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INFLUENCE OF DIFFERENT WEATHER PARAMETERS ON POPULATION OF MUSTARD APHID *LIPAPHIS ERYSIMI* (KALT.)

N.S. SOLANKI, S.L. MUNDRA AND O.P. AMETA

Department of Agronomy, Rajsthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur–313001

ABSTRACT

The mustard aphid, *Lipaphis erysimi* (Kalt), is one of the most nefarious biotic constraints of rapeseed–mustard. Mustard sown on 5th October (normal sowing) escaped from the attack of *Lipaphis erysimi* in Udaipur region of Rajasthan whereas, the crop with delayed sowing by 15 and 30 days than normal sowing resulted in significantly more aphid attack. Flowering and green seed stages were found sensitive stages for incidence and spread of aphids. The mean temperature of 13.7 to 17.2 °C and mean relative humidity of 54.5 to 60.0 % were found conducive for incidence of aphid attack under delayed sown crops. The peak infestation was observed when the mean temperature of 17.7 to 20.4 °C and mean relative humidity of 56.8 to 61.0 % prevailed during the period.

Key words: Brassica, mustard aphid, temperature, relative humidity

INTRODUCTION

Oilseeds play vital role in Indian economy, accounting for 5% of the gross national product and 10 % of the value of the agricultural product. Rapeseed–mustard account for 21 % (5.39 million ha) of the total oil seed area and 23 % (6.20 million tonne) of the total oil seed production in India next to groundnut and soybean. While in India, Rajasthan ranks first both in area and production of this crop with 2.46 million ha area and 2.35 million tonnes production during 2007–08 (Anonymous, 2008–09). Mustard aphid (*Lipahis erysimi*) is one of the most important hindrances responsible for severe reduction in its yield. Singh and Sachan, 1997 have reported 66–99 % yield reduction due to mustard aphids. Weather conditions in general and temperature as well as humidity in particular play an important role for its incidence and multiplication (Sinha *et al*., 1989, Rana *et al*., 1993 and Singh and Malik, 1998). Little work has been done to quantify the relationship between the thermal time and incidence of mustard aphid in rapeseed mustard in southern part of Rajasthan. In view of these facts, the present study was undertaken to establish the relationship between aphid population and weather parameters.

MATERIALS AND METHODS

Field experiments were conducted at ARS, Udaipur for three consecutive rabi seasons (2004–05, 2005–06 and 2006–07). The treatment comprised of three dates of sowing viz., 5th October (D_1), 20th October (D_2) and 4th November (D_3) and four irrigation levels viz., no irrigation (I0), one at 30 DAS (I_1), two at 30 and 55 DAS(I_2) and three at 30, 55 and 75 DAS (I_3). The experiment was laid out in split plot design with four replications. Mustard variety Pusa Bold was cultivated with fertilizer levels of 60 kg N and 40 kg P_2O_5/ha. Five plants were tagged randomly from each plot for recording observation on mustard aphids that were counted on top 10 cm inflorescence. Daily weather parameters were recorded in meteorological observatory. The crop was not protected by any insecticide during the course of experimentation. The data on aphid population during 2004–05 are not presented in the present text because the aphid population during the season was below ETL.

RESULTS AND DISCUSSION

The mustard aphid incidence differed during all three years. The aphid population initiated in Standard Meteorological Week 4th (2004–05), 52nd (2005–06) and 50th (2006–07). The corresponding initial populations on top 10 cm inflorescence were 13, 14 and 13. However, the peak infestation of aphids was observed at different times in all three years. The peak aphid population was recorded during 7th , 6th and 51st SMW in 2004–05, 2005–06 and 2006–07, respectively. During 2004–05, aphid incidence was recorded only under 20th October and 4th November sown crops. The crop sown on 5th October escaped from aphid infestation during 2004–05. The incidence of aphid occurred on 25th January under delayed sown crops when the mean temperature and relative humidity were 13.7 °C and 54.5 %, respectively during 2004–05 (Table 1) The present finding is in confirmation with Ansari *et.al* (2007)

Table 1. Aphid–weather relationship in mustard

Aphids	2004–05 Below ETL	2005–06 Peak infestation	2006–07 Peak infestation
Incidence	25th Jan (4th SMW) Green seed in D3	29 Dec Green seed in D2 & 16th Jan Flowering in D3	14th Dec (50th SMW) Seed initiation in D2 2nd Jan Flowering in D3
Mean Temperature (°C)	13.7	16.6	17.2
RH (%)	54.5	60	55.3
Peak infestation	12th Feb (7th SMW)	9th Feb (6th SMW)	23rd Dec (51st SMW)
Mean Temperature (°C)	20.4	19.7	17.7
RH (%)	58.0	56.8	61.0

SMW: Standard Meteorological Week

who reported that initiation of infestation of mustard aphids was observed on 11th January at 60 DAS at mean temperature and relative humidity of 11.4 °C and 79.7 %, respectively. The aphid population varied from 0–17 aphids/10 cm twig on different germplasm. The regression model based on weather parameter for prediction of mustard aphids was developed as under:

$$Y = -912.8+50.2 \text{ Max T} - 26.9 \text{ Min T} - 0.28 \text{ Mean RH}$$
$$R^2 = 0.99$$

Where, Y = aphid population on 10 cm top inflorescence

Thus, maximum temperature was positively correlated while minimum temperature and relative humidity were negatively correlated with aphid population. Similar reports were made by Singh and Singh (1994). However, 20th October sown crop at the time of aphid incidence was at brown seed stage while 4th November sown crop was at green seed stage. The peak infestation of aphid during 2004–05 was recorded on 12th February when the mean temperature and relative humidity were 20.4 °C and 58.0 %, respectively.

During 2004–05, the aphid incidence was recorded on 20th October and 4th November sown crop (Table 2). The crop sown on 5th October was free from aphids. Under 20th October sown crop incidence of aphids was observed when the crop was at brown seed stage. However, the population on top 10 cm inflorescence was below ETL level throughout the maturity. The incidence occurred on 25 January and when the mean temperature was 13.7ºC , mean RH was 54.5% and crop was at green seed stage under delayed sowing. The peak infestation was recorded on 12th February, when the mean temperature was 20.4ºC with mean RH of 58. Thereafter, aphid population decreased but was above ETL level upto the harvest of crop under 4th November sown crop (Table 2).

Table 2. Aphid populations on 10 cm top inflorescence of mustard under various treatments (2004–05)

Treatments	Standard Meteorological Week No.				
	4	5	6	7	8
D_1I_0	PM	0	0	0	0
D_1I_1	PM	0	0	0	0
D_1I_2	PM	0	0	0	0
D_1I_3	0	PM	0	0	0
Mean D_1	0	0	0	0	0
D_2I_0	4	PM	PM	0	0
D_2I_1	4	PM	PM	0	0
D_2I_2	5	5	PM	0	0
D_2I_3	5	6	5	PM	0
Mean D_2	4.5	2.8	1.3	0	0
D_3I_0	3	10	60	75	PM
D_3I_1	5	12	62	79	PM
D_3I_2	7	10	63	80	PM
D_3I_3	8	10	65	84	PM
Mean D_3	5.8	10.5	62.5	79.5	–
Max. T (°C)	22.8	22.2	31.2	28.1	23.0
Min T (°C)	4.6	3.5	9.6	9.5	3.1
Mean T (°C)	13.7	12.9	20.4	18.8	13.1
RH I (%)	79.0	81.4	85.1	74.3	63.6
RH II (%)	30.1	38.9	30.8	26.4	18.3
Mean RH (%)	54.5	60.2	58.0	50.4	40.9

PM= Physiological Maturity

During 2005–06, aphid incidence occurred both in 5th October and 20th October sown crop during 52nd SMW (29th December) when the crop was at seed development stage and the mean temperature and RH were 16.6 °C and 60.0 %, respectively. However, in 4th November sown crop aphid infestation started on 16th January when the crop was at flowering stage. The aphid population upto 16th January were in the range of 10–17 on top 10 cm inflorescence (Table 3). The aphid population abruptly

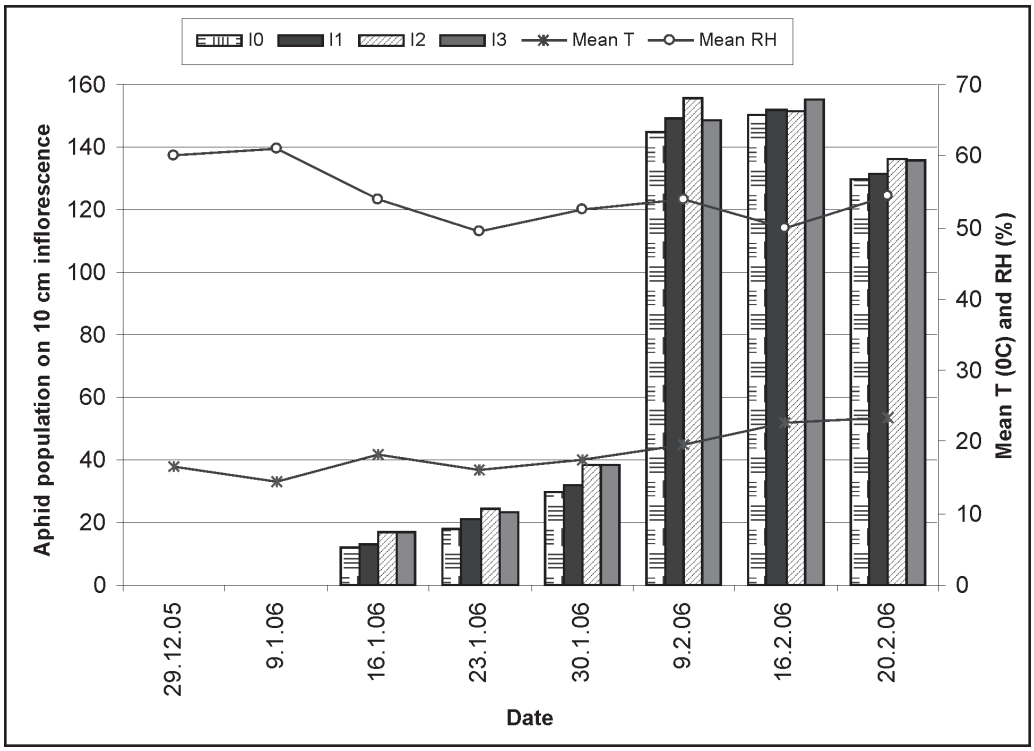

Fig.1: Aphid population on 10 cm top inflorescence under 4th November sown mustard (2005–06)

Table 3. Aphid populations on 10 cm top inflorescence of mustard under various treatments (2005–06)

Treatment/ Date	29.12.05	9.1.06	16.1.06	23.1.06	30.1.06	9.2.06	16.2.06	20.2.06
D_1I_0	10	14	10	11	20	126	112	108
D_1I_1	12	20	15	15	28	133	116	110
D_1I_2	18	19	16	17	29	128	122	115
D_1I_3	15	14	17	17	29	131	120	116
Mean D_1	14[a]	17	15	15	27[b]	130	118	112
D_2I_0	13	13	15	14	29	125	121	109
D_2I_1	12	14	17	16	30	133	124	114
D_2I_2	12	16	15	17	34	132	123	113
D_2I_3	14	19	15	15	31	134	123	116
Mean D_2	13[c]	16	16	16	31	131[d]	123	113
D_3I_0	0	0	12	18	30	145	150	130
D_3I_1	0	0	13	21	32	149	152	132
D_3I_2	0	0	17	25	38	156	152	136
D_3I_3	0	0	17	23	38	149	155	136
Mean D_3	0	0	15[e]	22	35	150[f]	152[g]	134
Max T	26.6	22.9	29.0	25.1	27.6	29.5	31.1	33.3
Min T	6.6	5.9	7.1	7.1	7.6	9.8	14.6	13.7
Mean T	16.6	14.4	18.1	16.1	17.6	19.7	22.8	23.5
RH I	92	83	88	78	83	82	71	80
RH II	28	39	20	21	22	26	29	29
Mean RH	60	61	54	49	53	54	50	55
SSH	8.4	7.5	8.4	8.5	8.7	9.0	8.6	9.6

Weather data for average of 3 days, a = seed development stage, b = brown seed stage, c = seed development stage, d = brown seed stage, e = flowering, f = green seed stage and g = brown seed stage

Table 4. Aphid population on 10 cm top inflorescence of mustard under different environment (2006–07)

Treatments	Standard Meteorological Week No.								
	50	51	52	1	2	3	5	6	7
D_1I_0	10	63	52	69	39	PM	PM	0	0
D_1I_1	11	236	136	160	10	PM	PM	0	0
D_1I_2	15	232	239	244	57	PM	PM	0	0
D_1I_3	15	550	464	386	76	PM	PM	0	0
Mean D_1	13	270	223	215	46	PM	PM	0	0
D_2I_0	5	181	104	70	9	5	PM	0	0
D_2I_1	5	360	154	176	4	6	PM	0	0
D_2I_2	5	132	120	122	32	22	PM	0	0
D_2I_3	5	154	148	75	10	16	PM	0	0
Mean D_2	5	207	132	111	14	12	PM	0	0
D_3I_0	0	6	17	14	12	6	15	15	1
D_3I_1	0	3	17	10	12	6	8	17	0
D_3I_2	0	3	11	10	11	13	14	12	1
D_3I_3	0	3	27	11	9	22	14	12	4
Mean D_3	0	4	18	11	11	12	13	14	2
Max. T (^{0}C)	26.3	26.7	25.8	24.3	23.6	25.6	29.6	28.0	24.7
Min T (^{0}C)	8.0	8.7	9.5	7.6	5.0	6.5	10.8	12.6	9.4
Mean T (^{0}C)	17.2	17.7	17.7	16.0	14.3	16.1	20.2	20.3	17.1
RH I (%)	83.4	89.1	88.6	89.0	88.0	85.0	85.0	83.0	80.0
RH II (%)	27.1	32.9	26.4	36.0	31.0	35.0	67.0	45.0	35.0
Mean RH (%)	55.3	61.0	57.5	62.5	59.5	60.0	76.0	64.0	57.5

PM= Physiological Maturity

increased in all the dates of sowing during 6th week when the mean temperature and mean RH were 19.7 ^{0}C and 54.0 %, respectively (Table 1 and Fig.1). The present findings are in agreement with the reports of Singh and Malik (1998) who reported that the increase in temperature was significantly conducive for aphid multiplication but relative humidity had negative response on its intensity. The aphid population started declining in 8th week when the mean temperature and mean RH were 23.5 ^{0}C and 55.0%, respectively (Table 3). However, at peak infestation, latest sowing *i.e.* 4th November sown crop was at green seed stage and the early sown crop (5th October and 20th October) at brown seed stage.

During 2006–07 the first appearance of aphid on top 10 cm inflorescence was noticed in 50th week, when mean temperature and mean RH were 17.2 ^{0}C and 55.3 %, respectively (Table 1). In contrast to previous year, it was interesting to note that 5th October (D_1) and 20th October (D_2) sown crops recorded more aphid population as compared to delayed sowing (4th November). The peak infestation reached reached in 52nd week in D_1 and D_2 when the crop was at brown seed (85 DAS) and at green seed stage (70 DAS) respectively (Table 4). In present finding, the aphid infestation was not recorded after 2nd week of January in 5th October sown crop. It was due to the maturation of crop that created net deficit in water content in plant tissues leading to food scarcity and alate formation of aphid colonies. Ansari *et al* (2007) reported that infestation of mustard aphid is largely governed by the average temperature and negatively by mean relative humidity. It was interesting to note that the crop sown on 4th November (D_3) was at siliquae initiation stage at the time of peak infestation. In 4th November sown crop the aphid population were in the range of 6 to 22 at peak infestation in 3rd week. Aphid population on top 10 cm inflorescence varied under different irrigation levels. It was noted that aphid population, in general, was more under irrigated conditions as compared to no irrigation.

It can be inferred that weather factors and phenological stage of the crop play an important role in incidence and spread of mustard aphid. So, the weather factors and stage of crop is important tool in prediction of aphid multiplication and thus farmers can be forewarned for the management of mustard aphid by various pest management strategies.

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