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Recent trends of mustard aphid (*Lipaphis erysimi)* infestation in rapeseed mustard in eastern Rajasthan

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Abstract

Field experiments were conducted during 2014-15 and 2015-16 to study the seasonal incidence of mustard aphid *(Lipaphis erysimi* Kalt.*)* on different varieties of rapeseed-mustard crops (*Brassica sp.*). The maximum peak population of mustard aphid were recorded on BSH-1 followed by GSC 6, Rohini and T 27 under timely sown conditions as well as under late sown conditions. In general the trend was observed as BSH-1 $\geq$ GSC 6 $\geq$ Rohini $\geq$ T 27 for peak population of mustard aphid during different seasons. The study revealed that Late (4th standard week) appearance of mustard aphid leads to low population build up and early appearance (1st standard week) leads to high population build. Alate mustard aphid was observed from 43rd standard week to 12th standard week with peak (145.7 aphids/trap) in 9th standard week and disappeared during 12th standard week during (2014-15). Similarly observations were recorded during 2015-16 week with peak (3447.4 aphids/trap). The results indicated that escape mechanism from mustard can be achieved if the crop would have sown 3 weeks earlier.

Keywords: *Infestation, mustard aphid, rapeseed-mustard crops*

Introduction

Rapeseed mustard crops are the important oilseeds crops in India. The mustard aphid *i.e., Lipaphis erysimi* (Kalt) is the most important limiting factors in lowering the grain yield of of these crops. Mustard (*B. juncea* L.) provides good source of edible oil and as many as twenty four insect pests of rapeseed and mustard were reported by Rai *et al*. (1976). Among them the loss caused by mustard aphid is estimated to the tune of 69.61 per cent (Singh and Sachan, 1994). It is considered as the most serious pest of rapeseed mustard responsible for a yield loss ranging from 35.4 tO 96 percent depending upon seasons (Bakhetia, 1986). Amongest the insect pests aphid alone causes 9-96 per cent yield reduction (Singh and Sharma, 2012). Aphids are widely distributed throughout the world on all *Brassica* crops (Yue and Liu, 2000).The best way to overcome this pest is to destroy it at its initial stage of the life cycle. This is possible if timely prediction of its occurrence can be made. Hence, the investigations on incidence of mustard aphid have been carried out by many workers by recording of different meteorological parameters. The data thus obtained were statistically analyzed and correlated with meteorological parameters. The rate of reproduction varies from 5 to 9 young's in a single day by a single female and total number of youngs produced by the female varies from 76 to 188 (Nair, 1986).

Aphid causes severe damage to the plants by sucking plant sap from the tender shoots and flowers in the beginning and later sucks the sap from tender pods (Begum, 1995; Atwal and Dhaliwal, 1997). Up to 87.7 per cent yield loss in different varieties of mustard has been reported (Brar *et al.,* 1987; Suri *et al.*, 1988).The excessive excretion of honey dew by the aphid on the leaves results in the growth of black sooty mould, which interferes the photosynthetic activity of the leaves. The management of the pest with systemic insecticides is quite effective but it adversely affects the predators and parasitoids of the pest. However, in addition to the high cost of insecticide, several other drawbacks of chemical control viz. development of resistance to commonly used insecticides, pest resurgence, secondary pest outbreak, build up of insecticide residue in oil and cake beyond the permissible limit and the degradation of the environment (Singh, 2001 and Singh and Sharma, 2002). Effective control of mustard aphid *L. erysimi* is possible by use of systemic insecticides but it could not be permanent solution as its population again attains the same level within a fortnight after spray of chemical (Singh *et al.*, 1984). Beside this, the chemical insecticides also reduced the population of natural enemies. Hence, the present investigation was undertaken to determine the effect of weather parameters on mustard aphid infestation and to find out the reaction of different varieties of various *Brassicas* crops against mustard aphid and monitoring of alate mustard aphid.

Materials and Methods

The experiments were carried out at the Experimental Farm Agricultural Research Station, Navgaon, Alwar (Rajasthan) during 2014-15 and 2015-16 *rabi* seasons. The trail was laid out with plot size of 12.6 m^2 in randomized block design with four treatments replicated thrice two environmental conditions *viz.*, timely and late sown conditions. The unit plot size was 3.0m × 4.2m with spacing of 30 cm between rows and 10 cm between plants. Observations were recorded at weekly interval right from the first appearance of mustard aphid. The four treatments selected for the investigation comprised of Indian mustard (Rohini), Taramira (T-27), Gobhi sarson (GSC-6) and Brown sarson (BSH-1). All necessary intercultural operations and crop management practices were done as per recommendations. Ten randomly selected plants were tagged in each plot for recording observations. Number of aphids was counted from selected plants (sampling units). Each sampling unit comprised of 10 cm long tip of inflorescence.

Monitoring of alate mustard aphid through installing yellow (chrome) painted smeared with transparent greasy material on 1 kg oil tin box (round) at five locations in the experimental farm at 1.5 m above ground from first week of October onwards. The height of the trap was so adjusted that it remained 1 feet above the crop canopy. The data on winged trapped mustard aphids were recorded daily by taking care of cardinal directions throughout the year.

The population counts recorded on weekly basis after appearance of mustard aphid till harvest of the crop. From these observations mean aphid population per ten plants was estimated and subjected to statistical analysis.

Results and Discussion

Mustard aphid (*L. erysimi*) infestation was first observed in Rohini, GSC 6 and BSH-1 than T 27 under timely and late sown condition respectively, during both the years. Though appearance of aphid was observed in 1^{st} to 4^{th} standard week in all the species but reached at peak population in 8^{th} to 9^{th} standard week in Rohini, T 27 and GSC-6 and 7^{th} to 8^{th} standard week in BSH-1 under timely and late sown conditions during both seasons. The maximum peak population of mustard aphid were recorded in BSH-1 (513.0) followed by GSC 6, Rohini and T 27 as (447.0, 293.0, 51.0) under timely sown conditions during 2014-15 and similar trends were also recorded as 1140.0, 476.6, 386.0, 326.6 in 2015-16. The order of maximum peak population and aphid infestation was BSH-1 e” GSC 6 e” Rohini e” T 27 as 752.6, 296.6, 251.6, 41.0 in 20014-15 and 1250.0, 913.3, 896.6, 796.6 in 2015-16 under late sown conditions. Result shows that late appearance (in 4^{th} standard week) of aphid in 2014-15 leads to low population build up and early appearance in 2015-16 (1^{st} standard week) leads to high population build up in over the seasons. The results clearly indicated that escape mechanism from mustard can be achieved if the crop would have sown 3 weeks earlier. Alate mustard aphid was observed from 43^{rd} standard week to 12^{th} standard week with peak (145.7 aphids/trap) in 9^{th} standard week and disappeared during 12^{th} standard week during (2014-15). Similarly during 2015-16 alate mustard aphid was observed from 43^{rd} standard week to 12^{th} standard week with peak (3447.4 aphids/trap) in 9^{th} standard week and disappeared during 12^{th} standard week.

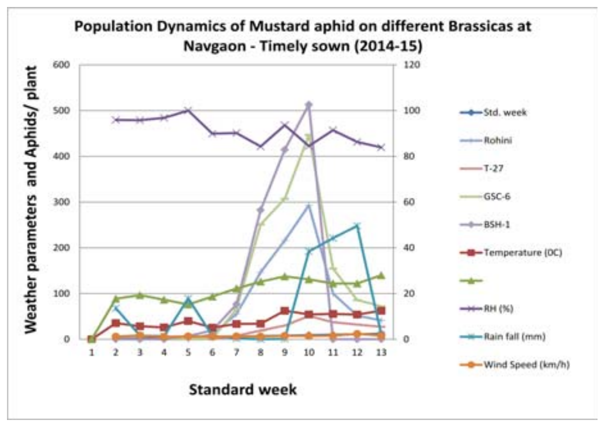


Figure 1: Relationship between aphid infestation and weather parameters.

Year 2014-15

Rohini Timely:

Aphid population=-1095.06-13.41T_{max}+32.93T_{min}+8.16 RH+3.13RF-159.52WS

(R^2=0.76)

T27 timely:

Aphid population=-74.65+0.29T_{max}+3.49T_{min}+0.24 RH+0.57RF-12.59WS

(R^2=0.96)

GSC 6 timely:

Aphid population=-1498.19-20.57T_{max}+49.02T_{min}+10.82

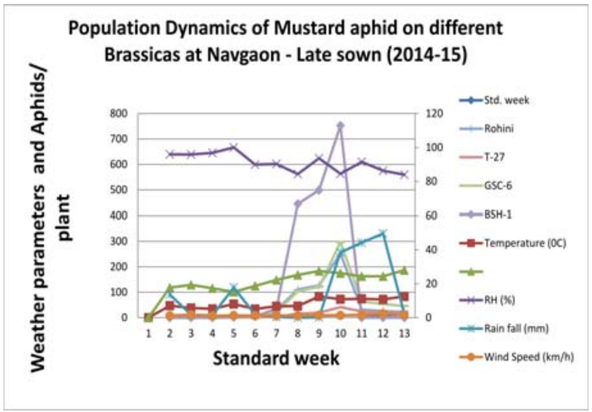
RH+4.88RF-242.17WS

(R^2=0.77)

BSH 1 timely:

Aphid population=-1877.95-24.83T_{max}+57.13T_{min}+14.57 RH+3.90RF-308.58WS

(R^2=0.55)



Year 2014-15

Rohini late:

Aphid population=-1602.34-73.15T_{max}+ 82.67T_{min}+ 3.48 RH+389.31RF-52.41WS

(R^2=0.92)

T27 late:

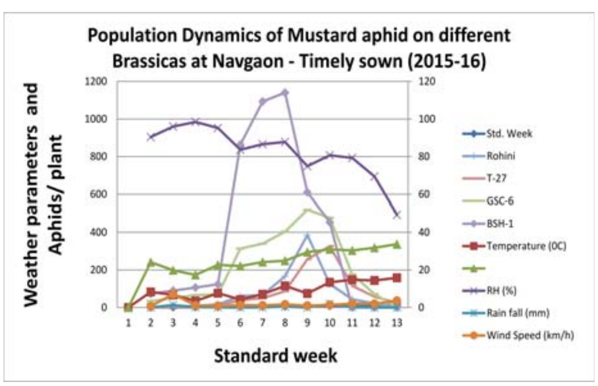
Aphid population=-42.80 -0.14T_{max} +2.59T_{min} +0.10RH +0.48RF -12.49WS

(R^2=0.93)

GSC 6 late:

Aphid population= -262.65 -5.77T_{max} +18.83T_{min} +1.26RH 2.96RF -140.05WS

(R^2=0.68)



BSH 1 late:

Aphid population= -2048.37 -36.32T_{max} +75.80T_{min}+15.35RH+6.37RF-457.23WS

(R^2=0.54)

2015-16

Rohini Timely:

Aphid population=-1239.51 -38.75T_{max} +46.34T_{min} +5.67RH +9.56RF +4.80WS

(R^2=0.52)

T27 timely:

Aphid population=-854.93-25.23T_{max} +35.36T_{min} +2.96RH +114.66RF -14.46WS

(R^2=0.89)

GSC 6 timely:

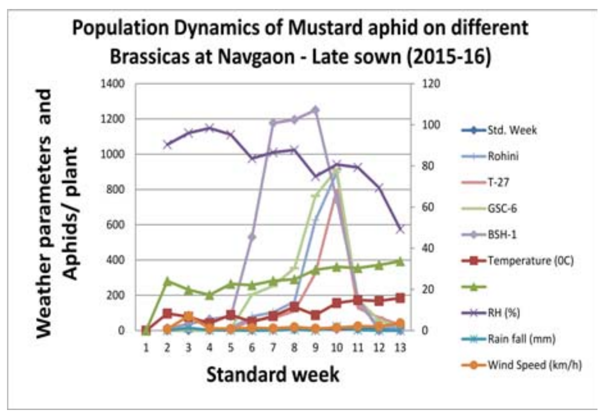
Aphid population=-860.22 -49.37T_{max} +49.14T_{min} +3.34RH +162.32RF -35.13WS

(R^2=0.57)

BSH 1 timely:

Aphid population=2020.06-47.67T_{max}-6.36T_{min}-10.94 RH+227.76RF-100.54WS

(R^2=0.21)



Year 2015-16

Rohini late:

Aphid population=-403.44 -8.58T_{max} +19.99T_{min} +2.67RH +2.35RF -133.10WS

(R^2=0.62)

T27 late:

Aphid population=-532.12 -36.60T_{max} +42.15T_{min} -1.22RH +368.65RF -58.08WS

(R^2=0.98)

Table 1: Population dynamics of mustard aphid in *Brassicas* at Navgaon (2014-15)

Meteorological observation						Number of aphid/10 cm twig							
Std. week	Temp. (°C) Max.	Temp. (°C) Min.	RH (%)	Rain fall (mm)	Wind Speed (km/h)	Rohini Timely sown	Rohini Late sown	T 27 Timely sown	T 27 Late sown	GSC 6 Timely sown	GSC 6 Late sown	BSH 1 Timely sown	BSH 1 Late sown
1	7.1	17.7	95.9	13.6	1.2	0	0	0	0	0	0	0	0
2	5.7	19.3	95.8	1.6	1.7	0	0	0	0	0	0	0	0
3	5.2	17.3	96.8	1.4	1.1	0	0	0	0	0	0	0	0
4	8	15.2	100	17.8	1.3	0.5	0.3	0.2	0.8	1	0.1	7	1.6
5	5.1	18.7	89.9	1.6	1.2	11	2.5	0.5	0.5	1.5	0.4	19.3	4.6
6	6.7	22.2	90.2	0.4	1.3	55.3	29.3	7.5	4.3	66.3	19.3	76.6	35
7	6.8	25.2	84.3	0	1.2	146.6	111.1	19	15	251	103.8	282.6	444.5
8	12.5	27.5	93.6	0.2	1.5	216	126.5	30.1	19.8	307.3	121.3	414.6	498.6
9	10.9	26.2	84.5	38.4	1.4	293	251.6	51	41	447	296.6	513	752.6
10	11.1	24.4	91.4	44.2	1.6	100	31.6	37.3	24.8	154.6	63.3	0	0
11	10.8	24.4	86.3	49.6	2.4	51.6	26.1	32.1	21.6	86	53.5	0	0
12	12.5	28	83.9	2	1.6	41.3	22.3	27.3	16.5	72.1	45.3	0	0

Table 2: Correation of mustard aphid with different weather parameters (2014-15).

Genotypes and sowing conditions	Correlation coefficient (r)					Coefficient of determination(R^2)
	Max. temp. (T_{max})	Min. temp. (T_{min})	Relative humidity (RH)	Rainfall (RF)	Wind speed (WS)	
Rohini Timely sown	0.56	0.71	-0.50	0.26	0.02	0.76
Rohini Late sown	0.20	0.42	-0.14	0.55	-0.23	0.92
T27 Timely sown	0.83	0.84	-0.66	0.62	0.44	0.96
T 27 Late sown	0.76	0.79	-0.66	0.62	0.38	0.93
GSC 6 Timely sown	0.56	0.72	-0.53	0.28	0.04	0.77
GSC 6 Late sown	0.53	0.64	-0.56	0.38	0.07	0.68
BSH 1 Timely sown	0.37	0.56	-0.37	0.03	-0.14	0.55
BSH 1 Late sown	0.35	0.55	-0.42	0.07	-0.14	0.54

Table 3: Population dynamics of mustard aphid in brassicas at Navgaon (2015-16).

Standard week		Meteorological observation				Number of aphid/10 cm twig							
Std. week	Temp. (°C) Max.	Temp. (°C) Min.	RH (%)	Rain fall (mm)	Wind Speed (km/h)	Rohini Timely sown	Rohini Late sown	T 27 Timely sown	T 27 Late sown	GSC 6 Timely sown	GSC 6 Late sown	BSH 1 Timely sown	BSH 1 Late sown
1	8.3	24.1	90.4	0.1	0.7	0	0	0	0	35	0	73.3	13.3
2	6.7	19.8	96	1.3	7.1	3.3	0	0	0	49	0	90	36.6
3	3.5	17.3	98.4	0.2	1.1	8.3	5	0	0	66.6	0	106.6	63.3
4	7.6	22.7	95.2	0.1	0.8	17	12.3	12.3	7.3	70	11	123.3	81
5	4.2	22.1	83.6	0	1.3	60	80	38.3	58.3	313.3	203.3	863.3	530
6	7.1	24.2	86.6	0.1	1.1	66.6	103.3	50	71.6	340	253.3	1093.3	1176.6
7	11.5	24.9	87.8	0.5	1.7	166.6	163.3	86.6	110	403.3	353.3	1140	1195.6
8	7.5	29.5	74.9	0	1	386	626.6	256.6	326.6	520	763.3	610	1250
9	13.4	31	80.7	1.9	1.4	125	896.6	326.6	796.6	476.6	913.3	453.3	743.3
10	14.8	30.4	79.3	0.3	2.1	44	156	115	128.3	176.6	176.6	0	183.3
11	14.4	31.8	69.4	0	2	21.6	22	57	73	71.3	56.6	0	0
12	15.8	33.7	49.3	0	3.6	0	17	24.3	31	0	24.3	0	0

Table 4: Correation of mustard aphid with different weather parameters (2015-16).

Genotypes and sowing conditions	Correlation coefficient (r)					Coefficient of determination(R^2)
	Max. temp. (T_{max})	Min. temp. (T_{min})	Relative humidity (RH)	Rainfall (RF)	Wind speed (WS)	
Rohini Timely sown	-0.04	0.25	-0.12	0.01	-0.27	0.52
Rohini Late sown	0.44	0.61	-0.51	0.24	-0.03	0.62
T27 Timely sown	0.31	0.53	-0.23	0.48	-0.24	0.89
T27 Late sown	0.31	0.45	-0.16	0.66	-0.19	0.98
GSC 6 Timely sown	-0.05	0.18	0.00	0.26	-0.36	0.57
GSC 6 Late sown	0.15	0.39	-0.14	0.46	-0.28	0.84
BSH 1 Timely sown	-0.28	-0.15	0.15	-0.00	-0.30	0.21
BSH 1 Late sown	-0.11	0.08	0.02	0.07	-0.33	0.30

Table 5: Monitoring of alate mustard aphid on sticky yellow traps at Navgaon (2014-15).

Standard Week	Mean Mustard aphid (alate) population/ trap (2014-15)	Mean Mustard aphid (alate) population/ trap (2015-16)
1	0.0	2.0
2	0.0	4.1
3	0.0	1.3
4	0.0	10.6
5	0.3	4.7
6	0.5	34.3
7	35.8	289.6
8	102.5	2431.4
9	145.7	3447.4
10	50.9	77.1
11	45.6	8.1
12	0.0	0.0

Table 6: Correation of alate mustard aphid with different weather parameters.

	Correlation coefficient (r)					Coefficient of determination(R^2)
Alate aphid	T_{min}	T_{max}	RH	RF	WS	
Alate aphid (2014-15)	0.77	-0.41	0.47	0.51	0.61	0.69
Alate aphid (2015-16)	0.88	-0.71	0.15	0.12	0.16	0.91

GSC 6 late:

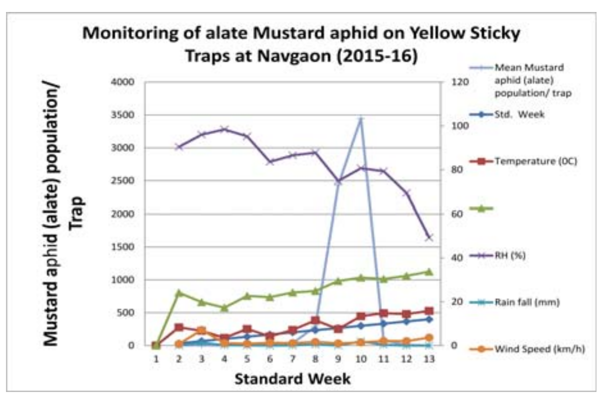
Aphid population=-1652.32 -82.78T_{max} +90.10T_{min} +3.73RH+378.89RF-57.93WS

(R^2=0.84)

BSH 1 late:

Aphidpopulation=-1839.82-110.15T_{max}+104.61T_{min}+8.14 RH+232.63RF-71.94WS

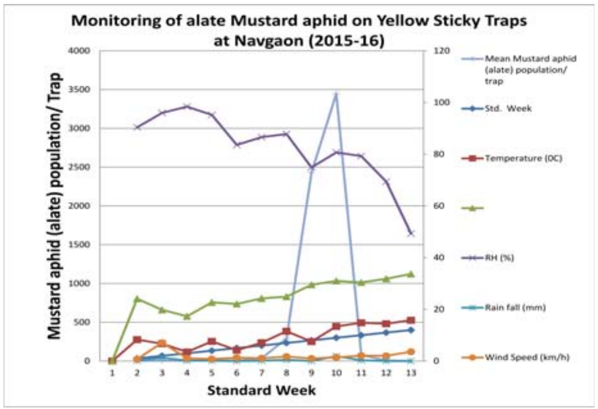
(R^2=0.30)



Year 2014-15

Alate Aphid population=-651.29-5.81T_{max}+15.13T_{min}+5.04 RH+1.92RF-61.34WS

(R^2=0.69)



Year 2015-16

Alate Aphid population = -5952.48 -313.67T_{max} + 328.40 T_{min} 8.90RH 1613.46RF-194.01WS (R^2=0.91)

The mustard aphid population exhibited positive correlation with maximum and minimum temperature while negative correlation was exhibited with relative humidity (Table 1 and 2). However, no clear relationship was observed with rainfall and wind speed. All the five meteorological parameters explained most of the variation in aphid population as evident from coefficient of determination. The maximum coefficient of determination was observed for aphid population on T 27 (R2=0.96, 0.93) for early and 0.89, 0.98 for late sown crop during 2014-15 and 2015-16, respectively. While it was minimum for BSH-1 (0.21 and 0.30 for early and late sown crop in 2015-16. Alate mustard aphid in different *Brassica* species is largely governed positively by temperature and negatively by relative humidity. The coefficient of determination was observed for alate aphid population as R2=0.69 in 2014-15 and 0.91 in 2015-16. Thus, infestation of mustard aphid in different *Brassica* species is largely governed positively by temperature and negatively by relative humidity. The increase in relative humidity in winter season is largely associated with reduced temperature which in turn is responsible for low aphid population at high relative humidity when temperature is low. Choudhary and Pal (2009), Singh and Malik (1998), Rupa *et al.* (2018) reported similar findings earlier. It can be concluded that different *Brassicas* had less aphid infestation in timely sown conditions than in late sown condition. However, it needs further investigation for more confirmation.

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