Original Article

Management Of Mustard Aphid (Lipaphis Erysimi Kalt.) By Manipulating Sowing Dates

Dr. Matangi Mishra[1], Dr. Kumar Gaurav[2]

[1]Assistant Professor, Department of Entomology, School of Agriculture, Lovely Professional University, Punjab, India (matangi.28192@lpu.co.in)
[2]Assistant Professor, Department of English, School of Humanities, Lovely Professional University, Punjab, India (kumargaurav.26619@lpu.co.in)
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Abstract

A field experiment was conducted at Tirhut College of Agriculture Dholi, Muzaffarpur during the rabi season in the year 2017-18 and 2018-19, to explore the management of mustard aphids by altering the sowing dates. By manipulating the dates of sowing, it was observed that the crops sown on the last date possessed the maximum mean number of aphid infestation for both years (23.15 in 2017-18 and 44.64 in 2018-19). The yield was reported maximum on the crops sown on the first date i.e. October 10th 1277.50 kg/ha in 2017-18 and 1245.00 kg/ha in 2018-19 along with the test weight of 250 seeds. It was observed that the crops sown earlier were reported with a minimum mean number of aphids for both years.

Key Words: Oilseed, dates of sowing, Lipaphis erysimi Kalt., infestation, mustard.

Introduction:

In order to achieve self-sufficiency in oilseed production, the gap between acreage and the production of mustard should be fulfilled. In Bihar, vast areas under Diara land are still untapped and the state has vast potential for enhancing the production of mustard. Aphids are the most common and destructive pests of Brassicaceous crops across the world, and often cause heavy losses in yield. Among all the attacking insects, the mustard aphid (Lipaphis erysimi Kalt.) is an insect that infests the crop right from the seedling stage to maturity of the crop" and limits the production. Mustard aphid lives on the underside of the leaves, inflorescence, young shoots and pod of growing plants. It causes rolling, chlorosis, yellowing, patches on young leaves, shortening of internodes of young shoots, distortion, and lesions on the growing plant parts and as a whole, the plant remains dwarf. The damage is caused by both, the "nymphs and adults". It sucks the sap, due to which the leaves become curled and discoloration takes place, appearance of spots can be seen on the foliage; plant wilts gradually turns yellowish or brown and ultimately dies. According to Narjary et. al. (2013) the activity of aphids on Mustard varied from end of January to first week of March. Several reports of reduction in the yield is reported; according to Singh et.al. (1980), the losses in the yield ranged from 9% to 95%, 35.4% to 72.3% reduction as per Bakhetia et.al. in 1986 and 35.4% to 91.3 % of yield loss was calculated by Patel et. al. at different places in India namely Haryana, Delhi, Kanpur and Gujarat, respectively.

Materials and methods:

In order to find out the synchrony between activity of mustard aphid and crop stage, field experiments were conducted in randomised block design (RBD) at the research farm of T.C.A. Dholi, Muzaffarpur (Bihar) during two consecutive crop (rabi) seasons i.e., 2017-18 and 2018-19. The mustard variety used was Pusa Mustard 25 as test variety with six different dates starting from 10th of October at every ten days interval to the 30th of November

each year. Pre-sowing operations i.e. field was prepared by cultural operations. The weeds were picked and leveling of field was done. Fertilizers were applied as per the local recommendations, without insecticidal application at any crop stages. All the treatments (planting dates) were replicated four times. The size of the plot was maintained at 2 x 1.5m with row and plant spacing of 2 x 1.5m.

The observations regarding number of aphids were recorded on ten randomly selected plants from each plot after the emergence of the pest during the morning hours (before 9 AM) from each plot. The number of aphids was collected by cutting the top 10 cm twig from randomly selected ten plants on each plot in brown envelopes and the number of aphids was counted with the help of a camel hair brush on a white sheet of paper. The mean number of aphids was calculated by addition of the counted number of aphids collected from each plant and dividing the whole by the number of observations (no. of standard weeks). The data so obtained were finally used to calculate the average number of aphids per plant and were further subjected to statistical analysis separately for both the year i.e. during the rabi seasons in 2017-18 and 2018-19. The yield (kg/ha) as well as test weight (250 seeds) was taken for each respective date during the experimental year 2017-18 and 2018-19. Simultaneously, further statistical analysis for every parameter namely: mean number of mustard aphids for each sowing date; seed yield (kg/ha) and test weight (gram) (250 in number) was done. 1000 seeds from five samples were taken and mixed. After proper mixing, 250 seeds were counted and taken as test weight.

Results and discussion

In order to explore the possibility of management of aphid on mustard by manipulating the sowing dates, a field experiment was conducted at Tirhut College of Agriculture Dholi, Muzaffarpur, during the rabi season of 2017-18 and 2018-19. The dates of sowing namely (six treatments); were 10th, 20th, 30th of October, 10th, 20th and 30th of November for each experimental year (i.e. 2017-18 and 2018-19) with four replications each.

Table (1). Mean of Mustard Aphid Infestation (2017-2018)

Dates of Sowing (Treatment)	**Mustard Aphid (Mean No.)***
October 10 (T_1)	1.02
October 20 (T_2)	1.58
October 30 (T_3)	2.52
November 10(T_4)	4.29
Novembe20 (T_5)	12.35
November 30 (T_6)	23.15

*Note: The mean number of aphids was calculated by addition of the counted number of aphids collected from each plant and dividing the whole by the number of observations (no. of standard weeks).

It was found that the crops sown on October 10 had minimum number of mustard aphid infestation (1.02) while as the date advanced the infestation level also increased. The crops sown on 20th of October had more mean number of mustard aphid top 10 cm inflorescence (1.58) than the first date, on October 30th the infestation was 2.52. Meanwhile, on November 10th, November 20th and November 30th the infestation level increased to 4.29, 12.35 and 23.15 respectively during 2017-18 as presented in table(1). During the second year (2018-19), the mean number of mustard aphid on top 10 cm inflorescence followed the same trend i.e. with every ten days of delay; the crop was affected by large number of mustard aphids on top 10 cm inflorescence of mustard. The number of infested plants were more during the second year (2018-19) which may be due to the environmental conditions prevailing in the particular year. On October 10th the mean number of insects was 1.17 which increased to 1.89 on the crops sown on 20th of October, while on 30th of the same month it was 6.38. However, on November 10th sown crop, the infestation level was much higher (21.03), ten days later i.e. for crops sown on 20th of November 2018-19, the mean number of aphids top 10 cm inflorescence was 31.21. The highest number of aphids (44.64) were recorded on the last sowing date i.e. November 30. Table (2) shows the mean number of the aphid population for the year 2018-19.

Table (2). Mean of Mustard Aphid Infestation (2018-2019)

Dates of Sowing (Treatment)	**Mustard Aphid (Mean No.)***

October 10 (T_1)	1.17
October 20 (T_2)	1.89
October 30 (T_3)	6.38
November 10(T_4)	21.03
Novembe20 (T_5)	31.21
November 30 (T_6)	44.64

*Note: The mean number of aphids was calculated by addition of the counted number of aphids collected from each plant and dividing the whole by the number of observations (no. of standard weeks).

It was found that the crops sown on October 10 had minimum number of mustard aphid infestation (1.02) while as the date advanced the infestation level also increased. The crops sown on 20th of October had more mean number of mustard aphid top 10 cm inflorescence (1.58) than the first date, on October 30th the infestation was 2.52. Meanwhile, on November 10th, November 20th and November 30th the infestation level increased to 4.29, 12.35 and 23.15 respectively during 2017-18. During the second year of research (2018-19), the mean number of mustard aphid on top 10 cm inflorescence followed the same trend i.e. with every ten days of delay; the crop witnessed more number of mustard aphid on top 10 cm inflorescence of mustard. The number of infested plant found was more during the second year (2018-19) which may be due to the environmental conditions prevailing in the particular year. On October 10th the mean number of insects was 1.17 which increased to 1.89 on the crops sown on 20th of October, while on 30th of the same month it was 6.38. However, in crops sown on November 10, the infestation level was much higher (21.03), ten days later i.e. 20th of November 2018-19, the mean number of aphids top 10 cm inflorescence was 31.21. The highest number of aphids (44.64) recorded was on the last sowing date i.e. November 30. Table (2) shows the mean number of aphid population for year 2018-19. The results thus obtained are in accordance with the findings of several other research done and are stated below: Sonkar and Desai (1999) observed that the manipulation in planting dates take advantage of pest absence or avoids susceptible stages of the crop. According to Chakravarthy and Goutham (2002), "the occurrences of aphid population are dependent on plant phenological events". Aslam et. al. (2005) and Saljoqi et. al. (2011) found that the maximum infestation by aphid was in the month of February while on the other hand, cultivars sown on October 25 escaped infestation which might be due to asynchronization of vulnerable crop stages and aphid multiplication period. Chandra et. al. (2013) recorded lowest aphid infestations by sowing crops on 20 October (9- 11.5 aphids/plant). Bajia and Singh (2014) reported peak aphid population of 117.96 on mustard variety Varuna when the crop was sown on 9th December. Several other findings also suggested "early or timely sowing of crop escaped aphid infestation as compared to the late sown" (Prasad and Singh, 1999; Karmakar, 2003; Chattopadhyay et. al.;2005; Rai and Mishra, 2007; Razaq et. al., 2011).

The infestations for both the years are presented in pie chart (A) and (B) during both the years 2017-18 and 2018-19.

Table 3: Statistical Analysis of Replicated data for different sowing dates 2017-18

Sl. No.	Sowing dates	Mean of aphid population	Standard Deviation	S Em (±)	CV	CD @ 5 %
1.	October 10	1.02	0.23	0.04	22.65	0.105
2.	October 20	1.58	0.57	0.09	36.00	0.260
3.	October 30	2.52	1.07	0.17	42.26	0.487
4.	November 10	4.29	2.70	0.43	62.88	1.233
5.	November 20	12.35	14.43	2.28	116.81	6.601
6.	November 30	23.15	27.35	4.33	118.16	12.512

Note: The mean number of aphids was calculated by addition of the counted number of aphids collected from each plant and dividing the whole by the number of observations (no. of standard weeks).

Table (3) shows the mean of mustard aphid population observed on different dates and the statistical analysis of the mean number of mustard aphid on top 10 cm of inflorescence. The mean number of mustard aphids

is the mean of total population of insect found on all the four replications. In the table (4), the statistical analysis of population mean of mustard aphid (mean of four replications) is presented for the experimental year 2018-19.

Table 4: Statistical Analysis of Replicated data for different sowing dates 2018-19

Sl. No.	Sowing dates	Mean of aphid population	Standard Deviation	S Em (±)	CV	CD @ 5 %
1.	October 10	1.17	0.34	0.06	29.28	0.165
2.	October 20	1.89	0.63	0.11	33.35	0.304
3.	October 30	6.38	6.20	1.03	97.22	2.991
4.	November 10	21.03	22.79	3.80	108.36	10.987
5.	November 20	31.21	30.57	5.09	97.93	14.738
6.	November 30	46.37	38.58	6.43	83.20	18.6

Note: The mean number of aphids was calculated by addition of the counted number of aphids collected from each plant and dividing the whole by the number of observations (no. of standard weeks).

Table 5: Yield traits of 2017-18 and 2018-19 and Pooled

Dates of Sowing of Pusa Mustard- 25	Yield (kg/ha) 2017-18	Yield (kg/ha) 2018-19	Pooled (2017-18 & 2018-19)
October 10	1277.5	1245	1899.50
October 20	1237.86	1205	1221.43
October 30	1180	1090	1135.00
November 10	1000	967.88	983.94
November 20	934.67	899	916.83
November 30	876	850.76	863.38

Note: The yield obtained on all dates is the mean of all the four replications for both the years (2017-18 and 2018-19).

The yield obtained for crops sown on six different dates for the years 2017-18 and 2018-19 along with the pooled are presented in table 5.

Table 6: Yield traits of 2017-18 and 2018-19 and Statistical analysis

Dates of Sowing of Pusa Mustard- 25	Yield (kg/ha) 2017-18	Yield (kg/ha) 2018-19
October 10	1277.5	1245
October 20	1237.86	1205
October 30	1180	1090
November 10	1000	967.88
November 20	934.67	899
November 30	876	850.76
Mean	1084.33	1042.94
	2.059	2.363
C.V.	11.16	12.321
S Em		

Table (6) shows the statistical analysis for both the years (2017-18 and 2018-19). The yield obtained during the first year (2017-18) varied according to each sowing date i.e., the crops sown on October 10 witnessed the highest yield (1277.50 kg/ha) while the minimum yield was observed on November 30th (876kg/ha). There

was a gradual decline in yield of crop when sown on crops sown on October 20th (1237.86 kg/ha) and on 30th October (1180 kg/ha). As the sowing dates advanced, there was a drastic decline in yield of mustard seed when sown on 10th November (1000 kg/ha), 20th of November (934.67 kg/ha). The trend regarding yield traits of mustard crop was similar during the second year (2018-19). Maximum yield was observed on October 10th sown crops (1245.00 kg/ha) while minimum yield was 850.76 kg/ha from the plots sown on November 30. Similar to the first year (2017-18), the yield of mustard crop during 2018-19 followed a descending trait with further advancement of sowing dates i.e. on 30th October (1090 kg/ha), 10th November (967.88 kg/ha), 20th November (899.0 kg/ha). The yield potential of mustard crop during 2018-19 was less than that of 2017-18 which might be due to higher aphid infestation during the second experimental year (2018-19) resulting from weather factors during 2017-18 and 2018-19.

In the present investigation, it is inferred that during both the years (2017-18 and 2018-19) crops which were sown early escaped mustard aphid infestation which might be due to asynchronization of vulnerable crop stages and aphid multiplication period is well supported by Saljogi et. al.,2011. Early sowing resulted in higher value for different plant height was observed by Angrej et. al. (2002). Occurrences of aphid population are dependent on plant phenological events (Chakravarthy and Goutham, 2002). The results obtained during the present experimentation are in conformity with the trial done by Panda et. al. (2004) and Kumar et. al. (2004) who reported greater yield of crop with earlier sowing dates. Saxena and Murty (2014) suggested sowing the crop early in order to prevent the losses from aphid attack on mustard. Patel et. al. (2004) observed that mustard seeds sown on November 8, November 18, November 28, December 8 and December 18, the yield was decreased with delayed sowing (the results are of an experiment conducted in India during winters of 1995-1998). The highest yield was recorded with the sowing done on November 8. In general, the results found during the experiment agreed with the findings of Kundu and Pant (1969), Lal (1969), "Dunn and Kempton (1971), Bakhetia and Sandhu (1973), Brar et. al. (1976), Singh et. al. (1982), Hussain (1983), Lipadhia et. al. (1992), Kher and Ratual (1992), Dutta and Saharia (1987), Yadav et. al. 1991), Upadhyay et. al. (1992) and Alipieva and Nankova (1996) who reported significant interactions between aphid population and crop yield. Fig. (6) and (7) shows the graphical presentation of interaction between mustard aphid and crop yield for the year 2017-18 and 2018-19.

Table 7: Test weight of 250 seeds for years 2017-18 and 2018-19 and Pooled

Dates of Sowing of Pusa Mustard- 25	Test weight (250) 2017-18 (g)	Test weight (250) 2018-19 (g)	Pooled
October 10	1.12	1.01	1.065
October 20	0.98	0.95	0.965
October 30	0.87	0.84	0.855
November 10	0.74	0.71	0.725
November 20	0.63	0.60	0.615
November 30	0.50	0.49	0.990

Note: The test weight obtained on all dates is the mean of all the four replications for both the years (2017-18 and 2018-19).

Table (7) represents the test weight of 250 seeds of mustard for years 2017-18 and 2018-19 and the pooled. It was found that with advanced date, the test weight decreased i.e. the crops sown late resulted in low test weight. This may be due to lack of moisture content, reduction in boldness of seeds and aphid attack. The test weight of seeds sown on October 10th was found maximum i.e. 1.12 g (2017-18) and 1.01 g (2018- 19), while minimum test weight was obtained on November 30th namely: 0.50g in 2017- 18 and 0.49g during 2018-19. Crops sown on October 20th revealed with more or less same test weight 0.98g (2017-18) and 0.95g (2018-19). Meanwhile, crops sown on October 30th weighed 0.87g (2017-18) and 0.84g (2018-19) weight for 250 mustard seeds. Besides crops sown on November 10th was recorded to have low weight i.e. 0.74g (2017-18) and 0.71g (2018-19) and the test weight was even at a low of 0.63g (2017-18) and 0.60g (2018-19) for the crops sown on November 20th . Among six dates of sowing, the test weight (250 seeds) was highest in crops sown on October 10th for both years (2017-18 and 2018-19) while minimum was for 30th of November during both the

experimental years. This might be due to the prevailing temperature at the time of harvesting, secondary branches and siliqua per plant that might have resulted into increased test weight while due to late sowing, the harvesting was done late and temperature was high which might result in low test weight.

Table 8: Test weight of 250 seeds for years 2017-18 and 2018-19 and Analysis

Dates of Sowing of Pusa Mustard- 25	**Test weight (250) 2017-18 (g)**	**Test weight (250) 2018-19 (g)**
October 10	1.12	1.01
October 20	0.98	0.95
October 30	0.87	0.84
November 10	0.74	0.71
November 20	0.63	0.60
November 30	0.50	0.49
Mean	0.80	0.76
	2.05	1.40
C.V.	0.008	0.005
S Em		

Table (8) shows the test weight of 250 seeds (g) for years 2017-18 and 2018-19 and statistical analysis of the data. Kalra et. al. (1985) and Scott et. al. (1973) reported to have decreased seeds per pod as well as reduction in 1000 seed weight in different trials with delayed sowing."Seeds per pod in mustard is affected directly by sowing dates"; Beech and Norman, 1964. Ghosh and Chatterjee (1988) stated that one-month delay in sowing decreased seeds per pod by 23 %. Similar results due to different sowing dates were reported earlier by Kaur et. al. (2011), Ram et. al. (2012), Sharma et. al. (2012), Amrawat et. al. (2013), Azharudheen et.al. (2013), Sudhir et. al. ((2013).

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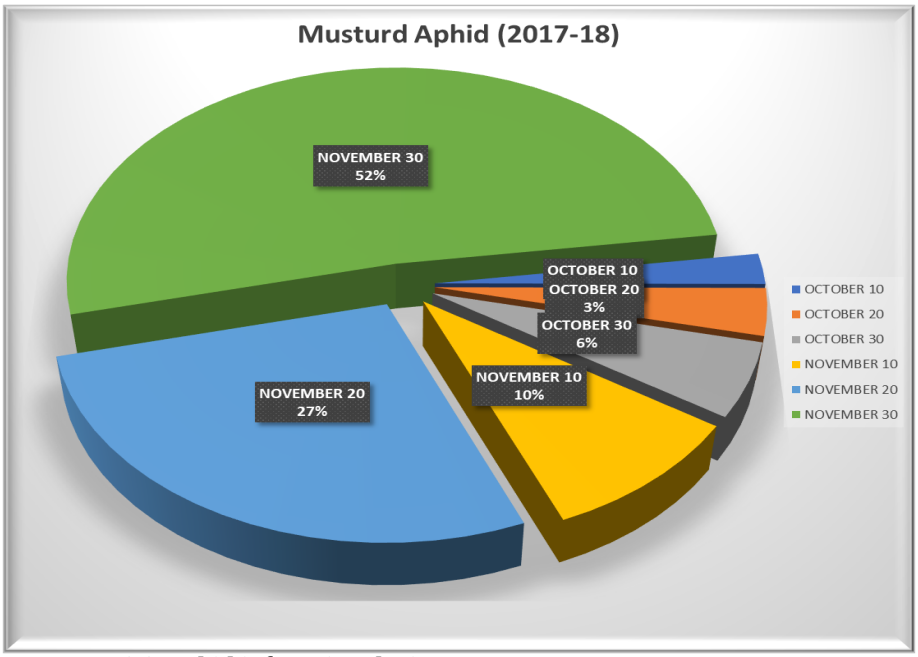
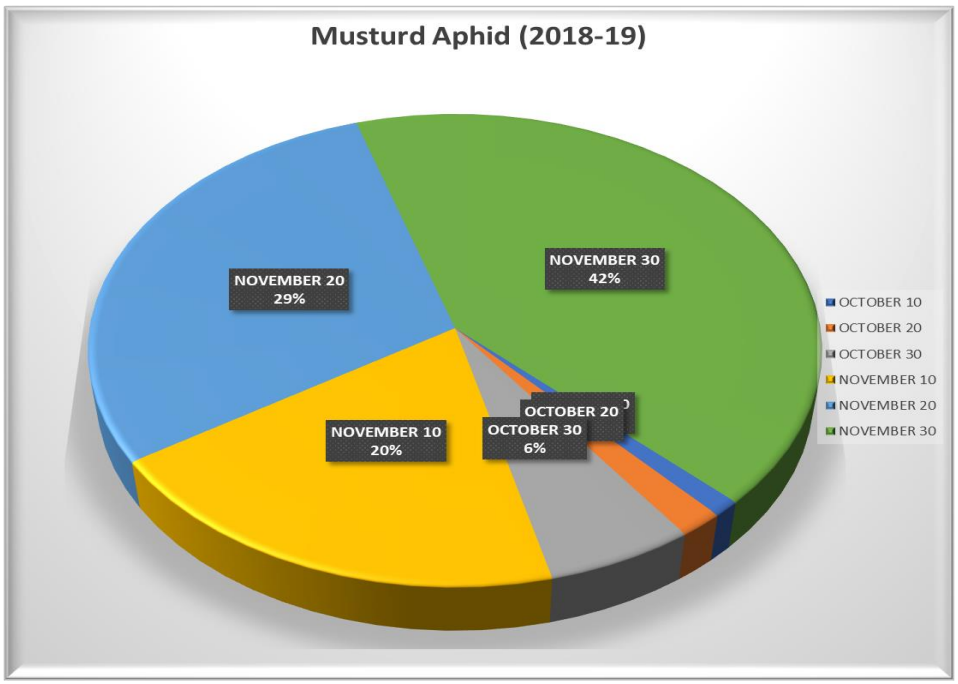
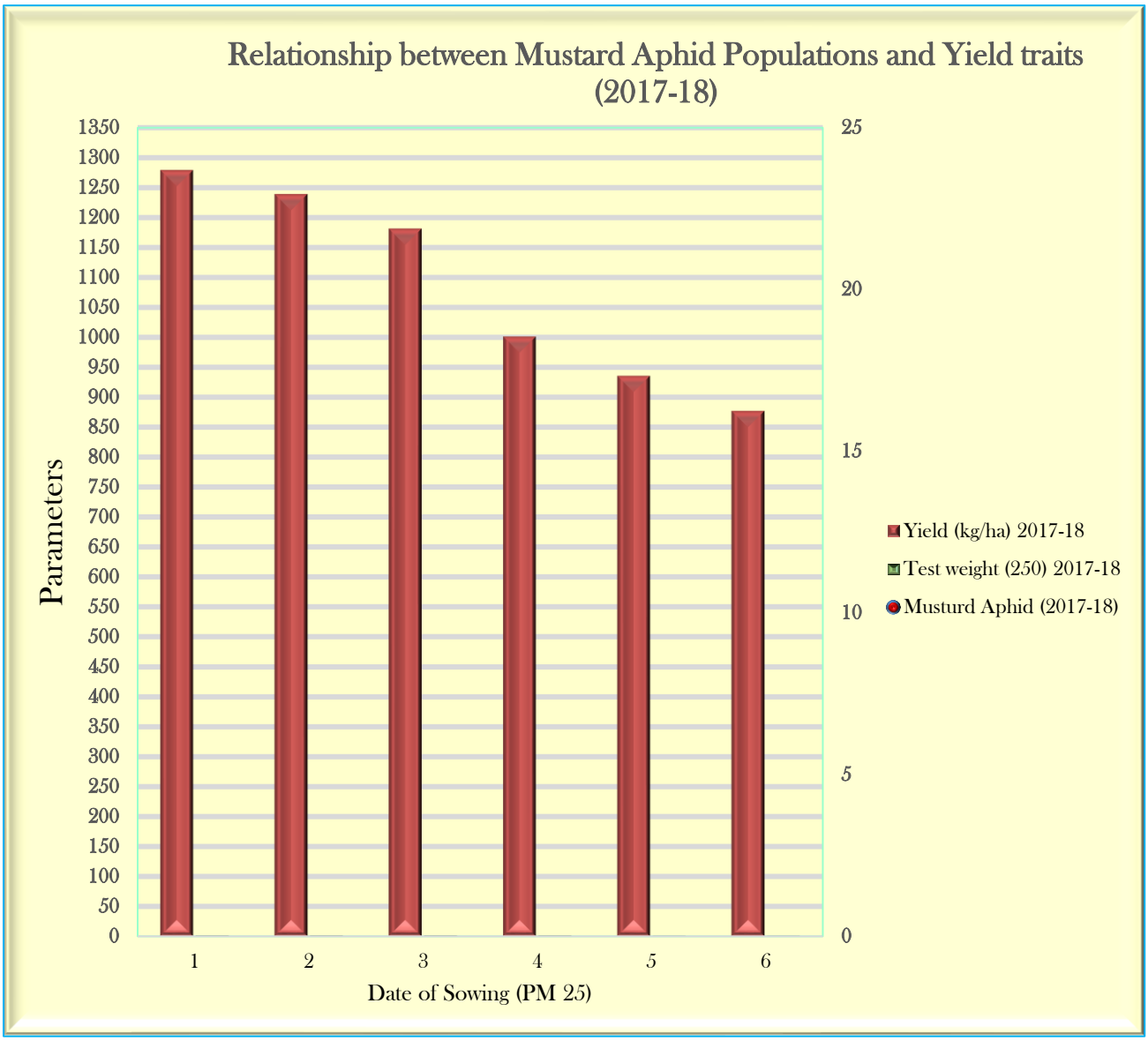
(A) Aphid infestation during year 2017-18



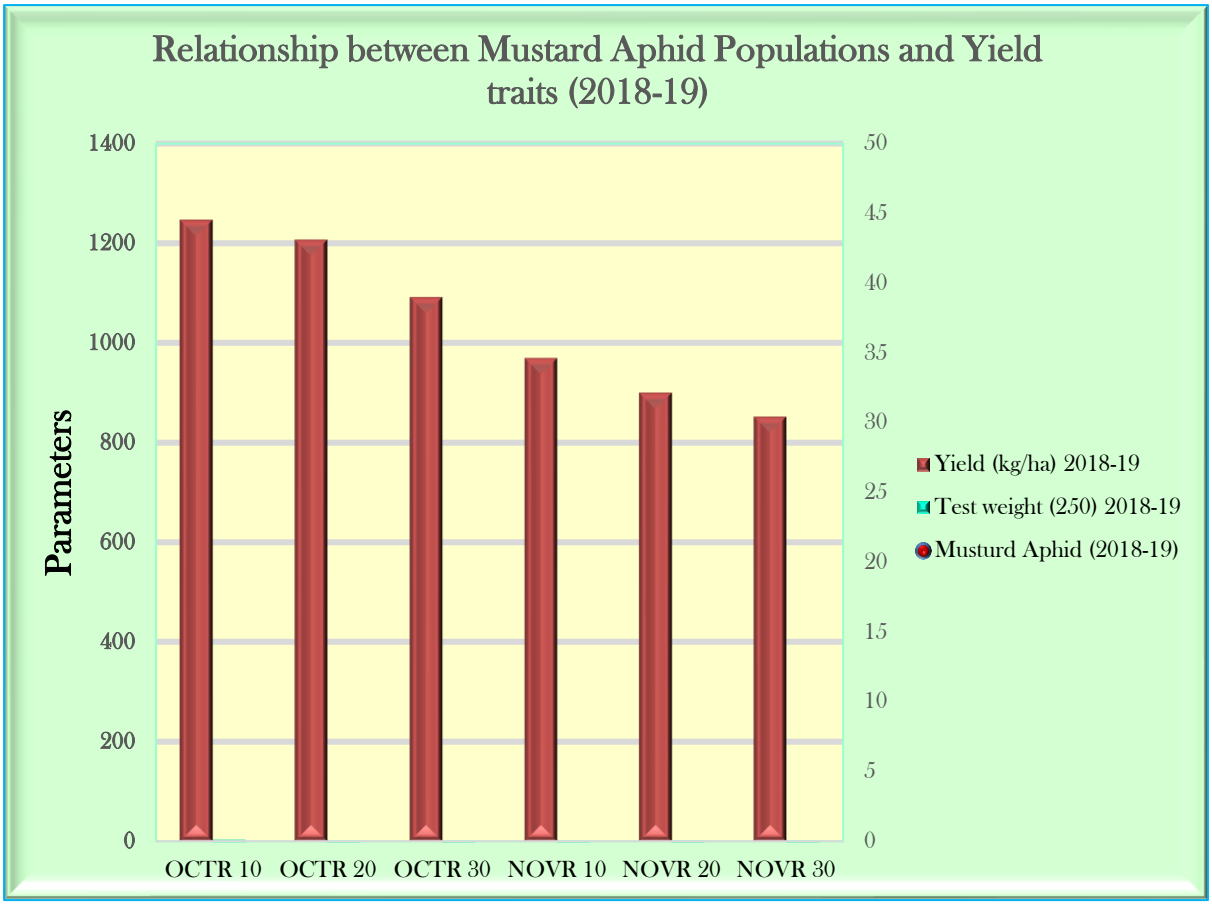
(B) Aphid infestation during 2018-19



(C) Interaction between mustard aphid, yield traits and test weight 2017-18.



(D) Interaction between mustard aphid, yield traits and test weight 2018-19


Relationship between Mustard Aphid Populations and Yield traits (2018-19)
Parameters
1400
1200
1000
800
600
400
200
0
50
45
40
35
30
25
20
15
10
5
0
OCTR 10
OCTR 20
OCTR 30
NOVR 10
NOVR 20
NOVR 30
Yield (kg/ha) 2018-19
Test weight (250) 2018-19
Musturd Aphid (2018-19)