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Periodic prevelence of mites (*Tropilaelaps clareae* and *Varroa destructor*) in the hives of Asian (*Apis cerana* f.) and European (*Apis mellifera*) honey bees correlated with colony and weather parameters

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Abstract
Seasonal incidence of mites (*Tropilaelaps clareae* and *Varroa destructor*) in hives of Asian (*Apis cerana* F.) and European (*Apis mellifera*) honey bees correlated with colony and weather parameters was carried out at apiary maintained by the Department of Entomology, Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan during January, 2019 to December, 2020. Pooled data on incidence of *Tropilaelaps clareae* in *Apis cerana* colonies showed that the incidence array from 1.80 to 7.20 per cent. The incidence was maximum (7.20%) in the month of June when temperature, relative humidity and rainfall were high and minimum incidence was observed in the month of March (1.80%) when temperature and relative humidity were low. Incidence of *Tropilaelaps clareae* in *Apis mellifera* colonies under stationary and migratory conditions was maximum in the month of June (10.40 mites/colony, 7.30% and 13.70 mites/ colony, 8.30%, respectively) in per hundred bees and brood inspection method while, minimum incidence was found in the month of February and August. *Varroa destructor* prevalence was also maximum in the month of June (14.90 mites/ colony, 10.20% and 16.30 mites/ colony, 10.20%, respectively) in both stationary and migratory conditions. Although the incidence was found to be minimum in the months of February, March and August. The mite incidence was assuredly correlated with temperature, colony strength and rainfall. No incidence of *Tropilaelaps clareae* and *Varroa destructor* was observed in the month of January, September, October, November and December in both the years of study.

Keywords: *Tropilaelaps clareae,* seasonal incidence*, Apis cerana, Varroa destructor*, temperature, colony strength, rainfall, *Apis mellifera*

Introduction
Honey bees are beneficial creatures playing a pivotal role in the pollination of a wide variety of crops and help in maintaining biological diversity (Johannesmeier and Mostert, 2001) [14]. These are attacked by many diseases and enemies, which cause weakness of colonies and ultimately low honey production. These include mites, diseases, insect pests, wasps, ants, lizards, bee-eater birds, etc. Among the ectoparasitic mites, *Tropilaelaps clareae* and *Varroa destructor* (Anderson and Trueman) are brood pest of Indian honey bee *Apis cerana* and European honey bee *Apis mellifera* L. causing loss of >50% of colonies (Martin *et al.,* 2012) [17]. The infestation by *Tropilaelaps clareae* (Delfinado and Baker) and *Varroa destructor* causes irregular pattern of sealed and unsealed brood and it mainly feed on haemolymph of brood and adult bees which cause colony disorder, weakness, decreasing brood and deforming immature and mature bees. *Varroa* and *Tropilaelaps* mite infested colonies lead to significant reduction of wing size and weight in worker bee of *A. mellifera* (Chauhan *et al.,* 2021) [8]. Beekeepers should be aware of these enemies and protect their colonies to get the maximum benefits. As only a few attempts have been made to observe the seasonal incidence of parasitic mites infesting *A. cerana* and *A. mellifera*, the present study was conducted.

Material and Methods
The present studies on seasonal incidence of *Tropilaelaps clareae* and *Varroa destructor* in hives of *A. cerana* and *A. mellifera* colonies were carried out during January, 2019 to December, 2020 in apiary maintained at the Department of Entomology, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh at 33.3°N latitude, 70.70°E longitude and 1256 m above mean sea level (amsl). The seasonal incidence of mites (*Tropilaelaps clareae* and *Varroa destructor*) in relation to environmental factors were studied under stationary conditions in both *A. mellifera* and *A. cerana* colonies and migratory conditions only in *A. mellifera* colonies. The incidence of ectoparasitic mites (*Varroa destructor* and *Tropilaelaps clareae*) in brood and adults were recorded in selected honey bee colonies by using two different methods of mite estimation (visual examination and per 100 bee methods) (Asha *et al.,* 2013 and Poonia *et al*., 2014) [3, 21]. The incidence of ectoparasitic mites in brood and adults was recorded in selected colonies of *A. cerana* by visual examination only and in *A. mellifera* colonies by both visual examination of brood cells and per hundred Bees method. For estimation of mite population in brood cells by visual examination method, 100 brood cells of *A. mellifera* and *A. cerana* colonies were observed in each selected colony with the help of hand lens. In case of per 100 Bees method random samples of about 100 bees from brood nest of selected colonies were collected and put into open mouthed glass bottle. Thereafter, powdered sugar (5g) was dusted over these bees in order to motivate them for grooming and slightly agitating them. After 4-5 minutes, the jar was inverted on a paper and dislodged mite falling on paper were counted. The statistics on incidence of mites were analysed by using method described by Gomez and

Gomez (1986) [13], subjected to analysis of variance (ANOVA). The completely randomized block design with least significant differences between treatments were calculated taking all the possible combinations of factors. The treatment effect was tested at 0.05 per cent level of significance. The incidence of mites was correlated with colony and weather parameters through pearson correlation method. The data on temperature, relative humidity and rainfall were collected from the Department of Environmental Science, College of Forestry Dr Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan.

Results and Discussion

Pooled data (2019-2020) on incidence of ectoparasitic mite (*Tropilaelaps clareae*) in *Apis cerana* colonies

Incidence of *T. clareae* in *A. cerana* colonies estimated by per cent brood infestation methods (Plate 1 and Fig.1). The colonies of *A. cerana* were noticed free from *T. clareae* infestation in January, February, August, September, October, November and December during both the years (Table 1). No mite population was detected on brood during this period. Population of *T. Clareae* mite increased rapidly in the monsoon months and reaching at its peak in July after that its population decline till August. It was observed that the population of mite varied during different months from January to December. During the period of study, the incidence of *T. Clareae* was started in the month of March, increasing March onwards and was maximum in June. No incidence was observed in the month of January, February, August, November and December when the temperature was low. The overall mean population of mite was found maximum in June (7.20%) followed by May (4.80), April (2.20), July (2.00) and was minimum in March (1.83). Highest *T. clareae* incidence was recorded in the month of June when the average colony strength and brood area was 3.32 frames and 880.42 cm^2 and the temperature, relative humidity were high i.e. 24.92°C, 58.50%, respectively whereas the rainfall was low 78.60 mm.

Table 1: Pooled data on incidence of ectoparasitic mite (*T. clareae*) in *A. cerana* colonies during January, 2019 to December, 2020

Months	Brood infestation# (%)	Colony parameters		Weather parameters		
	T. clareae	Average colony strength (bee frame)	Average brood area (cm^2)	Temperature (°C)	Relative humidity (%)	Rainfall (mm)
January	0.00 (1.00) *	2.22	195.43 (14.02) *	8.98	63.50	120.65
February	0.00 (1.00)	4.08	1166.16 (34.16)	11.25	60.00	70.80
March	1.80 (1.67)	4.48	1444.80 (38.02)	13.83	58.00	113.20
April	2.20 (1.79)	5.38	1815.00 (42.61)	19.59	50.00	42.25
May	4.80 (2.41)	4.73	1037.16 (32.22)	22.33	48.50	48.05
June	7.20 (2.86)	3.32	880.42 (29.69)	24.92	58.50	78.60
July	2.00 (1.73)	4.11	808.83 (28.46)	24.44	80.00	248.10
August	0.00 (1.00)	3.75	655.96 (25.63)	24.69	82.50	187.20
September	0.00 (1.00)	3.74	957.18 (30.95)	23.79	77.00	78.70
October	0.00 (1.00)	4.55	839.79 (29.00)	19.44	65.00	2.80
November	0.00 (1.00)	3.18	937.83 (30.64)	15.05	65.00	34.95
December	0.00 (1.00)	2.23	592.75 (24.37)	11.35	60.00	28.50
C.D $_{0.05}$	(0.54)	0.38	(3.51)			

*Figures in parentheses are square root (x+1) transformed values, # by visual examination

S No.	Pearson correlation Matrix (r) =	
1	Temperature × *T. clareae* incidence	0.48
2	Relative Humidity × *T. clareae* incidence	-0.44
3	Rainfall × *T. clareae* incidence	0.01
4	Colony Strength × *T. clareae* incidence	0.18
5	Brood Area × *T. clareae* incidence	0.24

The data on correlation of *T. clareae* infestation with colony and weather parameters showed negative correlation with relative humidity (r= -0.44).

Seasonal variation of ectoparasitic mite *T. clareae* varied from 1.80 per cent to 7.20 per cent. Maximum infestation of mites (7.20%) was observed in the month of June when temperature and rainfall was high and minimum incidence of *T. clareae* mite was observed in the month of March (1.80%). These observations coincide with increased brood rearing activity in *A. mellifera* colonies. Our findings are in line with Brar *et al.* (2019) [5] and Camphor *et al*. (2015) [6] who observed maximum incidence of *T. clareae* mite in the month of June and May, respectively when the temperature was high and relative humidity was low in *A. mellifera* colonies. In earlier studies also, minimum incidence of *T. clareae* in *A. cerana* and *A. mellifera* colonies was reported during few months and colonies overwintered in colder areas remained free from mite infestation (Negi, 2018; Brar, 2019 and Woyke, 1987a) [5, 19, 25]. Sharma *et al*. (2011) [22] found that *T. clarae* infestation in *A. cerana* have also been found maximum in summer months and was absent in winter months. They further reported that *T. clareae* infestation in *A. cerana* varied greatly from year to year and during different months.

Plate 1: Ectoparasitic mite (*Tropilaelaps clareae*) on *A. cerana* larva

Pooled data (2019-2020) on incidence of *Tropilaelaps clareae* under stationary conditions Nauni, Solan in *Apis mellifera* colonies

Incidence of *T. clareae* in *Apis mellifera* colonies was estimated by per 100 bees and visual examination of 100 brood cells for the presence of *T. clareae* mite (Plate 2). Pooled data on incidence of *T. clareae* in *A. mellifera* colonies under stationary conditions presented in Table 2 and Fig. 2 revealed that in per hundred Bees method maximum population of *T. clareae* was recorded in the month of June (10.40mites/colony) followed by April (6.40 mites/colony) and March (4.90 mites/colony). Minimum mite infestation (1.70 mites/colony) was observed in in the month of August, February (2.80 mites / colony) and July (3.50 mites / colony). Similarly, brood infestation was maximum in the month of June (7.30 %) and significantly minimum mite infestation was found in the month of August (1.20%). In both the methods of estimation of mite population, maximum population was observed in the month of June. Experimental colonies were found free from *T. clareae* in January, September, October, November and December. *T. clareae* showed highly significant positive correlation with brood area {(r= 0.76 (per 100 bees))} and r= 0.75 (visual examination)}, colony strength {(r= 0.63 (per 100 bees) and r= 0.67 (visual examination)} and negative with relative humidity {(r= -0.50 (per 100 bees), -0.42 (visual examination)}.

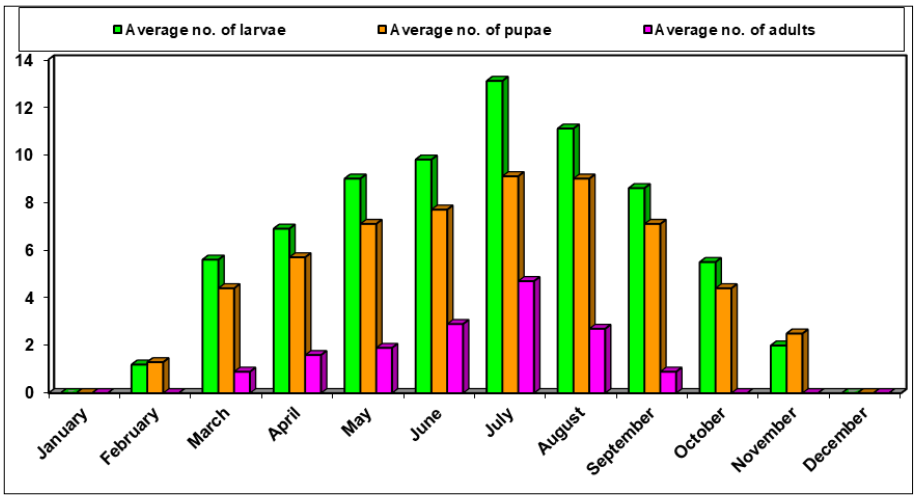

Fig 1: *Tropilaelaps clareae* incidence in *A. cerana* (2019-2020)

Table 2: Pooled data on incidence of *T. clareae* in *A. mellifera* colonies under stationary conditions at Nauni during January, 2019 to December, 2020

Months	Incidence of *Tropilaelaps clareae*		Colony parameters		Weather parameters		
	Per 100 bees (no.)	Brood infestation# (%)	Average colony strength (bee frame)	Average brood area (cm²)	Temperature (°C)	Relative humidity (%)	Rainfall (mm)
January	0.00 (1.00) *	0.00 (1.00)	2.23	661.13 (25.73)	8.98	63.50	120.65
February	2.80 (1.95)	1.80 (1.67)	2.73	1144.88 (33.85)	11.25	60.00	70.80
March	4.90 (2.43)	1.90 (1.70)	3.96	1873.73 (43.30)	13.83	58.00	113.20
April	6.40 (2.72)	4.10 (2.26)	4.82	2844.45 (53.34)	19.59	50.00	42.25
May	7.10 (2.85)	5.10 (2.47)	6.01	3308.85 (57.53)	22.33	48.50	48.05
June	10.40 (3.38)	7.30 (2.88)	4.18	1905.98 (43.67)	24.92	58.50	78.60
July	3.50 (2.12)	3.20 (2.05)	5.28	1754.40 (41.90)	24.44	80.00	248.10
August	1.70 (1.64)	1.20 (1.48)	4.37	1373.85 (37.08)	24.69	82.50	187.20
September	0.00 (1.00)	0.00 (1.00)	3.96	1291.19 (35.95)	23.79	77.00	78.70
October	0.00	0.00	3.31	1257.75	19.44	65.00	2.80

	(1.00)	(1.00)		(35.48)			
November	0.00 (1.00)	0.00 (1.00)	2.62	961.05 (31.02)	15.05	65.00	34.95
December	0.00 (1.00)	0.00 (1.00)	2.33	503.10 (22.45)	11.35	60.00	28.50
$CD_{0.05}$	(0.58)	(0.53)	0.54	(2.70)			

*Figures in parentheses are square root (x+1) transformed values, #by visual examination

S No.	Parameters	Per 100 Bees (r)	Brood Infestation (r)
1	Temperature × *T. clareae* incidence	0.42	0.51
2	Relative Humidity × *T. clareae* incidence	-0.50	-0.42
3	Rainfall × *T. clareae* incidence	0.05	0.10
4	Colony Strength × *T. clareae* incidence	0.63*	0.67*
5	Brood Area × *T. clareae* incidence	0.76*	0.75*

*Significant at 5%

These findings were comparable with earlier work of Chahal *et al.* (1986) [7] who observed two peak periods of *T. clareae* infestation in *A. mellifera* colonies i.e. February to May (33.7-51.7%) and September to November (26.8-42.0%), coincided with peak of brood rearing activity in Ludhiana, Punjab. Our findings are also in line with those of Brar *et al.* (2019) [5] who reported maximum incidence of *T. clareae* in the month of June and May, respectively when the temperature was high and relative humidity was low. In Palampur district of Himachal Pradesh *T. clareae* infestation was observed in the months of September (28.80±9.21) and October (25.70±8.52) than other months of the year (Mattu and Sharma, 2016) [18] may be due to different environmental conditions prevailing in that area.

Plate 2: Per hundred Bees method and ectoparasitic mites *(Tropilaelaps clareae*) and *(Varroa destructor)* on *A. mellifera* larva

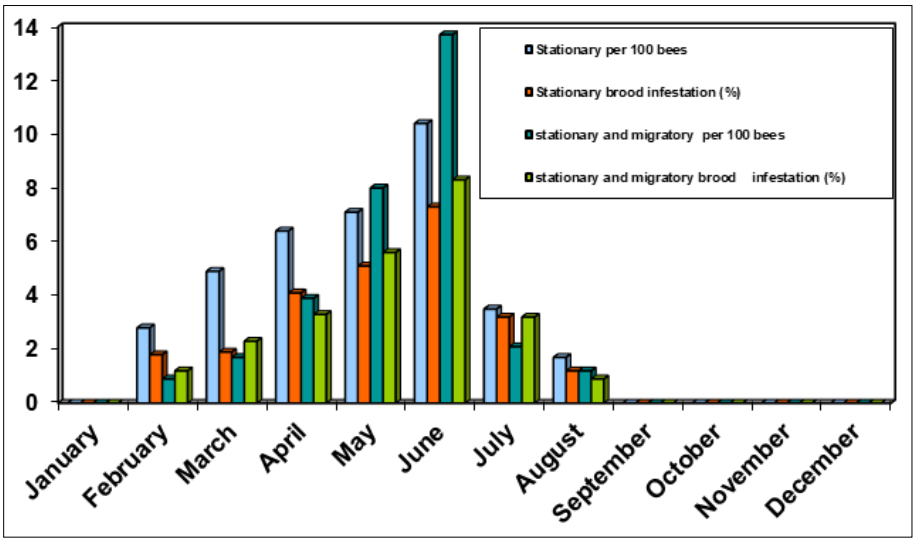

Fig 2: Incidence of *Tropilaelaps clareae* in *A. mellifera* under stationary and migratory conditions (2019-2020)

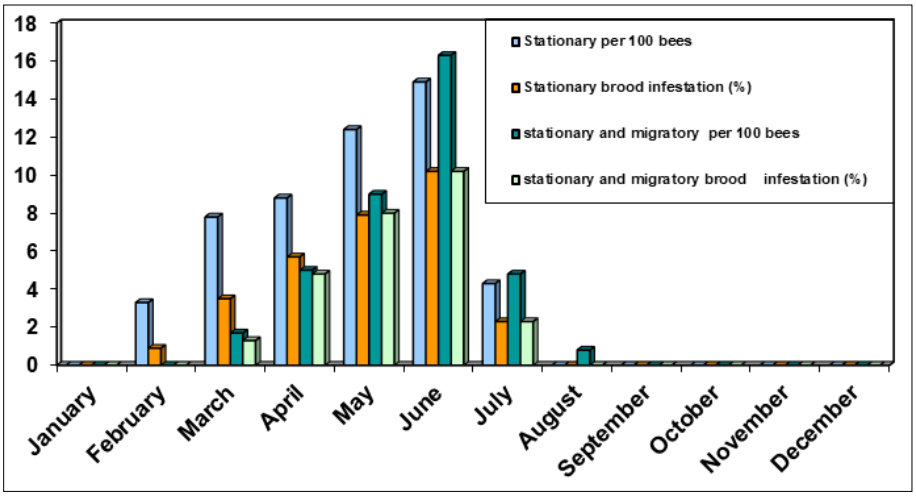

Fig 3: Incidence of *Varroa destructor* in *A. mellifera* under stationary and migratory conditions (2019-2020)

Incidence of *Tropilaelaps clareae* Pooled data (2019-2020) under migratory (Hisar, Haryana) and stationary (Nauni, Solan) conditions

Pooled data on *T. clareae* incidence in *A. mellifera* colonies under stationary (Nauni, Solan) and migratory (Hisar, Haryana) conditions during January, 2019 to December, 2020 is presented in Table 3 and Fig. 2. In per hundred Bees method the incidence of *T. clareae* mite was significantly maximum in the month of June (13.70 mites/colony) when the average colony strength and brood area were 4.29 bee frames and 1870.50 cm^2 and the temperature, relative humidity and rainfall were 25.74°C, 48.00 per cent and 98.50 mm, respectively while, minimum mite infestation was found in August (1.20 mites/colony). Per cent brood infestation was also maximum in the month of June (8.30%) and May (5.60%) followed by April (3.30%) and July (3.20%). Minimum incidence was observed in the month of August (0.90%) and February (1.20%).

Table 3: Pooled data on incidence of *T. clareae* in *A. mellifera* colonies under migratory (Hisar, Haryana) and stationary (Nauni, Solan) conditions during January, 2019 to December, 2020

Months	Incidence of *Tropilaelaps clareae*		Colony parameters		Weather parameters		
	Per 100 bees (no.)	Brood infestation# (%)	Average colony strength (bee frame)	Average brood area (cm^2)	Temperature (°C)	Relative humidity (%)	Rainfall (mm)
January**	0.00 (1.00) *	0.00 (1.00)	6.49	2741.25 (52.37)	11.43	97.50	9.65
February**	0.90 (1.00)	1.20 (1.48)	7.33	4040.93 (63.58)	15.68	95.00	9.80
March	1.70 (1.64)	2.30 (1.82)	4.39	2560.65 (50.61)	13.83	58.00	113.20
April	3.90 (2.21)	3.30 (2.07)	3.17	2215.58 (47.08)	19.59	50.00	42.25
May	8.00 (3.00)	5.60 (2.57)	6.05	2322.00 (48.20)	22.33	48.50	48.05
June	13.70 (3.83)	8.30 (3.05)	5.75	2073.68 (45.55)	24.92	58.50	78.60
July	2.10 (1.76)	3.20 (2.05)	5.96	1702.80 (41.28)	24.44	8.00	248.10
August	1.20 (1.48)	0.90 (1.38)	5.66	1535.10 (39.19)	24.69	82.50	187.20
September	0.00 (1.00)	0.00 (1.00)	5.13	1402.88 (37.47)	23.79	77.00	78.70
October	0.00 (1.00)	0.00 (1.00)	3.66	1364.18 (36.95)	19.44	65.00	2.80
November**	0.00 (1.00)	0.00 (1.00)	4.76	1041.68 (32.29)	18.95	89.00	16.10
December**	0.00 (1.00)	0.00 (1.00)	5.35	1612.50 (40.17)	12.35	93.50	2.25
$CD_{0.05}$	(0.56)	(0.54)	0.90	(4.00)			

*Figures in parentheses are square root (x+1) transformed values, #by visual examination
**Months of migration period of colonies to Haryana

S No.	Parameters	Per 100 Bees (r)	Brood Infestation (r)
1	Temperature × *T. clareae* incidence	0.47	0.46
2	Relative Humidity × *T. clareae* incidence	-0.39	-0.56
3	Rainfall × *T. clareae* incidence	0.10	0.24
4	Colony Strength × *T. clareae* incidence	0.10	0.11
5	Brood Area × *T. clareae* incidence	0.12	0.18

*Significant at 5%

The present studies are in close proximity with the finding of Brar *et al.* (2019) [5] who also reported maximum *T. clarae* mite infestation in the month of June in per hundred method (11.00 mites /colony) and brood examination method (5.00%) while minimum infestation was in the month of April (2.00 mites/ colony). The mite incidence was found maximum when the brood rearing was high. Similar observations were reported earlier by Singh *et al*. (2011) [23], Gatoria *et al.* (1995) [12] and Padhi and Rath (2012) [20]. Thakur *et al*. (2009) [24] observed two peaks in mite population in May-June and September-October. The difference in peak population from the present findings could be due to the different climatic conditions in study locations which affected the brood rearing in *A. mellifera* in H.P. In the present finding *T. clareae* mite was absent during migratory period from November, December and January and minimum incidence in the month of February could be attributed to the prevailing high humidity and low temperature conditions at Hisar. These studies are in conformity to the observations of earlier workers (Aggarwal and Kapil, 2013) [1] who have reported no mite population during winter. The present studies are also supported by findings of Chahal *et al.* (1986) [7], who have found positive correlation of *T. clareae* incidence with temperature and rainfall.

Incidence of *Varroa destructor* Pooled data (2019-2020) under stationary conditions Nauni, Solan

Incidence of *V. destructor* was estimated by two different methods *viz*. per 100 bees and visual examination of 100 brood cells (Plate 2). Incidence of *V. destructor* in *A. mellifera* colonies under stationary conditions is presented in Table 4 and Fig. 3. Maximum infestation was observed in the month of June (10.20 %) when average colony strength and brood area were 4.18 bee frames and 1905.98 cm^2, respectively in remaining months of study (January, August, September, October, November and December) no mite population was detected. In per 100 Bees method *A. mellifera* colonies showed maximum *Varroa* mite infestation also in June (14.90 mites/ colony) followed by May (12.40 mites/colony), April (8.80 mites/colony) and March (7.80 mites/colony). Significantly minimum number of *Varroa* mites were observed in the month of February (3.30 mites/colony).

Table 4: Pooled data on incidence of *V. destructor* in *A. mellifera* colonies under stationary (Nauni, Solan) conditions at Nauni during January, 2019 to December, 2020

Months	Incidence of *Varroa destructor*		Colony parameters		Weather parameters		
	Per 100 bees (no.)	Brood infestation# (%)	Average colony strength (bee frame)	Average brood area (cm^2)	Temperature (°C)	Relative humidity (%)	Rainfall (mm)
January	0.00 (1.00) *	0.00 (1.00)	2.23	661.13 (25.73)	8.98	63.50	120.65
February	3.30 (2.07)	0.90 (1.38)	2.73	1144.88 (33.85)	11.25	60.00	70.80
March	7.80 (2.97)	3.50 (2.12)	3.96	1873.73 (43.30)	13.83	58.00	113.20
April	8.80 (3.13)	5.70 (2.59)	4.82	2844.45 (53.34)	19.59	50.00	42.25
May	12.40 (3.66)	7.90 (2.98)	6.01	3308.85 (57.53)	22.33	48.50	48.05
June	14.90 (3.99)	10.20 (3.35)	4.18	1905.98 (43.67)	24.92	58.50	78.60
July	4.30 (2.30)	2.30 (1.82)	5.28	1754.40 (41.90)	24.44	80.00	248.10
August	0.00 (1.00)	0.00 (1.00)	4.37	1373.85 (37.08)	24.69	82.50	187.20
September	0.00 (1.00)	0.00 (1.00)	3.96	1291.19 (35.95)	23.79	77.00	78.70
October	0.00 (1.00)	0.00 (1.00)	3.31	1257.75 (35.48)	19.44	65.00	2.80
November	0.00 (1.00)	0.00 (1.00)	2.62	961.05 (31.02)	15.05	65.00	34.95
December	0.00 (1.00)	0.00 (1.00)	2.33	503.10 (22.45)	11.35	60.00	28.50
$CD_{0.05}$	(0.44)	(0.50)	0.54	(2.70)			

*Figures in parentheses are square root (x+1) transformed values, #by visual examination

S No.	Parameters	Per 100 Bees (r)	Brood Infestation (r)
1	Temperature × *V. destructor* incidence	0.36	0.42
2	Relative Humidity × *V. destructor* incidence	-0.59*	-0.57*
3	Rainfall × *V. destructor* incidence	-0.04	-0.08
4	Colony Strength × *V. destructor* incidence	0.63*	0.62*
5	Brood Area × *V. destructor* incidence	0.79*	0.77*

*Significant at 5%

Pooled data on correlation of incidence of *V. destructor* with colony and weather parameters showed positive significant correlation of incidence of *V. destructor* and negative correlation with relative humidity (significant) and rainfall (non-significant).

These observations coincide with increased brood rearing activity in *A. mellifera* colonies. Our findings are in line with those of Brar *et al.* (2019) [5] who observed maximum incidence of *Varroa* mite in the month of June when the temperature was high and relative humidity was low. No

Varroa incidence was recorded from August to December during the period of present investigation due to considerable increase in relative humidity in these months. The present finding got support from the observations of different research workers who have found possitive correlation of *Varroa* incidence with temperature (Deosai and Chhuneja, 2012) [11], Asha *et al.* (2013) [3] and Poonia *et al.* (2014) [21] who have also observed positive correlation of *Varroa* incidence with temperature and rainfall. According to Basavarajappa *et al.* (2010) [4] in general, the infestation was high during post monsoon both in 2008 and 2009 followed by monsoon season. However, during winter the per cent mite's infestation was reported low. In our studies, *Varroa* mite was present from March onwards become maximum in June and was absent in winter months. Our findings also got support from earlier studies by Kamath (2001) [15] and Anonymous (2007) [2] who reported that perhaps, the prevailed moderate weather fluctuations throughout year might have influenced the per cent incidence of mite's infestation that varied significantly during different months.

Incidence of *Varroa destructor* Pooled data (2019-2020) under migratory (Hisar, Haryana) and stationary (Nauni, Solan) conditions (2019-2020)

Pooled data on incidence of *V. destructor* in *A. mellifera* colonies under stationary (Nauni, Solan) and migratory (Hisar, Haryana) conditions during January, 2019 to December, 2020 is presented in Table 5 and Fig. 3. In per hundred Bees method, the incidence of *Varroa* mite was detected significantly maximum (16.30 mites/colony) during June when average colony strength and brood area were 5.75 bee frames and 2073.68 cm^2, respectively and the temperature, relative humidity and rainfall were 24.92°C, 58.50 per cent and 78.60 mm, respectively followed by May (9.00 mites/colony), April (5.00 mites/colony) and July (4.80 mites/colony). Significantly minimum infestation was found in the month of August (0.80 mites/colony). Experimental colonies were found free from *V. destructor* in January, September, October, November and December in visual examination of the brood. Brood infestation in migratory colonies was also found to be maximum in the month of June (10.20%) and minimum in the month of March (1.30 %). Pooled data on correlation of incidence of *V. destructor* with colony and weather parameters showed negative correlation (non-significant) with relative humidity (r= -0.51(per 100 bees) and -0.49 (visual examination)}.

Maximum incidence was observed in the month of June in both the methods of estimation. Brar *et al.* (2019) [5] also reported maximum *V. destructor* infestation in the month of June in per hundred bee method (16.00 mites /colony) and in brood examination method (7.00%). Minimum infestation was recorded in the month of April (4.00 mites/colony) in per hundred method and May (3.00%) in brood examination method under migratory conditions. In present finding the absence of *Varroa* mite in bee colonies during migratory period from November to February could be attributed to the prevailing high humidity and low temperature conditions at Hisar.

Table 5: Pooled data on incidence of *V. destructor* in *A. mellifera* colonies under migratory (Hisar, Haryana) and stationary (Nauni, Solan) conditions during January, 2019 to December, 2020

Months	Incidence of *Varroa destructor*		Colony parameters		Weather parameters		
	Per 100 bees (no.)	Brood infestation# (%)	Average colony strength (bee frame)	Average brood area (cm^2)	Temperature (°C)	Relative humidity (%)	Rainfall (mm)
January, 2020**	0.00 (1.00) *	0.00 (1.00)	6.49	2741.25 (52.37)	11.43	97.50	9.65
February**	0.00 (1.00)	0.00 (1.00)	7.33	4040.93 (63.58)	15.68	95.00	9.80
March	1.70 (1.64)	1.30 (1.52)	4.39	2560.65 (50.61)	13.83	58.00	113.20
April	5.00 (2.45)	4.80 (2.41)	3.17	2215.58 (47.08)	19.59	50.00	42.25
May	9.00 (3.16)	8.00 (3.00)	6.05	2322.00 (48.20)	22.33	48.50	48.05
June	16.30 (4.16)	10.20 (3.35)	5.75	2073.68 (45.55)	24.92	58.50	78.60
July	4.80 (2.41)	2.30 (1.82)	5.96	1702.80 (41.28)	24.44	8.00	248.10
August	0.80 (1.34)	0.00 (1.00)	5.66	1535.10 (39.19)	24.69	82.50	187.20
September	0.00 (1.00)	0.00 (1.00)	5.13	1402.88 (37.47)	23.79	77.00	78.70
October	0.00 (1.00)	0.00 (1.00)	3.66	1364.18 (36.95)	19.44	65.00	2.80
November**	0.00 (1.00)	0.00 (1.00)	4.76	1041.68 (32.29)	18.95	89.00	16.10
December**	0.00 (1.00)	0.00 (1.00)	5.35	1612.50 (40.17)	12.35	93.50	2.25
$CD_{0.05}$	(0.50)	(0.38)	0.90	(4.00)			

*Figures in parentheses are square root (x+1) transformed values, #by visual examination

**Months of migration period of colonies to Haryana

S No.	Parameters	Per 100 Bees (r)	Brood Infestation (r)
1	Temperature × *V. destructor* incidence	0.51	0.45
2	Relative Humidity × *V. destructor* incidence	-0.51	-0.49
3	Rainfall × *V. destructor* incidence	0.19	0.08
4	Colony Strength × *V. destructor* incidence	0.07	0.01
5	Brood Area × *V. destructor* incidence	0.05	0.09

*Significant at 5%

These studies are in conformity to the observations of earlier workers (Poonia *et al.,* 2014) [21] who have reported no mite population during winters in Hisar, Haryana. They have also found the positive correlation of *Varroa* incidence with temperature and rainfall. Similar results were also reported by Asha *et al.* (2013) [3], Deosai and Chhuneja (2012) [11], De jong *et al.* (1982) [9], De jong (1990) [10] and Kokkinis and Liakos (2004) [16].

Conclusions

Varrora and *Troplaelaps* mite is a new threat to important honey bee reared species, *A. cerana* and *A. mellifera*. Mite incidence in *A. cerana* colonies keep fluctuating during different months of both the years. During the whole period of study, the trend of incidence was found as maximum in the month of April, June and July and minimum in the moths of February, March and August. This mite reduced bee colony strength, produce weakness in brood cell and deforming effects on honey bee immature and adult stages. Incidence was highest when temperature, rainfall and relative humidity were high and become nil when temperature, rainfall and relative humidity were low. Incidence of mites has assuredly a correlation with mean temperature, colony strength, brood area, rainfall and relative humidity. Keeping in view the immense damage caused by mite species in apiaries leading to great loss, its infestation has to be checked before summer and management practices should be applied accordingly to protect honey bee colonies.

Conflict of interest: There is no conflict of interest.

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References

1. Aggarwal K, Kapil RP. Seasonal population dynamics of *Tropilaelaps clareae* (*Acari*: *Laelapidae*) in *Apis dorsata* colonies. International Journal of Acarology,2013:2:283–286.
2. Anonymous. Apiculture in India. Current Science,2007:92:1336.
3. Asha, Gulati R, Thakur D, Giroh M. Effect of *Varroa destructor* Anderson and Trueman infestation on *Apis mellifera* L. adults. Journal of Applied and Natural Science,2013:5:455–458.
4. Basavarajappa S, Raghunandan KS, Hegde SN. Seasonal incidence of the parasitic mite (Arachnida: Acarinidae) on *Apis dorsata* F. (*Hymenoptera*: *Apidae*) in Mysore, Karnataka. Hexapoda,2010:17:166–173.
5. Brar AS, Sharma HK, Rana K. Periodical prevalence of brood pestilence and epizoan mites in *Apis mellifera* L. underneath stationary and migratory surroundings of Himachal Pradesh. Journal of Entomology and Zoology Studies,2019:7:730–737.
6. Camphor ESW, Hashmi AA, Ritter W, Bowen ID. Seasonal changes in mite (*Tropilaelaps clareae*) and honeybee (*Apis mellifera*) populations in Apistan treated and untreated colonies. Apiacta,2005:40:34–44.
7. Chahal BS, Brar HS, Jagjit HS, Gatoria GS. Status of bee diseases and ectoparasitic mites in *Apis mellifera* in Punjab, India. Indian Journal of Ecology,1986:13:46–51.
8. Chauhan A, Dashi MV, Patnaik JP. Review on Varroa mite–An invasive threat to apiculture industry. Journal of Entomology and Zoology Studies,2021:9:535–539.
9. De Jong D, Morse RA, Eickwort GC. Mite pests of honeybees. Annual Review of Entomology,1982:27:229–252.
10. De Jong D. Mites: Varroa and other parasites of brood. In: Honey Bee Pests, Predators and Diseases. 2nd ed. Cornell University Press, 1990, 200–218.
11. Deosi HK, Chhuneja PK. Seasonal fluctuations in *Varroa destructor* population in *Apis mellifera* colonies. Journal of Insect Science,2012:25:188–193.
12. Gatoria GS, Brar HS, Jhajj HS. Seasonal incidence of ectoparasitic mite, *Tropilaelaps clareae* Delfiando and Baker and its control in *Apis mellifera* colonies. Journal of Insect Science,1995:8:157–159.
13. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research. 2nd ed. John Wiley and Sons, 1986, 99–107.
14. Johannesmeir MF, Mostert AN. Crop pollination. In: Beekeeping in South Africa. Pretoria Agricultural Research Council Africa, 2001, 235–250.
15. Kamath US. Karanataka State Gazetter. Govt. Press, 2001, 1–49.
16. Kokkinis M, Liakos V. Population dynamics of *Varroa destructor* in colonies of *Apis mellifera macedonica* in Greece. Apidologie,2004:43:150–154.
17. Martin SJ, Highfield AC, Brettell L, Villalobos EM, Budge GE, Powell M, *et al*. Global honey bee viral landscape altered by a parasitic mite. Science,2012:336:1304–1306.
18. Mattu VK, Sharma I. Seasonal variation of ectoparasitic mite *Tropilaelaps clareae* and *Varroa jacobsoni* on *Apis mellifera*. International Journal of Scientific Research,2016:5:18–20.
19. Negi N. Studies on Brood Diseases of *Apis mellifera* L. M.Sc. Thesis. Department of Entomology, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan, 2018, 69.
20. Padhi J, Rath LK. Seasonal incidence of ectoparasitic mite *Tropilaelaps clareae* Delfiando and Baker and effect of their varied infestation levels on brood and adult bees of *Apis mellifera* L. Journal of Plant Protection and Environment,2012:9:32–35.

21. Poonia A, Gulati R, Sharma SK. Effect of environment factors on the population of *Varroa destructor* in *Apis mellifera* L. colonies. The Ecoscan,2014:8:23–25.
22. Sharma V, Mattu VK, Thakur MS. Studies on seasonal variations of ectoparasitic mites of honey bee colonies in Shivalik hills of Himachal Pradesh. International Journal of Bio-Science,2011:1:21–23.
23. Singh B, Singh J, Yadav S, Chhuneja PK. Incidence of brood mite *Tropilaelaps clareae* Delfinado and Baker in *Apis mellifera* Linnaeus colonies during low brood rearing periods in Punjab. Insect Environment,2011:17:87–88.
24. Thakur RK, Thakur NS, Gupta JK. Seasonal variations of ectoparasitic mite *Tropilaelaps clareae* Delfinado and Baker infestation in *Apis mellifera* colonies. Pest Management and Economic Zoology,2009:17:55–61.
25. Woyke J. Length of stay of parasitic mite *Tropilaelaps clareae* outside sealed honey bee brood cells as a basis for its effective control. Journal of Apicultural Research,1987:26:104–109.