Int. J. Indust. Entomol. Vol. 4, No. 1, 2002, pp. 69~76

International Journal of
Industrial Entomology

Population Dynamics of Mustard Aphid, *Lipaphis erysimi* (Kaltenbach) as Influenced by Abiotic Factors and Different Rapeseed Mustard Genotypes

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(Received 25 January 2002; Accepted 9 February 2002)

Mustard aphid, *Lipaphis erysimi* (Kalt.) plays a key role in determining the productivity of rapeseed-mustard. This pest alone attributes 30-70% losses in yield potential in different agro climatic zones with a mean loss of 54.2% in India. Considering the extent of damage caused by the pest, the present experiment was conducted at Pulses and Oilseeds Research Station during 1992-93 to 1994-95 to study the migratory nature of mustard aphid by trapping them in yellow colour pan tray and their simultaneous growth and development on three different genotypes. The temperature during noon hours is the predominant factor to govern the appearance of alate mustard aphid in rapeseed-mustard field. Stepwise regression analysis revealed that temperature and relative humidity played an important role for its development. The variety RW white flower glossy stem harboured minimum number of aphid in comparison to other two varieties B 9 and T6342. The population reached a peak of 61.28 aphids/10 cm central twig during 6th standard week irrespective of varieties.

Key words : *Lipaphis erysimi* (Kalt.), Yellow coloured pan tray, Temperature, Relative humidity, Genotypes

Introduction

India holds a premier position in the global oilseeds scenario accounting for 19% of total area and 9% of production. The rapeseed-mustard is the most important oilseed crop after groundnut in India which recorded the total production of about 6.2 million tonnes in 1997-98 (Hedge and Kiresur, 1999). The average production of rapeseed-mustard in India is still low i.e. 874 kg/ha as compared to world average of 1,262 kg/ha (Chopra, 1991).

The low productivity of rapeseed-mustard is largely due to attack of insect pests and diseases. Among the insect pests and diseases, mustard aphid, *Lipaphis erysimi* (Kalt.) is reported to be the most serious (Rohilla *et al.*, 1987; Bakhetia and Sekhon, 1989). Environment plays an important role in influencing the multiplication of mustard aphid. Cloudy and cold weather (20°C or below) is the most favourable for multiplication of mustard aphid. The winged forms are observed to move from field to field during autumn and spring (Atwal, 1976). Among the environmental parameters, temperature, relative humidity and rainfall have profound effect on survival and multiplication of mustard aphid (Kumar *et al.*, 2000). A severe outbreak of aphid could be apprehended following continuous favourable weather conditions (Singh and Sidhu, 1959; Brar and Sadhu, 1976). Aerial movement of alate aphid is restricted when it settles on growing rapeseed-mustard crop and sheds its wing to multiply viviparous apterous young ones. Population build-up vary on different genotypes of rapeseed-mustard.

Moreover, the experiment was conducted to study the influence of different weather parameters on arrival, dispersal and subsequent population build-up of mustard aphid on rapeseed mustard genotypes and role of genotypes in governing its population. Such study would generate preliminary data on the population dynamics of the pest and help formulate effective management strategies for the same in future.

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Materials and Methods

The experiment was conducted at Pulses and Oilseeds

Table 1. Arrival and dispersal of mustard aphid, *L. erysimi* (Kalt.) population on yellow pan tray during 1992-93, 1993-94 and 1994-95

STD Week		Temp (°C)		RH (%)		Rain Fall (mm)	Sun Shine (hrs.)	Cloud Inten-sity	Wind Velocity (Km/hr)	Mean No.of Aphid/Tray
		Max	Min	Morning	Evening					
47	1	26.5	15.8	93	50	1.08	7.90	0.95	1.30	00
	2	27.7	14.9	89	40	0.00	9.00	0.57	1.00	00
	3	26.3	15.3	95	44	0.05	7.00	1.42	2.10	01
48	1	24.9	14.9	96	57	0.06	7.10	0.90	2.50	01
	2	27.6	15.1	92	41	0.00	8.01	0.71	1.20	00
	3	26.2	15.0	94	47	0.00	8.50	0.85	1.60	01
49	1	24.4	12.1	95	40	0.00	8.70	0.85	1.60	02
	2	27.2	14.0	93	36	0.00	8.57	0.28	0.70	01
	3	27.5	13.2	93	32	0.00	8.41	0.57	0.70	01
50	1	24.5	11.0	93	39	0.00	8.90	0.57	2.30	03
	2	24.9	12.2	89	40	0.00	8.67	0.14	1.20	02
	3	25.2	11.3	92	35	0.00	8.60	0.14	1.10	03
51	1	24.2	11.3	95	49	0.00	8.62	1.57	1.55	12
	2	26.2	12.9	92	38	0.00	8.73	1.43	1.30	03
	3	25.0	11.2	90	34	0.00	8.57	1.14	1.10	10
52	1	24.8	11.7	95	35	0.00	7.56	2.14	1.60	08
	2	24.8	12.1	89	37	0.00	8.43	1.86	2.10	05
	3	24.9	13.6	91	30	0.00	7.34	2.14	1.60	11
01	1	23.6	11.3	96	42	0.00	7.95	2.57	1.94	12
	2	25.6	12.8	92	39	0.00	7.98	2.43	1.80	06
	3	25.5	10.9	90	41	0.00	8.46	1.66	1.51	15
02	1	23.3	13.5	90	58	0.00	5.26	3.29	1.90	10
	2	25.5	12.3	94	39	0.00	8.10	2.86	2.25	03
	3	22.4	13.3	91	44	18.00	4.38	2.85	2.14	25
03	1	23.2	09.5	93	26	0.00	8.38	1.14	1.10	18
	2	25.7	12.9	92	41	0.00	7.74	3.28	1.80	04
	3	22.0	11.9	93	24	0.00	7.42	1.57	1.00	21
04	1	22.1	08.3	89	30	0.00	9.00	0.71	1.51	63
	2	21.8	11.0	91	55	16.40	6.41	1.43	0.98	19
	3	22.9	09.0	92	28	0.00	9.00	0.71	2.37	55
05	1	25.3	11.7	92	43	1.00	8.69	1.43	1.47	322
	2	24.4	10.5	89	35	0.00	8.74	1.29	1.10	158
	3	24.7	11.2	92	31	0.00	8.91	1.42	1.47	342
06	1	27.8	14.0	90	39	0.00	7.63	1.85	1.70	412
	2	23.3	13.4	93	57	26.40	4.93	3.43	2.30	264
	3	24.9	11.5	93	33	5.00	7.72	1.82	1.10	461
07	1	30.1	17.6	93	39	0.00	6.90	2.86	1.10	93
	2	24.6	13.4	95	51	2.20	7.86	2.43	1.30	75
	3	27.7	15.8	95	38	0.00	6.40	2.29	1.55	78
08	1	27.3	13.7	90	35	0.23	5.30	2.57	2.37	06
	2	26.2	13.0	87	38	0.00	9.82	0.00	2.37	06
	3	26.9	14.8	93	36	0.42	8.21	1.14	0.80	11
09	1	29.5	15.4	90	32	0.00	9.00	0.28	1.51	01
	2	30.3	15.2	90	32	0.00	9.90	0.00	1.47	04
	3	30.6	13.5	92	32	0.00	9.32	0.00	1.20	03
10	1	33.9	18.5	89	34	0.00	9.20	0.00	1.37	00
	2	32.3	17.2	92	33	0.00	9.97	0.00	1.10	01
	3	30.9	13.1	90	31	0.00	8.80	0.57	1.60	00

1=1992-93 2=1993-94 3=1994-95

Research Station, Berhampore, West Bengal during 1992-1993, 1993-1994 and 1994-1995. To trap the alate mustard aphid, yellow coloured iron trays of size 43 cm × 30 cm × 10 cm filled with water was placed at a height of 152 cm in the four corners of the experimental field through out the crop season. Everyday the catch reading was recorded and afterwards each tray was refilled with fresh water. Three varieties i.e., RW White flower glossy stem, T-6342 and B-9 were used to assess their response to mustard aphid [*Lerysimi* (Kalt.)]. With these three varieties, the experiment was laid out in split plot design with three replications.

Mustard aphid population was recorded during the period starting from one month age of crop till maturation of pods. The data of aphid population on three genotypes were collected from 10 cm central twig over 10 randomly selected plants from each plot at 7 days interval. Simultaneously, data on weather parameter were gathered from the meteorologist. The data of alate aphid on yellow tray, population dynamics on three genotypes and different weather parameters as collected were subjected to statistical analysis. The package on which the analysis was done is BMDP 1998 Statistical Software, Inc., Los Angles, USA.

Results and Discussion

The appearance, settlement and population dynamics of mustard aphid, *L. erysimi* (Walt.) were studied by two sep-

Table 2. Correlation matrix of different environmental variables on aphid during 1992-93

	Aphid	Temp. (max)	Temp. (min)	R.H. (morn)	R.H. (even)	Rainfall	Cloud	Sunshine hours
Aphid	1.000							
Temperature (Maximum)	-0.253	1.000						
Temperature (minimum)	0.015	0.887	1.000					
Relative Humidity (Morning)	0.644	0.062	0.049	1.000				
Relative Humidity (Evening)	-0.234	0.040	0.407	0.019	1.000			
Rainfall	0.392	0.052	-0.036	-0.064	0.096	1.000		
Cloud	-0.397	0.377	0.735	0.213	0.657	-0.232	1.000	
Sunshine Hours	0.239	0.254	0.634	0.143	0.595	0.298	-0.889	1.000

Temp.=Temperature, R.H.=Relative Humidity

Table 3. Stepwise regression for estimating effects of environmental variables on aphid during 1992-93

Step No	Variables Entered	Multiple R-Square	Regression Equation	Partial correlation with remaining variables						
				X_3	X_5	X_1	X_2	X_6	X_7	X_4
0	--	--	3.015	0.644	0.392	-0.253	0.015	-0.397	0.239	-0.234
1	X_3	0.42	$58.762\ 0.602 * X_3$		0.459	0.384	0.061	-0.348	0.438	-0.289
2	X_3,X_5	0.54	$53.002 + 0.581 * X_3 + 4.997 * X_5$			0.404	0.085	-0.283	0.349	-0.378
3	X_3,X_5,X_1	0.61	$48.087\ 0.598*X_3 + 4.778* X_5 + 0.266*X_1$				-0.661	-0.527	0.538	-0.428
4	X_3,X_5,X_1,X_2	0.78	$40.278 + 0.608*X_3 + 3.716* X_5 + 1.048* X_1\ 0.821*X_2$					0.536	-0.299	0.312
5	X_3,X_5,X_1,X_2,X_6	0.84	$40.215\ 0.802*X_3 + 5.033* X_5 +2.356*X_1 2.603* X_2 + 3.086 * X_6$						-0.023	0.615
6	X_3,X_5,X_1,X_2,X_6,X_7	0.85	$39.814\ 0.793*X_3 + 5.086*X_5 + 2.372 * X_1\ 2.620 * X_2 + 3.016* X_6\ 0.072 * X_7$							0.679

*If relative humidity (Evening) is introduced within regression equation, the reliability of the effect of temperature (minimum) is uncertain.

X_1=Temperature (maximum), X_2=Temperature (minimum), X_3=Relative humidity (morning), X_4=Relative humidity (evening), X_5=Rainfall (mm), X_6=Cloud intensity, X_7=Sunshine hours arate experiments on the rapeseed-mustard crop. In the first experiments, it was found that the alate of mustard aphid, *L. erysimi* (Kalt.), trapped in yellow tray, started appearing in the field from 47th standard week onwards, remaining at low level up to 50th standard week . Alate number gradually increased from 51st standard week and reached peak (397 no.) during 6th standard week. The trend was similar in all the experimental years. But numerically

Table 4. Correlation matrix of different environmental variables on aphid during 1993-94

	Aphid	Temp. (max)	Temp. (min)	R.H. (morn)	R.H. (even)	Rainfall	Cloud	Sunshine hours
Aphid	1.000							
Temperature (Maximum)	-0.533	1.000						
Temperature (Minimum)	0.199	0.415	1.000					
Relative Humidity (Morning)	0.446	0.130	0.741	1.000				
Relative Humidity (Evening)	-0.731	-0.742	0.265	0.498	1.000			
Rainfall	0.701	-0.829	0.073	0.219	0.914	1.000		
Cloud	-0.702	0.696	-0.260	-0.367	-0.907	-0.952	1.000	
Sunshine Hours	0.344	0.161	0.685	0.679	0.336	0.220	-0.498	1.000

Temp.=Temperature, R. H.=Relative Humidity

Table 5. Stepwise regression for estimating effects of environment variables on aphid during 1993-94

Step No	Variables Entered	Multiple R-Square	Regression Equation	Partial correlation with remaining variables						
0	--	--	2.183	X_4 -0.731	X_7 0.344	X_5 0.701	X_3 0.446	X_1 -0.533	X_2 0.199	X_6 -0.702
1	X_4	0.53	-4.165 + 0.146 * X_4		X_7 0.153	X_5 0.117	X_3 0.139	X_1 0.020	X_2 0.008	X_6 -0.134
2	X_4 , X_7	0.54	-4.355 + 0.138 * X_4 + 0.226 * X_7			X_5 0.158	X_3 0.055	X_1 -0.106	X_2 -0.123	X_6 -0.068
3	X_4, X_7,X_5	0.58	-2.700 0.088*X_4 + 0.279* X_7 + 0.259*X_5				X_3 0.231	X_1 -0.023	X_2 -0.069	X_6 0.381
4	X_4,X_7,X_5,X_3	0.58	-24.024 - 0.173*X_4 - 0.016* X_7 + 0.615 * X_5 + 0.275*X_3					X_1 0.222	X_2 -0.185	X_6 0.314
5	X_4,X_7,X_5,X_3 X_1	0.60	-26.572 0.089*X_4 + 0.109* X_7 +0.589*X_5+0.483* X_3 - 0.528 * X_1						X_2 0.039	X_6 0.288
6	X_4,X_7,X_5,X_3, X_1,X_2	0.60	-25.038 + 0.119 * X_4 + 0.089 * X_7 + 0.583 * X_5 + 0.513 * X_3 - 0.722 * X_1 + 0.154 * X_2							X_6 0.291

X_1=Temperature (maximum), X_2=Temperature (minimum), X_3=Relative humidity (morning), X_4=Relative humidity (evening), X_5=Rainfall (mm), X_6=Cloud intensity, X_7=Sunshine hours

Table 6. Correlation matrix of different environmental variables on aphid during 1994 - 95

	Aphid	Temp. (max)	Temp. (min)	R.H. (morn)	R.H. (even)	Rainfall	Cloud	Sunshine hours
Aphid	1.000							
Temperature (Maximum)	-0.052	1.000						
Temperature (Minimum)	-0.355	0.485	1.000					
Relative Humidity (Morning)	0.349	0.253	0.413	1.000				
Relative Humidity (Evening)	-0.255	0.298	0.362	-0.260	1.000			
Rainfall	0.162	-0.373	0.182	-0.084	0.578	1.000		
Cloud	0.278	0.131	-0.704	-0.174	-0.553	-0.765	1.000	
Sunshine Hours	-0.221	0.135	0.808	0.088	0.621	0.650	-0.908	1.000

the aphid was recorded maximum (461 no.) during 1994-95 followed by 1992-93 (412 no.) and minimum during 1993-94 (264 no.). This clearly indicate that mustard aphid pressure on the rapeseed- mustard crop is required to be observed from 51[st] to 6[th] standard week for its proper management in West Bengal. Mean weather parameters ranging from 23.3°C to 27.0°C for temperature (maximum), 11.5°C to 14.0°C for temperature (minimum), 90 to 93% for RH (morning), 33 to 57% for RH (evening), 0.0 to 26.4 mm for rainfall, 49.00 to 07.72 for sunshine hours, 1.82 to 3.43 for cloud intensity and 1.1 to 2.3 for wind velocity (Km/hr) during 6[th] standard week proved conducive for maximum aphid appearance as indicated by yellow tray catch (Table 1).

From the development of population on the genotypes as was observed during 1992-93 that temperature(maximum and minimum), relative humidity (morning and evening) rainfall (mm), cloud intensity and sunshine hours

Table 7. Stepwise regression for estimating effects of environmental variables on aphid during 1994-95

Step No	Variables Entered	Multiple R-Square	Regression Equation	Partial correlation with remaining variables						
				X_2	X_3	X_7	X_6	X_5	X_4	X_1
0	--	--	3.486	-0.355	0.349	-0.221	0.278	0.162	-0.255	-0.052
1	X_2	0.12	10.633 0.593 * X_2		0.583	0.119	0.043	0.246	-0.146	0.146
2	X_2 , X_3	0.42	-97.477 + 1.006 * X_2 + 1.231 * X_3			0.535	-0.078	0.437	0.191	0.133
3	X_2, X_3,X_7	0.59	-133.145 2.212 * X_2 + 1.703 * X_3 + 3.934 * X_7				0.785	-0.117	-0.093	0.581
4	X_2,X_3,X_7,X_6	0.84	-206.227 2.797 * X_2 + 2.202 * X_3 + 11.228 * X_7+ 2.854*X_6					0.854	-0.101	0.100
5	X_2,X_3,X_7,X_6 X_5	0.96	-204.791 0.848*X_2 + 1.839* X_3 + 6.555*X_7 + 4.558 * X_6 + 2.769 * X_5						-0.835	-0.827
6	X_2,X_3,X_7,X_6, X_5,X_4	0.98	-186.817 0.520 * X_2 + 1.617 * X_3 + 6.541 * X_7 + 4.848 * X_6 + 3.307 * X_5 0.129 * X_4							-0.320
7	X_2,X_3,X_7,X_6, X_5,X_4,X_1	0.99	-196.001 0.071 * X_2 + 1.674 * X_3 + 6.342 * X_7 + 5.519 * X_6 + 3.510 * X_5 0.073 * X_4 0.341 * X_1							

X_1=Temperature (maximum) , X_2=Temperature (minimum), X_3=Relative humidity (morning) , X_4=Relative humidity (evening), X_5=Rainfall (mm), X_6=Cloud intensity, X_7=Sunshine hours

Table 8. Population of mustard aphid, *Lipaphis erysimi* (Kalt.) recorded at weekly intervals on three varieties of rapeseed - mustard when pooled over three years (1992-93,1993-94,1994-95)

Standard Week	Mean population of aphids/plant (10 cm central twig)			Mean
	V_1	V_2	V_3	
52	0.11(0.78)	0.25(0.86)	0.50(0.97)	0.29(0.87)
01	0.75(1.08)	1.17(1.29)	0.44(0.95)	0.79(1.11)
02	1.35(1.32)	4.79(2.19)	1.55(1.33)	2.56(1.61)
03	1.82(1.50)	9.03(2.99)	6.67(2.52)	5.84(2.33)
04	8.50(2.77)	24.99(4.74)	14.39(3.64)	15.85(3.71)
05	19.69(4.29)	43.66(6.29)	32.02(5.31)	31.81(5.29)
06	48.33(6.59)	63.64(7.73)	71.86(8.91)	61.28(7.50)
07	7.99(2.46)	4.04(1.66)	22.51(4.54)	11.51(2.89)
Mean	11.02(2.59)	18.95(3.46)	18.75(3.43)	16.24(3.16)
	Variety(V)	Week(W)	V x W	
SEm(±)	0.023	0.035	0.107	
CD(5%)	0.069	0.099	0.300	

were correlated and found that all of them had non-significant impact on aphid population (Table 2). Considering the weather parameters individually RH (morning) affected the aphid number the most with multiple "R" square value being 0.42. Eliminating the effect of RH (morning) from aphid population, partial correlation was computed (Table 3). This indicated that important factor in presence of RH (morning) was rainfall. These two variables together recorded R^2 value of 0.54. The next important factor was temperature (maximum) in the presence of RH (morning) and rainfall. These three variables jointly gave the multiple R^2 value is 0.61. Similarly temperature (minimum) expressed itself as an important factor in presence of RH (morning), rainfall and temperature (maximum). They together recorded multiple R^2 value of 0.78. But during 1993-94 the RH (evening) only affected the aphid number appreciably with multiple R^2 value of 0.53 (Table 4 and 5). Other factors did not affect the aphid population significantly.

The multiple R^2 value of 0.12 during 1994-95 recorded when temperature (minimum) affected the aphid number the most (Table 6 and 7). Next important factor in presence of temperature (minimum) was RH (morning) and both these variables gave multiple R^2 value of 0.42. Sunshine hours affected the aphid population least which with all the variables recorded R^2 value of 0.99. Hence, the RH (morning), temperature (maximum), rainfall and cloud intensity were the four components that appeared to have comparatively effective contribution in determining growth and population build- up of mustard aphid in plants over other components. The present findings are in complete agreement with that of Ram and Gupta (1987). They

Table 9. Population of mustard aphid, *Lipaphis erysimi* (Kalt.) recorded at weekly intervals in different years when pooled over three varieties

Standard Week	Mean population of aphids/plant(10 cm central twig)			Mean
	1992-93	1993-94	1994-95	
52	0.32 (0.91)	0.02 (0.72)	0.52 (0.98)	0.29 (0.81)
01	1.08 (1.24)	0.46 (0.96)	0.82 (1.13)	0.79 (1.11)
02	2.30 (1.72)	0.82 (1.11)	4.26 (2.01)	2.56 (1.61)
03	8.82 (2.95)	1.99 (1.56)	6.77 (2.50)	5.84 (2.33)
04	20.04 (4.16)	4.08 (2.13)	23.42 (4.86)	15.85 (3.71)
05	31.42 (5.57)	8.35 (2.95)	55.36 (7.37)	31.81 (5.29)
06	64.19 (7.59)	24.86 (4.84)	98.33 (9.44)	61.28 (7.50)
07	4.77 (1.94)	23.31 (4.64)	6.51 (1.87)	11.51 (2.89)
Mean	16.55 (3.30)	7.74 (2.37)	24.44 (3.83)	16.24 (3.16)
	Year(Y)	Week(W)	Y x W	
SEm(±)	0.029	0.035	0.107	
CD(5%)	0.115	0.099	0.300	

Figures in parentheses are vn+ 0.5 transformed value
V_1= RW white flower glossy stem , V_2= B-9, V_3=T6342

Table 10. Population of mustard aphid , *Lipaphis erysimi* (Kalt.) recorded at weekly intervals in different years when pooled over weeks

Standard Week	Mean population of aphids/plant(10 cm central twig)			Mean
	1992-93	1993-94	1994-95	
V1	10.13 (2.68)	5.76 (2.15)	17.17 (2.96)	11.02 (2.59)
V2	20.48 (3.64)	7.48 (2.46)	28.91 (4.25)	18.95 (3.46)
V3	19.06 (3.52)	9.97 (2.49)	27.23 (4.28)	18.75 (3.43)
Mean	16.55 (3.30)	7.74 (2.37)	24.44 (3.83)	16.24 (3.16)
	Year(Y)	Variety(V)	Y x V	
SEm(±)	0.029	0.023	0.111	
CD(5%)	0.115	0.069	0.342	

Figures in parentheses are vn+ 0.5 transformed value
V_1= RW white flower glossy stem , V_2= B-9, V_3=T6342

observed that the development of mustard aphid was favoured by temperature (maximum and minimum) and RH (morning). Mild shower and cloudy weather resulting in an increase of mustard aphid population, get full support from the earlier observations (Atwal *et al.*, 1971; Roy, 1975; Sharia, 1984a; Jaglan *et al.*, 1988; Bakhetia and Sekhon, 1989; Bishnoi *et al.*, (1992).

The population build-up of mustard aphid were studied at fixed interval of weeks starting from 52nd standard weeks for three consecutive years i. e., 1992-93, 1993-94 and 1994-95 and the results are presented in (Table 8, 9 and 10). From the tables it is evident that in all the three seasons the population of mustard aphid was found to increase gradually from 1st standard week reaching its peak in the 6th standard week irrespective of varieties. The variety RW white flower glossy stem harboured lesser number of aphids in comparison to other two varieties in all the three seasons. The variety B-9 (V_2) recorded maximum number of aphids 20.48 during 1992-93 and 28.91 during 1994-95, while variety T-6342 (V_3) recorded 9.97 aphids/plant during 1993-94.

During all the seasons the aphid population of B-9 (V_2) was statistically at par with the variety T-6342 (V_3) but differed significantly from variety RW white flower glossy stem(V_1).From Table 8, the highest population of 61.28 nos of aphids/10 cm central twig was found on rapeseed-mustard irrespective of varieties over three years.

From the above findings it is revealed that genetic makeup of the variety had pronounced impact on the population build-up of mustard aphid, *L. erysimi* (kalt.). RW white flower glossy stem (V_1) in spite of significant variation in aphid pressure due to years and exposure periods harboured minimum no of aphids/plant than other two varieties. The mechanism of tolerance to aphid in RW white flower glossy stem (V_1) may be searched in the light of prevailing morphological difference of the test varieties. The variety RW white flower glossy stem (V_1) possess white petal and non-waxy stem and leaves, while rest of the two cultivars are having normal bright yellow petal and waxy stem and leaves. Aphid repelling characteristics of the above two traits (white flower and non-waxy stem & leaves) were also reported by Pathak (1961), Srinivaschar and Malick (1972), Rai and Sehgal (1975), Jadav *et al.* (1985), Chatterjee and Nath (1986) and Chatterjee and Sengupta (1987) in Indian rapeseed-mustard. Moreover, Pradhan *et al.* (1960) and Phadke (1982) reported that *B. campestris* varieties were more suitable for aphid multiplication.

In view of all the above information control strategies for mustard aphid should exploit agricultural practices i.e., date of sowing, field sanitation, irrigation and fertilizers along with judicious use of insecticides based upon ETL. Also further studies are required for understanding clearly the genetics of aphid resistance in rapeseed- mustard cultivars for breeding aphid resistant genotypes.

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