

SCREENING OF SOME MUSTARD VARIETIES AGAINST APHID

M. A. Hossain¹, M. R. Ali¹, F. Begum^{2*} and N. Akhter²

Abstract

The study was conducted to find out the resistant response of mustard varieties against mustard aphid (*Lipaphis erysimi* Kalt.). Among the tested varieties none was found to be resistant against aphid. The variety Agrani can be regarded moderately resistant to mustard aphid. The variety BARI Sarisha-9, BINA Sarisha-6, SS75, Sofol and BARI Sarisha-6 can be regarded as moderately susceptible; Tori-7 and SAU Sarisha-1 can be graded as susceptible to aphid infestation. The incidence of aphid infested plants, branch, inflorescence, pod and deformed pod, the variety Agrani was identified as least preferred host to mustard aphid. The variety BARI Sarisha-9, BINA Sarisha-6, SS 75, Sofol and BARI Sarisha-6 were identified as moderately susceptible; Tori-7 and SAU Sarisha-1 were identified as most preferred host for this aphid infestation. Considering the yield reduction caused by aphid infestation, the highly aphid infested mustard variety Tori-7 produced lowest yield and caused maximum yield loss. Conversely, the least aphid infested variety Agrani produced highest yield and caused minimum yield loss.

Keywords: Screening, mustard variety, *Lipaphis erysimi*

Introduction

The oilseed crop is very important in agricultural production of Bangladesh. This crop occupied 3,93,369 ha of land that produce 8,36,000 metric tons of oilseeds (BBS, 2012). Among these oilseed crops, mustard is the most important, dominant and popular oilseed crop in Bangladesh, which occupied 276 ha of land and produce about 74,000 metric tons of mustard seeds (BBS, 2008). So, mustard plays an important role in production of oilseeds in Bangladesh. The cultivated mustard plant (*Brassica* spp.) belongs to the family Cruciferae. Mainly three species of mustard namely, *Brassica campestris*, *Brassica juncea* and *Brassica napus* are cultivated in our country. The production rate of mustard

is 1001 kg/ha (BBS, 2008), which is low compared with many other mustard growing countries of the world (Ahmed *et al.*, 1988).

In Bangladesh, mustard crop is cultivated during Rabi season. This crop is infested in the field by several species of insect pests. Among them, the mustard aphid, *Lipaphis erysimi* (Kalt.) is one of the most serious and destructive aphid pests on these crops (Ansary *et al.*, 2007) and very devastating in Bangladesh (Alam *et al.*, 1964; Ahmed *et al.*, 1977; Kabir, 1987; Begum, 1988; Shahjahan, 1994; Husain and Shahjahan, 1997). The mustard aphid is distributed in India, Pakistan, Nepal, Bangladesh, USA and many other countries of the World and recognized as a hazardous pest of mustard plant (Arora *et al.*,

*Corresponding author. E-mail: fatema22_sau@yahoo.com, ¹Department of Entomology, Sher-e-Bangla Agricultural University, Dhaka-1207, ²Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka-1207.

1969; Jarvis, 1970; Srivatawa and Srivatawz, 1970; Mukhopadhyay and Ghosh, 1979; Husain and Shahjahan, 1997). Both nymphs and adults of mustard aphid, *Lipaphis erysimi* causes damage to mustard plants from vegetative to siliqua maturity stage (Brar and Sandhu, 1987). Siliqua is the most suitable part for development of this pest (Tripathi *et al.*, 1986); they suck sap from twigs, siliqua, flower buds, flower and leaves of the plants. Maximum damage is caused by aphid at pod/siliqua formation stage (Brar and Sandhu, 1987). The minute greenish insect remains in colonies on young stem, leaves, shoots, inflorescence and pods. The affected leaves become curled and wrinkled. As a result, plants loss their vigour and ultimately their growth is stopped. The infested flower fail to set pods, the affected pods get twisted and shriveled. In case of severe infestation, the plant fail to develop pods, they do not mature and unable to produce healthy seeds (Husain and Begum, 1984; Kabir, 1987; Begum, 1988 and Shahjahan, 1994). Recent studies reported that the yield loss due to aphid infestation in mustard ranged from 87.16 to 98.16% in Bangladesh (Anon, 1995).

The *Lipaphis erysimi* (Kalt.) causes enormous qualitative and quantitative losses in rape seed and mustard crop. The seed weight is reduced, which in turns reduces the viability of the seed and the oil content. Production of mustard is very low in Bangladesh in comparison to other countries of Asia. A substantial amount of yield is lost due to aphid infestation.

Generally the farmers of Bangladesh control this pest by the application of chemical insecticides. Though the pest is major in status, the management of this pest through

non chemical tactics (cultural, biological, and host plant resistance etc.) undertaken by the researcher throughout the world are scanty. So, the use of chemical regarded to be most useful measure to combat this pest. But the application of chemical insecticides has got many limitations and undesirable effects (Luckman and Metcalf, 1975). It pollutes our environment markedly. So save the environment the development of resistant mustard variety is urgent. Suitable rearing procedure and standard screening methods to evaluate resistant factors are still wanting.

It is the national demand to find out suitable measures to manage this pest and keep the pest population below economic level. The use of resistant variety of mustard for pest management program is considered to be economical and safer as compared to the chemical control. To minimize the use of synthetic insecticides and problems arising out of their frequent use, it is very essential to cultivate a resistant and tolerant variety against aphid.

A small number of mustard varieties have been reported to be resistant to the aphid, but most of them have poor agronomic character. In view of this requirement, the present research works were undertaken with a view to establish the responses of some varieties to mustard aphid leading to evaluate some promising mustard varieties resistant to mustard aphid.

Materials and Methods

The study was conducted at Sher-e-Bangla Agricultural University Research field, Dhaka during Rabi season from November 2007 to February, 2008. Eight varieties were

evaluated for their resistance against Aphid infestation under natural growing condition. Seeds were collected from different sources of BARI, BINA and SAU experimental farms. Each variety was considered as an individual treatment. The tested varieties were: SAU-1, BINA-6, TORI-7, BARI-9, BARI-6, SOFOL, AGRANI and SS-75. The crop was grown in the field and proper doses of manures and fertilizers were applied as per recommendation of BARC (2007). Intercultural operations such as irrigation, weeding and mulching were done as and when necessary. The crops were harvested at full maturity stage starting from 19th February, 2008.

Data collection and calculation

For data collection, six plants per plot were randomly selected and tagged and finally multiply with total no. of plants per plot. Data collection was started at 41 days after sowing. All the data were collected once a week. The different parameters considered were: The number of aphid infested plants, branch, inflorescence, pod; deformed pod, total yield (g) per plot and yield loss were recorded.

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:

$$\% \text{ aphid infested plant} = \frac{\text{No. of aphid infested plant}}{\text{Total no. of plant per plot}} \times 100$$

Percent of aphid infested branch by number

Number of aphid infested branch was counted from total branch and calculated by using the

following formula:

$$\% \text{ aphid infested branch} = \frac{\text{No. of aphid infested branch}}{\text{Total no. of branch per plot}} \times 100$$

Percent of aphid infested inflorescence

The total number of aphid infested and uninfested inflorescence at flowering were counted from 6 randomly selected plants of three rows. Thus, the percentage of infested inflorescence by aphid was calculated using following formula:

$$\% \text{ aphid infested inflorescence} = \frac{\text{No. of aphid infested inflorescence}}{\text{Total no. of inflorescence per plot}} \times 100$$

Percent of aphid infested pod

The total number of aphid infested and uninfested pod were counted from randomly 6 selected plants of three rows. The percentage of infested pod by aphid was calculated using following formula:

$$\% \text{ aphid infested pod} = \frac{\text{No. of aphid infested pod}}{\text{Total no. of pod per plot}} \times 100$$

Percent of aphid infested deformed pod

The total number of infested and uninfested deformed pods at flowering and pod forming stages were counted from 6 randomly selected plants of three rows and the percentage of infested deformed pod due to aphid was calculated with the following formula:

$$\% \text{ deformed pod} = \frac{\text{No. of aphid infested deformed pods}}{\text{Total no. of pods per plot}} \times 100$$

Statistical analysis

The data obtained from different parameters were statistically analyzed using MSTAT program. The means of statistically significant parameters were separated by using Duncan's

Multiple Range Test (DMRT) at 5% and 1% level. The correlation studies were also done to see relationship among different parameters.

Results and Discussion

Incidence of aphid infested plants among different mustard varieties

Statistically significant variations were observed in the incidence of aphid infested plants throughout the growing season in the field among 8 mustard varieties and the recorded results were represented in Fig. 1. At 41 DAS, the incidence of aphid infested plants among 8 mustard varieties ranged from 35.33 to 54.33%. The highest incidence of plant infestation was recorded in the variety Tori-7, which was statistically similar to that of SAU Sarisha-1, Sofol, BINA Sarisha-6 and BARI Sarisha-9. On the other hand, the lowest incidence of aphid infested plants was recorded in the variety Agrani, which was also statistically similar to BARI Sarisha-6

(36.80%) and SS 75 (38.87%).

More or less similar trends of results in terms of incidence of percent aphid infested plants among 8 mustard varieties were also observed and recorded at 49, 55, 62, 69 and 74 DAS, but percent incidences were increased with the increase of the plant ages (Fig. 1). The order of trend in the mean incidence of aphid infested plants per plot among eight mustard varieties is Tori-7 > SAU Sarisha-1 > BARI Sarisha-9 > BINA Sarisha-6 > SS 75 > Sofol > BARI Sarisha-6 > Agrani.

From the above findings, it was revealed that among the eight varieties of mustard, none was found to be highly resistant to aphid. The variety Agrani can be regarded as moderately resistant to mustard aphid. The varieties BARI Sarisha-9, BINA Sarisha-6, SS 75, Sofol and BARI Sarisha-6 can be considered as moderately susceptible; Tori-7 and SAU Sarisha-1 can be graded as susceptible to aphid infestation. The aphid infestation showed a sharp rise and reached the peak at 62 days

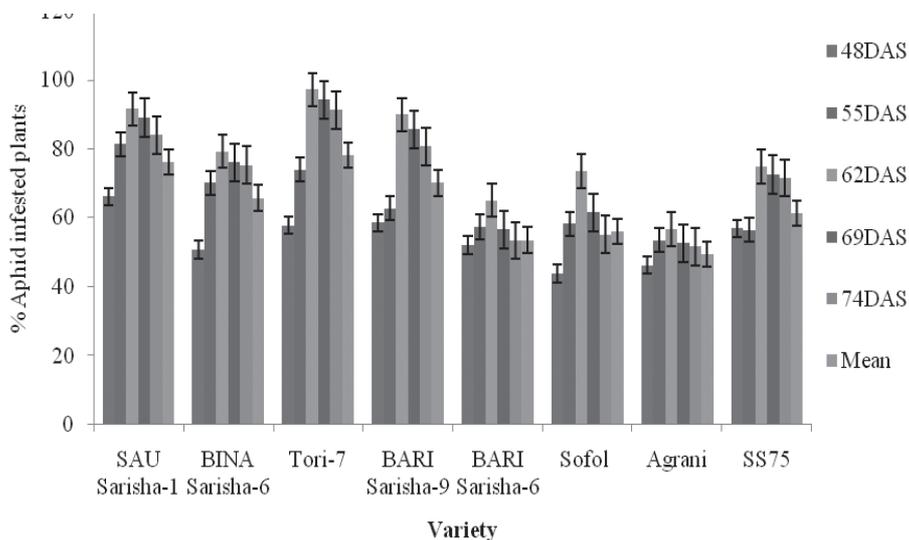


Fig. 1. Incidence of aphid infested plants among 8 mustard varieties

after sowing. During this period almost all the varieties of mustard had flowers and started setting pods. According to Rashid *et al.*, 2002 this stage is suitable to evaluate the level of susceptibility of mustard to mustard aphid, because this physiological stage of the mustard plant might be more favorable to aphid attack. The present results were in agreement with those of Husain and Begum (1984); Husain and Shahjahan (1997); Kabir (1987); Begum (1988), who also regarded Tori-7 as highly susceptible to mustard aphids.

Incidence of aphid infested branch among different mustard varieties

Statistically significant variations were observed in the incidence of aphid infested branch in the field of eight mustard varieties and presented in Fig. 2. At 41 DAS, the incidence of aphid infested branch among 8 mustard varieties was ranged from 16.60% to 40.00%. The highest incidence of infested

branch was recorded in the variety Tori-7, which was statistically similar to those of SAU Sarisha-1 (34.00%), SS 75 (28.50%) and BARI Sarisha-9 (28.30%). On the other hand, the lowest incidence of aphid infested branch was recorded in the variety Agrani and Sofol, which was statistically similar to BINA Sarisha-6 (18.10%) and BARI Sarisha-6 (22.20%).

More or less similar trends was observed in the percent aphid infested branch among 8 mustard varieties recorded at 48 DAS, 55, 62, 69 and 74 DAS. The mean incidence of aphid infested branch among 8 mustard varieties was ranged from 52.38% to 78.48% (Figure 2), where the highest incidence of infested branch was recorded in the variety Tori-7, which was statistically similar to that of SAU Sarisha-1 (73.00%) followed by BARI Sarisha-9 (68.78%). On the other hand, the lowest incidence of aphid infested branch was recorded in the variety Agrani, which

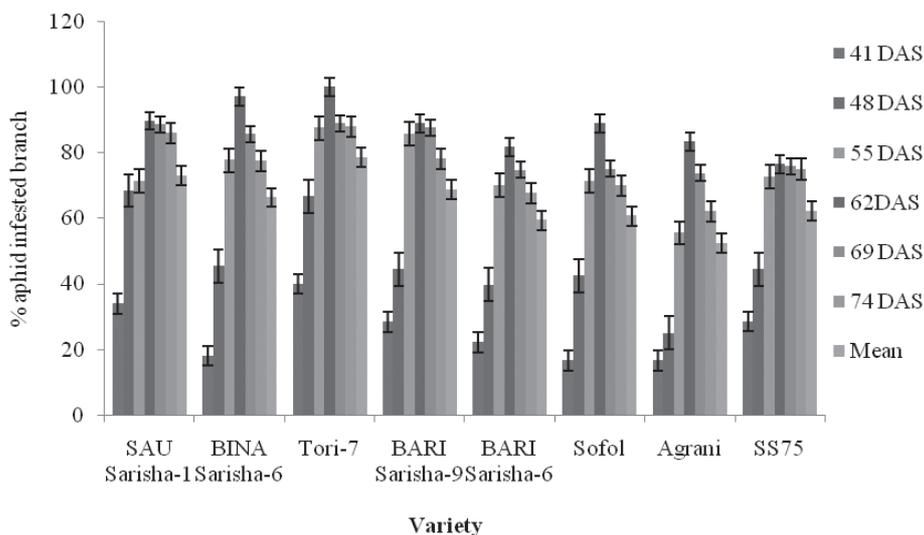


Fig. 2. Incidence of aphid infested branch among 8 mustard varieties

was statistically identical to that of BARI Sarisha-6 (59.35%) and Sofol (60.71%). The order of trend in the mean incidence of aphid infested branch among eight mustard varieties was Tori-7 > SAU Sarisha-1 > SS 75 > Sofol > BINA Sarisha-6 > BARI Sarisha-9 > BARI Sarisha-6 > Agrani.

Therefore, the variety Agrani can be identified as least preferred host for mustard aphid. The variety BARI Sarisha-9, BINA Sarisha-6, SS 75, Sofol and BARI Sarisha-6 may be categorized as moderately preferred; Tori-7 and SAU Sarisha-1 can be considered as most preferred host for aphid. The percent infested branch was sharply increased with the increase of the plant ages and reached the peak at 62 days after sowing and then gradually declined. This result was in agreement with those of Islam (1991).

Incidence of aphid infested inflorescence among the tested mustard varieties

Significant variations were observed in the

incidence of aphid infested inflorescence among eight mustard varieties shown in Figure 3. At 41 DAS, the incidence of aphid infested inflorescence among eight mustard varieties was ranged from 33.33 to 60.33%, where the highest incidence was recorded in the variety Tori-7, which was statistically similar to that of with SAU Sarisha-1 (34.00%) and SS 75 (47.77%). On the other hand, the lowest incidence of aphid infested inflorescence was recorded in the variety Agrani, which was statistically similar to that of BARI Sarisha-6 (34.70%), Sofol (36.93%) and BINA Sarisha-6 (37.50%).

More or less similar trends of results in terms of incidence of percent aphid infested inflorescences among 8t mustard varieties were also observed at 48 DAS and 55 DAS, but percent incidences were increased with the increase of the plant ages. The mean incidence of aphid infested inflorescence among eight mustard varieties was ranged from 44.00 to 73.87%, where the highest

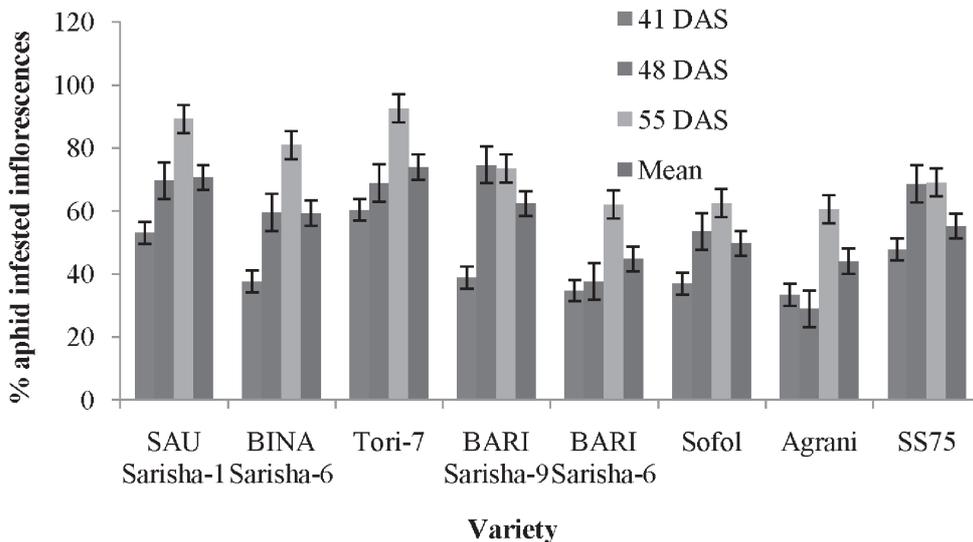


Fig. 3. % aphid infested inflorescences among 8 mustard varieties

incidence was recorded in the variety Tori-7, which was statistically similar to that of SAU Sarisha-1 (70.57%) followed by BARI Sarisha-9 (62.28%) (Fig. 3). On the other hand, the lowest incidence was recorded in the variety Agrani, which was statistically identical to that of BARI Sarisha-6 (44.73%) and Sofol (49.67%). Therefore, the order of trend in the mean incidence of aphid infested inflorescence among eight mustard varieties was Tori-7 > SAU Sarisha-1 > BARI Sarisha-9 > BINA Sarisha-6 > SS 75 > Sofol > BARI Sarisha-6 > Agrani.

Considering the incidence of aphid infested inflorescence, the variety Agrani can be identified as least preferred host to mustard aphid which might be due to rind hardness of the branch. The variety BARI Sarisha-9, BINA Sarisha-6, SS 75, Sofol and BARI Sarisha-6 can be categorized as moderately preferred; Tori-7 and SAU Sarisha-1 can be classified as most preferred host to aphid. The percent of infested inflorescence was sharply increased with the increase of the plant ages. This result was in harmony with those reported by Islam (1991), who obtained the highest incidence of aphid infested inflorescence in Tori-7.

Incidence of aphid infested pod among different mustard varieties

Significant variations were observed in the incidence of aphid infested pod among eight mustard varieties tested in the present trial and presented in Fig. 4. At 41 DAS, the incidence of aphid infested pod among eight mustard varieties was ranged from 7.83 to 18.70%, where the highest incidence was recorded in the variety Tori-7 and the lowest was recorded in the variety Agrani which might be due to toughness of the siliqua.

More or less similar trends in the percent of aphid infested pod among eight mustard varieties were also observed at 48 DAS and 55 DAS having increasing the incidences with the increase of the plant ages (Fig. 4). The highest range of incidence of aphid infested pod was observed at 62 DAS and the incidence was ranged from 43.74 to 81.35%.

The mean incidence of aphid infested pod among eight mustard varieties was ranged from 32.25 to 57.75%, where the highest incidence was recorded in the variety Tori-7, which was statistically similar to that of SAU Sarisha-1 (54.02%). On the other hand, the lowest incidence was recorded in variety Agrani (32.25%) followed by BARI Sarisha-6 (43.20%). Therefore, the order of trend of the mean incidence of aphid infested pod among eight mustard varieties was Tori-7 > SAU Sarisha-1 > BARI Sarisha-9 > BINA Sarisha-6 > SS 75 > Sofol > BARI Sarisha-6 > Agrani.

Among the eight varieties of mustard, none was found to be resistant to aphid (Figure 4). In respect of incidence of aphid infested pod, the variety Agrani can be identified as least preferred host to mustard aphid, whereas Tori-7 and SAU Sarisha-1 can be categorized as most preferred host to aphid infestation. The present supports the findings of Islam (1991), who obtained the highest incidence of aphid infested pod in Tori-7.

Incidence of deformed pod due to aphid infestation among 8 mustard varieties

Significant variation was observed in the deformed pod due to aphid infestation among 8 mustard varieties (Fig. 5). More or less similar trends of percent deformed pod due to

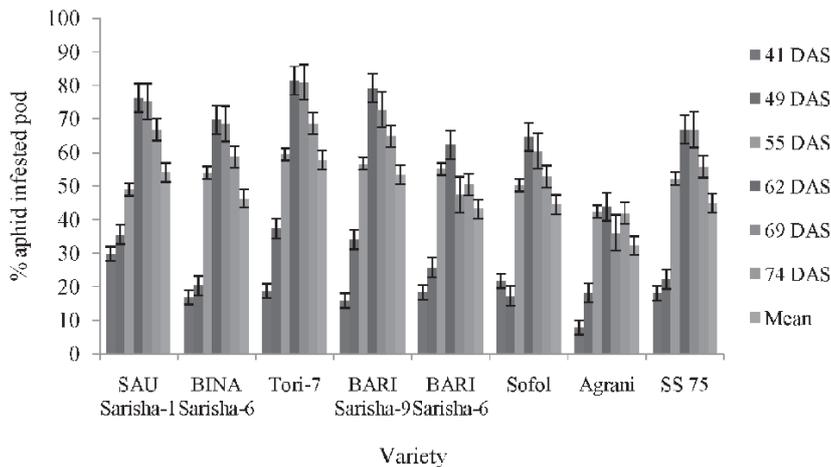


Fig. 4. % aphid infested pod among 8 mustard varieties

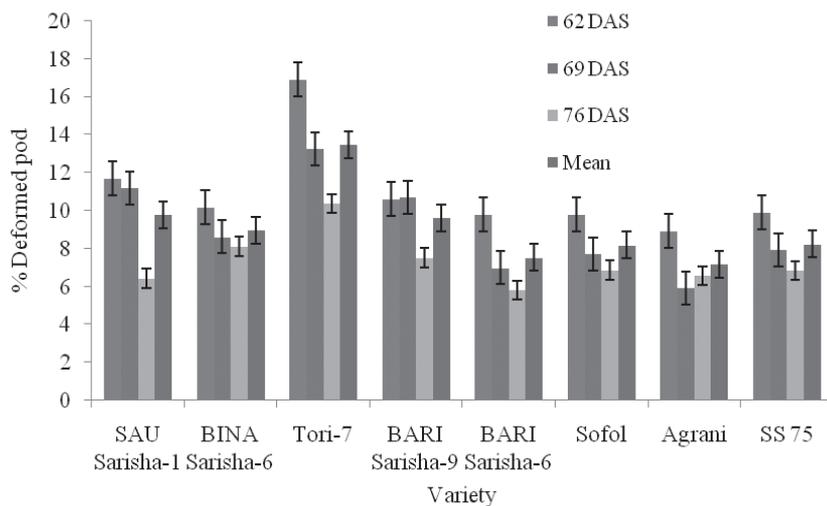


Fig. 5. Incidence of deformed pod among 8 mustard varieties

aphid infestation were observed at 62 DAS, 69 DAS and 76 DAS. Among different ages of the plant, the highest range was from 8.93 to 16.91% recorded at 62 DAS and it was decreased with the increase of the plant age. The mean incidence, deformed pod was ranged from 7.15 to 13.48%, where the highest incidence was recorded in the variety Tori-7, which was statistically different from other varieties. The lowest percentage of deformed

pod due to aphid infestation was recorded in variety Agrani.

It revealed that the highly susceptible variety Tori-7 produced higher percentages of deformed pod due to attack by the higher number of aphids. Conversely, Agrani produced lower percentage of deformed pod because of the lower incidence of the aphid population.

Effect of aphid infestation on yield and yield loss of among the mustard varieties

Significant variations were recorded in terms of yield and yield loss among eight mustard varieties (Fig. 6). The highest yield was recorded in the variety Agrani (615.50 kg/ha), which was statistically different from other varieties and the lowest yield was found in the variety Tori-7 (373.40 kg/ha). Therefore, the trend of yield of eight selected mustard varieties was Agrani > BARI Sarisha-6 > Sofol > SS 75 > BINA Sarisha-6 > BARI Sarisha-9 > SAU Sarisha-1 > Tori-7.

Considering the yield loss caused by aphid infestation among eight mustard varieties, the maximum yield loss (71.50%) was calculated in the variety Tori-7, which was statistically identical with that of SAU Sarisha-1 (70.00%), BARI Sarisha-9 (69.70%) and BINA Sarisha-6 (66.20%). Conversely, the minimum yield loss (46.20%) was calculated in Agrani, which was statistically similar with that of BARI Sarisha-6 (51.00%), SS 75 (51.70%) and Sofol (53.70%). Therefore, the trend of the yield loss caused by aphid infestation among eight mustard varieties was reverse and the trend was Tori-7 > SAU Sarisha-1 > BARI Sarisha-9 > BINA Sarisha-6 > SS 75 > Sofol > BARI Sarisha 6 > Agrani.

This finding revealed that the higher aphid infestation was in variety Tori-7 produced lowest yield and caused maximum yield loss. Conversely, the least aphid infested variety Agrani produced highest yield and caused minimum yield loss. This result was in agreement with those of Begum (1995) and Mondal *et al.* (1994), who found that higher aphid population increased yield loss markedly.

Conclusion

Based on findings of the present investigation, it may be concluded that among eight varieties of mustard only Agrani showed the best performance against Aphid infestation of plant, branch, inflorescences, pod and deformed pod under field condition. On the other hand Tori-7 showed the lowest performance in aphid infestation followed by SAU Sarisha-1 may be identified as most susceptible to *L. erysimi*. The variety, Agrani was the least susceptible and may be recommended for commercial cultivation of mustard in Bangladesh.

References

- Ahmed, M.U., A. Ahmed and M.A. Mannan. 1977. Studies on the comparative effectiveness of organophosphorus insecticides for the control of mustard aphid in Bangladesh. *Bangladesh J. Agric. Res.* 11 (II): 16 – 19.
- Alam, M.Z., A. Ahmed and A. Siddique. 1964. Control of winter aphids in East Pakistan. A Review of Research Division of Entomology, 1947-64. Agric. Inform. Serv., 3 R. K. Mission Road, Dhaka – 3, pp. 256-259.
- Anonymous. 1995. Assessment of losses due to aphid infestation at different growth of mustard. Ann. Rept., 1994-95, Bangladesh Agric. Res. Inst. Regional Agric. Res. Stat. Jessore, 120p.
- Ansary, M.S., B. Hussain and N.A. Qazi. 2007. Influence of abiotic environment on the population dynamics of mustard aphid, *Lipaphis erysimi* (Kalt.) on Brassica germplasm. *J. Biol Sci.* 7 (6), 993-996.

- Arora, S.K., M.L. Saini, R.S. Sandhu and. A.S. Mahendera. 1969. Effect of insecticide on yield and quality of Indian mustard (*B. juncea*). *Indian J. Agril. Sci.* 39 (V): 444-447.
- Bakhetia, D.R.C. 1983. Losses in rapeseed and mustard due to *Lipaphis erysimi* (Kalt.) in India. *In: A literature study proceeding of with international Rapeseed conference held at Paris from 17-19.*
- BARC. 2007. Fertilizer Recommendation Guide Bangladesh Agricultural Research Council BARC, Farm gate, New Airport Road, Dhaka-1215. 196 p.
- BBS. 2008. Statistical Pocket Book of Bangladesh-07. Bureau of Statistics (BBS,), Ministry of Planning, Government of the People's Republic of Bangladesh. 690p.
- Begum, M. 1988. Comparative study on the susceptibility of different genotypes of mustard *B. campestris* to aphid *Lipaphis erysimi* (Kalt.). M.S. (Ag). Thesis, Department of Entomology. Bangladesh Agricultural University, Mymensingh, 64p.
- Begum, S. 1995. Population activities of mustard aphids in relation to different sowing time. Annual Research Report 1994-95. Entomol. Div., BARI, Joydebpur, Gazipur. Pp.33-34
- Brar, K.S. and G.S. Sandhu. 1987. Comparative resistance of different *Brassica* species /varieties to the mustard aphid *Lipaphis erysimi* (Kalt.) under natural and artificial condition. *Indian Agril. Res.* 12 (III):198-200.
- Brar, K.S., H.S. Ratual and K.S. Lobana. 1976. Different of mustard aphid, *L. erysimi* (Kalt.) to different rapeseed and mustard varieties under natural and artificial infestation. *J. Res. Punjab Agril.Univ.* 13 (I):14-18.
- Husain, M. and N. Begum. 1984. Evaluation of *Brassica* germplasms for their reaction to aphids. *Bangladesh J. Agric.* 9 (IV):31-34.
- Husain, M. and M. Shahjahan. 1997. Field and net house evaluation of some *Brassica* varieties /mutants for reaction to aphid. *Bangladesh J. Entomol.* 7 (I-II): 27-35.
- Islam, N. 1991. Effect of sowing time on the abundance of mustard aphid, *Lipaphis erysimi* (Kalt.) on the infestation and yield of mustard. Annual Research Report (1990-91) .Entomol. Div., BARI, Joydebpur, Gazipur. pp. 28-29.
- Jarvis, J.L. 1970. Relative injury on some cruciferous oilseeds by the turnip aphid *J. Econ. Entomol.* 63 (v):1498-1502.
- Kabir, M.H. 1987. Evaluation of some mustard germplasms for their reaction to mustard aphid, *Lipaphis erysimi* (Kalt.). M.S. Thesis, Dept. of Entomol, Bangladesh Agricultural University, Mymensingh. 64p.
- Luckman, W.H. and R.L. Metcalf. 1975. The pest management concept. *In: Metcalf, R. L. and Luckman, W. H. (eds), Introduction to Insect Pest Management.* John Wiley and Sons, New York. Pp 3-35.
- Mukhopadhyay, D. and M.R. Ghosh. 1979. Effect of phased application of formation and methyl demeton on the incidence of *Lipaphis erysimi* (Kalt.) and the yield of rape seed. *Indian J. Agril. Sci.* 94 (II):898-900.

- Rashid, M.A., M. Hossain, M. Rahaman, M.H. Rahaman, M.H. Rash, M.S. Nahar, S.N. Alam, I. Faruk, H.S. Jasmine, S. Alam, A. Bahet, L. Black, J.F. Wang, N.E. Talesar, G. Luther and S. Miller. 2002. Varietal screening of plant for resistance to bacterial wilt, fruit and stem borer, leaf hopper and root knot nematode and tomato resistance to bacterial wilt, virus disease and root knot nematode. IPMCRSP, 8th Annual Report, 2001-2002 pp77-81.
- Shahjahan, M. 1994. Field and laboratory evaluation of some *Brassica* germplasms for resistance to aphid. M. S. Thesis, Dept. of Entomol., Bangladesh Agricultural University, Mymensingh. 89pp.
- Srivastava, A.S and J.L. Srivastava. 1970. Insecticides for the control of mustard aphids. *Inte. Pests Control*. 12 (II) :27.
- Tripathi, N.L.M., G.C. Sachan. S.K. Verma and P.K. Pathak. 1986. Developmental behaviour of *Lipaphis erysimi* (Kaltenback) on different part/stages of *Brassica campestris* var. toria. *Indian J. Entomol.* 48 (III): 295-300.

