Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(4): 1220-1225

Received: 11-05-2018
Accepted: 13-06-2018

Prakash Chand
M. Sc Student, Department of Entomology, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

Anil Kumar
Jr. Scientist, Department of Entomology, Sugarcane Research Institute, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

Nagendra Kumar
Jr. Scientist, Department of Entomology, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

Correspondence
Prakash Chand
M. Sc Student, Department of Entomology, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

Potential of natural enemy, *Epiricania melanoleuca* and *Tetrastichus pyrillae* against leaf hopper under sugarcane agro ecosystem in Bihar

Prakash Chand, Anil Kumar and Nagendra Kumar

Abstract
Potential of two natural enemies i.e. the nymph and adult parasitoid, *Epiricania melanoleuca* and the egg parasitoid, *Tetrastichus pyrillae* were studies during 2015-2016 against sugarcane leaf hopper, *Pyrilla. Perpusill.* Study revealed that the population of cocoons of *Epiricania melanoleuca* ranged from 0.10 to 3.7 per ten leaves and reached its peak (3.7 cocoon/ten leaves)) in the 2nd fortnight of August 2015. The minimum temperature with relative humidity (07 hrs and 14 hrs) and rainfall showed highly significant positive correlation with population of cocoons and the maximum parasitization of these natural enemy was recorded 61.4% on pyrilla during second fortnight of August, 2015. Thereafter, parasitization was observed in declined trend. Whereas weather factors i.e. minimum temperature, relative humidity and rainfall were showed highly positive significance relation with parasitization of *Epiricania melanoleuca.* In case of parasitization of pyrilla (eggs) by *Tetrastichus pyrillae* started parasitization from 1st week of June 8.56% and it was found increasing trend up to 100% in month of October and November. The weather parameters is concerned, the maximum temperature, relative humidity 07 hrs. Showed significant positive correlation with parasitization of (eggs) pyrilla.

Keywords: Leafhopper, natural enemy, population, sugarcane

Introduction
Sugarcane leaf hopper, *Pyrilla perpusilla* (Walk) (Hemiptera: Lophopidae) is one of the most serious pest widely distributed on wheat, barley, oats, maize, sorghum and numbers of grasses near sugarcane fields during out break situations. It is the most destructive in subtropical India and appears periodically. The damage caused by *P. perpusilla* has been reported up to 28% in the potential cane yield and 2-34% in sucrose content of sugarcane. *P. perpusilla* feeding results in poor growth which also causes difficulty in milling of affected canes [5]. The nymphs and adults cause heavy damage to the plant and excrete thick transparent liquid known as honey dew which is good medium for the growth of black mould. The mould reduces the photosynthetic activity of the leaves and reduces about 25% of the sugar yield. In recent decades, elevated awareness of the impacts of pesticide on the environment and human health has resulted in efforts to reduce reliance on chemical control. Use of biological control agents is most suitable eco-friendly management strategy which minimize disturbance of the ecosystem. In this context, for the better adoption of eco-friendly management technique in sugarcane, the first step is to know the ecosystem, pest status and their natural enemies by monitoring and identification. Different weather factors are quite important in regulating the insect populations and its bioagents. Ecto-parasitoid *Epiricania melanoleuca* (Flatcher) (Lepidoptera: Epipyropidae) was recorded in India as the most important adult and nymphal parasitoid of *P. perpusilla*. *E. melanoleuca* has been extensively used for the bio control programme against *Pyrilla* in the recent past. *Pyrilla* can be effectively managed through the parasitoids, *E. melanoleuca* without the use of insecticides [7]. The egg parasitoid, *Tetrastichus pyrillae* (Hymenoptera: Eulophidae) first reported from Bihar parasitizing 20 to 50 per cent *Pyrilla* eggs [6]. So in the present study an attempt was made to evaluate the impact of *Epiricania melanoleuca* and *Tetrastichus pyrillae* against sugarcane leaf hopper.

Materials and Methods
The present investigation were carried out during 2015-16 to study on Potential of natural enemy, *Epiricania melanoleuca* and *Tetrastichus pyrillae* against leaf hopper under sugarcane agro ecosystem in Bihar at Sugarcane Research Institute, R.A.U., Pusa, Bihar, India. For this a

sugarcane variety BO-153 was planted with an area of 0.5 acre in the 3rd February, 2015 and followed recommended agronomical practices for sugarcane cultivation in Bihar. The absolute population were recorded during course of investigation. The population count of stages of parasitoids were counted very carefully from 10 leaves randomly selected plants at three different locations in the field. The different stages of parasitoids count were taken from each leaf at top, middle and lower portion of sugarcane plant, where no insecticidal spray was done. The data were recorded at fortnightly intervals starting from the March, 2015 to till February, 2016.The population of cocoons of *Epiricania melanoleuca* was recorded per 10 leaves and finally average number work out. The parasitizations were calculated on the basis of total number of nymphs & adults of pyrilla & parasitized nymphs and adults by *E. melanoleuca* and eggs of pyrilla parasitized by *T. pyrillae.* The data obtained was finally used to work out average no. of per cent parasitization of *E. melanoleuca* and *T. pyrillae*. The meteorological data i.e. temperature ^{0}C (max. and min.), relative humidity % (07 hrs and 14 hrs) and rainfall (mm) during crop season were recorded from Department of Meteorology, R.A.U., Pusa. Correlation coefficient and multiple linear regressions were also worked out to study the influence of weather parameter on pest population and its parasitization.

$$\text{Av. No. of cocoons} = \frac{\text{Total No. of cocoons on ten leaves}}{10}$$

The percent parasitization of *E. melanoleuca* was assessed by selection of 10 leaves at randomly throughout active season of *P. perpusilla* infestation. Parasitized nymphs and adults were differentiated by presence of white cottony cushion on back and on pleural abdomen region, respectively.

$$\text{Percent parasitized eggs} = \frac{\text{Total No.of parasitized eggs}}{\text{Total No. of eggs}} \times 100$$

Percentage of parasitization by *T. pyrillae* was assessed by selection of 10 leaves at randomly. Parasitized and un-parasitized eggs were differentiated on the basis of colour. Un-parasitized eggs were creamy white and parasitized eggs were dark brown to black in colour. Per cent parasitization was then calculated.

$$\text{Percent parasitized eggs} = \frac{\text{Total No.of parasitized eggs}}{\text{Total No. of eggs}} \times 100$$

Results and Discussion

Population of cocoons of *Epiricania melanoleuca,* on sugarcane

The data on the population of cocoons are presented in Table 1 and illustrated in figure 1. The data reveals that population of the *E. melanoleuca* which comprised of cocoons started to build up from the first fortnight of May, 2015. There were steady increase in the population of cocoons during next four months i.e. May (0.1 and 0.3) to August (2.9 and 3.7), thereafter gradually decreased trend was observed. The population of cocoons ranged from 0.10 to 3.7 per ten leaves during course of investigation. The data indicated that the peak was observed in the second fortnight of August (3.7), when the maximum and minimum temperature (^{0}C) were 33.1 ^{0}C and 24.3 ^{0}C, respectively with relative humidity (%) 07 hrs. and 14 hrs. were 92% and 75%, respectively. The rainfall (mm) was 400.4 mm during second fortnight of August, 2015, respectively. Cocoons of *E. melanoleuca* population increased during rainy season. It was also seen that cocoons of *E. melanoleuca* tolerated heavy rains and population was noticed in increasing trend. Ecto-parasitoid *Epiricania melanoleuca* cocoons was available in the field @ 1-5/leaf of pyrilla population level ranging from 20 to 150 nymphs and adults/leaf [2].

Correlation Coefficient

Simple correlation was worked out between weather factors and population of cocoons of *E. melanoleuca* presented in Table 2. It was observed that minimum temperature with relative humidity 07 hrs and 14 hrs, and rainfall showed high significant positive correlation with population (cocoons) of the parasitoid(r = 0.568, r = 0.547, r = 0.661 and r = 0.771), respectively. While, maximum temperature, showed positive but non-significant correlation. Multiple linear regressions were worked by taking *E. melanoleuca* population (cocoons) as dependant variable and climatic factors as independent variables (Table 2a), which revealed that coefficient of determination (R^2 = 0.822) was significantly high representing 82.21 per cent correlation over the population. This is clear that relative humidity (07 hrs and 14 hrs) and minimum temperature were the congenial weather elements for buildup of *E. melanoleuca* population. Thus, it may be inferred that prevalence of maximum temperature, during the period of observation is the congenial weather element for increase in population of *E. melanoleuca* The present finding on the population fluctuation of *E. melanoleuca* were in similar trend with the result of Rana [10] while they reported that the peak population of pyrilla and *E. melanoleuca* were recorded during August.

Natural parasitization of *Pyrilla perpusilla* by *Epiricania melanoleuca*

The extent of parasitization of *Pyrilla perpusilla* (nymphs and adults) by *Epiricania melanoleuca* Walker in sugarcane during 2015-16 and its correlation with weather parameters are presented in Table 1 and illustrated figure, 2. It is evident from the data the parasitization of nymphs and adults started from first fortnight of May till the first fortnight of November (1.39-0.2%). Parasitization ranged from 0.2 to 61.4 per cent during the course of investigation. Parasitization showed a steady increased and reaching the peak (61.4%) in second fortnight of August, 2015. Thereafter, parasitization was observed a gradual declining trend. However, there was statistically significant difference in the extent of parasitization during different months of study (March 2015 to Feb 2016) on sugarcane crop. So far as the effect of the weather parameters is concerned, the maximum (61.4%) parasitization was observed during second fortnight of August, 2015 when, corresponding weather parameters i.e., temperature (^{0}C) maximum, minimum, relative humidity (%) at 07 and 14 hrs and rainfall (mm) were 33.1 ^{0}C, 24.3 ^{0}C, 92%, 75% and 400.4 (mm), respectively. On the other hand minimum (0.2%) parasitization was recorded during first fortnight of November when the aforesaid weather parameters were 30.4^{0}C, 15.4^{0}C, 90%, 50% and untraceable, respectively. It was evident from the data that the parasitization started declining from first fortnight of September to first fortnight of November and became untraceable in the second fortnight of November, 2015.The present findings on parasitization of

sugarcane leaf hopper are in partial agreement with the results of Khan [4] who recorded mean parasitization of nymphs and adults in the ranges of (17.92 – 29.44% and 14.21 – 25.24%), respectively. Natural parasitization of pyrilla was found to be (0 – 66.67%) in nymphs and (2.40 – 63.42%) in adults during July to August 1988 as reported by Patnaik [8]. Joshi and Sharma [3] reported that peak parasitism of the pyrilla was observed in October (47.9%) declining to December, when very few parasitized hosts were observed.

Correlation Coefficient

The correlation analysis of weather factors with extent of paraitization has been summarized in Table 2. It was observed form the table that minimum temperature, relative humidity (14 hrs) and rainfall bring r = 0.562, r = 0.702 and r = 0.764, respectively showed highly significant positive relation with parasitization of *P. perpusilla* while, maximum temperature (r = 0.390) showed non-significant with positive correlation with parasitization. Thus, it is clearly indicates that relative humidity was congenial element for parasitization on *P. perpusilla*. Multiple linear regressions were also worked out by taking parasitization as dependent variable and climatic factors as independent variables (Table 2a). It reveals that coefficient of determination (R^2 = 0.7443) was significantly high and showed that viability in parasitization during different fortnight of the study was governed to the extent of 74.43 per cent due to combined effect of climatic factors. Patel [9] recorded a significant negative correlation between *E. melanoleuca* populations and maximum sunshine hours and temperature. A significant negative and positive correlation was observed between percentage of parasitism and average temperature and morning relative humidity, respectively.

Natural egg parasitization of prilla by *Tetrastichus pyrillae*

Data present in table 1 and illustrated in fig.3, it clearly revealed that the parasitization of eggs started from first fortnight of June to first fortnight of November, 2015 (8.56-100%). This might be due to low relative humidity during the crop period. Parasitization showed a steady increased and reaching peak of 100 per cent in October to first fortnight of November, 2015, However, there was statistically significant difference in the extent of parasitization during 2015-16 of study (March 2015 to Feb 2016) on sugarcane crop. So far as the effect of the weather parameter is concerned, the maximum (100%) parasitization during October to first fortnight of November was recorded when corresponding weather parameters i.e., temperature ^{0}C (maximum, minimum), relative humidity (%) at (07 hrs and 14 hrs) and rainfall (mm) were 30.4 ^{0}C, 15.4 ^{0}C, 90%, 48% with negligible rainfall, respectively. On the other hand minimum (8.56%) parasitization was recorded during first fortnight of June, 2015 when the weather parameters were 38.2 ^{0}C, 25.5 ^{0}C, 83%, 44% and 19.8 mm, respectively. The present findings on parasitization of sugarcane leaf hopper is in partial agreement with the results of Earlier, Bannerjee [1]who reported 60-90 per cent parasitization in northern states during 1973 pyrilla epidemics and Singh [11] observed that parasitization by *T. pyrillae* was between 16.0-54.0 per cent.

Correlation Coefficient

The correlation analysis between weather parameters and extent of paraitization has been depicted Table 2. It was observed form the table that minimum temperature, relative humidity 07 hrs, (r = 0.4883 and r = 0.5446) showed significant positive correlation with parasitization of pyrilla while, maximum temperature (r = 0.3994) relative humidity 14 hrs, (r = 0.4046) and rainfall (r = 0.3589) showed non-significant positive correlation with parasitization. Thus, it is clearly indicate that minimum and maximum relative humidity and minimum temperature were congenial element for parasitization on leafhopper. Multiple linear regression was also worked out by taking parasitization as dependent variable and climatic factors as independent variables (Table 2a). It reveals from the data that coefficient of determination (R^2) was showed 67.70 per cent with parasitization this shows that viability in parasitization during 2015-16 of the study could be governed to the extent of 67.70 per cent due to combined effect of climatic factors.

Table 1 Potential of natural enemy, *Epiricania melanoleuca* and *Tetrastichus pyrillae* against sugarcane leaf hopper

Month	Fortnight	Av. no of Cocoons and parasitization of *E. melanoleuca /10 leaves*		% parasitization *T. pyrillae*	Temperature (0C)		Humidity (%)		Rainfall (mm)
		Cocoons	% parasitization		Max.	Min.	07 hrs	14 hrs	
Mar, 2015	i	0	0	0	27.5	13.3	83	0	1.4
	ii	0	0	0	31.7	17.6	84	0	5.4
Apr, 2015	i	0	0	0	33.3	19.1	80	0	12.5
	ii	0	0	0	32.9	20.7	84	1.2	25.3
May, 2015	i	0.1	1.39	0	34.6	23.0	82	3.7	27.3
	ii	0.3	7.53	0	36.4	24.1	81	5.4	33.4
Jun, 2015	i	0.3	11.95	8.56	38.2	25.5	83	7.0	45.5
	ii	0.5	28.48	21.33	35.1	25.5	85	4.8	29.1
Jul, 2015	i	0.9	36.65	27.65	33.7	25.2	87	3.2	24.3
	ii	1.7	42.22	42.05	33.8	24.9	88	3.3	17.3
Aug, 2015	i	2.9	56.32	52.86	34.1	24.4	89	2.7	11.3
	ii	3.7	61.40	63.25	33.1	24.3	92	2.3	8.4
Sep, 2015	i	2.9	29.07	83.74	34.3	24.5	89	1.9	5.2
	ii	1.6	18.10	89.69	33.0	23.4	89	1.1	1.3
Oct, 2015	i	1.1	3.61	100	34.1	21.6	89	0.7	0.7
	ii	0.7	0.8	100	32.0	18.8	89	0.3	0.5
Nov, 2015	i	0.3	0.2	100	30.4	15.4	90	0.1	0.3
	ii	0	0	0	28.3	13.7	88	0	0.1
Dec, 2015	i	0	0	0	24.4	12.2	85	0	0
	ii	0	0	0	22.3	5.1	87	0	0
Jan, 2016	i	0	0	0	23.6	7.4	88	0	0
	ii	0	0	0	20.4	8.5	89	0	0
	i	0	0	0	24.7	10.0	89	0	0
	ii	0	0	0	28.4	14.1	86	0	0
Feb, 2016	i	0	0	0	27.5	13.3	83	0	1.4
	ii	0	0	0	31.7	17.6	84	0	5.4

Table 2: Correlation matrix: Effect of weather parameters on Natural enemies of sugarcane

No. of observation	Effect of weather parameters on Natural enrmies	Temperature (^{0}C)		Relative humidity (%)		Rainfall (mm)
		Maximum	Minimum	07 hrs.	14 hrs.	
24	Cocoons of *E. melanoleuca*	0.4167	0.5688**	0.5475**	0.6610**	0.7713**
24	Parasitization of *E. melanoleuca*	0.3909	0.5621**	0.4276*	0.7029**	0.7644**
24	Parasitization of *T. pyrillae*	0.3994	0.4882*	0.5446**	0.4046	0.3589

* Significant at 5% probability level.
** Significant at 1% probability level.

Table 2(a): Multiple linear regression models for weather parameters and population dynamics on Natural enemies of sugarcane

No. of observation	Effect of weather parameters on Natural enrmies	Pure constant	Temperature (^{0}C)		Humidity (%)		Rainfall (mm) (X_5)	R^2
			Maxi. (X_1)	Mini. (X_2)	07 hrs. (X_3)	14 hrs. (X_4)		
24	Cocoons of *E. melanoleuca*	-11.2522	-0.1540 (-1.0446)	0.1945 (1.6916)	0.1661 (3.3670)	-0.0283 (-0.9487)	0.0058 (3.1485)	0.8221**
24	Parasitization of *E. melanoleuca*	-73.8610	-2.2031 (-0.7216)	2.6642 (1.1188)	1.0801 (1.0569)	0.1052 (0.1704)	0.0958 (2.5234)	0.7443**
24	Parasitization of *T. pyrillae*	-705.9905	-6.3583 (-0.9522)	8.8740 (1.7039)	10.0653 (4.5036)	-2.0274 (-1.5018)	-0.0313 (-0.3769)	0.6770**

* Significant at 5% probability level.
** Significant at 1% probability level.
Figure in parenthesis indicate‘t’ value.

Multiple linear regression equation

Cocoon (Y_1 = -11.2522 – 0.1540 (X_1) + 0.1945 (X_2) + 0.1661 (X_3) - 0.0283 (X_4) + 0.0058 (X_5)
Cocoon (Y_2 = -73.8610 – 2.2031 (X_1) + 2.6642 (X_2) + 1.0801 (X_3) + 0.1052 (X_4) + 0.0958 (X_5)
Cocoon (Y_3) = - 705.990 –6.3583 (X_1) + 8.8740 (X_2) + 10.0653 (X_3) – 2.0274 (X_4) – 0.0313 (X_5)

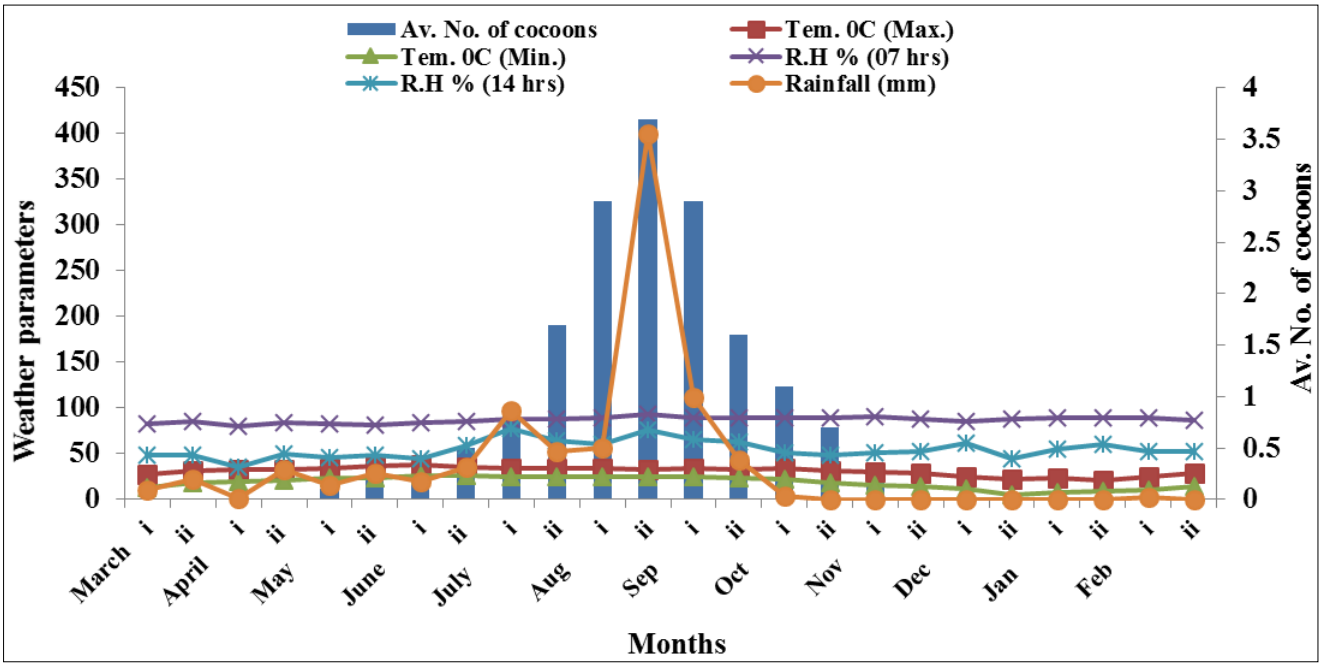

Fig 1: Population dynamics of cocoons of *E. melanoleuca* on sugarcane

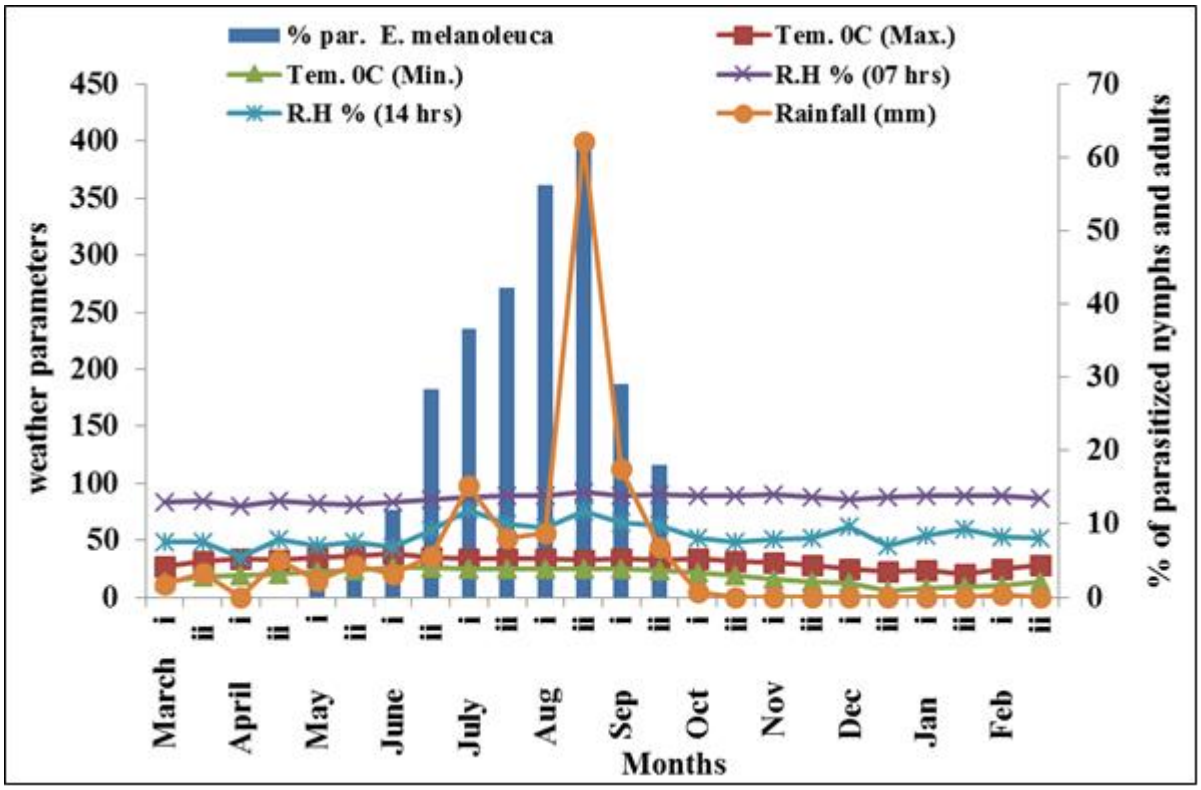

Fig 2: Extent of parasitization by *Epiricania melanoleuca* on pyrilla

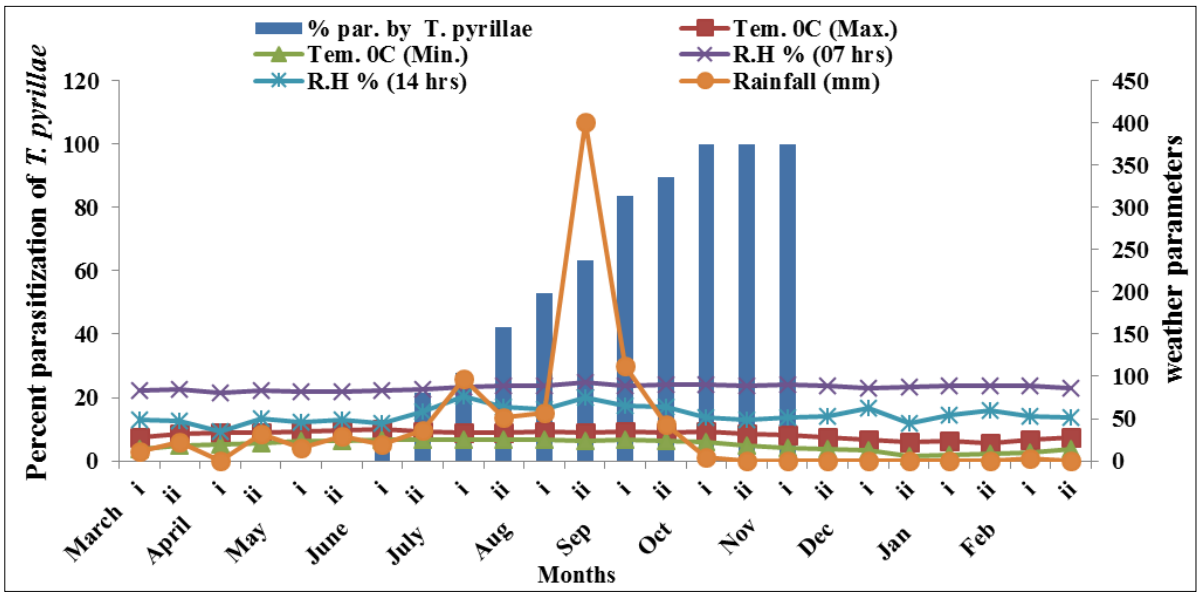

Fig 3: Extent of parasitization by *T. pyrillae* on eggs of pyrilla

Conclusion

The population of cocoons of *Epiricania melanoleuca* ranged from 0.10 to 3.7 per ten leaves and reached its peak (3.7 cocoon/ten leaves)) in the 2nd fortnight of August 2015.The minimum temperature with relative humidity (07 hrs and 14 hrs) and rainfall showed highly significant positive correlation with population of cocoons and the maximum parasitization of these natural enemy was recorded 61.4% on pyrilla during second fortnight of August, 2015. Thereafter, parasitization was observed in declined trend. Whereas weather factors i.e. minimum temperature, relative humidity and rainfall were showed highly positive significance relation with parasitization of *Epiricania melanoleuca*. In case of parasitization of pyrilla (eggs) by *Tetrastichus pyrillae* started parasitization from 1st week of June 8.56% and it was found increasing trend up to 100% in month of October and November. The weather parameters is concerned, the maximum temperature, relative humidity 07 hrs. Showed significant positive correlation with parasitization of (eggs) pyrilla.

Acknowledgement

The authors are thankful to Head, Department of Entomology, Sugarcane Research Institute, RAU, Pusa for providing field and laboratory facilities during course of investigation.

Reference

1. Banerjee SN. Integrated control of sugarcane pyrilla in India. Pesticides (Annual Number), 1973, 73-74.
2. Gangwar SK, Srivastava DC, Tewari RK, Singh MR,

Rajak DC. Management of *Pyrilla perpusilla* Walker in sugarcane with ecto-parasitoid *Epiricania melanoleuca* Fletcher during epidemics in sub-tropical India. Sugar Tech. 2008; 10(2):162-165.
3. Joshi RK, Sharma SK. Seasonal parasitization and carryover of *Epiricania melanoleuca* Fletcher, an ectoparasite of *Pyrilla perpusilla* Walker under arid conditions. Annals of Arid Zone. 1992; 31:33-35.
4. Khan MA. Population dynamic of *Epiricania melanoleuca* Fletcher-a potential natural enemy of *Pyrilla perpusilla* Walk. on different cultuvars of sugarcane. Indian Journal of Plant Protection. 1988; 16(1):19-92.
5. Kumarsinghe NC, Wratten SD. The Sugarcane lophopid plant hopper, *Pyrilla perpusilla* (Homptera: Lophopidae), a review of its biology, pest status and control. Bulletin of Entomological Research. 1996; 86:485-498.
6. Lakshamanan K, Mutiyil JA, Singh R. The effects of healthy and parasitoid eggs of *pyrilla* spp. in wire gauze cages on the population of pest and its natural enemies. Indian Journal of Entomology. 1942; 4:221-223.
7. Mishra MP, Pawar AD. Use of *E. melanoleuca* Fletcher for the control of sugarcane Pyrilla in India. Indian Journal of Agriculture Sciences. 1984; 54:742-750.
8. Patnaik NC, Mohanty JN, Mishra BK, Ghode MK. Control of sugarcane pyrilla by *Epiricania melanoleuca* Fletcher.(Epipyropidae; Lepidoptera)in Puri District Orissa. Journal Bio-control. 1990; 4(1):15-17.
9. Patel DR, Patel MB, Patel CB. Evaluation of granular insecticides against sugarcane leaf hopper, *Pyrilla perpusilla* Walker on sugarcane. Gujarat Agricultural University Research Journal. 1993; 19(1):52-55.
10. Rana AZ, Mahmood MM, Hashmi AA. Population dynamics of Pyrilla perpusilla Walker and its Parasite *Epiricania melanoleuca* Fletcher at Faisalabad. Pakistan Journal of Agricultural Research. 2002; 17(3):267-272.
11. Singh B, Bal RS, Duhra MS, Kumar S. Ovicidal action of extract of dill seed, *Anethum graveolens* L. against eggs of *Pyrilla perpusilla* Walker. Pest Management and Economic Zoology. 1994; 2(1):89-90.