardan	Rohini	Urvashi	Maya	Basanti
2008-09							
Temperature °C							
Min.	a	5.91	-19.78	-77.61	1.392	-11.57	-38.65
	b	15.13	19.48	25.69	12.30	19.13	23.69
	r	0.292	0.331	0.460	0.334	0.302	0.364
Max.	a	-312.87	-352.47	-409.65	-222.43	-385.35	-418.00
	b	19.17	21.45	23.86	14.12	23.02	25.04
	r	0.628	0.619	0.725*	0.652	0.617	0.428
Ave.	a	-195.07	-233.74	-296.43	-172.01	-248.84	-262.44
	b	20.55	23.78	27.58	16.56	24.98	30.15
	r	0.518	0.528	0.645	0.558	0.515	0.226
Relative humidity %							
Min.	a	530.67	573.05	622.46	410.63	625.28	666.47
	b	-8.09	-8.66	-9.69	-6.21	-9.67	-10.20
	r	-0.685	-0.647	-0.762*	-0.741*	-0.669	-0.689
Max.	a	1650.8	1779.7	2124.9	1206.8	2068.5	2149.7
	b	-16.78	-18.05	-21.90	-12.17	-21.22	-21.95
	r	-0.542	-0.514	-0.656	-0.553	-0.560	-0.565
Ave.	a	972.88	1048.58	1172.67	633.97	1167.03	1233.07
	b	-12.05	-12.94	-14.74	-7.73	-14.60	-15.33
	r	-0.675	-0.638	-0.765*	-0.579	-0.668	-0.684
Wind speed							
a	a	9.26	-6.07	-60.57	-7.13	-9.95	-25.01
	b	31.35	38.24	50.67	28.01	40.20	47.18
	r	0.434	0.466	0.651	0.546	0.455	0.521
Rainfall							
a	a	0.0	0.0	0.0	0.0	0.0	0.0
	b	0.0	0.0	0.0	0.0	0.0	0.0
	r	0.0	0.0	0.0	0.0	0.0	0.0
2009-10							
Temperature °C							
Min.	a	-340.12	-367.04	-350.58	-219.38	-380.48	-440.51
	b	49.68	54.13	51.51	33.80	56.42	63.16
	r	0.937***	0.932***	0.946***	0.902***	0.927***	0.955***
Max.	a	-304.99	-311.83	-334.00	-216.95	-359.00	-380.53
	b	21.10	22.17	22.84	15.39	24.85	26.09
	r	0.828*	0.795*	0.873***	0.855***	0.850**	0.821*
Ave.	a	-339.47	-400.71	-409.49	-264.52	-442.77	-482.93
	b	30.66	36.34	36.37	24.30	39.69	42.61
	r	0.900**	0.901**	0.961***	0.933***	0.939***	0.927***
Relative humidity %							
Min.	a	403.39	418.28	451.48	312.05	487.77	483.76
	b	-4.28	-4.27	-4.93	-3.31	-5.24	-5.11
	r	-0.514	-0.468	-0.576	-0.563	-0.548	-0.492
Max.	a	4481.85	4796.93	4931.79	3314.52	5257.66	5635.11
	b	-47.0	-50.24	-51.79	-34.71	-55.13	-59.17
	r	-0.845**	-0.825*	-0.906**	-0.882**	-0.863**	-0.852**
Ave.	a	717.91	813.36	890.16	606.77	954.13	953.70
	b	-7.63	-8.54	-9.63	-6.47	-10.24	-10.18
	r	-0.557	-0.526	-0.633	-0.618	-0.602	-0.551
Wind speed							
a	a	-60.15	-48.68	-56.49	-17.21	-61.25	-78.66
	b	71.11	72.56	72.34	44.07	80.31	88.23
	r	0.684	0.638	0.677	0.599	0.673	0.680
Rainfall							
a	a	75.33	81.45	88.73	63.96	92.94	90.21
	b	24.57	28.60	21.78	16.44	27.23	30.05
	r	0.702*	0.746*	0.606	0.665	0.678	0.692

NB: *, ** and *** indicate significance of values at P=0.05, 0.01 and 0.10, respectively

As for as the susceptibility level of the varieties to aphid is concerned, Urvashi was found least susceptible followed by Varuna, Vardan, Rohini, Maya and Basanti in both the years. These results are in accordance with those of Singh and Malik (1998); Kumar *et al.* (2000); Singh *et al.* (2009) and Jat *et al.* (2006) recorded the infestation of aphid on mustard started in third week of January (48 aphids/5 plants) that the increased gradually, reached to its peak (295 aphids/5 plants) in the second week of February and disappeared completely after second week of March. Jandial *et al.* (2007) reported the incidence of mustard aphid started in the last week of December and reached at peak in second week of February. Pal *et al.* (2018) reported the peak population of mustard aphid on yellow sticky traps was recorded with 35.4 ± 2.9 aphids/trap from 7th SW. This indicated that mustard aphid incidence was higher when maximum and minimum temperature ranged between 20 to 27°C and 5 to 10°C, respectively and relative humidity during morning and evening hours ranged from 72-90 per cent and 53-61 per cent, respectively.

Simple correlation co-efficient (r) of aphid with weather factors showed a positive relationship with temperature ($r=0.226-0.645$ and $0.900-0.961$) and wind speed ($r=0.434-0.651$ and $0.599-0.684$), while negative impact with relative humidity ($r=-0.579$ to -0.765 and $r=-0.526$ to -0.633) during both the years. During this period, the range of average temperature 10.7-17.2°C, average relative humidity 64.5-79.5 per cent and wind speed 2.6-6.0 km/h were found favourable during first year, while average temperature 11.3-19.2°C, average relative humidity 66.0-89.1 per cent, wind speed (1.2-5.3 km/h) and rainfall 3.2-10.2 mm/day were observed suitable for best multiplication of this aphid in second year. The impact of environment on mustard aphid can be argued with those of Kumar *et al.* (2000) who reported that increase in the aphid population were positively correlated with temperature and negatively correlated with relative humidity and wind velocity. Temperature between 11.42-25.14°C, relative humidity at 84.10-57.57 per cent and wind velocity below 3.0 km/h were conducive for the aphid on cv. VARUNA. Jat *et al.* (2006) reported that correlation coefficient workout between aphid population and morning and evening relative humidity showed a significant negative correlation ($r = 0.485$ and -0.464), respectively. Jandial *et al.* (2007) reported positive and non significant correlation existed

between maximum temperature and aphid population, while negative and non significant correlation observed with minimum temperature, morning and evening relative humidity. Cheema *et al.* (2018) reported that the insect population buildup showed positive correlation with temperature (0.752) and negative correlation with relative humidity (-0.850). Sharma *et al.* (2019) observed the mustard aphid population had negative correlation with relative humidity and positive correlation with maximum temperature.

Acknowledgement:

The financial assistance provided by C.S. Azad University of Agriculture and Technology in the form of University Research Fellowship is gratefully acknowledged.

REFERENCES

- Bakhetia, D.R.C. and Ghorband, A.W. (1989).** Relationship between the parameters of aphid population per plant and percentage of plant infested by *Lipaphis erysimi* Kalt. in Indian mustard crop. *J. Aphidol.*, **31**(2) : 119-124.
- Cheema, S.A., Zubair, M., Saleem, M.J., Malik, M.K., Aslam, A., Maan, N.A. and Khurshid, M.R. (2018).** Evaluation of *Brassica napus* germplasm for susceptibility status against Mustard Aphid (*Lipaphis erysimi* Kalt.). *J. Entomology & Zoology Studies*, **6** (6) : 39- 42 .
- Gupta, M.P., Verma, M.L., Chourasia, S.K. and Rai, H.S. (2003).** Assesment of avoidable yield losses in karanrai (*Brassica carinata* Braun) varieties due to mustard aphid (*Lipaphis erysimi* Kalt.). *Ann. Pl. Protec. Sci.*, **11** (1) : 11-15.
- Jandial, Vinay Kumar and Kumar, Anil (2007).** Seasonal incidence and population fluctuation of mustard aphid, *Lipaphis erysimi* Kalt.in relation to ecological parameters. *Indian J. Entomol.*, **69** (2) : 162-167.
- Jat, D.S., Jat, M.C. and Sharma, M.M. (2006).** Seasonal incidence of insect pests of mustard in relation to abiotic factors. *Ann. Pl. Protec. Sci.*, **14** (2) : 475-476.
- Kumar, J., Singh, S.V. and Malik, Y.P. (2000).** Population dynamics and economic status of *Lipaphis erysimi* on mustard *Brassica juncea*. *Indian J. Entomol.*, **62**(3): 253-259.
- Malik, Y.P., Kumar, J., Singh, S.V., Singh, Mahak and Bisen, R.S. (2003).** Influence of crop management inputs on aphid infestation in Indian mustard. *Indian J. Entomol.*, **65** (4): 439-493.
- Pal, S., Singh, D.K. and Umrao, R.S. (2018).** Population

dynamics of insect pests in mustard and eco-friendly Management of *Lipaphis erysimi* (Kaltenbach) in Uttrakhand. *Internat. J. Curr. Microbial. App. Sci.*, **7** (7) : 324 -331.

Sharma, D., Yadav, S. and Yadav, S. (2019). Population dynamics of mustard aphid, *Lipaphis erysimi* Kaltin various *Brassica* spp. *Internat. J. Curr. Microbial. App. Sci.*, **8** (2) : 2952 -2959

Singh, R.K., Rajak, S.K. and Verma, R.A. (2009). Influence of abiotic factors on population of *Lipaphis erysimi* Kalt. *J. Entomolog. Res.*, **33** (2): 129-131.

Singh, S.V. and Malik, Y.P. (1998). Population dynamics and economic threshold of *Lipaphis erysimi* on mustard. *Indian J. Entomol.*, **60**(1): 43-49.

12th
Year
★★★★★ of Excellence ★★★★★