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INFLUENCE OF ABIOTIC AND BIOTIC FACTORS ON THE POPULATION DYNAMICS OF MUSTARD APHID, *LIPAPHIS ERYSIMI* (KALT.) AND POLLINATORS ASSOCIATED WITH THE MUSTARD CROP

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ABSTRACT
Mustard aphid (*Lipapahis erysimi*) is an important pest of the mustard and Crucifer plant family. Experiment was conducted to observe the fluctuations in the population dynamics of mustard aphid. Results revealed that peak population of mustard aphid and coccinellids predator was found in the 50th SW of the December month. *Coccinella septempunctata*, *Cheilomenes sexmaculatus* and *Coccinella transversalis* were mainly found in the mustard field as predatory insects. Correlation studies indicated negative significant correlation of maximum temperature, sunshine and evaporation with average mustard aphid population at 1% level. Whereas, significant positive correlation was observed with relative humidity and wind velocity. *Apis mellifera*, Syrphid fly, Non *Apis* bees (*Megachile* spp., *Trigona* spp. *etc*) and some other flies were mainly found as pollination source for mustard during experiment. Significant negative correlation of pollinators was found with temperature(max. & min.) and evaporation at 1%level and with Sunshine at 5 % level. Significant positive correlation was found with R.H. (M).

KEYWORDS: *Apis*, *Coccinellids*, Correlation and Mustard aphid**.**

INTRODUCTION

Mustard is a totally essential oilseed crop and constitutes the predominant source of edible oil in the country. As demand for oilseed running ahead of supplies, production developments had been unsatisfactory because of the attack of diverse insect pests. It is prone to the attack of a number of insect pests. More than three dozen of pests are acknowledged to be associated with numerous phenological stages of rapeseed and mustard vegetation in India (Bakhetia *et al.*, 1989). Among the insect pests attacking mustard, the "mustard aphid", *Lipaphis erysimi* (Kalt.), is a serious insect pest, infesting the crop right from seedling stage to maturity that ravages the crop at some point of the reproductive phase and acts as a major limiting element in the production. Due to sap sucking feeding behaviour, leaves grow to be curled and discoloured, spots appear on the foliage, and plants may gradually wilt, turn yellowish or brownish and die. Besides, aphids secrete honeydew which enhances the growth of sooty moulds, giving the stem and leaves black appearance and interfering in the photosynthesis. The losses in yield caused by mustard aphid ranged from 9% to 95% (Singh *et al.*, 1980), 35.4% to 72.3% (Bakhetia *et al.*, 1986), 24.0% to 96.0% (Phadke, 1985), up to 96% (Verma, 2000) at different places of India such as Haryana, Delhi, and Kanpur, respectively. The infestation by pests reduces the oil content up to 66.87% along with reduction in total yield (Singhvi *et al.*, 1973).The basic information regarding population densities of the insect species throughout the crop cycle is necessary for making timely measures for controlling phytophagous insects and minimizing economic losses caused by them (Díaz *et al.*, 2004). Such research can help in finding the synchronization of pest and predator emergence and suggest ways for better implementation of biological control strategies. So, it was planned to study the seasonal fluctuations in population density of the mustard aphid and its correlation with weather parameters and biotic factors (natural enemies) was studied. Pollinating agents, like insects, birds, wind etc are also needed for better production of mustard crop. Among all pollination agencies, insects *viz.*, honey bees and non apis bees, syrphids have proved as boon for efficient and effective pollination medium. These pollinators are affected directly or indirectly by the environmental conditions around them. Among all the different aspects, the weather factors play an important role in pollinator's activity. Keeping in view the importance of insect pollinators, the study was undertaken to decide the impact of abiotic factors on the foraging activity of the main insect pollinators.

MATERIALS & METHODS

The experiment was conducted at mustard crop grown in Norman E. Borlaug Crop Research Centre (NEBCRC), G.B. Pant University of Agriculture and Technology, Pantnagar from the month October to December, 2016. Ten plants were randomly selected from the field and observations were taken on these plants at weekly interval from 42nd standard week upto 52th standard week. These plants were observed weekly for aphid infestation, appearance of coccinellids predators and pollinators visiting these plants in the morning as well as evening hours (twice in a day). The data on temperature, relative humidity and rain fall were obtained from the Department of Agrometerology and were correlated with the insect pollinators activity. Further average of mustard aphid, coccinellids and pollinators were calculated per 10 plants. Hence, data thus obtained were subjected to statistical

analysis using software SPSS DMRT. Correlation and regression analysis was done between aphid populations and abiotic as well as predator population. Similarly, in case of pollinators correlation and regression analysis was done with weather parameters.

RESULTS & DISCUSSION

Population dynamics of Mustard aphid, *Lipaphis erysimi* and Coccinellids

Data presented in the table 1 revealed that minimum average aphid population (0.0) and minimum coccinellids population (0.1) was observed in 42nd std. week. Whereas, maximum population of aphid/ 10 plants (15.2) was observed in 50th SW of December and maximum coccinellids per 10 plants were observed in 45th and 49th std. week, when temperature (max.) was 19.96°C, temp. (min.)-9.91 °C, R.H (M)- 94.43 % (E)- 66.43%, Sunshine- 2.23 hours, Wind velocity- 2.7 km/hr and evaporation was 1.13mm. Coccinellids species mainly found in mustard field were *viz.,Coccinella septempunctata, Cheilomenes sexmaculatus* and *Coccinella transversalis.* In a similar way, Chaudhary and pal, 2009 and Rashid *et al.*, 2009 found mustard aphid population during the month December and January which supports the present studies.

TABLE 1: Population dynamics of Mustard aphid, *Lipaphis erysimi* and Coccinellids on mustard

Standard weeks	Temperature (°C)		Relative Humidity (%)		Sunshine (Hrs)	Wind velocity (Km/hr)	Evaporation (mm)	Mean no. of coccinellids/ 10 plants	Mean no. of aphids/ 10 plants
	Max.	Min.	M	E					
42	31.4	17.2	80	47	7.6	2.2	2.8	0.1	0
43	31.1	13.9	90	37	7.8	2.3	2.9	0.3	0
44	30.3	13.5	85	39	8	1.7	2.5	0.2	0.1
45	29	11.4	90	36	7.9	2.5	2.4	0.8	1.5
46	27.8	10.6	91	37	7.8	2.3	2.8	0.5	3.8
47	26.64	9.83	93.5	39.25	7.31	2.22	1.94	0.3	6.4
48	26.04	11.32	92.37	44.87	7.27	2.6	1.78	0.4	9.8
49	23.42	11.5	95.75	54.85	4.8	3.07	1.3	0.8	13.9
50	19.96	9.91	94.43	66.43	2.23	2.7	1.13	0.6	15.2
51	25	8.01	93	50.23	5.4	1	1.06	10.2	0.2
52	24	9.18	95	53.4	4.5	0	1.15	8.5	0.1

TABLE 2: Correlation and regression analysis between abiotic as well as biotic factors and Mustard aphid, *Lipaphis erysimi*

Parameters	Correlation coefficient (r)	Regression equation	Coefficient of determination (R^2)
Abiotic factors			
Maximum temp.	-0.962**	Y= -1.5141x + 46.868	0.9248
Minimum temp.	-0.653	Y= -1.4302x + 22.736	0.4265
Morning R.H	0.778*	Y= 0.93x -78.242	0.6052
Evening R.H	0.815**	Y= 0.4763x -15.557	0.6646
Sunshine	-0.851**	Y= -2.5122x + 22.435	0.7243
Windvelocity	0.273*	Y= 12.326x -23.935	0.6087
Evaporation	-0.898**	Y= -6.8712x + 19.902	0.8058
Biotic factors			
Coccinellid spp.	0.346	0.0157x + 0.292	0.1198

*Coefficient is significant at 0.05 level, ** Coefficient is significant at 0.01 level

Correlation and regression analysis between abiotic as well as biotic factors and Mustard aphid, *Lipaphis erysimi*

Data presented in the table 2 showed that negative significant correlation was found between maximum temp., sunshine and evaporation and average mustard aphid population at 1% level. Whereas, significant positive correlation was observed with relative humidity and wind velocity. Results also showed that the no significant correlation was observed between minimum temperature and aphid population. Correlation between coccinellids and aphid population also gave non- significant results. Further regression analysis revealed that if all the weather parameters will be increased by 1 unit then there will be decline in the aphid population by 1.5414, 1.4302, 2.5122 and 6.8712 numbers in case of max temp., min. temp, Sunshine and evaporation respectively. Whereas, population will be increased by 0.93, 0.476, 2.8217, 8.6455 & 0.0157 numbers in case of R.H (M&E), wind velocity and coccinellids number respectively. Further coefficient of determination was found out to be 0.9248, 0.4265, 0.6052, 0.6646, 0.7243, 0.0744, 0.8058 and 0.1198 in case of temp.(max & min.), R.H (M & E), Sunshine, wind velocity, evaporation and coccinellids respectively. In accordance to the present findings, Gami *et al.*, 2002 observed that aphid population registered significant negative correlation with maximum and minimum temperatures. Whereas, Ahuja, 1990 found that aphid population was positively correlated with relative humidity which is in accordance with the present studies.

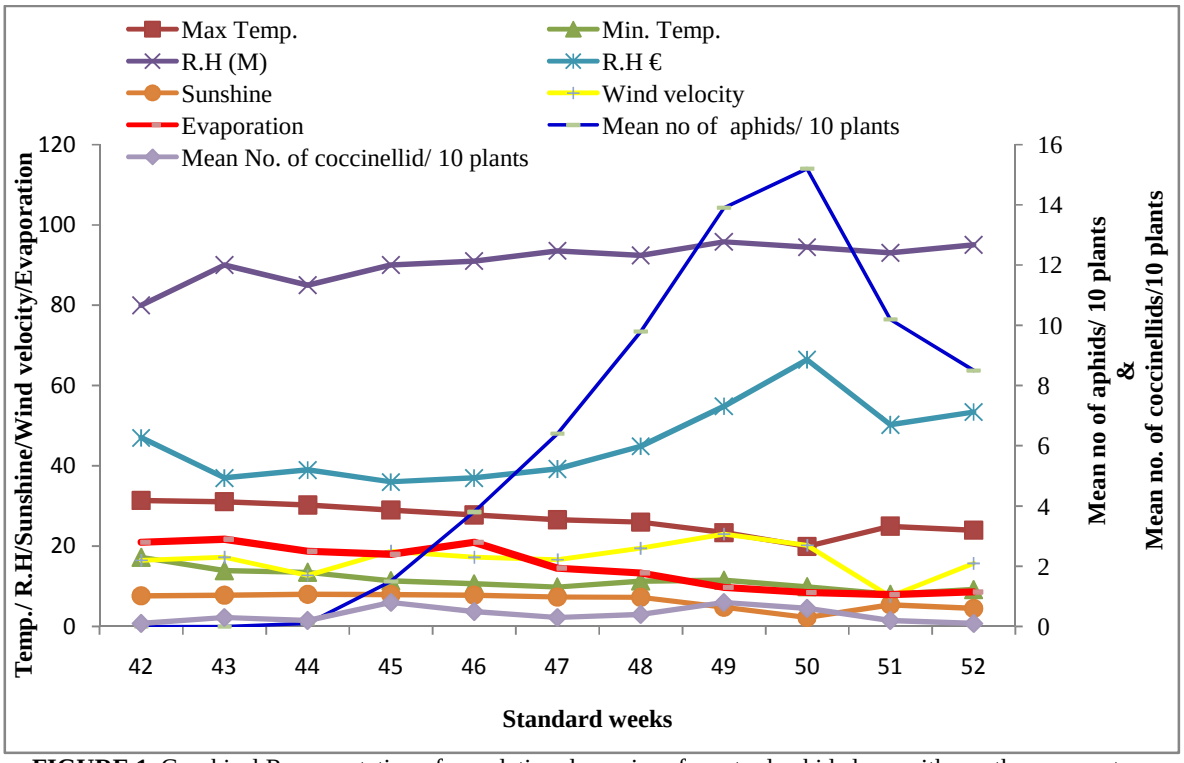
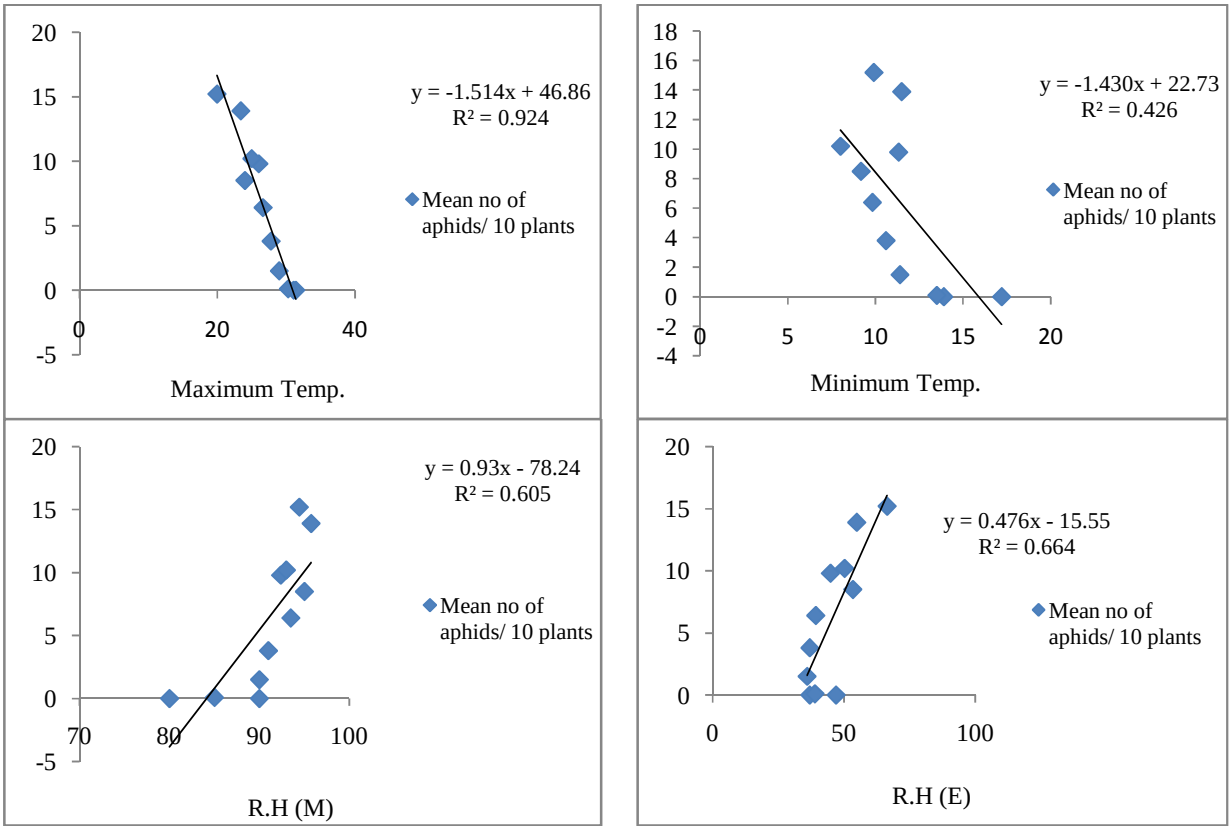
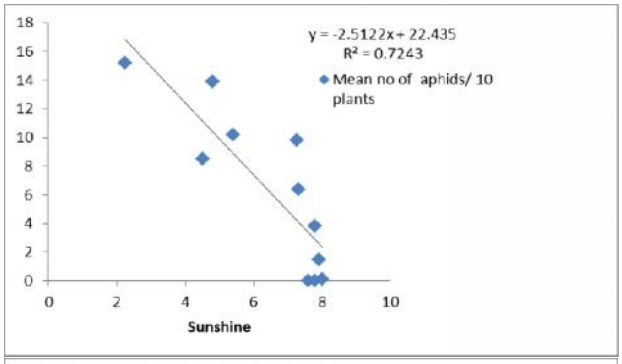
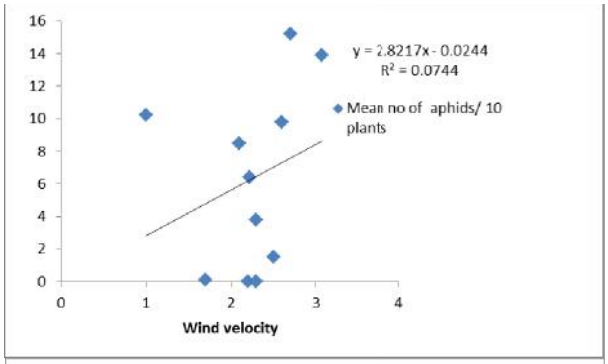
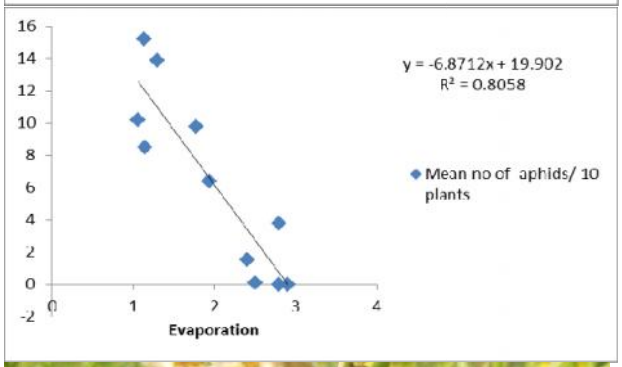


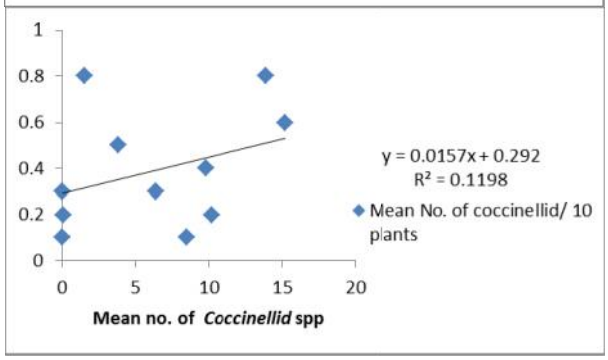
FIGURE 1. Graphical Representation of population dynamics of mustard aphid along with weather parameters











Infestation of Mustard aphid

Coccinella spp. in the mustard field

TABLE 3: Analysis of correlation and multiple regression between weather parameters and pollinators associated with the mustard crop

Correlation coefficient (r)	Temperature (°C)		Relative Humidity (%)		Sunshine (Hrs)	Wind velocity (km/hr)	Evaporation (mm)
	Max.	Min.	M	E			
	-0.925**	-0.854**	0.879**	0.569	-0.684*	0.659	-0.900**

*Coefficient is significant at 0.05 level,** Coefficient is significant at 0.01 level

Multiple regression equation	Y= -24.948 + 0.76 (X1) - 0.660(X2) + 0.159(X3) + 0.291(X4) + 1.321 (X5) -0.130 (X6) - 0.817 (X7)
Coefficient of Determination ($R^{2)}$	0.999

Where,

X1= Maximum temp., X2= Minimum temp., X3= R.H (M), X4= R.H (E), X5= Sunshine, X6 = Wind velocity, X7 = Evaporation

Analysis of correlation and multiple regressions between weather parameters and pollinators associated with the mustard crop

Major pollinators found to be associated with the mustard were *Apis mellifera*, Syrphid fly, Non *Apis* bees (*Megachile* spp., *Trigona* spp. *etc*) and some other flies. Correlation studies revealed significant negative correlation with temp. (max. & min.) and evaporation at 1 percent level and with Sunshine at 5 per cent level. Significant positive correlation was found with R.H (M). No significant correlation was observed with R.H (E) and wind velocity. Further regression analysis revealed that if min. temp, wind velocity and evaporation will be increased by 1 unit then pollinators will decline by 0.660, 0.130 and 0.817 numbers, respectively. If temp. max., R.H (M &E) and sunshine will be increased by 1 unit then

population will be increased by 0.76, 0.159, 0.291 and 1.321, respectively. Similarly, Kunjwal *et al.,* 2014 also found same insect diversity on mustard crop which is in accordance with the present studies.

CONCLUSION

Peak population of mustard aphid was observed in the end of December month. Weather parameters put significant pressure on population fluctuation of insect species. Whereas, non-significant correlation was found between aphid and predator population. Pollinators associated with mustard crop were also significantly influenced by temperature. Whereas, Non-significant correlation of aphid population was found with relative humidity (E) and wind velocity. Hence this study will further help in taking timely measures for the management of aphid population.

REFERENCES

Ahuja, D.B. (1990) Population dynamics of mustard aphid *Lipaphis erysimi* (Kalt.) on Indian mustard, *Brassica juncea* (subsp. *juncea*). *Indian J of Pl. Prot.* 18(2): 233-235.

Bakhetia, D.R.C., Brar, K.S. and Sekhon, B.S. (1986) Bio-efficacy of some insecticides for the control of aphid, *L. erysimi* on rapeseed and mustard. *Ind. J. of Entom.*, 48(2): 137-143.

Bakhetia, D.R.C., Sekhon, B.S., Brar, K.S. and Ghorbandhi, A.W. (1989) Determination of economic threshold of *L. erysimi* on Indian Mustard. *J. of Aphidol*., 3: 125-134.

Choudhury, S. and Pal, S. (2009) Population dynamics of mustard aphid on different Brassica cultivars under terai agro-ecological conditions of West Bengal. *J. of Pl. Prot. Sc.*, **1**(1) : 83-86.

Díaz, B.B., Rossa, R.A., Cortero, H.G.C. and Martínez, N.B. (2004) Identification and population fluctuation of cabbage pests (*Brassica oleracea* cv. Capitata) and their natural enemies inAcatzingo, Puebla, México. *Agrociencia*, **38**: 239-48.

Gami, L.M. Bapodra, J.G. Rathod, R.R. (2002) Population dynamics of mustard aphid [*Lipaphis erysimi* (Kaltenbach)] in relation to weather parameters. *Indian Journal of Plant Protection.***30:** 202-04.

Kunjwal, N., Kumar, Yogesh and Khan, M.S. (2014) Flower visiting insect pollinators of Brown Mustard, *Brassica juncea* (L.) Czern and cross and their foraging behaviour under caged and open pollination. *African J of Agri. Research*, **9(16) :** 1278-1286

Phadke, K.G. (1985) Insect pest - A major constrains in the production of some oilseeds. In oil Seed Production, Constrain and Opportunities IBH Publishing Co. Pp-413-422.

Rashid, M.H., Rahman, M.M., Rahman, A.K.M.M., Mohiuddin, M. and. Choudhury, M.A.R. (2009) Study on the population dynamics of mustard aphid, *Lipaphis erysimi* (kalt.) in relation to weather parameters in Chittagong. *J.Soil.Nature*. 3(1):20- 22.

Singh, H., Gupta, D.S., Yadav, T.P. and Dhawan, K. (1980) Post harvest losses caused by aphid *L. erysimi* and Painted bug *B. cruciferarum* to mustard. *Haryana Agri. Univ. J. of Res.*, 10(3): 407-409.

Singhvi, S.M., Verma, N.D. and Yadava, T.P. (1973) Estimation of losses in rapeseed (*B. compestris* L. var. *toria*) and mustard (*B. juncea* Cross) due to mustard aphid (*L. erysimi*). *Haryana Agri. Univ. J. of Res.*, 3: 5-7.

Verma, K.D. (2000) Economically important aphids and their management, Pp. 144-162. In: Upadhyay, R.K., Mukherji, K.G. and Dubey, O.P. (eds). IPM System in Agriculture. Vol.7 Aditya Books Pvt. Ltd. New Delhi, India.