

# DIFFERENTIAL RESPONSE OF RAPESEED AND MUSTARD CULTIVARS AGAINST MUSTARD APHID, *LIPAPHIS ERYSIMI*, KALTENBACH WITH RESPECT TO SOWING DATES

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## Abstract

Sixty-seven cultivars (brown sarson-1, Indian mustard-44, gobhi sarson-4, kiran rai-4, taramera-2, toria-5 and yellow sarson-7) of rapeseed and mustard were screened against mustard aphid, *Lipaphis erysimi* during winter season of 2004-05 and 2005-06. The findings revealed that aphids commenced their attack 7 weeks after sowing (WAS) and reached to a maximum level at 14 WAS on October 25 sown cultivars. Whereas, on November 10 and 25 seeded cultivars, the incidence was initially recorded at 6 WAS and 4 WAS and reaching to maximum at 13 WAS and 11 WAS, respectively. The early sown (October 25) cultivars escaped the aphid infestation and exhibited better growth due to stored moisture with minimum aphid load than late seeded (November, 10 and 25) cultivars. While calculating mean aphid infestation index (MAII), it remained < 1.00 on Maya, MYSL-203, Pusa Agrani (Indian mustard); Pusa Swarnim (kiran rai); NDYS-2 and YST-151 (yellow sarson) on first (October 25) and second (November 10) sown cultivars. Therefore, these cultivars could safely be placed under relative tolerant category. Among the late sown cultivars (November 25<sup>th</sup>), only Pusa Swarnim (kiran rai) exhibited tolerance to aphid (having MAII < 1.00), whereas, other cultivars namely CS-52, GM-2, Pusa Bahar and RN-393 were found highly susceptible to aphid attack (> 2.00 MAII). Interestingly, the gobhi sarson and kiran rai showed less damage due to their late flowering than other cultivars.

## Key words

Mustard aphid, Rapeseed and mustard cultivars, Screening, Sowing dates

## Introduction

Rapeseed and mustard are important oilseed crops, constituting a major source of edible oil for human as well as cake for animals. These crops are being cultivated in about 53 countries spreading over the six continents (Europe, Africa, North America, South America, Oceania and Asia) across the globe. In Asia it is primarily cultivated in China, India and Pakistan. Asian continent alone contributes 59.1 per cent of the acreage and 48.6 per cent of the world's production. However, India alone contributes about 28.3 per cent acreage and 19.8 per cent production of the world oilseeds (Yadava and Singh 1999).

In India, the position of rapeseed and mustard are next to groundnut in both area and production. These crops are mainly grown in tropical and subtropical regions of the world. The rapeseed and mustard crops are highly vulnerable to attack of insect pests. Bakhietia and Sekhon (1989) have listed more than three dozens of insect pests, associated with various

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phenological stages of the crop. Of all the insect pests, mustard aphid, *Lipaphis erysimi* is a widely distributed. It causes damage by sucking phloem from different parts and indirectly as a vector of plant viruses (Ali and Rizvi 2007). The attack is severe in those regions where the numbers of cloudy days are more during the pest activity period. Under heavy infestation, aphids are largely congregated underside of leaves and stems resulting in curling and yellowing of them. The yield loss in rapeseed and mustard also varies with their germplasms and agro-technological practices (Ansari et al. 2007). Therefore, in present investigations, sixty-seven cultivars of rapeseed and mustard were screened against mustard aphid with three different sowing dates to find out relative tolerant varieties.

### Materials and Methods

Sixty-seven promising varieties (brown sarson-1, Indian mustard-44, gobhi sarson-4, kiran rai-4, taramera-2, toria-5 and yellow sarson-7) were seeded in a randomised block design during rabi season of 2004-05 and 2005-06. To ensure good germination, ploughing of the experimental field was done with the help of soil turning plough followed by two cross ploughing with harrow. Farmyard manure @ 1.5 tones/ha and recommended level of fertilizers (60 kg N + 40 kg P<sub>2</sub>O<sub>5</sub> and 40 kg K<sub>2</sub>O) were properly mixed into soil. Each cultivar/variety was sown in one row of 4 m in length (replicated thrice) with spacing of 15 cm and 45 cm plant-to-plant and row-to-row, respectively. Three different sowing dates, October 25 (First sowing), November 10 (Second sowing) and November 25 (Third sowing) were selected for raising the crop. To determine the effect of abiotic factors on *L. erysimi* population, meteorological data was also recorded daily till harvesting of the crop.

All the cultivars, mentioned below, were obtained from the National Research Centre on Rapeseed-Mustard (NRCRM), Sear, Bharatpur, Rajasthan, India.

Brown Sarson (*Brassica rapa* var. Brown sarson)

1. BSH-1

Indian Mustard (*Brassica juncea*)

2. Alankar

3. Basanti

4. Bio-772

5. Bio-902

6. BS-2

7. CS-52

8. Durgamani

9. GM-2

10. GM-111

11. JM-1

12. Kranti

13. Krishna

14. Maya

22. Pusa Agrani

23. Pusa Bahar

24. Pusa Bold

25. Pusa Jagannath

26. RH-30

27. RH-718

28. RH-819

29. RH-8113

30. RH-8812

31. RL-1359

32. RLM-514

33. RLM-619

34. RN-393

35. Rohini

36. Sanjuct Asech

37. Sarma

- |  |               |
|--|---------------|
| 15. MYSL-203   | 38. Seeta     |
| 16. PBR-91   | 39. SEJ-2     |
| 17. PBR-97   | 40. TM-2      |
| 18. PCR-7  | 41. TM-4      |
| 19. PM-66  | 42. Urvashi   |
| 20. PM-67  | 43. Vardan    |
| 21. PR-8988  | 44. Varuna    |
| Gobhi Sarson ( <i>Brassica napus</i> )                   |               |
| 46. GSL-1  | 45. Vaibhav   |
| 47. GSL-2  | 63. Jhumka    |
| 48. Neelam   | 64. NDYS-2    |
| 49. Sheetal  | 65. PS-66     |
|  | 66. Pusa Gold |
|  | 67. YST-151   |
| Kiran Rai ( <i>Brassica carinata</i> )                   |               |
| 50. JTC-1  |               |
| 51. PBC-9902   |               |
| 52. PC-5   |               |
| 53. Pusa Swarnim   |               |
| Taramira ( <i>Eruca sativa</i> )                         |               |
| 54. RTM-314  |               |
| 55. TMLC-2   |               |
| Torja ( <i>Brassica rapa</i> var. torja)                 |               |
| 56. M-27   |               |
| 57. PT-30  |               |
| 58. PT-303   |               |
| 59. TL-15  |               |
| 60. TS-38  |               |
| Yellow Sarson ( <i>Brassica rapa</i> var. Yellow sarson) |               |
| 61. B-9  |               |
| 62. GS-1   |               |

Observations of *Lipaphis erysimi* infestation per 10 cm terminal inflorescence were recorded at weekly intervals (starting from initial incidence to disappearance of aphid) on 5 randomly selected plants from each row as per suggestions of Bakhetia and Sandhu (1973). The plants were categorised into 6 grades (0-5) depending upon aphid population and its symptoms. In order to get the mean aphid infestation index, the number of plants in each grade was multiplied by the respective grade and then the number of plants divides the figure. The grades were distributed as under

Grade no.	Description
0.	Plants are completely free from aphid.
1.	Plants having 1-15 aphids per inflorescence shoot. There is no symptom of aphid damage.
2.	Plants having 16-100 aphids per inflorescence. Shoots and plants start curling due to aphid attack.
3.	Plants having more than 100 aphids per shoot. Aphids infest most of the branches. Leaves start drying. Pods are curled.
4.	Each and every branch of the plant is fully covered with aphids and some of the branches start drying.
5.	Plant is completely dry immatures due to aphid infestation.

## Results

### First sowing (October 25)

The first observation on aphid infestation index recorded on December 13 exhibited its range from 0.00 to 0.33, followed by 0.00 to 0.67 in the following week (December 20). It progressively increased from 0.67 to 2.00, 1.00 to 2.50 and 1.84 to 2.84 on 03, 10 and 17 January, respectively. The Index reached to a maximum of 1.67 to 3.00 on 24 January except for toria and yellow sarson cultivars, wherein the maximum value of Index (2.00 to 2.84) was witnessed on 17 January. Thereafter, in subsequent weeks, 31 January, 14 and 28 February, the infestation decreased from 2.67 to 1.17, 1.67 to 0.00 and 0.33 to 0.00, respectively. The infestation on toria and yellow sarson cultivars was, however, found nil on 21 February due to early crop maturity (Table 1).

While comparing mean infestation index on different cultivars, it was computed below 1.00 on Maya, MYSL-203 and Pusa Agrani (Indian mustard), Pusa Swarnim (kiran rai) and NDYS-2, PS-66 and YST-151 (yellow sarson) (Table 1).

Table 1. Aphid Infestation Index of *Lipaphis erysimi* during first sowing (October 25) of rapeseed and mustard

Germplasms	13-Dec	20-Dec	27-Dec	3-Jan	10-Jan	17-Jan	24-Jan	31-Jan	7-Feb	14-Feb	21-Feb	28-Feb	Mean AII
<b>Brown Sarson (<i>Brassica campestris</i> var. brown sarson)</b>													
BSH-1	0.00	0.33	0.67	1.00	1.50	1.84	2.17	2.50	1.50	0.84	0.33	0.00	1.06
<b>Indian Mustard (<i>Brassica juncea</i>)</b>													
Alankar	0.00	0.33	0.67	1.00	1.67	2.00	2.67	2.17	1.50	1.00	0.67	0.33	1.17
Basanti	0.00	0.17	0.67	1.17	1.67	2.33	2.67	2.33	1.67	1.00	0.33	0.00	1.16
Bio-772	0.17	0.33	0.67	1.17	1.33	2.00	2.33	2.34	1.67	1.00	0.50	0.17	1.14
Bio-902	0.17	0.33	0.67	1.50	1.84	2.33	2.67	2.00	1.67	1.00	0.67	0.33	1.27
BS-2	0.00	0.17	0.67	1.33	1.67	2.00	2.17	2.67	1.84	1.00	0.33	0.00	1.15
CS-52	0.17	0.50	0.84	1.50	1.84	2.33	2.67	2.00	1.33	0.67	0.33	0.00	1.18
Durgamani	0.00	0.33	0.67	1.00	1.33	2.00	2.33	2.34	1.67	1.00	0.67	0.33	1.14
GM-2	0.00	0.33	1.00	1.33	1.84	2.17	2.67	2.00	1.50	1.00	0.67	0.33	1.24
GM-111	0.00	0.17	0.67	1.34	1.67	2.00	2.33	2.17	1.67	1.67	0.67	0.33	1.22
JM-1	0.17	0.50	1.00	1.50	1.84	2.33	2.67	2.33	1.67	1.00	0.50	0.17	1.31
Kranti	0.00	0.00	0.67	1.50	1.84	2.34	2.33	2.00	1.33	0.67	0.33	0.00	1.08
Krishna	0.00	0.33	0.67	1.00	1.67	2.00	2.33	1.84	1.17	0.67	0.33	0.00	1.00
Maya	0.00	0.00	0.33	0.67	1.67	2.00	2.33	2.00	1.33	0.67	0.33	0.00	0.94
MYSL-203	0.00	0.00	0.33	0.67	1.34	2.00	2.34	2.33	1.67	0.67	0.33	0.00	0.97
PBR-91	0.17	0.50	0.84	1.67	2.00	2.33	2.67	2.33	1.67	0.67	0.33	0.00	1.26
PBR-97	0.00	0.33	0.67	1.34	1.67	2.17	2.50	1.84	1.17	0.67	0.33	0.00	1.05
PCR-7	0.00	0.33	0.67	1.00	1.33	1.84	2.33	1.67	1.17	0.67	0.33	0.00	0.94
PM-66	0.33	0.67	1.00	1.50	2.17	2.50	2.84	2.00	1.67	0.67	0.33	0.00	1.31
PM-67	0.00	0.33	0.67	1.33	1.84	2.17	2.17	1.67	1.17	0.67	0.33	0.00	1.03
PR-8988	0.00	0.33	0.67	1.00	2.33	2.67	2.17	1.33	1.00	0.67	0.33	0.00	1.04
Pusa Agrani	0.33	0.67	1.00	1.33	1.67	2.00	1.67	1.17	0.67	0.33	0.00	0.00	0.90
Pusa Bahar	0.00	0.33	0.67	1.00	1.84	2.33	2.67	2.00	1.33	1.00	0.33	0.00	1.13
Pusa Bold	0.00	0.33	0.67	1.50	2.00	2.33	2.67	2.33	1.67	0.67	0.33	0.00	1.21
Pusa Jagannath	0.17	0.50	1.00	1.50	2.00	2.33	2.67	2.67	1.33	1.34	0.33	0.00	1.32
RH-30	0.00	0.33	0.67	1.50	2.17	2.50	2.50	2.00	1.33	1.00	0.33	0.00	1.19
RH-718	0.00	0.67	1.00	1.84	2.50	2.67	3.00	2.33	1.67	1.17	0.33	0.00	1.43
RH-819	0.00	0.33	0.67	1.34	2.00	2.34	2.84	2.33	2.00	1.50	0.33	0.00	1.31
RH-8113	0.00	0.33	0.67	1.34	2.00	2.50	2.84	2.67	2.00	1.50	0.67	0.33	1.40
RH-8812	0.00	0.33	0.67	1.33	2.00	2.17	2.67	2.33	1.67	0.67	0.00	0.00	1.15
RL-1359	0.00	0.33	0.67	1.33	2.00	2.34	2.33	2.17	1.50	0.67	0.00	0.00	1.11
RLM-514	0.00	0.33	0.67	1.67	2.00	2.33	2.84	2.33	1.67	0.84	0.17	0.00	1.24
RLM-619	0.00	0.00	0.33	1.00	1.67	2.00	2.50	2.33	1.67	0.84	0.17	0.00	1.03
RN-393	0.33	0.33	0.67	1.67	2.00	2.50	2.84	2.50	2.17	1.67	0.67	0.33	1.47
Rohini	0.00	0.33	1.00	1.50	2.33	2.67	3.00	2.33	1.50	1.00	0.67	0.17	1.38
Sanjuct Asech	0.00	0.33	0.67	1.34	2.33	2.67	3.00	2.67	2.17	1.00	0.33	0.00	1.38
Sarma	0.00	0.00	0.33	0.67	1.33	2.00	2.33	2.67	2.17	1.33	0.67	0.17	1.14
Seeta	0.00	0.33	0.67	1.00	1.67	2.17	2.67	2.33	2.00	1.17	0.67	0.17	1.24
SEJ-2	0.17	0.50	0.84	1.17	1.67	2.17	2.50	2.00	1.67	0.84	0.33	0.00	1.15
TM-2	0.00	0.33	0.67	1.33	2.00	2.33	2.67	2.00	1.67	1.34	0.67	0.17	1.27
TM-4	0.00	0.33	0.67	1.00	1.67	2.00	2.33	2.00	1.67	1.33	0.67	0.33	1.17
Urvashi	0.33	0.50	1.00	1.33	1.67	2.00	2.33	2.00	1.67	1.00	0.33	0.00	1.18

Vardan	0.00	0.33	0.67	1.67	2.00	2.33	2.67	2.33	2.00	1.33	0.67	0.33	1.36
Varuna	0.00	0.00	0.33	1.33	1.84	2.17	2.50	2.17	1.67	1.33	0.50	0.17	1.16
Vaibhav	0.00	0.17	0.50	1.34	2.17	2.50	2.67	2.00	1.67	0.67	0.33	0.00	1.17
<b>Gobhi Sarson (<i>Brassica napus</i>)</b>													
GSL-1	0.00	0.32	0.50	1.17	1.84	2.17	2.33	2.00	1.34	0.84	0.33	0.00	1.07
GSL-2	0.00	0.17	0.50	1.33	1.67	2.17	2.50	1.84	1.67	1.00	0.33	0.00	1.10
Neelam	0.00	0.00	0.33	1.00	1.67	2.33	2.67	2.17	1.50	1.17	0.67	0.17	1.14
Sheetal	0.00	0.33	0.67	1.50	2.00	2.50	2.84	2.17	1.67	1.00	0.33	0.00	1.25
<b>Kiran Rai (<i>Brassica carinata</i>)</b>													
JTC-1	0.00	0.33	0.67	1.00	1.67	2.00	2.33	2.00	1.67	0.67	0.33	0.00	1.06
PBC-9902	0.00	0.17	0.50	1.00	1.84	2.33	2.67	2.33	1.84	1.00	0.67	0.33	1.22
PC-5	0.00	0.33	0.67	1.00	1.67	2.17	2.67	2.33	1.67	1.00	0.33	0.00	1.15
Pusa Swarnim	0.00	0.00	0.33	0.67	1.17	1.84	2.17	1.67	1.33	0.67	0.33	0.00	0.85
<b>Taramira (<i>Eruca sativa</i>)</b>													
RTM-314	0.17	0.50	0.84	1.17	1.84	2.33	2.67	2.50	2.17	1.50	0.67	0.33	1.39
TMLC-2	0.00	0.33	0.50	0.84	1.34	2.00	2.33	2.17	1.50	1.00	0.50	0.00	1.04
<b>Toria (<i>Brassica rapa</i> var. toria)</b>													
M-27	0.00	0.50	0.84	1.67	2.17	2.84	2.50	2.17	1.17	0.50	-	-	1.30
PT-30	0.00	0.33	1.00	1.67	2.00	2.50	2.33	1.84	1.17	0.50	-	-	1.22
PT-303	0.33	0.67	1.67	2.00	2.33	2.84	2.50	2.17	1.50	0.50	-	-	1.51
TL-15	0.00	0.33	1.33	1.84	2.33	2.67	2.33	1.67	0.67	0.33	-	-	1.24
TS-38	0.17	0.67	1.17	1.67	2.00	2.50	2.34	1.67	1.00	0.33	-	-	1.24
<b>Yellow Sarson (<i>Brassica rapa</i> var. yellow sarson)</b>													
B-9	0.00	0.00	0.33	0.67	1.50	2.67	2.17	2.33	1.00	0.33	-	-	1.01
GS-1	0.00	0.33	0.67	1.50	1.84	2.67	2.33	2.00	1.33	0.50	-	-	1.21
Jhumka	0.00	0.00	0.33	0.84	1.84	2.67	2.50	1.67	1.00	0.50	-	-	1.03
NDYS-2	0.00	0.00	0.33	0.67	1.67	2.33	1.84	1.34	0.67	0.33	-	-	0.84
PS-66	0.00	0.00	0.33	0.67	1.67	2.33	2.00	2.00	0.84	0.50	-	-	0.94
Pusa Gold	0.00	0.17	0.50	1.00	2.00	2.84	2.33	2.33	1.33	0.33	-	-	1.18
YST-151	0.00	0.00	0.33	0.67	1.00	2.00	1.67	1.67	0.67	0.00	-	-	0.73

Given values are the means of two successive cropping years (2004-05 and 2005-06)

## Second Sowing (November 10)

On November 10 sown cultivars, aphids commenced their attack on 20 December, showing infestation index from 0.00 to 0.33. The index further increased from 0.33 to 1.67 and 1.00 to 2.33 on 03 January and 17 January, respectively, and thereafter reaching to its peak of 2.00 to 3.00 at the end of January. Interestingly, from the very next week (February 07), the infestation index decreased gradually from 2.67 to 1.00 followed by 2.00 to 0.67, 1.67 to 0.00, 0.67 to 0.00 and 0.33 to 0.00 on 14, 21, 28 February and 07 March, respectively. On account of early maturity of toria and yellow sarson, the infestation remained nil on 28 February (Table 2).

Table 2. Aphid Infestation Index of *Lipaphis erysimi* during second sowing (November 10) of rapeseed and mustard

Germplasm	20-Dec	27-Dec	3-Jan	10-Jan	17-Jan	24-Jan	31-Jan	7-Feb	14-Feb	21-Feb	28-Feb	7-Mar	Mean AII
Brown Sarson ( <i>Brassica campestris</i> var. brown sarson)													
BSH-1	0.00	0.33	0.67	1.00	1.50	1.84	2.17	2.50	1.50	0.84	0.33	0.00	1.06
Indian Mustard ( <i>Brassica juncea</i> )													
Alankar	0.00	0.33	0.67	1.00	1.67	2.00	2.67	2.17	1.50	1.00	0.67	0.33	1.17
Basanti	0.00	0.17	0.67	1.17	1.67	2.33	2.67	2.33	1.67	1.00	0.33	0.00	1.17
Bio-772	0.17	0.33	0.67	1.17	1.33	2.00	2.33	2.34	1.67	1.00	0.50	0.17	1.14
Bio-902	0.17	0.33	0.67	1.50	1.84	2.33	2.67	2.00	1.67	1.00	0.67	0.33	1.26
BS-2	0.00	0.17	0.67	1.33	1.67	2.00	2.33	2.67	1.84	1.00	0.33	0.00	1.17
CS-52	0.17	0.50	0.84	1.50	1.84	2.33	2.67	2.00	1.33	0.67	0.33	0.00	1.18
Durgamani	0.00	0.33	0.67	1.00	1.33	2.00	2.33	2.34	1.67	1.00	0.67	0.33	1.14
GM-2	0.00	0.33	1.00	1.33	1.84	2.17	2.67	2.00	1.50	1.00	0.67	0.33	1.24
GM-111	0.00	0.17	0.67	1.34	1.67	2.00	2.33	2.17	1.67	1.67	0.67	0.33	1.22
JM-1	0.17	0.50	1.00	1.50	1.84	2.33	2.67	2.33	1.67	1.00	0.33	0.00	1.28
Kranti	0.00	0.00	0.67	1.50	1.84	2.34	2.33	2.00	1.33	0.67	0.33	0.00	1.08
Krishna	0.00	0.33	0.67	1.00	1.67	2.00	2.33	1.84	1.17	0.67	0.33	0.00	1.00
Maya	0.00	0.00	0.33	0.67	1.67	2.00	2.33	2.00	1.33	0.67	0.33	0.00	0.94
MYSL-203	0.00	0.00	0.33	0.67	1.34	2.00	2.34	2.33	1.67	0.67	0.33	0.00	0.97
PBR-91	0.17	0.50	0.84	1.67	2.00	2.33	2.67	2.33	1.67	0.67	0.33	0.00	1.26
PBR-97	0.00	0.33	0.67	1.34	1.67	2.17	2.50	1.84	1.17	0.67	0.33	0.00	1.06
PCR-7	0.00	0.33	0.67	1.00	1.33	2.00	2.33	1.67	1.17	0.67	0.33	0.00	0.96
PM-66	0.33	0.67	1.00	1.50	2.17	2.50	2.84	2.00	1.67	0.67	0.33	0.00	1.31
PM-67	0.00	0.33	0.67	1.33	2.00	2.17	2.17	1.67	1.17	0.67	0.33	0.00	1.04
PR-8988	0.00	0.33	0.67	1.00	2.33	2.67	2.17	1.33	1.00	0.67	0.33	0.00	1.04
Pusa Agrani	0.33	0.67	1.00	1.33	1.67	2.00	2.00	1.00	0.67	0.33	0.00	0.00	0.92
Pusa Bahar	0.00	0.33	0.67	1.00	1.84	2.33	2.67	2.00	1.33	1.00	0.33	0.00	1.12
Pusa Bold	0.00	0.33	0.67	1.50	2.00	2.33	2.67	2.33	1.67	0.67	0.33	0.00	1.21
Pusa Jagannath	0.17	0.50	1.00	1.50	2.00	2.33	2.67	2.67	1.33	1.34	0.33	0.00	1.32
RH-30	0.00	0.33	0.67	1.50	2.17	2.67	2.33	2.00	1.33	1.00	0.33	0.00	1.19
RH-718	0.00	0.67	1.00	1.84	2.50	2.67	3.00	2.33	1.67	1.17	0.33	0.00	1.43
RH-819	0.00	0.33	0.67	1.34	2.00	2.34	2.84	2.33	2.00	1.50	0.33	0.00	1.31
RH-8113	0.00	0.33	0.67	1.34	2.00	2.50	2.84	2.67	2.00	1.50	0.67	0.33	1.40
RH-8812	0.00	0.33	0.67	1.33	2.00	2.17	2.67	2.33	1.67	0.67	0.00	0.00	1.15
RL-1359	0.00	0.33	0.67	1.33	2.00	2.34	2.33	2.17	1.50	0.67	0.00	0.00	1.11
RLM-514	0.00	0.33	0.67	1.67	2.00	2.33	2.84	2.33	1.67	0.84	0.17	0.00	1.24
RLM-619	0.00	0.00	0.33	1.00	1.67	2.00	2.50	2.33	1.67	0.84	0.17	0.00	1.04
RN-393	0.33	0.33	0.67	1.67	2.00	2.50	2.84	2.50	2.17	1.67	0.67	0.33	1.47
Rohini	0.00	0.33	1.00	1.50	2.33	2.67	3.00	2.33	1.50	1.00	0.67	0.17	1.37
Sanjuct Ascch	0.00	0.33	0.67	1.34	2.33	2.67	3.00	2.67	2.17	1.00	0.33	0.00	1.38
Sarma	0.00	0.00	0.33	0.67	1.33	2.00	2.33	2.67	2.17	1.33	0.67	0.17	1.14
Seeta	0.00	0.33	0.67	1.00	1.67	2.17	2.67	2.33	2.00	1.17	0.67	0.17	1.24
SEJ-2	0.17	0.50	0.84	1.17	1.67	2.17	2.50	2.00	1.67	0.84	0.33	0.00	1.15

TM-2	0.00	0.33	0.67	1.33	2.00	2.33	2.67	2.00	1.67	1.34	0.67	0.17	1.26
TM-4	0.00	0.33	0.67	1.00	1.67	2.00	2.33	2.00	1.67	1.33	0.67	0.33	1.17
Urvashi	0.33	0.50	1.00	1.33	1.67	2.00	2.33	2.00	1.67	1.00	0.33	0.00	1.18
Vardan	0.00	0.33	0.67	1.67	2.00	2.33	2.67	2.33	2.00	1.33	0.67	0.33	1.36
Varuna	0.00	0.00	0.33	1.33	1.84	2.17	2.50	2.17	1.67	1.33	0.50	0.17	1.17
Vaibhav	0.00	0.17	0.50	1.34	2.17	2.50	2.67	2.00	1.67	0.67	0.33	0.00	1.17
<b>Gobhi Sarson (<i>Brassica napus</i>)</b>													
GSL-1	0.00	0.32	0.50	1.17	1.84	2.17	2.33	2.00	1.34	0.84	0.33	0.00	1.07
GSL-2	0.00	0.17	0.50	1.33	1.67	2.17	2.50	1.84	1.67	1.00	0.33	0.00	1.10
Neclam	0.00	0.00	0.33	1.00	1.67	2.33	2.67	2.17	1.50	1.17	0.67	0.17	1.14
Sheetal	0.00	0.33	0.67	1.50	2.00	2.50	2.84	2.17	1.67	1.00	0.33	0.00	1.25
<b>Kiran Rai (<i>Brassica carinata</i>)</b>													
JTC-1	0.00	0.33	0.67	1.00	1.67	2.00	2.33	2.00	1.67	0.67	0.33	0.00	1.06
PBC-9902	0.00	0.17	0.50	1.00	1.84	2.33	2.67	2.33	1.84	1.00	0.67	0.33	1.22
PC-5	0.00	0.33	0.67	1.00	1.67	2.17	2.67	2.33	1.67	1.00	0.33	0.00	1.15
Pusa Swarnim	0.00	0.00	0.33	0.67	1.17	1.84	2.17	1.67	1.33	0.67	0.33	0.00	0.85
<b>Taramira (<i>Eruca sativa</i>)</b>													
RTM-314	0.17	0.50	0.84	1.17	1.84	2.33	2.67	2.50	2.17	1.50	0.67	0.33	1.39
TMLC-2	0.00	0.33	0.50	0.84	1.34	2.00	2.33	2.17	1.50	1.00	0.50	0.00	1.04
<b>Toria (<i>Brassica rapa</i> var. toria)</b>													
M-27	0.00	0.50	0.84	1.67	2.17	2.50	2.84	2.17	1.17	0.50	-	-	1.43
PT-30	0.00	0.33	1.00	1.67	2.00	2.17	2.50	2.00	1.33	0.67	-	-	1.37
PT-303	0.33	0.67	1.67	2.00	2.33	2.67	2.84	2.17	1.50	0.67	-	-	1.68
TL-15	0.00	0.33	1.33	1.84	2.33	2.67	2.33	1.67	0.67	0.33	-	-	1.35
TS-38	0.17	0.67	1.17	1.67	2.00	2.50	2.50	1.67	1.00	0.33	-	-	1.37
<b>Yellow Sarson (<i>Brassica rapa</i> var. yellow sarson)</b>													
B-9	0.00	0.00	0.33	0.67	1.50	2.17	2.67	2.33	1.00	0.33	-	-	1.10
GS-1	0.00	0.33	0.67	1.50	1.84	2.50	2.50	2.00	1.33	0.50	-	-	1.32
Jhumka	0.00	0.00	0.33	0.84	1.84	2.50	2.67	1.67	1.00	0.67	-	-	1.15
NDYS-2	0.00	0.00	0.33	0.67	1.67	2.00	2.33	1.67	0.67	0.33	-	-	0.97
PS-66	0.00	0.00	0.33	0.67	1.67	2.00	2.33	2.00	1.00	0.67	-	-	1.07
Pusa Gold	0.00	0.17	0.50	1.00	2.00	2.33	2.84	2.33	1.33	0.33	-	-	1.28
YST-151	0.00	0.00	0.33	0.67	1.00	1.67	2.00	1.67	0.67	0.00	-	-	0.80

Given values are the means of two successive cropping years (2004-05 and 2005-06)

The mean aphid infestation index (MAII) showed a significant variation (0.80 to 1.68) on different cultivars. It was recorded beyond 1.50 on PT-303 (toria) and below 1.00 on Maya, MYSL-203 and Pusa Agrani (Indian mustard), Pusa Swarnim (kiran rai) and NDYS-2 and YST-151 (yellow sarson) (Table 2).

### Third sowing (November 25)

Initially, the commitment of aphid was witnessed on 27 December, showing infestation index between 0.00 to 0.84 followed by 0.33 to 1.50 and 1.17 to 2.67 on 03 and 17 January, respectively. The index increased (2.33-3.17) further on 07 February and thereafter, the index



decreased gradually from 3.17 to 1.50, 2.67 to 0.84, 1.67 to 0.33 and 0.84 to 0.00 on 14, 21, 28 February and 07 March, respectively. Likewise other sowing dates, the infestation on toria and yellow sarson was observed nil on 07 March due to early maturity of crops (Table 3).

The mean aphid infestation index (MAII) showed a considerable variation (0.98 to 2.14) on different cultivars. It remained maximum (> 2.00) on CS-52, GM-2, Pusa Bahar and RN-393 (Indian mustard). Whereas, Pusa Swarnim (kiran rai) demonstrated minimum (0.98) mean aphid infestation index (Table 3).

Table 3. Aphid Infestation Index of *Lipaphis erysimi* during third sowing (November 25) of rapeseed and mustard

Germplasm	27-Dec	3-Jan	10-Jan	17-Jan	24-Jan	31-Jan	7-Feb	14-Feb	21-Feb	28-Feb	7-Mar	Mean AII
<b>Brown Sarson (<i>Brassica campestris</i> var. brown sarson)</b>												
BSH-1	0.17	0.67	1.34	1.67	2.00	2.50	2.84	2.17	1.67	1.17	0.50	1.52
<b>Indian Mustard (<i>Brassica juncea</i>)</b>												
Alankar	0.17	0.50	1.17	1.67	2.17	2.50	2.84	2.17	1.67	1.00	0.17	1.45
Basanti	0.33	0.84	1.50	2.00	2.50	2.67	3.00	2.84	2.33	1.50	0.67	1.83
Bio-772	0.17	1.17	1.67	2.00	2.50	2.84	3.00	2.67	2.17	1.50	0.67	1.85
Bio-902	0.33	1.17	1.84	2.50	2.84	2.84	3.00	2.67	2.33	1.50	0.84	1.99
BS-2	0.33	1.00	1.67	2.50	2.84	2.84	3.17	2.17	1.67	1.00	0.33	1.77
CS-52	0.33	1.17	1.84	2.33	2.84	2.84	3.17	3.17	2.50	1.67	0.67	2.05
Durgamani	0.33	1.17	1.84	2.33	2.67	2.84	3.00	2.84	2.33	1.50	0.67	1.96
GM-2	0.33	1.17	1.83	2.50	3.00	3.17	3.34	3.17	2.67	1.67	0.67	2.14
GM-111	0.00	0.84	1.84	2.17	2.34	2.67	2.84	2.50	1.84	1.17	0.34	1.68
JM-1	0.17	1.00	1.84	2.17	2.67	2.67	3.00	2.50	1.84	1.34	0.34	1.77
Kranti	0.00	0.67	1.34	1.67	2.34	2.67	3.00	2.33	2.00	0.84	0.00	1.53
Krishna	0.00	0.84	1.67	2.00	2.17	2.67	2.84	2.17	1.50	0.50	0.00	1.49
Maya	0.00	0.50	1.34	1.84	2.17	2.67	2.84	2.34	1.67	0.67	0.17	1.47
MYSL-203	0.00	0.67	1.34	2.00	2.50	2.50	3.00	2.33	1.67	0.50	0.00	1.50
PBR-91	0.00	0.84	1.84	2.00	2.17	2.67	3.00	2.84	2.17	1.17	0.50	1.74
PBR-97	0.17	0.84	1.84	2.17	2.50	2.84	3.00	2.50	1.84	1.17	0.50	1.76
PCR-7	0.00	0.84	1.50	1.84	2.00	2.50	2.84	2.34	1.50	0.67	0.17	1.47
PM-66	0.50	1.50	2.00	2.34	2.50	3.00	3.00	2.67	1.50	0.67	0.00	1.79
PM-67	0.00	0.84	1.67	2.33	2.67	3.00	3.34	3.00	2.33	1.50	0.67	1.94
PR-8988	0.00	0.84	1.67	2.34	2.00	2.50	2.84	2.33	1.67	0.67	0.00	1.53
Pusa Agrani	0.00	1.17	1.84	2.33	2.50	3.00	3.00	2.33	1.67	0.50	0.00	1.67
Pusa Bahar	0.33	1.17	1.67	2.50	3.00	3.00	3.17	3.17	2.34	1.50	0.84	2.06
Pusa Bold	0.00	1.17	1.67	2.33	2.84	3.00	3.17	3.17	2.00	1.50	0.84	1.97
Pusa Jagannath	0.00	1.50	2.00	2.67	3.00	3.00	3.17	2.83	2.00	1.17	0.50	1.99
RH-30	0.50	1.17	1.84	2.17	2.50	3.00	3.17	2.84	2.17	1.67	0.84	1.99
RH-718	0.00	1.00	2.00	2.34	2.50	3.00	3.17	2.67	1.84	1.50	0.33	1.85
RH-819	0.00	0.67	1.67	2.17	2.33	2.84	3.00	2.67	2.17	1.67	0.33	1.77
RH-8113	0.00	0.67	1.67	2.17	2.50	2.84	3.00	2.67	2.17	1.67	0.67	1.82
RH-8812	0.00	0.84	1.67	2.17	2.34	2.67	2.84	2.33	1.67	0.67	0.00	1.56
RL-1359	0.00	0.67	1.50	2.00	2.00	2.50	2.84	2.17	1.67	0.67	0.00	1.46
RLM-514	0.00	0.84	1.84	2.00	2.33	2.50	3.00	2.00	1.67	0.67	0.00	1.53
RLM-619	0.00	0.67	1.34	2.00	2.00	2.50	2.84	2.34	1.84	0.67	0.00	1.47
RN-393	0.67	1.17	2.00	2.34	2.84	3.00	3.17	3.17	2.50	1.67	0.67	2.11

Rohini	0.17	1.00	1.84	2.33	2.50	2.84	3.00	2.17	1.67	0.84	0.50	1.71
Sanjuct Asech	0.00	0.84	1.84	2.17	2.50	3.00	3.00	2.50	2.00	0.84	0.17	1.71
Sarma	0.00	0.50	1.50	2.17	2.50	2.67	3.00	2.17	1.50	0.67	0.00	1.52
Seeta	0.00	0.67	1.00	1.84	2.34	2.67	3.00	2.34	1.84	0.67	0.00	1.49
SEJ-2	0.00	0.67	1.17	2.00	2.00	2.67	3.00	2.34	1.67	0.67	0.00	1.47
TM-2	0.00	0.67	1.17	2.00	2.17	2.67	3.00	2.33	1.67	0.67	0.00	1.49
TM-4	0.00	0.67	1.50	2.34	2.17	2.84	3.00	2.17	1.67	0.67	0.00	1.55
Urvashi	0.17	1.34	1.84	2.33	2.67	3.00	3.17	3.00	2.34	1.17	0.50	1.96
Vardan	0.17	0.84	1.84	2.00	2.50	2.67	3.00	2.84	2.33	1.34	0.50	1.82
Varuna	0.00	0.50	1.50	2.00	2.17	2.50	3.00	2.34	1.84	0.50	0.00	1.49
Vaibhav	0.00	0.50	1.67	2.17	2.17	2.67	3.00	2.50	2.17	1.34	0.33	1.68
<b>Gobhi Sarson (<i>Brassica napus</i>)</b>												
GSL-1	0.00	0.50	1.33	1.84	1.84	2.34	2.33	1.67	1.50	0.67	0.00	1.27
GSL-2	0.00	0.33	1.33	1.67	2.00	2.33	2.67	1.84	1.33	0.50	0.00	1.27
Neelam	0.00	0.50	1.00	1.50	2.00	2.50	2.67	2.00	1.33	0.67	0.00	1.29
Sheetal	0.00	0.67	1.50	1.67	2.00	2.17	2.50	1.67	1.00	0.33	0.00	1.23
<b>Kiran Rai (<i>Brassica carinata</i>)</b>												
JTC-1	0.00	0.67	1.33	1.50	1.67	2.17	2.50	1.67	0.84	0.33	0.00	1.15
PBC-9902	0.00	0.50	1.00	1.50	1.50	2.33	2.67	2.00	1.17	0.67	0.00	1.21
PC-5	0.00	0.50	1.00	1.50	1.50	2.33	2.67	2.00	1.17	0.67	0.00	1.21
Pusa Swarnim	0.00	0.33	0.84	1.17	1.17	2.00	2.33	1.67	0.84	0.50	0.00	0.98
<b>Taramira (<i>Eruca sativa</i>)</b>												
RTM-314	0.17	0.67	1.17	1.50	2.00	2.50	2.84	2.33	1.67	0.84	0.33	1.45
TMLC-2	0.00	0.50	0.84	1.50	1.67	1.84	2.50	1.84	1.17	0.67	0.00	1.14
<b>Toria (<i>Brassica rapa</i> var. toria)</b>												
M-27	0.17	1.00	1.84	2.17	2.50	2.67	3.00	2.17	1.67	0.67	-	1.78
PT-30	0.67	1.34	1.84	2.17	2.50	2.67	3.17	2.34	1.67	0.67	-	1.90
PT-303	0.33	0.67	1.34	2.00	2.17	2.67	2.84	2.17	1.17	0.33	-	1.57
TL-15	0.34	1.50	1.34	1.84	2.50	2.50	2.67	1.67	1.00	0.34	-	1.57
TS-38	0.00	0.67	1.33	1.67	2.00	2.00	2.50	1.50	0.84	0.34	-	1.28
<b>Yellow Sarson (<i>Brassica rapa</i> var. yellow sarson)</b>												
B-9	0.00	0.67	1.34	1.67	2.00	2.33	2.84	2.00	1.00	0.67	-	1.45
GS-1	0.33	1.00	1.67	2.17	1.84	2.17	2.84	2.00	1.33	0.67	-	1.60
Jhumka	0.34	0.83	1.50	1.83	1.67	2.50	2.84	1.83	1.17	0.67	-	1.52
NDYS-2	0.34	1.00	1.33	1.83	1.67	2.00	2.67	1.67	1.17	0.50	-	1.42
PS-66	0.34	1.00	1.33	1.84	2.00	2.50	2.84	1.67	1.34	0.67	-	1.55
Pusa Gold	0.17	0.84	1.50	1.84	2.17	2.33	2.67	1.84	1.33	0.67	-	1.53
YST-151	0.84	0.67	1.17	1.67	1.84	2.00	2.33	1.84	0.84	0.33	-	1.35

Given values are the means of two successive cropping years (2004-05 and 2005-06)

## Discussion

*Lipaphis erysimi* commenced its attack 7 week after sowing (WAS) coinciding with second week of December on October 25 sown cultivars and reached to a maximum at 14 WAS (January last week). Whereas, on November 10 and November 25 sown cultivars, the aphid attack was initially recorded on third (6 WAS) and last (4 WAS) week of December, however, attaining maximum population in first (13 WAS) and second (11 WAS) week of February,

respectively. The cultivars sown on October 25 escaped the infestation due to asynchronization of vulnerable crop stages and aphid multiplication period. In contrast, the late seeded cultivars (November, 10 and 25) showed heavy infestation, covered all plant organs including leaves, stem, apical shoots and developing pods during last week of January. Many workers have reported similar findings and suggested that early or timely sown crop escaped aphid infestation compared to the late sown crop (Prasad and Singh, 1999; Karmakar, 2003; Chattopadhyaya et al., 2005; Rai and Mishra, 2007). However, the climatic conditions were found to be one of determining factors for aphid multiplication. The crops sown on October 25 experienced high temperature (24.7 to 29.1°C) and low relative humidity (43.7 to 51.6 %) at vegetative stage and low temperature (6.1 to 11.1°C) and high relative humidity (78.9 to 93.5 %) at siliqua formation. Hence, it could be attributed that the cultivars escaped serious attack of aphid. Contrary to this, late sown cultivars (November 10 and 25) received low temperature range (10.0 to 18.6°C) and high relative humidity (57.5 to 87.3 %) at vegetative as well as siliqua formation stages, which would have favored aphid multiplication. Similar reports on the climatic factors on aphid multiplication are available (Srivastava et al., 1995; Prasad, 2003; Chattopadhyaya et al., 2005; Ansari et al., 2007).

The overall mean aphid infestation index was recorded  $< 1.00$  on Maya, MYSL-203 and Pusa Agrani (Indian mustard), Pusa Swarnim (kiran rai), NDYS-2 and YST-151 (yellow sarson), for those cultivars that were seeded on October 25 as well as November 10. These cultivars could be placed under relative tolerant category against *L. erysimi*. In contrast, PT-303 (toria) showed  $> 1.50$  MAII and therefore put into highly susceptible category. With regard to late sown crop (November 25), only Pusa Swarnim (kiran rai) exhibited relative tolerance to aphid (MAII  $< 1.00$ ), whereas, CS-52, GM-2, Pusa Bahar and RN-393 (Indian mustard) were found more vulnerable to aphid attack (MAII  $> 2.00$ ). Differences in MAII on cultivars are likely to have been caused by seasonal variations in aphid pressure and plant growth factors. The cultivars identified as promising in these trials confirm the earlier findings (Manzar et al., 1998; Kumar Roy and Baral, 2003; Naqvi and Rizvi, 2004). Among the late seeded cultivars (November 25), kiran rai and gobhi sarson showed less damage owing to their late flowering, whereas remaining cultivars were found heavily infested with aphids.

In conclusion, *Lipaphis erysimi* population can be reduced considerably on rapeseed and mustard crop by manipulating the sowing dates. The early sown cultivars (October 25<sup>th</sup>) could avoid the aphid multiplication to a great extent as compared to late sown cultivars (November 10 and 25). Therefore, the farmers are strongly advised of seeding rapeseed-mustard by October last week, using any of the tested cultivars, such as, Maya, MYSL-203 and Pusa Agrani (Indian mustard); Pusa Swarnim (kiran rai); NDYS-2 and YST-151 (yellow sarson).

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