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Incubation Period of *Endaphis Aphidimyza* (Zoophagous Cecidomyiids, (Cecidomyiidae : Diptera) In Chitrakoot, India

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Abstract

The weather parameters affect aphid population. Data revealed that there is positive correlation among these variables. It is evident that as the temperature decreases humidity increases which favors the arrival of aphids. At the same time, rainfall and wind velocity exhibit negligible effect on the population of aphid. The observations further revealed that the emergence of Endaphis aphidimyza was maximum during 3 to 4 p.m. The female midges started egg laying 30 to 40 minutes after mating, preferably on the lower surface of leaves and around the stem. At the time of egg laying, the color of egg was yellowish. The process of egg laying started at 4.15 p.m. and continued up-to 6.30 p.m. The mating give rise to eggs, eventually hatching takes place and produces the larvae. The larva enter in to the stomach of the aphid and completes three stages namely first, second, third and consequently tears off the stomach of the aphid and penetrate in to the soil. Then it makes a cover for its protection to survive in the unfavorable conditions in the soil. When conditions become favorable, it comes out of the cover and mate again to produce the eggs that hatch into larvae and attack the aphids, and thus the life cycle goes on. These revelations of the lifecycle of the midge are useful in protection of the crop plants from the aphid population and thus have better harvest. In absence of Zoophagous Cecidomyiids and absence of ppm, this indicates the climatic conditions when the midges would attack and reduce the host aphid population to have aphid free crop. In the light of this fact, Zoophagous cecidomyiids is eco-friendly and crop protections insect.

Keywords: Endaphis aphidimyza, temperature, humidity, rain fall, wind velocity, pvns – 12, zoophagous cecidomyiids.

Introduction

The experiment was conducted w.e.f. 2007 to 2010 at agriculture farm house of the university, India by Tripathi[1,2]. The influence of biotic and a-biotic factors on the egg lying of midges (*Zoophagous cecidomyiids*) was studied. The findings of development of PVNS: 12 and population dynamics of aphid in the agriculture field of of the University. These are similar to the work of Grover and Kashyap[3-6]. The longevity of eggs of *Endaphis aphidimyza* (*Zoophagous cecidomyiids*) ranges from 3 to 6 days. The duration of reproductive life of *Endaphis aphidimyza* ranges from 3 to 6 days. The average sex ratio was 47 to 52 between male and female which concurred with the results of[1]. The female lives longer than male. At lower temperature midges live longer than at high temperature. In higher temperature gall midges survive only for 2 to 3 days. The midges were most active on the second day of emergence. There were no significant differences between water and honey solution on the longevity of males, while female fed with honey solution lived significantly longer than those with Sugar + Water and Water + Nectar alone. The number of eggs laid during the adult lifespan is known as fecundity. It was significantly greater in females fed with the mixture of Honey + Water then in those with Water + Sugar and Water + Nectar alone[7-9]. Duration between egg laying and hatching is known as incubation period. During unfavorable climatic conditions, hatching can vary. Generally hatching depends upon the climatic conditions and was completed in 70 to 96 hours. But in the cold condition, hatching takes place in more than 6 days. With the help of magnification, leaves were observed through the transparent shell. At completion time of hatching, the shell bursts and the larva comes out and starts crawling on the plant in search of aphid and attached with leg joints of its aphid host. It ruptures the inter-segmental membrane of aphid and enters in to the body of aphids. After completing three stages in the stomach of the aphid, the midge tears off the stomach of the aphid and come out in the soil where it forms a cover to perenate through the unfavorable conditions. When the conditions turn favorable, it comes out of the cover and again mate to produce eggs that hatch into larvae which are ready to enter into the stomach of its host aphid. Weather factors like temperature, humidity, and rain fall affect the process of hatching.

Methodology

The weather factors namely Temperature, Humidity, Rainfall, and Wind velocity were recorded at regional meteorological laboratory Nagpur Maharashtra. The un-variate and multivariate analysis were conducted to evaluate the effect of each factor separately with step-up regression technique. The results of the different models are as given under:

The following statistical tools were applied for evaluating a-biotic factors

$$A.M. = \sum X / N \quad (1)$$

Correlation Coefficient , (r)

$$r = \sum xy / \sqrt{\sum x^2 \sum y^2} \quad (2)$$

$$\text{Where } \sum xy = \sum XY - (\sum x)(\sum y) / N \quad (3)$$

$$\sum x^2 = \sum X^2 - (\sum x)^2 / N \quad (4)$$

$$\sum y^2 = \sum Y^2 - (\sum y)^2 / N \quad (5)$$

Student t- test, t = Estimate / S.E (Estimate), (6)

Results and Discussion

The observations on incubation period recorded from 2007 to 2010 for 20 periods each. The difference between egg laying and hatching of eggs was three days. The statistical tools like, coefficient of dispersion, student t- test along with their averages were worked out. The incubation period of various eggs are given the following table.

During the year 2007 to 2008, the coefficient of dispersion was observed to be 15.71. During 2008 to 2009 its value came out to be 12.39 percent and lastly in the year 2009 and 2010 it was observed that dispersion value was 13.44 percent. For the entire period ranging from 2007 to 2010 the average dispersion coefficient was 13.15 percent. It is relevant to indicate that incubation period in the month of January was highest that is 92 hours. In the month of February its value came down to 75 hours. Similar results were observed during the year 2008 -2009 and 2009 – 2010. It is relevant to indicate that the effect of rainfall was highly significant (t = 4 .09) in case of incubation and the effect of temperature and wind velocity was observed. The effects of temperature and humidity were meager and their respective values were .1345 and .1178. The partial regression coefficient of rain came out to be 2.0337. However, the effect of wind velocity adversely effected the incubation period.

The results are in conformity with the works of other scientists[7-10]. Several workers have also studied the effects of environmental factors[11-15], although their works were on Environment and their legal issues in India, effect of Global Warming on mankind, Climate Change, Water Resources and Food Production, Environmental Impact Assessment (EIA) and Construction.

Table-1
Incubation period of *Endaphis aphidimyza* during 2007-2008

Egg laying		Hatching of egg		Incubation period in (hrs)
Date	**Time**	**Date**	**Time**	
7.01.2008	5.10 pm	11.01.2008	1.10 pm	92.00
8.01.2008	4.55 pm	12.01.2008	11.10 am	91.15
10.01.2007	5.25 pm	14.01.2008	5.35 pm	96.10
11.01.2008	6.10 pm	15.01.2008	7.15 am	85.05
12.01.2008	6.20 pm	16.01.2008	0.25 am	88.05
13.01.2008	5.15 pm	16.01.2008	8.10 pm	74.55
14.01.2008	5.05 pm	18.01.2008	7.10 am	86.05
15.01.2008	4.45 pm	18.01.2008	7.50 pm	75.05
16.01.2008	5.11 pm	20.01.2008	12.10 pm	90.00
17.01.2008	5.30 pm	20.01.2008	2.45 pm	74.15
18.01.2008	6.05 pm	21.01.2008	10.10 pm	76.05
19.01.2008	5.12 pm	22.01.2008	6.15 pm	73.05
20.01.2008	5.25 pm	23.01.2008	7.35 pm	74.15
21.01.2008	5.40 pm	24.01.2008	10.55 pm	78.15
16.02.2008	6.10 pm	19.02.2008	8.25 pm	74.15
17.02.2008	5.15 pm	20.02.2008	6.25 pm	73.15
17.02.2008	4.42 pm	20.02.2008	5.45 pm	73.03
18.02.2008	5.35 pm	21.02.2008	5.35 pm	72.00
8.03.2008	5.55 pm	11.03.2008	4.55 pm	71.00
9.03.2008	5.25 pm	12.03.2008	3.25 pm	70.00

Table-2
Incubation period of *Endaphis aphidimyza* in 2008-2009

Egg laying		Hatching of egg		Incubation period in (hrs)
Date	**Time**	**Date**	**Time**	
10.01.2009	4.30 pm	14.01.2009	11.40 am	91.10
12.01.2009	4.56 pm	16.01.2009	8.59 am	88.03
13.01.2009	5.12 pm	17.01.2009	9.12 am	88.00
14.01.2009	5.48 pm	18.01.2009	12.10 pm	91.38
15.01.2009	5.27 pm	18.01.2009	10.27 pm	77.00
16.01.2009	5.55 pm	20.01.2009	2.45 am	81.10
18.01.2009	5.15 pm	22.01.2009	10.15 am	89.00
19.01.2009	4.42 pm	22.01.2009	5.50 pm	73.08
20.01.2009	4.35 pm	23.01.2009	7.10 pm	75.25
21.01.2009	5.39 pm	25.01.2009	12.20 am	89.01
22.01.2009	5.05 pm	25.01.2009	7.25 pm	74.20
22.01.2009	4.59 pm	25.01.2009	2.49 pm	82.10
23.01.2009	5.21 pm	26.01.2009	9.25 pm	76.04
24.01.2009	5.49 pm	27.01.2009	7.55 pm	74.06
25.01.2009	6.8 pm	28.01.2009	11.10 pm	77.02
25.01.2009	5.55 pm	28.01.2009	8.00 pm	74.05
30.01.2009	4.48 pm	2.02.2009	7.50 pm	75.02
30.01.2009	5.15 pm	2.02.2009	10.20 pm	77.05
01.02.2009	4.32 pm	4.02.2009	5.32 pm	73.00
2.02.2009	6.10 pm	5.02.2009	5.10 pm	71.00

Table-3
Incubation period of *Endaphis aphidimyza* in 2009-2010

Egg laying		Hatching of egg		Incubation period in (hrs)
Date	**Time**	**Date**	**Time**	
14.01.2010	4.55 pm	18.01.2010	5.00 pm	97.05
13.01.2010	3.25 pm	17.01.2010	10. 25am	91.00
15.01.2010	5.32 pm	19.01.2010	10.40 am	89.08
16.01.2010	6.38 pm	20.01.2010	9.45 am	87.07
17.01.2010	5.37 pm	21.01.2010	12.40 pm	91.03
18.01.2010	5.15 pm	22.01.2010	2.30 pm	93.15
20.01.2010	5.14 pm	24.01.2010	11.20 pm	78.06
12.02.2010	4.32 pm	15.02.2010	11.35 pm	79.03
16.02.2010	4.18 pm	20.02.2010	3.23am	83.05
16.02.2010	5.19 pm	20.02.2010	1.25 am	80.06
17.02.2010	6.15 pm	21.02.2010	4.25 am	82.10
18.02.2010	4.49 pm	21.02.2010	8.56 pm	76.07
18.02.2010	5.23 pm	21.02.2010	10.33 pm	77.10
19.02.2010	5.42 pm	23.02.2010	8.59 am	87.17
22.02.2010	6.10 pm	26.02.2010	2.18 pm	98.08
22.02.2010	6.15 pm	26.02.2010	1.25 pm	91.10
23.02.2010	4.50 pm	27.02.2010	5.10 pm	90.20
23.02.2010	5.25 pm	25.02.2010	10.42 pm	77.17
24.02.2010	4.42 pm	27.02.2010	7.52 pm	75.10
24.02.2010	4.05 pm	27.02.2010	5.05 pm	74.05

Conclusion

From the above results, it may be safely concluded that there is direct effect of temperature on incubation of midges. More clearly as the temperature increases incubation period in hour's decreases. The effect of rainfall and humidity was meager (r = .015) and positive during this period. This indicates a balance in environmental conditions when the midges would produce more eggs and more larvae to attack and reduce the aphid population that would otherwise adversely affect the crop plants. Therefore the environmental conditions favoring the midges and reducing the aphid population are considered as safe the ecological factors for good harvesting of crops. In absence of Zoophagous Cecidomyiids and absence of ppm, this creates a balance for better productivity. In the light of this fact, Zoophagous Cecidomyiids is eco-friendly insect for crops.

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