Plant Archives Vol. 18 No. 2, 2018 pp. 2495-2500 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

POPULATIONS BUILD UP OF MUSTARD APHID AND THEIR NATURAL ENEMIES IN RELATION TO BIOTIC AND ABIOTIC FACTORS

S.A. Dwivedi*[1], R. S. Singh[2] and S.K.Gharde[1]

[1*]Department of Entomology, Lovely Professional University, Punjab-144411
[2]Department of Entomology, C.S.A.U.A.& T., Kanpur-208002

Significance of statements: This study showed that Temperature and humidity like abiotic factors play key role to control mustard aphid population and Biotic factors like *Coccinella Septempunctata* and *Syrphid* fly like predators helpful for decline the aphid population.

Abstract

To determine the populations build up of mustard aphid and their natural enemies in relation to biotic and abiotic factors. Field experiment was conducted C.S.A. University of Agriculture and technology Kanpur during the *rabi* season (October-March) of 2013-14 and 2014-15 respectively. The maximum aphid population 270.18 aphids /10 shoot was recorded in the first week of February and at the fourth week of March. Synchronization in the appearance of mustard aphid predators *Coccinella* spp. and *Syrphid* larvae was population maximum 11.25 beetles/ 10 shoot and 5.90 larvae/10 shoot, respectively in fourth week of February that was one of the main reasons for the low multiplication of aphid population in 2013-14. During *Rabi* 2014-15 Maximum aphid population was recorded third week of February 385.12aphids/10 shoots with its predators population *Coccinella spp*. and *Syrphid* larvae 10.15 beetles/10 shoot and 4.80 larvae/10 shoot, respectively. Simple correlation studies to evaluate the instantaneous effects of the meteorological variables revealed that of the abiotic factors (Temperature, relative humidity and rainfall), the temperature had the biggest role in the buildup of the mustard aphid population. The appearance of *Coccinella* spp. and the larvae of *Syrphid* flies were positively correlated with temperature, while there was negative correlation with the incidence of mustard aphid *Lipaphis erysimi*. There was positive correlation between the population of aphid and relative humidity.

Key words: Biotic, Abiotic, Natural enemies, Aphid and Lady bird beetle.

Introduction

Mustard is the 2nd most important edible oil seeds in India after groundnut and accounts for nearly 30% of the total oil seeds produced in the country. As compare other oil seeds mustard contain lowest amount of saturated fatty acid that is harmful with two essential fatty acid linoleic and linolenic that have absent many other edible oil. Sulphur deficiency cover by leaves used as green vegetable. Mustard oil used in medicine preparation and hair oil. For the fulfilment of fats and oils demand of the country, it is essential to increase mustard production. Among the various factors, optimum plant population in relation to fertilization and efficient utilization of nutrients by the crop are the most important (Singh and Prasad, 2003). Mustard aphid a potentially serious Key pest of mustard crop has still been taking away of heavy loss of production. This noxious pest is responsible to inflict 27 to 96 percent yield loss in mustard in India (Bakhetia and Sidhu, 1983). For successful cultivation, crop needs repeated application of insecticides which leads to several residual hazard effects. Among several bio-agents of mustard aphid, lady bird beetles are important predator, as majority of them *Coccinella septempunctata* and *Syrphid* flies are predaceous on several groups of insect pests, including aphids, coccids, adelgids and aleyrodids. 90% of the known 4200 *Coccinellid* species are predaceous (Iperti and Paoletti, 1999), and Indian *Coccinellid* diversity includes 119 predaceous species (Omkar and Pervez, 2000c). Of these, *Micraspis discolor* (Fabricius) is native to India (Agarwala and Ghosh, 1988; Gautam, 1994). The beetle has distinct sexual dimorphism (Omkar and Pervez, 2000a) and a wide range of aphid prey provides effective biological

***Author for correspondence :** E-mail : dwivedi.sunilkumar46@gmail.com

control of certain aphid species, *viz.*, *Aphis gossypii* Glover and *A. craccivora* Koch. (Agarwala, 1987; Omkar and Pervez, 2000b and Hemchandra *et al.*, 2010). Abiotic factors play key role in the influence aphid infestation due to large variation in the date of aphid infestation and its multiplication. Under suitable climatic conditions, mustard aphids spread very rapidly and cross ETL boundary and reach EIL frequently due to grower need to repeatedly use insecticides. Several studies have been done to develop correlation between weather parameters and aphid population. They reported that the peak period of aphid activities on *B. juncea* varied from end of January to first week of March. Based on simple linear regression analysis between aphid population and the corresponding weather for 3 years, Bishnoi *et al.* (1992) reported that the either mean temp. or saturation deficit play significant role to the buildup aphid population. Samdur *et al.* (1997) from Delhi observed that average maximum and minimum relative humidity had positive relationship with mean aphid infestation index a minimum relative humidity of 30 to 35% and average maximum relative humidity of 85 to 88% were found to be the most congenial conditions for increase in aphid population. Kulat *et al.* (1997) found that in Nagpur, a combination of ambient maximum temperature (26.4 to 29.0^{0}C), minimum temperature (8.4 to 12.6^{0}C) and high relative humidity ranging from 75 to 85 percent in the month of January favoured aphid multiplication.

Material and methods

The experiment carried out on population dynamics of mustard aphid and their natural enemies in relation to biotic and abiotic factors, field experiments were conducted in Department of Entomology C.S.A. University of Agriculture and technology Kanpur during two consecutive years *i.e.* 2013-14 and 2014-15 at the student instructional farm of the university in rabi season. The sowing date of the experimental material for 2013-14 and 2014-15 was 15 October. The population counts were made regularly at the interval of seven days on mustard variety "Varuna" sown in 5×3m^2 area. The experiment was replicated three times and from each plots ten plants were selected randomly. Three leaves, one each from upper, middle and lower portions of the plants were selected at random the population were counted. In addition to this during flowering stage of the crop, the population were also recorded on a randomly selected twinges (10 cm long from tip) of each randomly selected plant. The observations were recorded during morning hour on the defined day. Weekly meteorological data on temperature, relative humidity and rainfall were obtained from the meteorological observatory of the university. In order to study the influence of abiotic and biotic factors on the pest incidence, simple correlation was worked out between incidence and meteorological factors for the same period.

Result and Discussion

Record and incidence of mustard aphid (*Lipaphis erysimi*)

The mustard aphid was seen initially in the first week of January during 2013-14 while in the second week of December in 2014-15. In the beginning the population was low but increased to its maximum at full flowering stage of the crop in the first and second week of February during 2013-14 and 2014-15 respectively. It was interesting to note that maximum population of aphid during 2013-14 was 245.20 aphids per ten twigs, where as it were 385.12 aphids per ten twigs in the second year 2014-15 showing a variation in the level of epidemics in the both years. There after a decline in the population was noted with rising temperature and decline relative humidity. The pest population was at its minimum in the middle of March.

Record and incidence of the natural enemies of mustard aphid (*Lipaphis erysimi*)

In the field condition *Coccinella* spp. and *Syrphid* larvae were found predating on mustard aphid. During both the years' predator's population appeared in the month of January. The seasonal incidence of these predators are described below.

Coccinella spp.: During 2013-14 this aphidophagous predators appeared along with aphid in first week of January and reminded till the presence of aphid (table-1). The population of predator was maximum (11.25 per ten twigs) in the last week of February and there after decrease in the population was noted with decline in aphid population. During 2014-15 predators appeared in the Second week of January and reached its peak 12.35 *Coccinella* spp. per ten twigs by the third week of February (7th standard weeks). There after a sharp decline in the predator population was noted due to abrupt decrease in aphid population (table-2).

Syrphid larvae

Syrphid larvae appeared one week after aphid incidence *i.e.* in the second week of January during 2013-14, whereas during 2014-15 the larval population was recorded five week after aphid population appearance on the crop in the second week of January and reminded till the availability of mustard aphid. Maximum population of 5.90 and 4.80 larvae per ten twigs fourth week of

Table 1: Weekly population of *Lipaphis erysimi* and its predators on mustard crop with abiotic and biotic factors (2013-14).

Year, Month &S.W	Temp (^{0}C)	Relative Humidity (%)	Rainfall (mm)	Mean predators population		Mean aphid Population
				Coccinella spp.	*Syrphid* spp.	
2013DecIV 2014Jan I	18.5	93.4	11.2	0.77	-	3.00
Jan II	17.3	96.9	19.0	1.80	0.60	4.10
Jan III	17.5	97.3	67.2	2.45	1.25	12.00
Jan IV	19.3	94.6	8.4	3.51	1.70	110.25
Feb I	19.0	94.9	-	4.11	1.90	270.18
Feb II	23.5	92.0	1.2	7.80	3.10	245.20
Feb III	19.7	91.1	13.6	10.20	5.17	170.15
Feb IV	22.7	96.3	12.0	11.25	5.90	115.00
March I	23.7	94.4	10.0	11.00	5.80	92.00
March II	23.7	90.4	-	9.10	4.00	85.00
March III	29.8	85.1	-	6.25	4.10	34.00
March IV	31.3	74.3	10.6	4.00	3.15	17.05

*Population base on 10 plants

Table 2: Weekly population of Lipaphis erysimi and its predators on mustard crop with abiotic and biotic factors (2014-15).

Year, Month &S.W	Temp (^{0}C)	Relative Humidity (%)	Rainfall (mm)	Mean predators population		Mean aphid Population
				Coccinella spp.	*Syrphid* spp.	
2014 Dec I	26.1	85	0	0	0	0
Dec II	21.7	92	16.8	0	0	5.17
Dec III	17.1	97	0	0	0	16.20
Dec IV	16.4	100	0	0	0	20.61
2015 Jan I	19.2	97	0	1.10	0.80	80.10
Jan II	14.0	96	0	7.20	1.30	110.29
Jan III	14.2	96	14.9	3.00	1.90	210.25
Jan IV	18.3	98	0	4.25	2.20	225.00
Feb I	21.5	92	0	5.10	2.10	270.21
Feb II	22.3	93	0	8.25	3.61	340.10
Feb III	26.4	89	0	10.15	4.21	385.12
Feb IV	29.6	95	0	10.01	4.80	305.17
March I	25.3	95	0	5.50	3.20	223.00
March II	26.9	84	0	3.20	2.20	170.00
March III	26.9	92	95.0	2.05	1.0	120.00
March IV	31.2	82	0	0	1.5	90.25

*Population base on 10 plants

February. (9th SW) during 2013-14 and 2014-15 respectively.

Correlation between mustard aphid and predators population with abiotic factors

The data given in the table -7 show that incidence of aphid had significant positive correlation with relative humidity while negative correlation was observed with temperature during both years (2013-14 and 2014-15). Significant correlation could not obtain with rainfall in both years. Thus it is clear that aphid population increased with declined temperature and increased humidity.

The populations of predators (*Coccinella* spp. and *Syrphid* larvae) were observed positively correlated with average temperature during both years. The correlation between predators and relative humidity and rainfall on the other hand were non-significant. Thus it is evident from the correlation coefficient between predators and abiotic factors that population of predators increasing with rising temperature. Correlation between aphid and predators population with biotic factors Correlation coefficient between aphid and both predators (*Coccinella spp*. and *Syrphid* larvae) were found non-significant during both years. Hence no definite conclusion could be obtained (table 3).

Roy and Baral (2002), Varmora *et al.* (2009) reported that the correlation coefficient between different weather parameters and aphid population were non-significant that why temperature and relative humidity have played an important role for appearance of late aphid in field Rahalkar *et al.* (2006) reported that temperature negative correlation with aphid population. The incidence of mustard aphid recorded on mustard crop at first fortnight of January and lasted till the fourth week of March in 2013-14 and first week of December to fourth week of March during 2014-15 in two successive year. These result conform finding of Kulkarni and Patel (2001), Kumar *et al*. (2000), Deepak *et al*. (2002), Mishra and Kanwat (2003), Jat *et al.* (2006), Dhaliwal *et al.* (2007) and Tomar and Yadav (2009). The peak population count first week of February (270.18 aphids/10 plant) in 2013-14 and third week of February (385.12 aphids/10 plants) similar finding have been reported by Biswas and Das (2000), Panda *et al.* (2000),

Table 3: Correlation of *Lipaphis erysimi* Kalt and its predators on mustard crop with respect to biotic and abiotic factors (2013-14 and 20-14-15 in a vertical sequence

Aphid and Predators	Biotic Factor		Abiotic Factor		
	Coccinella spp.	*Syrphid* larvae	Ave Temp.	R.H.	Rainfall
Aphid	0.07	0.06	-0.13	-0.21	-0.43
	0.15	0.11	-0.24	0.01	-0.13
Coccinella spp			0.32	0.1	-0.33
			0.15	0.10	-0.18
Syrphid larvae			0.50	-0.18	-0.31
			0.40	-0.06	-019

*Significant at 5% level.

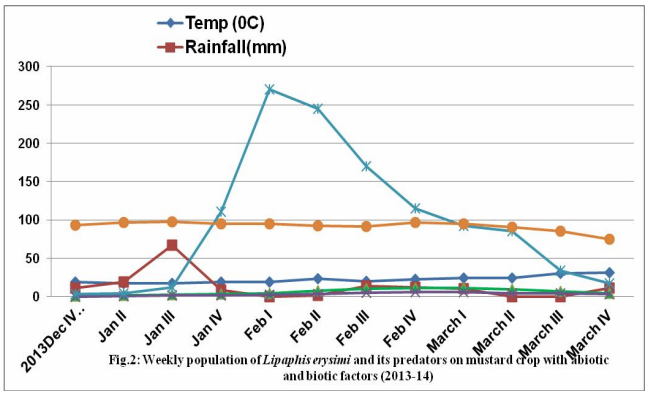

Fig.2: Weekly population of *Lipaphis erysimi* and its predators on mustard crop with abiotic and biotic factors (2013-14)

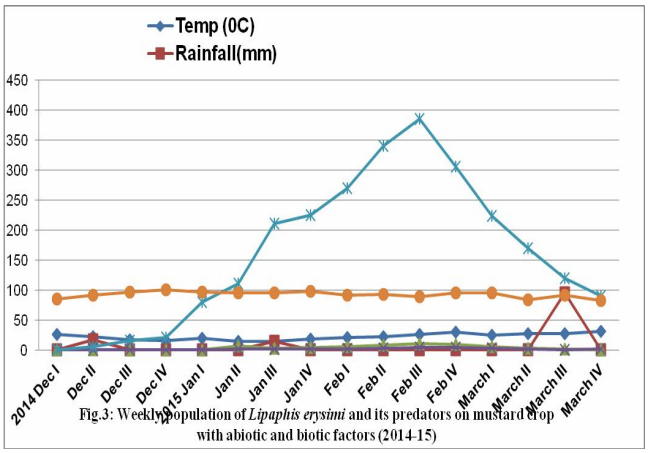

Fig.3: Weekly population of *Lipaphis erysimi* and its predators on mustard crop with abiotic and biotic factors (2014-15)

Prasad *et al.* (2003), Vekaria and Patel (2005), Jandial *et al.* (2007) and Singh *et al.* (2009).

The aphid population disappeared in fourth week of March in both year in the present investigation. The intensity of aphid population have been worked out by Panda *et al.* (2000) who also found that aphid population reaches its peak in the middle of February when crop was 75 day's old and after that it started decline, Mishra and Kanwat (2003) report that the peak infestation of *L. erysimi* was the most abundant during the last week of January and the sharp decline the aphid population in the first week of February was attributed to rising temperature and production of a late forms coupled with crop maturity, Hakim Ali *et al.* (2016), Singh *et al.* (2009) reported that aphid incidence reached its peak in 2nd and 3rd week of February after this the population started decreasing and vanish at the end of February and first week of march when temperature ranged in between 24.7 and 24.7^{0}C (maximum) and 10.6^{0}C (minimum) with R.H. of 83.6-94.7%.

The correlation coefficient between mustard aphid and its predators *Coccinella septempunctata* and *Syrphid* fly was found to be positive (r=0.07 and 0.15 and 0.06 and 0.11) in both year which indicated that the rising population of predators was due to increase in aphid population, predators of mustard aphid (*Coccinella septempunctata*) lady bird beetle and (*Xanthogramma scutellarae*) the activity of lady bird beetle appeared during the first fortnight of January and reached its peak level fourth week of February and lasted during last week of march. Arshad Ali and Rizvi (2012), Kulkarni and Patel (1999) also support present finding the fast multiplication of Coccinellids was positively correlated with rainfall and relative humidity. Atwal (1971) also observed that *Coccinella* multiplied to reach its maximum population inspite of decline aphid population. As a consequence of limited population of aphid, predators migrated to alternative host on different crops including orchards and vegetable. The *Syrphid* fly appeared in a second week of January and attains its peak period fourth week of February that is confirmed from the report by Kulkarni and Patel (2001) and Vekaria and Patel (1999). Rainfall had negative correlated on *Syrphid* fly in both year of observation therefore it was non-significant.

Conclusion

The infestations to know the "population build up of mustard aphid and their natural enemies in relation to biotic and abiotic factors" was carried out for two consecutive years at student instructional farm of C.S. Azad University of Agriculture and Technology, Kanpur during 2013-14 and 2014-15. The population builds up of mustard aphid and their natural enemies in relation to biotic and abiotic factors Mustard aphid (*Lipaphis erysimi* Kalt.) incidence was observed from January (first week) to the fourth week of March during the first year (2013-14). The pest appeared on the crop in December (second week) and maximum population of 385.12 aphids/10 shoot was noted in the third week of February, while during the previous year (2014-15). The population was low being 270.18 aphids/10 shoot in the first week of February. Synchronization in the appearance of mustard aphid

predators (*Coccinella* spp. and *Syrphid* larvae) was found in 2013-14 and might be one of the main reasons for the low multiplication of aphid. In the second year predators appeared in the first week of January (3 week after aphid appearance) and found predating up to March. Simple correlation studies to evaluate the instantaneous effects of the meteorological variables revealed that of the abiotic factors (Temperature, relative humidity and rainfall), the temperature had the biggest role in the buildup of the mustard aphid population. The appearance of *Coccinella* spp. and the larvae of *Syrphid* flies were positively correlated with temperature, while there was negative correlation with the incidence of mustard aphid *Lipaphis erysimi*. There was positive correlation between the population of aphid and relative humidity. There was no significant correlation between the aphid population and rainfall. The correlation between aphid and predators were not found to be significant .thus it was concluded that the abiotic factors had stronger influence on the build of aphid and predators.

Acknowledgment

I deem it to be my privilege to thank Dr. R. S. Singh, Professor Entomology, Department of Entomology, C.S. Azad University of Agriculture and Technology Kanpur for availing me fervent and enthusiastic sprit during course of study and preparation of this manuscript. I feel humble that his advice, teaching and noble suggestions will gave me an ideal way of life. I thank his from the core of my heart.

Competing Interest: In the above study there is no competing interest exist.

References

Agarwala, B.K. (1987). Natural food range and feeding habits of aphidophagous insects in north east India. *A review Journal of Aphidology*. **1:**18-22

Agarwala, B.K. and A.K. Ghosh (1988). Prey records of aphidophagous *Coccinellidae* in India. *A review and bibliography Crop Pest Management.* **34:** 1-14.

Ali, Arshad and Parvez Qamar Rizvi (2012). Influence of Abiotic and Biotic Factors on the Population Dynamics of Mustard Aphid, *Lipaphis erysimi* (Kalt.). On Indian Mustard, *Brassica juncea* with Respect to Sowing Dates. *Academic Journal of Plant Sciences,* **5(4):** 123-127.

Atwal, A.S., J.P. Chaudhary and M. Ramrazan (1971). Mortality factor in natural population of cabbage aphid *Lipaphis erysimi* Kalt. (Aphididae: Homoptera) in relation to parasite, Predators and weather conditions. *Indian journal of Agricultural Sciences,* **41(4)**: 507-510.

Bakhetia, D.R.C. and S.S. Sidhu (1983). Effect of rainfall and temperature on the mustard aphid, *Lipaphis erysimi* Kalt. *Indian Journal of Entomology,* **45(2)**: 202-205.

Bishnoi, O.P., H. Singh and R. Singh (1992). Incidence and multiplication of mustard aphid (*Lipaphis erysimi*) in relation to meteorological variables. *Indian Journal Agricultural Science,* **62(10)**: 710-712.

Biswas, G. C. and G.P. Das (2000). Population dynamics of the mustard aphid, *Lipaphis erysimi* (Kalt.) (Homoptera :Aphididae) in relation to weather parameters. *Bangladesh Journal of Entomology*, **10(1/2)**: 15-22.

Deepak, Gauraha, S.S. Shaw, R.K. Sahu and S. Bhandarkar (2002). Effect of abiotic factors on population build up of *Lipaphis erysimi* Kalt on mustard *Brassica juncea*. *Journal of Applied Zoological Researchers,* **13(2/3)**: 154-155.

Dhaliwal, L.K., S.S. Hundal, J.S. Kular, Sarabjot Chahal and A.K. Aneja (2007). Effect of meteorological parameters on aphid, *Lipaphis erysimi* (Kalt.) population on Indian mustard, *Brassica juncea* (L.) Czern & Coss. *Journal of Oil seeds Research,* **24(1)**: 151-154.

Gautam, R.D. (1994). Biological Pest Suppression. *Westvill Publishing House*, New Delhi. p. 219.

Hakim Ali Sahito, R. Solangi, T. Kousar, Zafar Hussain Shah and Md. Mangrio Wali (2016). Population fluctuation of aphids, *Lipaphis erysimi* (Kalt) with response of biological control under mustard field conditions *Journal of Entomology and Zoology Studies,* **4(5)**: 326-33.1

Hemchandra, O., B. Sarmah, T. Zamal, A. Premila1and J. Kalita (2010). Affect of temperature on age-specific fecundity of the ladybird beetle, *Micraspis discolour* (fabricius). *The Bioscan.* Special issue. **2:** 523-528.

Iperti, G. and M.G. Paoletti (1999). Biodiversity of predaceous Coccinellidae in relation to bio indication and economic importance Special issue. Invertebrate biodiversity as bioindicators of sustainable landscapes. Practical use of invertebrates to assess sustainable land use. *Agric. Ecosyst. Environ*., **74**: 323-342.

Jandial, V.K. and A. Kumar (2007). Seasonal incidence and population fluctuation of mustard aphid, *Lipaphis erysimi* Kalt. in relation to ecological parameters. *Indian Journal of Entomology,* **69(2)**: 162-167.

Jat, D.S., M.C. Jat and M.M. Sharma (2006). Seasonal incidence of insect pests of mustard in relation to abiotic factors. *Annals of Plant Protection Sciences,* **14(2)**: 475-476.

Kulat, S.S., S.G. Radke, V.J. Tambe and D.K. Wankhede (1997). Role of abiotic components on the development of mustard aphid, *Lipaphis erysimi* Kalt. *PKV Res. J.* **21(1)**: 53-56.

Kulkari, A.K. and I.S. Patel (2001). Seasonal abundance of mustard aphid *Lipaphis erysimi* Kalt. and associated bioagents in Indian mustard (*Brassica juncea*) crop. *Indian journal of Agricultural sciences,* **71(10)**: 681-682.

Kumar, J., S.V. Singh and Y.P. Malik (2000). Population dynamics and economic status of *Lipaphis erysimi* on mustard *Brassica juncea*. *Indian Journal of Entomology,* **62(3)**:

253-259.

Mishra, S.K. and P.M. Kanwat (2003). Impact of temperature and humidity on the population dynamics of *Lipaphis erysimi* Kalt.on mustard in semi-arid region of Eastern Rajasthan. *Annals of Agricultural Research,* **24(3)**: 645-648.

Omkar and A. Pervez (2000c). Biodiversity of predaceous *coccinellids* (Coleoptera: Coccinellidae) in India: *A review. Journal of Aphidology*, **14**: 41- 66.

Omkar and A. Pervez (2000b). Well marked sexual dimorphism in a ladybird beetle, *Micraspis discolor* (Fabricius) (Coccinellidae: Coleoptera). *Insect Environment,* **5**: 150-151.

Panda, D., B.S. Thakur and B. Patro (2000). Population dynamics of *Lipaphis erysimi* (Kalt.) on *Brassica juncea* L. at Raipur, Madhya Pradesh. *Plant Protection Bulletin Faridabad,* **52(3/4)** : 28-30.

Prasad, S.K. (2003). Studies on population dynamic of mustard aphid, *Lipaphis erysimi* on mustard in relation to some meteorological factors. *Indian Journal of Entomology,* **65(4)**: 569-578.

Reza, M.W., A.K. Biswas and K. Roy (2004). Seasonal abundance of *Lipaphis erysimi* (Kalt.) population on mustard. *Uttar Pradesh Journal of Zoology,* **24(2)**: 129-132.

Rohilla, H.R., H. Singh, T.P. Yadava and H. Singh (1996). Seasonal abundance of aphid pests on rapeseed-mustard crop in Haryana. *Annals Agri. Bio. Res.,* **1(1-2)**: 75-78.

Samdur, M.Y., S.C. Gulati, R. Raman and P. Manivel (1997). Effect of environmental factors on mustard aphid (*Lipaphis erysimi* Kalt.) infestation in different germplasm of Indian mustard. *Journal of Oilseed Research,* **14(2)**: 278-283.

Singh, G. K. and K. Prasad (2003). Effect of row spacing, nitrogen levels and basis of nitrogen application on yield attributes and yield of mustard variety Basanti, *Crop Res*earch, **25(3)**: 427.

Singh, R.K., S.K. Rajak and R.A. Verma (2009). Influence of abiotic factors on population of *Lipaphis erysimi* Kalt. *Journal of Entomological Research,* **33(2)**: 129-131.

Tomar, S.K. and P.R. Yadav (2009). Studies on population and infestation of mustard aphid *lipaphis erysimi* (Kalt.). *Journal of Experimental Zoology,* **12(1)**: 149-152.

Varmora J.M., K.L. Raghvani, M.D. Joshi, R.R. Makadia, N.G. Dalwadi and H.V. Boricha (2009). Population dynamics of aphid, *Lipaphis erysimi* (Kalt.) and predators on cabbage. *Asian Sciences,* **(4)**:56-58

Vekaria, M.N. and G.M. Patel (1999). Succession of important pests of mustard in North Gujrat. *Indian journal of Entomology,* **61(4)**: 356-361.

Vekaria, M.V. and G.M. Patel (2005). Seasonal abundance of *Lipaphis erysimi* (Kalt.) and their natural enemies on important cultivars of mustard in North Gujarat. *Indian Journal of Entomology,* **67(4)**: 369-377.