International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 13-05-2025, Accepted: 12-06-2025, Published: 27-06-2025
Volume 10, Issue 6, 2025, Page No. 130-135

Integrated field screening of mustard varieties and sowing dates against aphid (*Lipaphis erysimi)* infestation in Bangladesh

Md. Ahasan Habib[1], Lazia Rahman[2*], Md. Ashikur Rahman[3], Md. Marju Alam[2], Md. Rabiul Islam[4]
[1] Department of Agricultural Botany, Faculty of Agriculture, Sher-E-Bangla Agricultural University, Dhaka, Bangladesh
[2] Department of Horticulture, Faculty of Agriculture, Bangladesh Agricultural University, Mymensingh, Bangladesh
[3] Department of Entomology, Faculty of Agriculture, Sher-E-Bangla Agricultural University, Dhaka, Bangladesh
[4] Department of Agronomy, Faculty of Agriculture, Bangladesh Agricultural University, Mymensingh, Bangladesh

Abstract
Aphid infestation significantly limits mustard (Brassica spp.) output in Bangladesh. This research aimed to assess the effects of varying planting periods and mustard cultivars on aphid infestation at Sher-e-Bangla Agricultural University, Dhaka. A two-factorial randomized complete block design was utilized, including three planting dates (9, 16, and 23 November) and eight mustard varieties (Tori-7, BARI Sharisha-6, -9, -11, -13, -14, -15, and -16). The results indicated a considerable increase in aphid infection associated with delayed seeding. Early sowing (9 November) yielded the lowest mean plant infestation (49.41%), whereas late sowing (23 November) exhibited the greatest (78.48%). BARI Sharisha-13 had the greatest resistance to aphids, with a mean infestation of 46.45%, whereas Tori-7 demonstrated the highest susceptibility at 80.71%. The interaction impact between sowing time and variety was substantial. Early sowing combined with BARI Sharisha-13 resulted in the lowest infestation. These findings suggest that adjusting sowing time and selecting appropriate varieties can substantially reduce aphid infestation and improve mustard yield in Bangladesh.

Keywords: Mustard, aphid infestation, sowing time, varietal screening, integrated pest management

Introduction

Mustard (*Brassica spp.*) is a major oilseed crop in South Asia, particularly in Bangladesh, where it occupies a significant position in the national oilseed production system. Commonly referred to as "sharisha," mustard is extensively grown during the Rabi (winter) season and contributes not only to edible oil production but also to rural livelihoods through its by-products, including oil cake for livestock feed and plant residues for fuel and fodder (Rahman, 2012; BARI, 2012) [19]. In Bangladesh, *B. campestris* cv. Tori-7 is cultivated across approximately 75% of the total mustard-growing area, followed by *B. juncea* at 25%, while *Brassica napus* is acquiring significance due to recent introductions (Wahhab *et al*., 2012) [29].

Despite its significance, mustard productivity in Bangladesh remains low, with an average yield of 757 kg ha^{-1}, which is considerably below the global average and far behind leading producers like Germany and France, where yields exceed 3,000 kg ha^{-1} (FAO, 2011) [9]. Several constraints contribute to this yield gap, among which biotic stresses such as insect pest infestation especially by the mustard aphid are of paramount importance.

The mustard aphid is a phloem-feeding bug classified under the family Aphididae. Nymphs and adults consume the vulnerable portions of the mustard plant, such as inflorescences, siliquae, and young leaves, resulting in curling, yellowing and stunted development, which eventually diminishes seed output and oil content (Verma *et al*., 2005; Alam *et al.*, 1964; Tripathi *et al.*, 1986) [2, 26, 27]. Severe infestations may result in yield losses of up to 90% (Bakhetia, 1983; Begum, 1994) [3, 4]. Aphids excrete honeydew, facilitating the development of sooty mold, hence diminishing photosynthesis and seed quality (Shahjahan, 1994) [23].

The population dynamics of *L. erysimi* are significantly affected by environmental factors, especially temperature, relative humidity and precipitation (Nasir *et al.*, 1998; Sinha *et al*., 1990) [15, 24]. Optimal development transpires in chilly, humid conditions, with maximum population recorded between January and February in Bangladesh (Kabir and Khan, 1980; Biswas and Das, 2000) [6]. Thus, the time of seeding is pivotal in influencing the extent of aphid infection. Several researchers have documented that early sowing enables mustard plants to escape peak aphid periods, thereby significantly reducing damage (Patel *et al*., 2004) [16]. Early-planted crops are typically more vigorous and resilient, while late-planted crops often suffer from aphid colonization during sensitive growth phases, such as flowering and pod formation, which are crucial for the growth of seeds (Rahman *et al*., 1993; Mondal and Islam, 1993) [14, 18].

In addition to sowing time, varietal resistance also plays a significant role in mitigating aphid-induced losses. While no variety has been found to be completely immune, some show moderate to high levels of tolerance due to morphological or biochemical traits (Phadke, 1992; Verma *et al*., 2005; Bhat *et al*., 2004) [8, 17, 27]. Breeding efforts continue to focus on integrating resistance traits to develop high-yielding, aphid-tolerant cultivars (Lal *et al*., 1997; Roy and Baral, 2002) [13, 21].

Given the interplay between sowing time, varietal resistance and pest incidence, an integrated approach is essential for sustainable mustard cultivation. However, there is a paucity of data in Bangladesh evaluating the combined effects of sowing time and varietal resistance on aphid infestation under field conditions. The current study aims to evaluate the impact of sowing time on aphid incidence in mustard, assess the resistance levels of various mustard varieties against *Lipaphis erysimi* and identify optimal sowing time-variety combinations to reduce aphid infestation and enhance yield.

Materials and Method

1. Geographical Position

This investigation was done in the experimental plot of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka. The experimental location is situated inside the agro-ecological zone known as "Modhupur Tract," AEZ-28.

2. Experimental treatments

The experiment was structured using a factorial Randomized Complete Block Design (RCBD), with sowing time as the first factor at three levels and mustard variety as the second factor at eight levels (varieties). The experimental treatments consisted of three planting dates (9, 16, and 23 November) and eight mustard types (Tori-7, BARI Sharisha-6, -9, -11, -13, -14, -15, and -16).

3. Experimental design and setup

The experiment was designed as a Two-factorial Randomized Complete Block Design (RCBD) with three replications, resulting in a total of 72 plots. The experimental design was established to evaluate the effects of various planting times and mustard types. Each unit background designated for each type measured 2.5 m × 1.5 m. The distances between blocks and plots were 0.75 m and 0.5 m respectively.

4. Soil Preparation

The soil was adequately prepared, ensuring optimal tilth for commercial crop production. The designated property was partitioned into 72 uniform plots of 2.5 m by 1.5 m, with a gap of 0.5 m between plots and 0.75 m between blocks. The experimental field was cultivated using a motorized tiller. Land preparation commenced 10 days prior to the seeding of mustard seeds. The soil was subsequently prepared with three plowing sessions, followed by laddering and meticulous leveling to achieve optimal tilth. The corners of the fields were tilled, and bigger clods were fragmented into smaller pieces. After tilling and leveling, the stubble and uprooted weeds were removed, rendering the field fit for cultivation. The soil was treated with Furadan 5G at a rate of 10 kg per hectare during final ploughing to safeguard the young plants from cutworm infestation. 2.5 Fertilizer application

The crop was fertilized according to the recommendations of BARC (1999). Cow dung was applied ten days prior to the final soil preparation. The complete quantity of triple superphosphate, gypsum, zinc sulfate, boric acid, and fifty percent of urea was administered at basal rates during the final land preparation. Fifty percent of the urea was applied as a side dressing 40 days after sowing (DAS).

Fertilizers	Dose (kg ha^{-1})	Dose (g plot^{-1})
Cow dung	10,500	1000
Urea	150	43.25
TSP	75	22.00
MoP	150	45.00
Gypsum	75	22.00
Zinc sulphate	5	1.20
Boric Acid	10	2.50

5. Sowing of seed

Each of the eight selected mustard varieties was treated as an individual treatment. Before sowing seed, the germination test was done in laboratory under the Department of Entomology and the 90% germination was found for all varieties. Seeds at a rate of 8 kg ha-1 were then seeded directly in the field, according to three sowing dates at seven-day intervals: 9 November (S1), 16 November (S2), and 23 November (S3), 2013. Subsequent to germination, the plants in the field were irrigated with water using a hand sprayer. The soils of the experimental units were irrigated 3 to 4 times per week until significant plant growth was achieved.

6. Data Acquisition

Ten (10) plants per plot were randomly picked and labeled for data collection. Data collection commenced in the field at 42 days after sowing (DAS) for all three sowing periods. Data were obtained weekly. The data were gathered based on various parameters, including the number of aphids per plant, the number of aphid-infested plants, the number of aphid-infested inflorescences at 42, 49, and 56 days after sowing (DAS), the total and infested siliqua per plant, plant height, pod length, number of seeds per pod and total yield per plot.

6.1 Methodology for Quantifying Aphid Population

The aphid count on 10 randomly chosen plants from each plot was recorded at 42, 49, and 56 days after sowing (DAS). The upper 10 cm apical branches of three randomly chosen inflorescences from the selected plants were excised with a sharp knife and transported to the laboratory in separate transparent polythene bags for the enumeration of aphids per plant. Aphids were extracted from the afflicted plant sections using a soft camel hair brush and transferred onto a sheet of white paper. The aphid population was enumerated using a magnifying lens and a tally counter. The afflicted twigs and inflorescences were meticulously examined to ensure that no one aphid could evade capture during the counting process.

6.2 Compilation of yield-enhancing data

The crops were collected at full ripeness. To investigate yield-contributing characteristics, data on the total and infected siliqua per plant, plant height, pod length per plant, and yield were recorded for five healthy and five afflicted plants.

7. Data Computation

A concise summary of the data computation based on the gathered information is provided below:

7.1 Percent of aphid infested plant by number

Number of aphid infested plant was counted from total plants per plot and percent plant infestation by aphid was calculated by using the following formula:

Percentage of aphid-infested plants = (Number of aphid-infested plants) / (Total number of plants per plot) × 100

7.2 Percentage of aphid-infested inflorescences

The total count of aphid-infested and uninfested inflorescences during both the blooming and pod-forming stages was obtained from 10 randomly selected plants per plot, and the percentage of plant infection by aphids was estimated using the following formula:

Percentage of aphid-infested inflorescences = (Number of aphid-infested inflorescences) / (Total number of inflorescences per plot) × 100

Fig 1: Severely Aphid infested mustard plant

Fig 2: Severely Aphid infested inflorescence

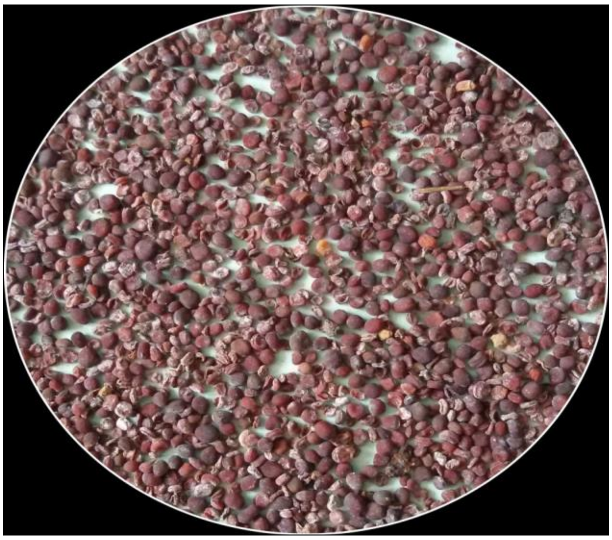

Fig 3: Grain of severely infested plant

Fig 4: Grain of less infested plant

8. Data analysis

The data collected for various parameters were statistically examined using analysis of variance techniques with the MSTAT-C software tool. The substantial differences between the treatment means were analyzed using the Least Significant Difference (LSD) test and Duncan's Multiple Range Test (DMRT) at 1% and 5% probability levels as applicable (Gomez and Gomez, 1984) [10].

Results and Discussion

1. Impact of Sowing Time on Aphid Infestation

The timing of sowing significantly affected the level of aphid (Lipaphis erysimi) infection in mustard plants (Table 1). Of the three planting dates evaluated, the earliest date (9 November) shown the least aphid infestation at all development stages, while the latest date (23 November) revealed the greatest infestation rates. At 42 days after sowing (DAS), the mean aphid-infested plant percentage was 30.41% in the early sowing (S1), which rose to 49.59% in the late sowing (S3). This trend intensified at later growth stages at 56 DAS, infestation rose sharply to 96.26% in S3, compared to only 61.16% in S1. The overall mean infestation was lowest in early sowing (49.41%) and highest in late sowing (78.48%).

These results align with previous studies that have reported a strong correlation between sowing date and aphid attack severity. Early sown crops tend to escape the peak aphid infestation period, which generally occurs in late January to early February in the Indian subcontinent due to favorable temperatures and humidity (Sinha *et al*., 1990; Biswas and Das, 2000) [6]. Patel *et al*. (2004) [16, 24] observed a consistent reduction in aphid population and corresponding yield increases with early sowing in Indian mustard. Similarly, Ahuja (1990) [1] and Kabir and Khan (1980) found that aphid populations thrive under moderate temperatures (15–25°C) and higher relative humidity, conditions typically encountered by late-sown mustard crops.

Table 1: Impact of sowing time on aphid infestation in mustard at various days after sowing (DAS)

Treatments	Plant infestation (%) at			
	42 DAS*	49 DAS*	56 DAS*	Mean
S_1 (9 November)	30.41 c	56.66 b	61.16 c	49.41 c
S_2 (16 November)	39.85 b	58.76 b	74.59 b	57.73 b
S_3 (23 November)	49.59 a	89.59 a	96.26 a	78.48 a
$LSD_{(0.01)}$	5.17	5.09	3.07	1.45
CV (%)	12.87	7.40	3.94	5.48

2. Effect of Mustard Variety on Aphid Infestation

Significant differences in aphid infestation were observed among the eight mustard varieties tested (Table 2). Tori-7 (V1) consistently showed the highest susceptibility across all observation periods, with a mean plant infestation of 80.71%, while BARI Sharisha-13 (V5) exhibited the highest resistance, with a mean of 46.45%.

The resistance observed in BARI Sharisha-13 could be attributed to morphological or biochemical traits unfavorable to aphid colonization, such as thicker cuticles, higher glucosinolate content, or less favorable phloem composition. These results corroborate findings by Husain and Begum (1984) [4, 11], Kabir (1987) [12], and Verma *et al*. (2005) [27], who noted significant varietal differences in aphid susceptibility among *Brassica* species. Phadke (1992) [17] emphasized that *B. juncea* generally shows more resistance than *B. campestris* due to inherent genetic and physiological traits. Furthermore, the reduced infestation in BARI Sharisha-13 supports earlier screening outcomes reported by Biswas and Das (2000) [6], who found this variety among the least infested genotypes in multi-location trials in Bangladesh. The high susceptibility of Tori-7 observed in this study confirms earlier reports by Begum (1988) [5] and Shahjahan (1994) [23], both of whom identified Tori-7 as a favorable host for rapid aphid multiplication.

Table 2: Impact of cultivar on aphid infestation in mustard at various days after sowing (DAS)

Treatments	Plant infestation (%) at			
	42 DAS*	**49 DAS***	**56 DAS***	**Mean**
V_1 (Tori-7)	64.33 a	83.37 a	94.47 a	80.71 a
V_2 (BARI Sharisha-6)	34.10 c	64.47 c	66.67 d	55.07 d
V_3 (BARI Sharisha-9)	54.43 b	77.77 ab	94.43 a	75.55 b
V_4 (BARI Sharisha-11)	33.33 cd	65.53 c	84.47 b	61.11 c
V_5 (BARI Sharisha-13)	25.56 d	55.57 d	58.23 e	46.45 e
V_6 (BARI Sharisha-14)	38.90 c	74.47 b	73.33 c	62.23 c
V_7 (BARI Sharisha-15)	33.37 cd	63.33 cd	71.57 cd	56.09 d
V_8 (BARI Sharisha-16)	35.58 c	62.20 cd	75.53 c	57.77 d
LSD $_{(0.01)}$	8.45	8.04	5.01	2.85
CV (%)	12.87	7.40	3.94	5.49

*DAS = Days after sowing; Columns with identical letters indicate statistical similarity, whereas those with differing letters exhibit significant differences according to DMRT at the 0.01 probability level.

3. Interaction between Sowing Time and Variety

The interaction effect between sowing time and variety was also statistically significant (Table 3). The lowest aphid infestation (27.76%) was recorded in BARI Sharisha-13 sown on 9 November (S1V5), whereas the highest (93.33%) occurred in Tori-7 sown on 23 November (S3V1). This interaction suggests that even susceptible varieties like Tori-7 can experience reduced aphid damage when sown early, while resistant varieties may become vulnerable under late sowing conditions due to environmental favorability for aphid proliferation.

These findings are supported by Singh and Lal (1999), who showed that aphid population peaks vary with sowing dates and are significantly moderated by host plant resistance. Roy and Baral (2002) [21] also demonstrated that early sowing not only reduced aphid numbers but also limited the expression of reproductive traits in *L. erysimi*.

4. Inflorescence Infestation and Its Consequences

Inflorescence infestation followed a pattern similar to plant infestation, with significant increases in later sowings. At 49 DAS, late sowing (S3) recorded an average of 95.60% inflorescence infestation, compared to just 20.85% in early sowing (S1) (Table 4). High infestation at the flowering stage can have a pronounced impact on pod formation, leading to a substantial decrease in siliqua number and seed set, as also noted by Rohila *et al*. (1987) and Begum (1994) [4]. The importance of protecting reproductive structures from aphid damage is well documented; infestation during flowering and pod formation stages can reduce yield by over 50% (Srivastava *et al*., 1996; Bhadauria *et al*., 1995) [7, 25].

From the findings it was revealed that the mustard varieties considering the mean infestation, the highest inflorescence infestation (74.70%) was observed in V_1 (Tori-7), which was statistically different from other seven mustard varieties. On the other hand, the lowest infestation (43.80%) was recorded in variety V_5 (BARI sharisha-13) (Table 5).

Considering the rate of aphid infestation, the order of inflorescence infestation among highest mustard varieties is $V_1 > V_3 > V_6 > V_4 > V_8 > V_7 > V_2 > V_5$. About similar works also done by several workers. This result was in harmony with Islam (1991), who also regarded that the highest incidence of aphid infested inflorescence recorded in Tori-7.

Table 3: Interaction effect of sowing time and variety on plant infestation of mustard by aphid at different days after sowing

Sowing time	Variety	Plant infestation (%) at			
		42 DAS*	**49 DAS***	**56 DAS***	**Mean**
S_1	V_1	53.00 bc	66.70 f	83.30 c	67.67 j
	V_2	20.00 hi	50.00 hi	66.70 d	45.57 s
	V_3	36.70 ef	43.30 ij	48.00 g	42.67 t
	V_4	13.30 ij	40.00 jk	60.00 e	37.77 v
	V_5	10.00 j	33.30 k	40.00 h	27.76 w
	V_6	36.70 ef	50.00 hi	83.30 c	56.67 n
	V_7	40.00 d-f	80.00 de	96.70 ab	72.76 h
	V_8	56.70 b	90.00 bc	96.70 ab	81.13 d
S_2	V_1	35.70 ef	56.70 gh	66.00d	52.80 q
	V_2	33.33 fg	60.00 fg	68.00 d	53.78 p
	V_3	33.33 fg	36.70 jk	50.00 fg	40.01 u
	V_4	43.30 de	53.30 gh	86.70 c	61.10 l
	V_5	33.30 fg	76.70 e	82.00 c	64.00 k
	V_6	56.30 b	96.70 ab	100.0 a	84.33 c
	V_7	46.70 cd	93.30 a-c	100.0 a	80.00 e
	V_8	46.70 cd	86.70 cd	96.70 ab	76.70 f
S_3	V_1	80.00 a	100.0 a	100.0 a	93.33 a
	V_2	26.70 gh	56.70 gh	83.30 c	55.57 o
	V_3	56.70 b	86.70 cd	100.0 a	81.13 d
	V_4	33.30 fg	53.30 gh	86.70 c	57.57 m
	V_5	16.70 ij	60.00 fg	70.00 d	48.90 r
	V_6	53.30 bc	96.70 ab	100.0 a	83.33 b
	V_7	33.33 fg	93.30 a-c	96.70 ab	74.44 g
	V_8	36.70 ef	80.00 de	93.30 b	70.00 i
LSD $_{(0.01)}$		8.45	8.04	5.01	0.45
CV (%)		12.87	7.40	3.94	1.79

*DAS = Days after sowing; Columns with identical letters indicate statistical similarity, whereas those with differing letters exhibit significant differences according to DMRT at the 0.01 probability level.

Table 4: Effect of sowing time on inflorescence infestation of mustard by aphid at different days after sowing (DAS)

Treatments	Inflorescence infestation (%) at			
	42 DAS*	49 DAS*	56 DAS*	Mean
S_1 (9 November)	20.47 c	20.85 c	91.71 b	44.34 c
S_2 (16 November)	21.61 b	45.54 b	92.81 b	53.32 b
S_3 (23 November)	42.75 a	95.60 a	98.09 a	78.81 a
$LSD_{(0.01)}$	0.25	2.62	3.37	4.57
CV (%)	1.86	4.83	3.56	2.48

*DAS = Days after sowing; Columns with identical letters indicate statistical similarity, whereas those with differing letters exhibit significant differences according to DMRT at the 0.01 probability level.

Table 5: Effect of variety on inflorescence infestation of mustard by aphid at different days after sowing

Treatments	Inflorescence infestation (%) at			
	42 DAS*	49 DAS*	56 DAS*	Mean
V_1 (Tori-7)	45.57 a	78.67 a	99.87 a	74.70 a
V_2 (BARI Sharisha-6)	28.30 c	46.90 cd	97.60 ab	57.60 d
V_3 (BARI Sharisha-9)	37.53 b	62.57 b	95.80 ab	65.30 b
V_4 (BARI Sharisha-11)	28.26 c	51.17 c	95.97 ab	58.47 d
V_5 (BARI Sharisha-13)	19.34 g	37.70 e	74.37 c	43.80 g
V_6 (BARI Sharisha-14)	26.17 d	59.63 b	99.17 a	61.65 c
V_7 (BARI Sharisha-15)	20.93 e	49.70 cd	98.03 b	56.22 e
V_8 (BARI Sharisha-16)	20.11 f	45.63 d	92.83 b	52.86 f
$LSD_{(0.01)}$	0.39	4.29	5.51	1.47
CV (%)	1.86	4.83	3.56	2.45

*DAS = Days after sowing; Columns with identical letters indicate statistical similarity, whereas those with differing letters exhibit significant differences according to DMRT at the 0.01 probability level.

5. Implications for Mustard Cultivation and Pest Management

The results of this study provide strong empirical support for integrating agronomic practices (timely sowing) with varietal resistance as part of an Integrated Pest Management (IPM) strategy. Early sowing helps mustard plants escape the peak aphid season, and using resistant varieties like BARI Sharisha-13 can minimize the damage even under conducive conditions. Similar recommendations have been proposed by Lal *et al*. (1997) [13] and Samdur *et al*. (1997) [22], who emphasized the synergistic benefits of optimal sowing timing and cultivar selection for sustainable mustard production.

Conclusion

The findings of this study clearly demonstrate that both sowing time and varietal choice significantly influence the extent of aphid (*Lipaphis erysimi*) infestation in mustard. Early sowing (9 November) effectively minimized aphid attack, likely due to asynchrony with peak aphid populations. Among the tested genotypes, BARI Sharisha-13 showed the highest level of resistance, while Tori-7 was highly susceptible. The interaction effects further confirmed that sowing time and genotype must be jointly considered to optimize pest avoidance. These results provide a foundation for developing an eco-friendly, low-cost integrated pest management (IPM) strategy that includes appropriate varietal selection and timely sowing. Future research should explore the physiological or biochemical bases of resistance in promising varieties and assess their performance under multi-location and multi-year trials for broader recommendations.

References

1. Ahuja DB. Population dynamics of *Lipaphis erysimi* on mustard in Rajasthan. Indian Journal of Entomology,1990:52(3):395–400.
2. Alam MZ, Ahmed A, Siddique A. Control of winter aphids in East Pakistan. A Review of Research Division of Entomology, 1947–1964. Agric Inform Serv,1964:3:256-9.
3. Bakhetia DRC. Losses in rapeseed and mustard due to aphid in India. In: A literature study proceeding of with international Rapeseed conference held at paris from 17–19 May, 1983.
4. Begum M. Assessment of yield loss due to aphid infestation in mustard. Bangladesh Journal of Entomology,1994:4(1–2):55–61.
5. Begum M. Relationship between aphid infestation and mustard plant characters. Bangladesh Journal of Zoology,1988:16:115–21.
6. Biswas GC, Das GP. Seasonal incidence and varietal resistance of mustard aphid. Bangladesh Journal of Agricultural Research,2000:25(3):495–502.
7. Bhadauria NS, Srivastava SC, Bhalla PN. Screening of mustard genotypes against aphid, *Lipaphis erysimi* (Kalt.). Indian Journal of Entomology,1995:57(2):113–7.
8. Bhat GN, Wani AR, Ansari IA. Screening of mustard varieties against mustard aphid. Shashpa,2004:11(1):79–81.
9. FAO. FAOSTAT database. Food and Agriculture Organization of the United Nations, 2011.
10. Gomez KA, Gomez AA. Statistical procedure for agricultural research. Second Edn. Intl Rice Res Inst, John Wiley and Sons. New York, 1984, 1–340.
11. Husain M, Begum M. Screening of mustard varieties for resistance to *Lipaphis erysimi*. Bangladesh Journal of Zoology,1984:12(1):25–9.
12. Kabir MH. Screening of mustard germplasms for aphid resistance. Bangladesh Journal of Agricultural Research,1987:12(2):123–8.
13. Lal R, Singh H, Singh V. Screening of Brassica germplasm for resistance to mustard aphid. Journal of Oilseeds Research,1997:14:25–30.
14. Mondal MRI, Islam MA. Effect of seed rate and date on yield and yield components of rapeseed. Bangladesh J Agril Sci,1993:20(1):29–33.
15. Nasir AB, Javed H, Aslam M, Khan A. Influence of abiotic factors on the population of mustard aphid. Sarhad J Agric,1998:14(5):453–5.
16. Patel GM, Patel RK, Patel JR. Effect of different sowing dates on incidence of mustard aphid. Indian Journal of Entomology,2004:66(3):252–6.
17. Phadke KG. Life table and population growth parameters of mustard aphid on different host plants. Annals of Plant Protection Sciences,1992:1:53–6.
18. Rahman MM, Hossain SM, Islam AN, Salam MU. Effect of sowing date and boron fertilizer on yield and oil content of mustard and rapeseed. Bangladesh Agron J,1993:15(1):73–8.
19. Rahman MM. Status of Oil Seeds and Future Prospects in Bangladesh, 2012, 34–40.
20. Rohilla HR, Singh H, Kalra VK, Kharub SS. Losses caused by mustard aphid in different mustard genotypes. 7th Int Rapeseed Cong, Poznan, Poland, 1987, 11–4.

21. Roy NC, Baral K. Reproductive performance of L. erysimi on mustard under field conditions. Bangladesh Journal of Entomology,2002:12:33–41.
22. Samdur MY, Gulati SC, Rajni R, Manivel P. Effect of environmental factors on mustard aphid infestation in different germplasm of Indian mustard. Coss Oilseeds Res,1997:14(2):278–88.
23. Shahjahan M. Field and laboratory evaluation of some mustard germplasms for resistance to aphid. M.S. Thesis. Dept of Entomology, BAU, Mymensigh, 1994, 89.
24. Sinha TB, Verma SN, Jha AN. Influence of weather on the incidence of mustard aphid. Journal of Entomological Research,1990:14(2):146–50.
25. Srivastava SC, Bhadauria NS, Verma A. Effect of aphid infestation on yield of mustard. Indian Journal of Entomology,1996:58(2):103–7.
26. Tripathi NLM, Sachan GC, Verma SK, Pathak PK. Developmental behavior of mustard aphid on different part of mustard. Indian J Entomol,1986:48(3):295–300.
27. Verma AK, Singh RP, Yadav RK. Screening of mustard cultivars for aphid resistance. Journal of Insect Science,2005:18(1):87–91.
28. Verma RK, Neeraja A, Rajak SK. Screening of mustard genotypes against mustard aphid. J Oilseeds Res,2005:22(1):202–22.
29. Wahhab MA, Mondal MRI, Akbar MA, Alam MS, Ahmed MU, Begum F. Status of oil crops production in Bangladesh. Oilseed Res Centre, Bangladesh Agril Res Inst, Joydebpur, Gazipur, 2012, 4–62.