Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2019; 7(3): 291-298

Received: 04-03-2019
Accepted: 06-04-2019

Muntaha Qamar
Department of Plant Protection Sciences, Faculty of Agricultural Sciences, Aligarh Muslim University, Aligarh Uttar Pradesh, India

Masarrat Haseeb
Department of Plant Protection Sciences, Faculty of Agricultural Sciences, Aligarh Muslim University, Aligarh Uttar Pradesh, India

Correspondence
Muntaha Qamar
Department of Plant Protection Sciences, Faculty of Agricultural Sciences, Aligarh Muslim University, Aligarh Uttar Pradesh, India

Population dynamics of *Henosepilachna* spp. in relation to various host plants

Muntaha Qamar and Masarrat Haseeb

Abstract
A comparative study on population dynamics of *Henosepilachna vigintioctopunctata* and *H. dodecastigma* was carried out for two consecutive years (2015 and 2016) on three vegetable crops i.e. brinjal, bitter guard and tomato and one medicinal crop i.e. winter cherry with recommended fertilizers and cultural practices in 3.5 x 3m plots replicated 9 times, in an experimental field of Department of Plant Protection, Aligarh Muslim University, Aligarh, India. Observations were taken on 4 randomly selected plants from each plot. Adults and grubs of these two species were found feeding upon early to late growth stage of all crops tested. Results from these studies revealed that, in both the study year the highest population of adults and grubs were recorded on brinjal followed by the rest of the tested host plants in the month of July and August. The weather parameters i.e. temperature (29.37ºC), relative humidity (83.21%) and rainfall (70mm) found favorable for the adults to reach its peak density on all tested host plants. From the present study, it can be concluded that host plants and abiotic factors influenced the temporal abundance of this species. Therefore, it is necessary to consider these factors in the study of population dynamics of *Henosepilachna* spp., which will be helpful in devising a successful and better strategy to timely manage the pest on various crops in Aligarh agro-climatic conditions.

Keywords: *Henosepilachna* spp; abiotic factors, host plants, population dynamics

Introduction

The knowledge of distribution and occurrence of a particular pest are important aspects of pest management program. The seasonal incidence and quality of host as food plays an important role to maintain the population of an organism in a particular geography and climate [1]. Various important abiotic factors like temperature, rainfall, humidity, and photoperiod affect the temporal abundance of insect population [2]. Therefore, it is important to include these factors in any study of population dynamics [3], and to identify the causes of population fluctuation at different spatial scales [4].

The previous studies conducted on population dynamics of various species of *Henosepilachna* include *H. vigintioctopunctata* by Hirano [2], Sharma & Tayde [5], *H. pustulosa* by Nakamura & Ohgushi [6], *H. niponica* by Ohgushi & Sawada [7], *E. chiysomelina* by Ali & Saeady [8] and *H. dodecastigma* by Tripathi & Misra [9]. *Henosepilachna* spp. causes considerable economic loss to brinjal and other host plants depending on the season, place and environmental conditions. Both stages i.e. adult and larvae caused significant losses to the crop by scrapping the chlorophyll content thereby damage leaves, flowers and fruits [10]. The beetle and the grub of *H. vigintioctopunctata* cause considerable damage to the eggplant by scrapping away the green leaf tissue [11] resulting in drying of leaves, which may result into complete defoliation of the plant [12]. The grubs of *Henosepilachna* spp. attack on the lower surface of leaves, however adults usually feed on the upper surface of the leaves [13]. Present studies therefore undertaken as basic requirement with a view to develop management strategies against this notorious pest.

2. Materials and methods

2.1 Population dynamics of *Henosepilachna* spp. on various crops

The experiments on the population dynamics of *H. vigintioctopunctata* and *H. dodecastigma* were carried out in 2015 and 2016 on three vegetable crops i.e. brinjal, bitter gourd and tomato and one medicinal crop i.e. winter cherry in experimental field of Department of Plant Protection, Aligarh Muslim University, Aligarh, India.

Brinjal and bitter guard were sown as a summer and monsoon season crops, tomato was sown as spring season crop and winter cherry was sown as monsoon season crop in Complete

Randomized Block Design (CRD) followed by recommended agronomic practices in 3.5m x 3m plots replicated 9 times without any plant protection measures.

Observations on population density were taken as soon as their infestations noticed on tested host plants and recorded till the harvesting of crops, by counting number of grubs and adults on 36 randomly selected plants (4 plants/plot) at weekly intervals.Meteorological data for two consecutive years (2015 and 2016) were collected from the Meteorological station, Department of Physics, Aligarh Muslim University, Aligarh.

2.2 Statistical analysis

The weekly population data of *Henosepilachna* spp. were analyzed statistically by using analysis of variance (ANOVA) (P = 0.05%). Pearson's correlation was used to correlate the various abiotic factors i.e. temperature (ºC), Relative humidity (%) and rain fall (mm) with the population of *Henosepilachna* spp. Further comparisons were made by using box plot between the years 2015 and 2016 to know the variation in populations of *Henosepilachna* spp. on tested host plant by computing the Mann Whitney U test for independent samples. The statistical analysis and graphic presentation was performed by using the language program R 2.10.1[14].

3. Results

Results pertaining to the data on population density of *Henosepilachna* sp. on brinjal indicated significant variation in the mean density of adults of *H. vigintioctopunctata*, *H. dodecastigma* and grubs of these species (Table 1). The density of adults of *H. vigintioctopunctata* and *H. dodecastigma* reached to its peak with 25.80 and 16.29 adults/plant respectively in 32nd std. wk of year, 2015. However, the population of grub reached to its peak (76.89 grubs/plant) in 31st std. wk. (Table-1)

Results of correlation studies among abiotic factors and pest population (Table-2) showed that the density of adults had significant and positive correlation with average relative humidity and average rainfall. However, the density of grub showed positive non-significant correlation with average relative humidity and average rainfall.

Similarly, on bitter gourd a significant variation was seen in the mean density of adults of *H. vigintioctopunctata*, *H. dodecastigma* and grubs (Table 1). Population of *H. vigintioctopunctata* and *H. dodecastigma* reached to the peak in 31st (12.37 adults/plant), 32nd (8.1 adults /plant) respectively while grubs density in 30th (63.09 grubs/plant) std. wk of 2015 (Table 1).

Data on adult population subjected to Pearson's correlation showed significant and positive correlation with average temperature, average relative humidity and average rainfall (Table-2). However, the density of grubs had positive but non-significant correlation with the weather parameters (P=NS).

A significant variation was apparent in the mean density of adults of *Henosepilachna* spp. and grubs on tomato in, 2015 (Table 1). Peak population of adults of both the species was attained in 23rd std. wk. However, maximum population of grubs (61.50 grubs/plant) was observed in 20th std. wk of 2015.

Pearson's correlation test showed a significant and positive correlation between average temperature and adult density of *H. vigintioctopunctata* and *H. dodecastigma*. However, density of adults of both the species exhibited a negative and non-significant correlation with average relative humidity and average rainfall. Similarly, data on density of grubs indicated a negative and non-significant correlation with average relative humidity and average rainfall (Table 2).

On winter cherry, a significant variation was visible in the mean density of adults of the spp. and grubs in 2015 (Table 1). Peak density of adults of *H. vigintioctopunctata* (17.27 adults/plant) and *H. dodecastigma* (10.01 adults/plant) observed in 33rd std. wk, 2015. However, peak density of grubs (85.02 individuals/plant) witnessed in 31ststd. wk, 2015. Population data subjected to Pearson's correlation test exhibited a non-significant but positive correlation between average temperature and adults of *H. vigintioctopunctata* and *H. dodecastigma*. A positive and significant correlation was also observed between adults of both the spp. and average relative humidity and average rainfall (Table 2). Various meteorological data of year, 2015 from Aligarh region that affected population densities of *Henosepilachna* spp. were summarized in figure 1.

Further, a significant variation was determined in the mean density of adults of spp. of beetle and grubs in year, 2016 on brinjal (Table 3). The population of adults of *H. vigintioctopunctata* (3.21 adults/plant) and *H. dodecastigma* (0.45 adults/plant) were visible on 10th and 11th std. wk of the year, 2016 (Table 3) while, density of grubs first noticed in 10th std. wk. Thereafter, the density of adults of both species fluctuated and reached to the maximum of 26.30 adults/plant for *H. vigintioctopunctata* and 15.60 adults/plant for *H. dodecastigma* in 29th std. week of the year, 2016 (Table 3).

Results from Pearson's correlation test revealed that a non-significant but positive correlation exhibited between average temperature and adults of both the spp. and grubs of beetle. However, a positive and significant correlation of adults population was evident with average relative humidity and average rainfall. Similarly, grubs density is also positively and significantly correlated with relative humidity and average rainfall (Table 4).

Furthermore, on bitter gourd a significant variation was also noticed in the mean density of adults of both spp. and grubs in 2016 (Table 3). The density of adults and grubs reached to the peak in 29th (13.76 adults of *H. vigintioctopunctata*/plant), 29th (7.74 adults of *H. dodecastigma*/plant) and 28th (54.17 grubs/plant) std. wk of 2016 (Table 3).

Analyzed results (Table 4) indicated a non-significant and negative correlation between average temperature and adults of both the spp. of beetle. However, it showed a positive and non-significant relation with grubs. Moreover, a positive and significant correlation of adults and grub density was evident with average relative humidity and average rainfall (Table 4).

On tomato, a significant variation was seen in the mean density of adults and grubs of both beetle spp. in 2016 (Table 3). Peak density of adults and grubs of both species noticed in 19th std. wk of 2016.

Pearson's correlation test showed a non-significant and positive correlation between average temperature and adults of *H. vigintioctopunctata* and *H. dodecastigma* and grubs. However, density of adults of *H. vigintioctopunctata* exhibited a positive and significant correlation with average relative humidity. However, a positive but non-significant correlation is evident between adults of *H. dodecastigma* and average rainfall and average rainfall (P=NS) (Table 4).

On winter cherry, a significant variation was witnessed in the mean density of adults of both spp. and grubs of beetle in 2016 (Table 3). Peak density of adults of *H.*

vigintioctopunctata (6.49 adults/plant) observed in 39th std. week of 2016. However, peak population of adults of *H. dodecastigma* (6.71 adults/plant) and grubs (10.09 individuals/plant) observed in 31st std. wk of 2016. Various meteorological data of year, 2016 from Aligarh region that affected population densities of *Henosepilachna* spp. were summarized in figure 2. Results pertaining to Pearson's correlation test showed a significant and positive correlation between average temperature and adults of *H. vigintioctopunctata*. However, average temperature exhibited a positive and non-significant correlation with adults of *H. dodecastigma* and density of grubs. Further, a positive and non-significant correlation was exhibited between adult density and average relative humidity. (Table 4).

Overall density of adults and grubs of *H. vigintioctopunctata* and *H. dodecastigma* were compared between the two consecutive years (2015 and 2016) on each tested host plant using Mann-Whitney U test. The test statistics showed a non-significant difference in population densities on each test crop between 2015 and 2016 (Fig 3)

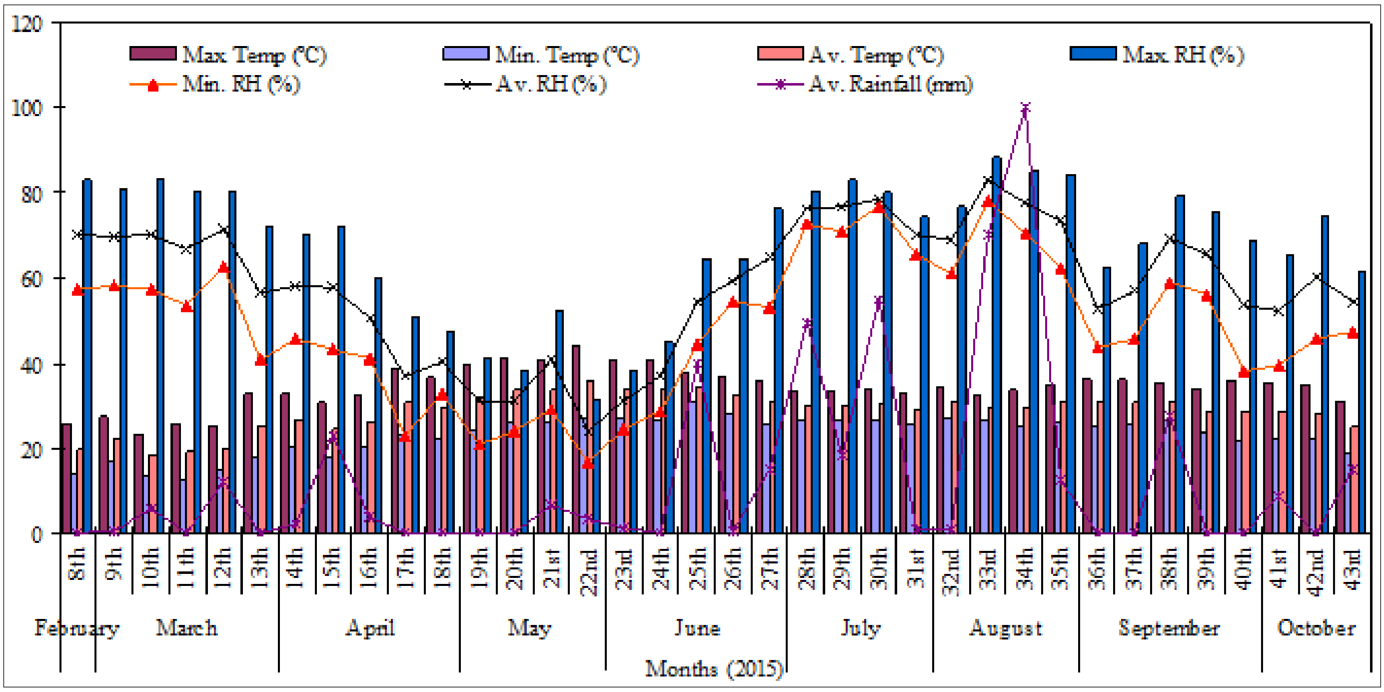

Fig 1: Meteorological data of Aligarh, India (2015). (Av. = Average; Temp. = Temperature; RH = Relative humidity; Max. = Maximum, Min. = Minimum, mm = millimeter).

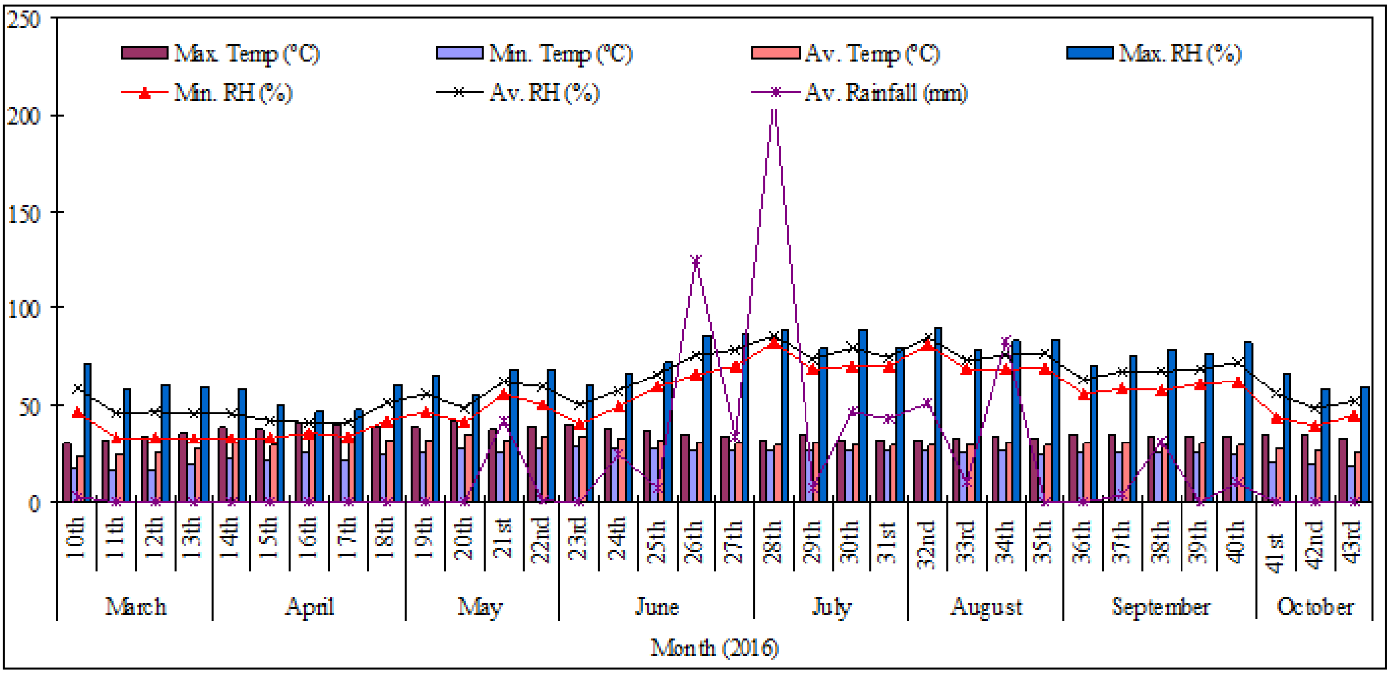

Fig 2: Meteorological data of Aligarh, India (2016). (Av. = Average; Temp. = Temperature; RH = Relative humidity; Max. = Maximum, Min. = Minimum, mm = millimeter).

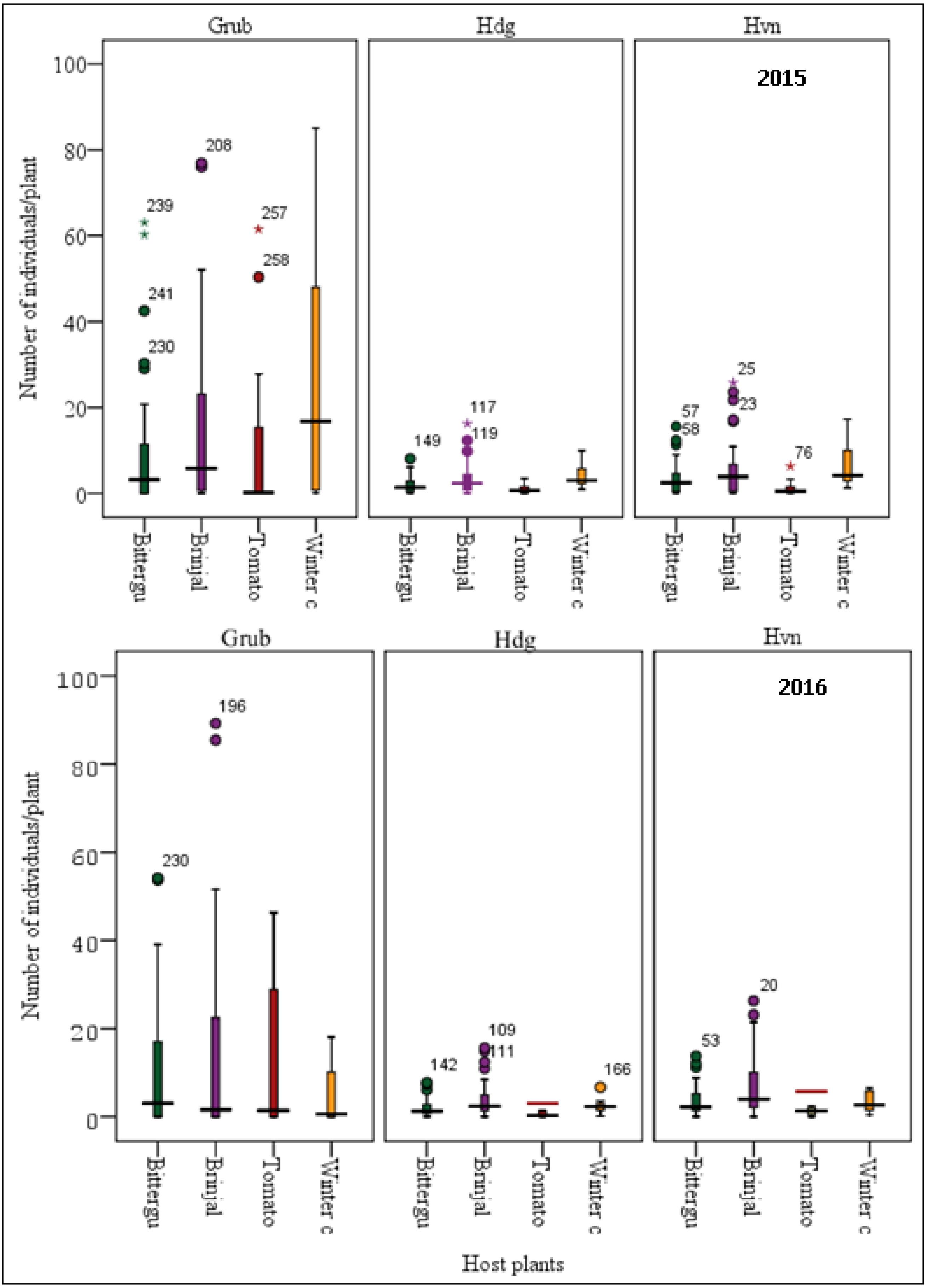

Fig 3: Average population of different stages (Grubs and adults) of *Henosepilachna* spp. (Hvn = *Henosepilachna* vigintioctopunctata and Hdg = H. dodecastigma) on various crops for two consecutive years i.e. 2015 and 2016. Comparisons were made using Mann Whitney U test for independent samples. The limits of a box denote the upper and lower quartiles, the horizontal bar is the median, and the 1.5 IQR criterion has been used to classify outliers.

Table 1: Seasonal incidence of adults and grubs of *H. vigintioctopunctata* and *H. dodecastigma* on various hosts (2015).

Months	Std. weeks	Mean Number (±SD) of Hvn adults/Plant				Mean Number (±SD) of Hdg adults/Plant				Mean Number (±SD) of grubs/Plant			
		Brinjal	**Bitterguard**	**Tomato**	**Winter cherry**	**Brinjal**	**Bitterguard**	**Tomato**	**Winter cherry**	**Brinjal**	**Bitterguard**	**Tomato**	**Winter cherry**
February	8th	0.64	NCS	NCS	NCS	0.03	NCS	NCS	NCS	0.00	NCS	NCS	NCS
March	9th	0.28	NCS	NCS	NCS	0.53	NCS	NCS	NCS	2.20	NCS	NCS	NCS
	10th	0.53	NCS	NCS	NCS	3.06	NCS	NCS	NCS	3.50	NCS	NCS	NCS
	11th	0.31	NCS	NCS	NCS	1.42	NCS	NCS	NCS	0.58	NCS	NCS	NCS
	12th	0.03	0.03	0.03	NCS	0.03	0.03	0.00	NCS	0.00	0.00	0.00	NCS
	13th	0.33	0.17	0.17	NCS	0.03	0.03	0.00	NCS	10.67	0.00	0.00	NCS
April	14th	0.03	0.03	0.03	NCS	0.03	0.03	0.00	NCS	6.33	0.67	0.00	NCS
	15th	1.22	0.64	0.72	NCS	1.53	0.78	0.93	NCS	2.08	0.16	0.00	NCS
	16th	0.94	0.49	0.56	NCS	1.42	0.75	0.88	NCS	0.08	0.00	0.00	NCS
	17th	0.25	0.15	0.14	NCS	0.89	0.44	0.55	NCS	0.00	0.00	0.00	NCS
	18th	0.47	0.24	0.28	NCS	0.36	0.19	0.22	NCS	26.83	7.88	1.50	NCS
May	19th	0.33	0.16	0.19	NCS	0.44	0.22	0.28	NCS	14.58	9.75	27.87	NCS
	20th	0.72	0.39	0.42	NCS	0.58	0.31	0.36	NCS	35.75	20.75	61.50	NCS
	21st	1.72	0.92	1.03	NCS	2.67	1.33	1.65	NCS	30.87	30.25	50.41	NCS
	22nd	4.97	2.67	2.89	NCS	2.14	1.08	1.32	NCS	31.50	6.33	15.37	NCS
June	23rd	10.90	5.69	6.33	NCS	5.72	2.86	3.52	NCS	5.25	3.88	0.75	NCS
	24th	5.67	2.97	3.3	NCS	4.31	2.14	2.64	NCS	0.25	0.13	0.13	NCS
	25th	2.83	1.47	1.64	NCS	3.22	1.6	1.98	NCS	0.83	0.00	0.25	NCS
	26th	3.64	1.94	NCS	NCS	2.14	1.06	NCS	NCS	1.75	0.00	NCS	NCS
	27th	4.17	2.17	NCS	NCS	1.97	0.97	NCS	NCS	6.83	2.83	NCS	NCS
July	28th	4.72	2.47	NCS	NCS	2.14	1.08	NCS	NCS	15.08	9.08	NCS	NCS
	29th	10.02	5.24	NCS	2.75	5.72	2.86	NCS	1.32	24.08	13.16	NCS	25.13
	30th	17.19	9.03	NCS	5.83	6.44	3.22	NCS	3.52	75.98	63.09	NCS	27.18
	31st	23.60	12.37	NCS	10.01	9.31	4.64	NCS	3.96	76.89	60.27	NCS	85.02
August	32nd	25.80	15.6	NCS	13.75	16.29	8.1	NCS	5.72	52.07	42.54	NCS	84.28
	33rd	21.74	11.38	NCS	17.27	12.35	6.14	NCS	10.01	34.89	29.07	NCS	66.09
	34th	16.82	8.81	NCS	12.60	9.86	4.89	NCS	7.59	8.95	3.56	NCS	48.02
	35th	7.75	4.06	NCS	9.78	6.44	3.2	NCS	6.05	1.14	0.13	NCS	12.55
September	36th	4.72	2.47	NCS	4.51	3.75	1.89	NCS	3.96	0.15	0.00	NCS	0.71
	37th	5.11	2.67	NCS	2.75	3.42	1.69	NCS	2.31	0.13	0.00	NCS	0.10
	38th	6.06	3.16	NCS	2.97	3.75	1.89	NCS	2.09	1.75	0.13	NCS	0.50
	39th	6.61	3.46	NCS	3.53	4.11	2.05	NCS	2.31	8.56	7.85	NCS	0.83
	40th	6.42	NCS	NCS	3.83	3.75	NCS	NCS	2.53	22.03	NCS	NCS	15.55
October	41st	6.94	NCS	NCS	3.75	4.47	NCS	NCS	2.31	15.48	NCS	NCS	18.05
	42nd	2.28	NCS	NCS	1.33	1.61	NCS	NCS	0.99	1.75	NCS	NCS	1.13
	43rd	2.06	NCS	NCS	NCS	0.78	NCS	NCS	NCS	0.00	NCS	NCS	NCS
F =		4.8	3.9	3.2	4.2	5.3	4.2	3.1	4.3	10.3	5.8	4.1	6.3
df =		35, 35	27, 35	13, 35	13, 35	35, 35	27, 35	13, 35	13, 35	35, 35	27, 35	13, 35	13, 35
P =		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LSD =		0.98	0.68	0.48	1.48	0.78	0.58	0.47	1.20		1.78 2.58	1.47	2.20

Hvn = H. vigintioctopunctata, Hdg = H. dodecastigma, NCS = No crop season

Table 2: Pearson's correlation between the population of *Henosepilachna* spp. and abiotic factors

		Abiotic factors					
Stages	**Host plants**	**Av. Temp (ºC)**	**P value**	**Av. RH (%)**	**P value**	**Av. Rainfall (mm)**	**P value**
2015							
Hvn Adults	Brinjal	0.296ns	0.10	0.411*	0.01	0.046**	0.01
	Bitterguard	0.004*	0.03	0.512**	0.01	0.385*	0.04
	Tomato	0.536*	0.05	.-0.457ns	0.10	.-0.028ns	0.93
	Winter cherry	0.117ns	0.69	0.613*	0.02	0.539*	0.05
Hdg adults	Brinjal	0.281ns	0.10	0.401*	0.02	0.430**	0.01
	Bitterguard	0.439*	0.02	0.500**	0.01	0.406*	0.03
	Tomato	0.592*	0.03	.-0.381ns	0.18	0.180ns	0.54
	Winter cherry	0.149ns	0.69	0.575*	0.03	0.648*	0.01
Grubs	Brinjal	0.285ns	0.09	0.110ns	0.52	0.170ns	0.32
	Bitterguard	0.274ns	0.16	0.276ns	0.16	0.163ns	0.41
	Tomato	0.438ns	0.12	.-0.458ns	1.00	.-0.205ns	0.48
	Winter cherry	.-0.035ns	0.91	0.503ns	0.07	0.294ns	0.31

Av. = Average; Temp. = Temperature; RH = Relative humidity; mm = milimeter
** Significant at 0.01 level; * Significant at 0.05 level; ns- Not significant

Table 3: Seasonal incidence of adults and grubs of *H. vigintioctopunctata* and *H. dodecastigma* on various hosts (2016).

Months	**Std. weeks**	**Mean Number (±SD) of Hvn adults/Plant**				**Mean Number (±SD) of Hdg adults/Plant**				**Mean Number (±SD) of grubs/Plant**			
		Brinjal	**Bitterguard**	**Tomato**	**Winter cherry**	**Brinjal**	**Bitterguard**	**Tomato**	**Winter cherry**	**Brinjal**	**Bitterguard**	**Tomato**	**Winter cherry**
March	10th	3.21	NCS	1.87	NCS	0.00		0.00	NCS	8.75	NCS	0.00	NCS
	11th	3.40	1.78	1.98	NCS	0.45	0.23	0.28	NCS	3.67	0.33	1.56	NCS
	12th	0.62	0.33	0.36	NCS	1.34	0.67	0.83	NCS	0.50	0.00	0.56	NCS
	13th	0.95	0.49	0.55	NCS	0.00	0.00	0.00	NCS	0.00	0.00	0.08	NCS
April	14th	0.00	0.00	0.00	NCS	0.45	0.23	0.27	NCS	0.00	0.00	0.00	NCS
	15th	0.95	0.49	0.55	NCS	0.45	0.23	0.27	NCS	0.00	1.50	0.26	NCS
	16th	0.95	0.49	0.55	NCS	0.36	0.18	0.22	NCS	0.00	3.58	46.29	NCS
	17th	0.62	0.32	0.36	NCS	0.45	0.23	0.27	NCS	27.14	14.42	28.83	NCS
	18th	2.27	1.18	1.32	NCS	2.42	1.20	1.48	NCS	51.39	24.83	30.08	NCS
May	19th	9.92	5.19	5.78	NCS	4.92	2.44	3.03	NCS	6.14	2.50	31.41	NCS
	20th	4.06	2.13	2.37	NCS	2.33	1.15	1.43	NCS	2.64	0.58	12.18	NCS
	21st	3.40	1.78	1.98	NCS	1.97	0.98	1.21	NCS	0.14	0.08	0.08	NCS
	22nd	3.02	1.58	1.76	NCS	1.52	0.75	0.94	NCS	0.00	0.00	1.26	NCS
June	23rd	3.59	1.88	2.09	NCS	1.97	0.98	1.21	NCS	0.00	0.00	1.74	NCS
	24th	3.97	2.08	NCS	NCS	2.33	1.16	NCS	NCS	17.50	8.83	NCS	NCS
	25th	4.73	2.47	NCS	NCS	2.86	1.42	NCS	NCS	22.44	19.58	NCS	NCS
	26th	14.40	7.52	NCS	NCS	5.91	2.93	NCS	NCS	24.78	20.03	NCS	NCS
	27th	16.80	8.81	NCS	NCS	8.41	4.18	NCS	NCS	89.27	53.67	NCS	NCS
July	28th	21.40	11.18	NCS	NCS	12.40	6.14	NCS	NCS	85.42	54.17	NCS	NCS
	29th	26.30	13.76	NCS	NCS	15.60	7.74	NCS	NCS	51.58	39.03	NCS	NCS
	30th	23.10	12.07	NCS	NCS	14.90	7.38	NCS	NCS	44.93	22.28	NCS	NCS
	31st	8.13	4.25	NCS	4.73	10.90	5.42	NCS	6.71	15.06	5.75	NCS	10.09
August	32nd	10.20	5.34	NCS	5.94	5.73	2.84	NCS	3.52	0.17	0.08	NCS	1.25
	33rd	3.97	2.07	NCS	2.31	4.83	2.40	NCS	2.97	0.00	0.00	NCS	0.08
	34th	4.54	2.37	NCS	2.64	1.97	0.97	NCS	1.21	0.00	0.00	NCS	0.08
	35th	4.35	2.27	NCS	2.53	2.51	1.24	NCS	1.54	0.08	0.14	NCS	1.24
September	36th	7.37	3.86	NCS	4.29	4.83	2.40	NCS	2.97	13.43	6.97	NCS	18.03
	37th	10.80	5.64	NCS	6.27	3.76	1.86	NCS	2.31	22.97	11.94	NCS	14.03
	38th	10.00	5.24	NCS	5.83	5.19	2.58	NCS	3.19	5.74	8.75	NCS	12.76
	39th	11.20	NCS	NCS	6.49	4.83	NCS	NCS	2.97	0.50	NCS	NCS	0.58
	40th	2.46	NCS	NCS	1.43	3.22	NCS	NCS	1.98	0.00	NCS	NCS	0.00
October	41st	2.08	NCS	NCS	1.21	2.33	NCS	NCS	1.43	0.00	NCS	NCS	0.00
	42nd	1.89	NCS	NCS	1.10	1.61	NCS	NCS	0.99	0.00	NCS	NCS	0.00
	43rd	0.76	NCS	NCS	0.44	0.18	NCS	NCS	0.11	0.00	NCS	NCS	0.00
F =		5.82	6.82	4.82	3.82	6.22	5.92	3.72	4.52	12.32	7.92	6.70	5.52
df =		33, 35	27, 35	13, 35	12, 35	33, 35	27, 35	13, 35	12, 35	33, 35	27, 35	13, 35	12, 35
P =		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LSD =		0.78	0.98	0.76	0.56		0.88			0.78 0.66	0.46 1.52	2.17 1.26	1.46

Hvn = *H. vigintioctopunctata*, Hdg = *H. dodecastigma*, NCS = No crop season

Table 4: Pearson's correlation between the population of *Henosepilachna* spp. and abiotic factors

		Abiotic factors					
Stages	**Host plants**	**Av. Temp (ºC)**	**P value**	**Av. RH (%)**	**P value**	**Av. Rainfall (mm)**	**P value**
2016							
Hvn Adults	Brinjal	0.132ns	0.44	0.710**	0.00	.534**	0.00
	Bitterguard	.-0.088ns	0.66	0.722**	0.00	.527**	0.00
	Tomato	0.210ns	0.47	0.552*	0.04	0.094ns	0.75
	Winter cherry	0.689**	0.01	0.505ns	0.08	0.227ns	0.46
Hdg adults	Brinjal	0.133ns	0.44	0.718**	0.00	.0494**	0.46
	Bitterguard	.-0.109ns	0.58	0.725**	0.00	0.476*	0.01
	Tomato	0.482ns	0.08	0.444ns	0.11	0.119ns	0.69
	Winter cherry	0.496ns	0.09	0.517ns	0.07	0.299ns	0.32
Grubs	Brinjal	0.132ns	0.44	0.428*	0.01	0.511**	0.00
	Bitterguard	0.001ns	1.00	0.465*	0.01	0.516**	0.01
	Tomato	0.430ns	0.13	.-0.280ns	0.33	.-0.218ns	0.00
	Winter cherry	0.430ns	0.13	0.014ns	0.96	.-0.44ns	0.89

Av. = Average; Temp. = Temperature; RH = Relative humidity; mm = milimeter
** Significant at 0.01 level; * Significant at 0.05 level; ns- Not significant

4. Discussion

The results of present studies on population dynamics of *Henosepilachna spp.* suggested that the population of this pest is significantly influenced by environmental conditions as well as host plants [2]. Moreover, it is clearly indicated from the results of present studies that the infestation of *H. vigintioctopunctata* and *H. dodecastigma* varies with the host plants tested. For instance, on brinjal the peak population of adults was noted in 32nd std. wk of year, 2015 and 29th std. week of the year, 2016. Similarly, density of grub reached to the peak in 31st std. week of 2015 and 27th std. wk of 2016. Interestingly, these std. wks fall from June end to August. Through this period the abiotic factors like temperature may vary from 28.95º to 30.70ºC with relative humidity 74.64 to 85.42% and rainfall 7.40 to 209.2 mm. It was previously reported that the period of infestation of *H. vigintioctopunctata* varies with region, but the peak is generally recorded in July- August [15]. Similar results were obtained and confirmed by earlier workers [16] that the population of beetles was highest during August. Moreover, Haseeb *et al.* [17] noted the initial incidence of the *H. vigintioctopunctata* on third week of January, 2009 in Aligarh, Uttar Pradesh. Similarly, Khursheed & Desh [18] found the total peak population (grubs, pupae and adults) of 36.9 and 59.7 insects per plant was recorded during 3rd and 4th week of August in 2009 and 2010, respectively. Furthermore, Sharma & Tayde [5] recorded the population of *H. vigintioctopunctata* on 30th (last week of July) standard week and the population reached to its peak in the 35th (last week of August) standard week.

Results of the present studies also demonstrated that the peak density of adults of *H. vigintioctopunctata* and *H. dodecastigma* was attained in 31st and32nd std. wk, respectively and peak density of grub was attained in 30th std. wk of 2015. However, the peak density of adults and grubs was noted in 29th std. wk of year, 2016 on bitter gourd. Similarly, on tomato the peak density of adults of both species was noted in 23rd std. wk. However, peak density of grubs was observed in 20th std. wk of 2015. Further the observations on winter cherry showed a peak density of adults of *H. vigintioctopunctata* and *H. dodecastigma* in 33rd std. wk, 2015.

From the contemporary discussion it can be concluded that *Henosepilachna* spp. can adopt a vast range of temperature (27 to 35ºC), relative humidity (24 to 83%) and rainfall (0.80 to 70mm). But the adoption of these prevailing climatic conditions by *Henosepilachna* spp. depends on the crop types and season, which enable the beetle to thrives well. Raghuraman and Veeravel [19] reported that the *H. vigintioctopunctata* population in brinjal was greatest in February and March and further highest population of the beetles was observed by them in mid-September.

Results of present studies also showed that the population of *Henosepilachna* spp. displays a positive correlation with average temperature, average relative humidity and rainfall on almost all the host plant tested except on tomato where population of *Henosepilachna* spp. indicated a negative correlation with average relative humidity. Similar observations were made by Rajak [20], who reported that red pumpkin beetle showed a positive correlation with average temperature, average relative humidity and average rainfall. According to Saljoqi & Khan [21], minimum RH had a negative effect on the incidence of beetle while maximum RH showed a positive correlation with the incidence of beetle. Moreover, Tushar *et al*. [22] reported that the temperatures showed positive correlation but only minimum temperature exerted significant influence on the population growth of this beetle.

Comparison of adults and grubs of *H. vigintioctopunctata* and *H. dodecastigma* between the study years (2015 and 2016) on each tested host plant showed a non-significant difference in population densities. These observations suggested that the density of *Henosepilachna* spp. was maintained throughout the year but host dependent. Similar results were reported by Tripathi & Misra [9] and Sharma & Tayde [5].

5. Conclusion

From the present studies it can be concluded that the seasonal occurrence and food quality display an important function in the population dynamics of *Henosepilachna* spp. in a particular geography and climate. Host plants and abiotic factors like temperature, rainfall and humidity influenced the temporal abundance of this species. Thus, it is necessary to consider these factors in the study of population dynamics of *Henosepilachna* spp. to formulate a successful and better strategy for timely management of this pest on various crops in Aligarh agro-climatic conditions.

6. Acknowledgements

The authors acknowledge UGC, Government of India, New Delhi for providing financial assistance in the form of MANF Fellowship and Chairman, Department of Plant Protection, Aligarh Muslim University for providing facilities to conduct the present study.

7. References

1. Hirano K. Population dynamics of a phytophagous lady beetle, *Epilachna vigintioctopunctata* (Fabricius) (Coleoptera: Coccinellidae), living in spatio temporally heterogeneous habitats II. Seasonal changes in adult movement and spatial distribution of the population. Applied Entomology and Zoology. 1993; 28:131-140.
2. Hirano K. Study on the movements of the 28-spotted ladybeetle, *Henosepilachna vigintioctopunctata* by the mark-recapture method. Japanese Journal of Applied Entomology and Zoology. 1985; 29:7-13.
3. Ehrlich PR, White RR, Singer MC, Mckechnie SW, Gilbert LE. Checkerspot butterflies: a historical perspective. Science. 1975; 188:221-228.
4. Hanski I, Gilpin M. Meta population dynamics: brief history and conceptual domain. Biological Journal of Linnaeus Society. 1991; 42:3-16.
5. Sharma JH, Tayde AR. Population Dynamics of Brinjal Fruit and Shoot Borer, *Leucinodes orbonalis* Guen. and Hadda Beetle, *Epilachna vigintioctopunctata* Fab. on Brinjal at Allahabad Agroclimatic Region. International Journal of Current Microbiology and Applied Science. 2017; 6:2055-2060.
6. Nakamura K, Ohgushi T. Studies on the population dynamics of a thistle-feeding lady beetle, *Henosepilachna pustulosa* (Kono) in a cool temperate climax forest. II. Life tables, key-factor analysis, and detection of regulatory mechanisms. Research on Population Ecology. 1981; 23:210-231.
7. Ohgushi T, Sawada H. Population equilibrium with respect to available food resource and its behavioural basis in an herbivorous lady beetle, *Henosepilachna niponica*. Journal on Ecology. 1985; 54:781-796.
8. Ali MA, Saeady AA. Phenology and population dynamics of the melon lady bird beetle *Epilachna chrysonielina* (F) in Egypt (Coleoptera: Coccinellidae). Agricultural Research Review. 1986; 61:79-191.
9. Tripathi SR, Misra A. Population dynamics of Epilachna dodecastigtna Wied (Coleoptera: Coccinellidae). Bioved. 1991; 2:203-212.
10. Ghosh SK, Senapati SK. Biology and seasonal fluctuation of *Henosepilachna vigintioctopunctata* Fab. on brinjal under terai region of West Bengal. Indian Journal of Agricultural Research. 2001; 35:149-154.
11. Suman M, Swaminathan R. Bio-ecology and management *of Henosepilachna vigintioctopunctata* (Fabricius) (Coleoptera: Coccinellidae) infesting aswagandha *(Withania somnifera* L. Dunal). Journal of Medicinal and Aromatic Plant Sciences. 2007; 29:16-19.
12. Mishra BK, Mishra PR, Patnaik NC, Mohapatra H. Effect of neem oil on ovipositional behavior of epilachna beetle. Orissa Journal of Agricultural Research. 1989; 2:70-71.
13. Khan MH, Islam BN, Rahman AKMM, Rahman ML. Life table and the rate of food consumption of epilaclina beetle, *Epilachna dodecastigma* (Wied) on different host plant species in laboratory condition. Bangladesh Journal of Entomology. 2000; 10:1-2.
14. R Development Core Team *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing, Australia. ISBN, 2010, 3-17. 900051-07-0 [WWW document]. URL http:// www.R-project.org
15. Rajagopal D, Trivedi P. Status, bioecology and management of epilachna beetle, *Epilachna vigintioctopunctata* (Fab.) (Coleoptera: Coccinellidae) on potato in India: a review. Tropical Pest Management. 1989; 35:410-413.
16. Venkatesha MG. Seasonal occurrence of *Henosepilachna* vigintioctopunctata (F.) (Coleoptera: Coccinellidae) and its parasitoid on Ashwagandha in India. Journal of Asia Pacific Entomology. 2006; 9:265-268.
17. Haseeb M, Qamar M, Sharma DK. Seasonal incidence of brinjal hadda beetle *Henosepiluchnu vigintioctopunctata* (F.) (Coleoptera: Coccinellidae) in Aligarh. Uttar Pradesh. Trends in Biosciences. 2009; 2 (3):1-32.
18. Khursheed S, Raj D. Population Dynamics of Hadda Beetle, *Henosepilachna vigintioctopunctata* on Bitter gourd in Mid-hill Himalayas. Indian Journal of Plant Protection. 2014; 42:59-63.
19. Raghurainan M, Veeravel R. Seasonal incidence of *Pediohius foveolatus* Craw. (Hymenoptera: Eulophidae). A parasitoid of spotted leaf beetle *Henosepiluchna vigintioctopunclatu* F. in brinjal. Shashpa, 1999; 6:89-90.
20. Rajak DC. Studies on the population fluctuation of red pumpkin beetle on muskmelon (*Cucumis melo* L.). Agricultural Science Digest. 2000; 20:54-55.
21. Saljoqi AUR, Khan S. Relative abundance of the red pumpkin beetle, (*Aulacophora foveicollis* Lucas) on different cucurbitaceous muskmelon (*Cucumis melo* L.) crop. Sarhad Journal of Agriculture. 2007; 23:109-114.
22. Tushar MG, Uikey BL, Barma P, Jha S. Incidence studies on some important insect pests of cucumber (*Cucumic sativus* L.), The Ecosan. 2014; 8:177-180.