The Ecoscan 8(1&2): 23-25, 2014
AN INTERNATIONAL BIANNUAL JOURNAL OF ENVIRONMENTAL SCIENCES

EFFECT OF ENVIRONMENTAL FACTORS ON THE POPULATION OF *VARROA DESTRUCTOR* IN *APIS MELLIFERA* L. COLONIES

ASHA POONIA*, RACHNA GULATI AND S. K. SHARMA
[1]Departments of Zoology and Aquaculture, CCS HAU, Hisar -125 004 (Haryana), INDIA
[2]Directorate of Research; [3]Entomology, CCS HAU, Hisar (Haryana), INDIA
e-mail: asha.poonia@gmail.com

ABSTRACT

Maximum number of mites was observed in second fortnight of May (38 and 51 mites/per hive) which was found significantly positively correlated with maximum (r = 0.659) and minimum (r = 0.648) temperature. However, *V. destructor* population was found negatively correlated with relative humidity (-0.416) and sunshine hours (-0.023). Rainfall was found none significantly correlated (0.019) with *V. destructor* population. Data suggested that during summer months, when temperature is high and flower availability is less, mite population increases in *Apis mellifera* L. colonies.

KEY WORDS
Varroa destructor
Apis mellifera
temperature, relative humidity, rainfall, sunshine hours

Received : 22.10.2013
Revised : 13.02.2014
Accepted : 18.04.2014

***Corresponding author**

INTRODUCTION

Varroa mite (Acari: Mesostigmata), parasitizing the European honeybee, *Apis mellifera* L. (Hymenoptera: Apidae) is responsible for loss of more than 50% of *Apis mellifera* colonies worldwide (Shaw *et al.,* 2002; Topolska *et al*., 2010; Martin *et al*., 2012; Nazzi *et al*., 2012). 90 per cent apiaries and 50 per cent colonies of state of Haryana are affected by this mite (Gulati *et al.*, 2009). This mite which feeds on haemolymph of brood and adult bees causes colony disorder, weakness, decreasing brood and deforming immature and mature bees (Kotwal and Abrol, 2013)

The temperature relations within honey bee colonies are complex, as honey bees thermoregulate their colonies according to the season and the presence or absence of brood (Seeley and Heinrich, 1981). *Varroa destructor* preferentially reproduces on at 32·5-33·4ºC temperature as it is the temperature on which drone brood maintained (Le Conte *et al.,* 1990). Various workers have tried to investigate the relationship of *Varroa destructor* population with abiotic factors in *Apis mellifera* colonies (Martin, 1995; Crane, 1978; Harbo, 2000; Webster *et al.,* 2000; Harris *et al.,* 2003; Underwood and Currie, 2003; Bahreini *et al.,* 2004; De Guzman *et al.,* 2007; Kotpal, 2008). In Hisar, Haryana various abiotic factors (Temperature, rainfall, sunshine hours, relative humidity) shows a wide range in a year. Present investigation was carried with the objective to study the effect these abiotic factors on the population of *Varroa destructor* in *Apis mellifera* colonies in Hisar, Haryana.

MATERIALS AND METHODS

The experiment was conducted in CCS Haryana Agricultural apiary from May 2009 to February 2010. Three colonies statistically comparable in terms of *Varroa* infestation, colony strength, brood, pollen and honey area were taken for the experiment.

There are three standard methods of *Varroa* population estimation (Ritter, 1981; De Jong *et al*., 1982; Branco *et al*., 2006; Dietemann *et al.,* 2013) *i.e.*

1. Acaricides to kill all mites in a colony. Mites fall to the bottom of the hive and can be counted.
2. Without the use of acaricides, the natural mortality can be quantified from the bottom of the hive to determine the population size of the live mites.
3. The infestation rates of adults and brood can be estimated from adult and brood samples.

All three methods (using acaricides, monitoring natural mite fall and assessing infestation levels) were found to provide comparable results (Branco *et al*., 2006). First method could not be chosen as it involved killing of the *Varroa* mites, which could not be used as samples of natural *Varroa* population needed to be taken throughout the year. Third method also could not be chosen as it involved killing

of brood, thus, interrupted with the natural population of *Apis mellifera*. In this light, monitoring natural mite fall was used to know colony infestation rate of *Varroa destructor* in *Apis mellifera* colonies. In this method mites that die naturally or due to grooming behaviour of bees get dislodged from bees and can be collected from the bottom board of the hive in debris. This natural mite fall count can be used to estimate colony infestation. This method has been used by various workers (Devlin, 1998; Dietemann *et al.,* 2013). Ants were prevented from access to bottom boards by using a hive stand resting in water containers over which ants cannot walk (Dietemann *et al.,* 2013). Dirt accumulated in water containers was cleared regularly so that ants could not reach the hive.

Data on weather parameters viz., maximum and minimum temperature (ºC), relative humidity (%), rainfall (mm) and bright sunshine hours (h) was collected from Department of Meteorology, CCS Haryana Agricultural University, Hisar (Haryana) in order to correlate these factors with seasonal abundance of *V. destructor* in *A. mellifera* colonies. Correlation matrix was calculated between *V. destructor* incidence and abiotic factors to see their effect on population build up of mite.

Table 1: Comparative sampling methods to record *Varroa destructor* population in *Apis mellifera* colonies

Date of observation	Number of mites (Mean ± S. D.)/ colony*Sticky paper
05.05.08	36.00 ± 2.00
12.05.08	38.00 ± 2.00
19.05.08	51.50 ± 5.00
26.05.08	35.00 ± 3.00
02.06.08	23.00 ± 2.00
09.06.08	14.00 ± 2.00
17.06.08	13.50 ± 2.00
24.06.08	11.00 ± 3.00
01.07.08	10.50 ± 1.00
07.07.08	18.00 ± 5.00
14.07.08	18.50 ± 2.00
21.07.08	18.50 ± 5.00
28.07.08	19.50 ± 2.00
05.08.08	20.50 ± 5.00
11.08.08	9.50 ± 2.00
19.08.08	7.50 ± 2.00
26.08.08	7.00 ± 2.00
02.09.08	4.50 ± 2.00
08.09.08	9.50 ± 2.00
15.09.08	9.50 ± 2.00
24.09.08	12.00 ± 2.00
29.09.08	9.50 ± 2.00
08.10.08	8.50 ± 2.00
15.10.08	8.50 ± 2.00
22.10.08	2.00 ± 0.00
30.10.08	0.00 ± 0.00
06.11.08	0.00 ± 0.00
No mites were noticed from 09.11.08 to 25.12.08	
24.12.08	2.50 ± 1.00
01.01.09	1.00 ± 0.00
07.01.09	1.00 ± 0.00
15.01.09	1.00 ± 0.00
19.01.09	1.00 ± 0.00
No mites were noticed from 23.01.09 to 30.04 09	

*Average of three colonies

RESULTS AND DISCUSSION

Table 1 shows the population of *V. destructor* from May 2008 to February 2009. To find the relationship between biotic (number of *V. destructor* in *A. mellifera* colonies) and abiotic factors (maximum and minimum temperature, relative humidity, rainfall and sunshine hours), correlation matrix was calculated and presented in Table 2. The study revealed that among abiotic factors, maximum and minimum temperature played a significant role in the population build up of *V. destructor*. The mite population was significantly positively correlated with the maximum (r = 0.659) and minimum (r = 0.648) temperature. The positive values of correlation coefficient revealed that as the maximum temperature with in a range from 18.6 to 39.6ºC and minimum temperature within a range from 3.3 to 26.3ºC increased, there was a corresponding increase in *V. destructor* population. The maximum population of *V. destructor* was found in the month of May when maximum temperature fluctuated between 36.4 to 39.6°C which indicated that a higher temperature around 38°C favoured the buildup of mite population. It is also evident from Table 2 that there is a negative correlation between *V. destructor* population and relative humidity, sunshine hours, but it was non significant. Similarly, non-significant relation between *V. destructor* population and rainfall was recorded in present investigation.

Differences in mite population due to climatic variation are reported by several workers. Earlier studies reported that level of *Varroa* mite infestation was lower in tropical regions as compared to temperate regions. Underwood and Currie (2003) observed maximum mite fall at 35°C when various doses of

Table 2: Correlation matrix between *Varroa destructor* population and weather parameters

Treatments	No of mites on Sticky paper	Temperature (ºC)		Relative Humidity (32 to 89%)	Sunshine) hours (0.04 to10.2h	Rainfall (0.0 to 21 mm)
		Maximum (18.6 to39.6ºC)	Minimum (3.3 to25.8ºC)			
No of mites on Sticky paper	1.00					
Maximum Temperature (°C)	0.659*	1.00				
Minimum Temperature (°C)	0.648*	0.887*	1.00			
Relative Humidity (%)	-0.416^{NS}	-0.224^{NS}	0.077^{NS}	1.00		
Sunshine hours (h)	-0.023^{NS}	-0.063^{NS}	-0.162^{NS}	-0.492*	1.00	
Rainfall (mm)	0.019^{NS}	0.132^{NS}	0.243^{NS}	0.269^{NS}	-0.449*	1.00

*Significant at 0.05 % level; NS = Non significant

formic acid at different temperatures were applied. Populations of *Varroa* increase very rapidly in some regions such as Europe but remain at a low level in some tropical countries (De Jong *et al.*, 1984; Ruttner *et al.*, 1984). De Jong *et al*. (1984) attributed this to a lower rate of reproduction in temperate conditions. Woyke (1987) reported a high infestation rate of *A. mellifera* colonies by *Tropilaclaps clareae* in Southern Vietnam and a low rate in northern Vietnam. Harris *et al*. (2003) also reported correlation beween ambient temperature and relative humidity with growth of mite populations during 10 year study period (1993-2002). Webster *et al*. (2000) also reported that total mite fall follow temperature regime. A modest positive correlation was found between proportion of mite fall and mean daily high temperature (r = 0.515), overall mean weekly temperature (r = 0.508) and weekly mean low temperature (r = 0.452). The reason attributed was that weather has sub-lethal effect on mites as in case of heat treatment which is used to kill mites in brood cells (Martin, 1995; Harbo, 2000) and in entire hives (Crane, 1978). Bahreini *et al*. (2004) calculated correlation between *Varroa* mortality with temperature and relative humidity. Kotwal *et al*. (2013) has also observed similar results of *Varroa* population in various months in 2006-07 and 2007-08 with peak of population in March.

Kotwal (2008) in Jammu and Kashmir (India) recorded significant negative correlation with rainfall and evening relative humidity during 2006-07 whereas significant negative correlation was obtained with minimum temperature in 2007-08. However, in the present study, relative humidity and rainfall had no significant relation with the population build up of *V. destructor* in *A. mellifera* colonies.

REFERENCES

Bahreini, R., Thamasebi, G. H., Nowzari, J. and Talebi, M. 2004. A study of the efficacy of formic acid in controlling *Varroa destructor* and its correlation with temperature in Iran. *J. Api. Res.* **43**(**4**): 158-161.

Branco, M. R., Kidd, N. A. C. and Pickard, R. S. 2006. A comparative evaluation of sampling methods for *Varroa destructor* (Acari: Varroidae) population estimation. *Apidologie.* **37**: 452-461.

Crane, E. 1978. The *Varroa* mite. *Bee World.* **59:** 164-167.

De Guzman, L. I., Rinderer, T. E. and Frake, A. M. 2007. Growth of *Varroa destructor* (Acari: Varroidae) Populations in Russian Honey Bee (Hymenoptera: Apidae) Colonies. *Annals of the Entomological Society of America* **100**(**2**): 187-195.

De Jong, D., Goncalves, L. S. and Morse, R. A. 1984. Dependance on climate of virulence of *Varroa jacobsoni*. *Bee World.* **65:** 117-121.

De Jong, D. D., Morse, R. A. and Eickwort, G. C. 1982. Mite pests of honey bees. *Annual Review of Entomology.* **27**: 229-252.

Devlin, S. M. 1998. Comparative analyses of sampling methods for *Varroa* mites *(Varroa destmcîor* Anderson and Arueman) on honey bees *(Apis meiliferra* l .). *M.Sc. Thesis, Simon Fraser University, Canada.*

Dietemann, V., Nazzi, F., Martin, S. J., Anderson, D. L., Locke, B., Delaplane, K. S., Wauquiez, Q., Tannahill, C., Frey, E., Ziegelmann, B., Rosenkranz, P. and Ellis, J. D. 2013. Standard methods for Varroa research. *J. Api. Res.* **52**(**1**): 1-54.

Gulati, R., Sharma, S. K. and Saini, R. K. 2009. *Varroa*, enemy of honeybees: its effect, life cycle and control. *Tech. Bull., Dept of Entomology, CCS HAU, Hisar.* p. 24.

Harbo, J. R. 2000. Heating adult honey bees to remove *Varroa jacobsoni J. Api. Res.* **39**(**3-4**): 181-183.

Harris, J. W., Harbo, J. R., Villa, J. D. and Danka R. G. 2003. Variable Population Growth of *Varroa destructor* (Mesostigmata: Varroidae) in Colonies of Honey Bees (Hymenoptera: Apidae) During a 10-Year Period. *Environ. Ento.* **32**(**6**):1305-1312.

Kotwal, S., Abrol, D. P., Shahnwaz, A. and Gandotra, A. 2013. Mite pests of honeybee (*Apis mellifera* l.) and their seasonal incidence in Jammu division of Jammu and Kashmir, India. *The bioscan* **8**(**2**): 529-531.

Kotwal, S. and Abrol, D. P. 2013. Evaluation of essential oils and cultural practices for the management of *Varroa destructor*. *The bioscan* **8(1):** 15-20.

Kotwal, S. 2008. Bioecology and management of honeybee (*Apis mellifera* L.) mites with special reference to *Varroa destructor* Anderson and Truemann. *Ph. D Thesis, SKUAST, Jammu.*

Le Conte, Y., Arnald, G., Trouiller, J. and Masson, C. 1990. Identification of brood pheromone in honeybees. *Naturwissenschaften* **77:** 334-336.

Martin, S. J. 1995. Reproduction of *Varroa jacobsoni* in cells of *Apis mellifera* containing one or more mother mites and the distribution of these cells. *J. Api. Res.* **34**: 187-196.

Martin, S. J., Highfield, A. C., Brettell, L., Villalobos, E. M., Budge, G. C., Powell, M., Nikaido, S. and Schroeded, D. C. 2012. Global honey bee viral landscape altered by a parasitic mite. *Science* **336**: 1304-1306.

Nazzi, F., Brown, S. P., Annoscia, D., Del Piccolo, F., Di Prisco, G., Varricchio, P., Della Vedova, G., Cattonaro, F., Caprio, E. and Pennacchio, F. 2012. Synergistic parasite-pathogen interactions mediated by host immunity can drive the collapse of honey bee colonies. *PLoS Pathogens* **8**(**6**): 1-16.

Ritter, W. 1981. *Varroa* disease of the honey bee *Apis mellifera*. *Bee World.* **62**: 141-153.

Ruttner, F., Marx, H. and Marx, G. 1984. Observation about a possible adaptation of *Varroa jacobsoni* to *Apis mellifera* in Uruguay. *Apidologie* **15:** 43-62.

Seeley, T. and Heinrich, B. 1981. Regulation of temperature in the nests of social insects. Pages 159-234 in B. *Heinrich, ed. Insect thermoregulation. Wiley, New York.*

Shaw, K. E., Davidson, G., Clark, S. J., Ball, B. V., Pell, J. K., Chandler, D. and Sunderland, K. D. 2002. Laboratory bioassays to assess the pathogenicity of mitosporic fungi to *Varroa destructor* (Acari: Mesostigmata), an ectoparasitic mite of the honeybee, *Apis mellifera*. *Biological Control.* **24(3):** 266–276.

Topolska, G., Gajda, A., Pohorecka, K., Bober, A., Kasprzak, S., Skubida, M. and Semkiw, P. 2010. Winter colony losses in Poland. *J. Api. Res.* **49**: 126-128.

Underwood, R. and Currie, R. W. 2003. The effect of temperature and dose of formic acid on treatment efficacy against *Varroa destructor* (Acari:Varroidae), a parasite of *Apis mellifera* (Hymenoptera: Apidae). *Experimental and applied acarology.* **29**: 303-313.

Webster, T. C., Thacher, E. M. and Vorisek, F. E. 2000. Live *Varroa jacobsoni* (Mesostigmata: Varroidae) fallen from honey bee (Hymenoptera: Apidae) colony. *J. Economic Entomology.* **93**(6): 1596-1601.

Woyke, J. 1987. Comparative population dynamics of *Tropilaelaps clareae* and *Varroa jacobsoni* mites on honeybees. *J. Api. Res.* **26**:196-202.

APPLICATION FORM

NATIONAL ENVIRONMENTALISTS ASSOCIATION (N.E.A.)

To,
The Secretary,
National Environmentalists Association,
D-13, H.H.Colony,
Ranchi-834002, Jharkhand, India

Sir,
I wish to become an Annual / Life member and Fellow* of the association and will abide by the rules and regulations of the association

Name _____

Mailing Address _____

_____

Official Address _____

_____

E-mail _____Ph. No._____(R)_____(O)

Date of Birth _____ Mobile No. _____

Qualification _____

Field of specialization & research _____

Extension work (if done) _____

_____

Please find enclosed a D/D of Rs..... No. ..... Dated ..... as an *Annual / Life membership fee*.

*Attach **Bio-data and some recent publications along with the application form when applying for the Fellowship of the association.**

Correspondance for membership and/ or Fellowship should be done on the following address :

SECRETARY,
National Environmentalists Association,
D-13, H.H.Colony,
Ranchi - 834002
Jharkhand, India
E-mails : m_psinha@yahoo.com Cell : 94313 60645; 91352 47800; 95255 21335; 95726 49448
dr.mp.sinha@gmail.com Ph. : 0651-2244071