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Ruchie Gupta
Department of Zoology, University of Jammu, Jammu (Tawi) - 180006, J & K, India.

J.S. Tara
Department of Zoology, University of Jammu, Jammu (Tawi) - 180006, J & K, India.

Correspondence:
Ruchie Gupta
Department of Zoology, University of Jammu, Jammu (Tawi) - 180006, J & K, India.

First Report On the Infestation Dynamics of *Euproctis Scintillans* Walker (Lepidoptera: Lymantridae) On Apple (*Malus Domestica* Borkh) and Its Relation with Important Weather Factors In Jammu, India

Ruchie Gupta and J.S. Tara

ABSTRACT
The present investigation was aimed to study the seasonal variation, percent infestation and effect of important weather factors viz. rainfall, relative humidity and temperature on the population dynamics of yellow tailed tussock moth *Euproctis scintillans* Walker (*Somena scintillans* Walker) in J&K State of India for the first time. Seasonal abundance of the pest was recorded on monthly basis in various apple orchards from March 2008 to February 2011, located in Jammu. Studies revealed that the pest remained active in the field for six months from June to November during all three studied years. Peak infestation was recorded during September. Correlation analysis indicated that maximum temperature, morning relative humidity, evening relative humidity and average relative humidity showed a highly significant positive correlation ($p \leq 0.01$) with the pest population. Pest population also had a significant positive correlation ($p \leq 0.05$) with average temperature and minimum temperature. However, average rainfall did not show any significant effect on the population of *E. scintillans.*

Keywords: *Euproctis scintillans*, *Somena scintillans* Walker or *Malus domestica*, infestation dynamics, weather factors, seasonal variation ymes.

1. Introduction

Euproctis scintillans Walker (1856) is a polyphagous pest that causes considerable damage to apple plantations (*Malus domestica* Borkh.) in Jammu Province of Jammu and Kashmir State. During regular surveys in the apple orchards, the leaves of apple plantations were found damaged heavily by the caterpillars of *Euproctis scintillans* Walker which are voracious feeders and in severe cases of infestation, the entire trees may be defoliated. Some authors [1, 2, 3, 4, and 5] have reported that the larvae of this pest are polyphagous and infest a wide variety of trees. In 1996, Barwal and Joshi recorded *Euproctis scintillans* for the first time as a major pest of Capsicum in the Katrain region of Himachal Pradesh, India [6].

Euproctis moths are well known destructive insects to agro horticultural crops and about 52 species of *Euproctis* have been reported from India and Pakistan and some of these have been recorded as serious pests of various fruit plants, vegetable crops, forest trees and ornamental plants by various authors [7, 8, 9, 10, 11, 12]. In view of lack of documentation on the bionomics and population studies on *E. scintillans* Walker on apple trees, detailed biology of the pest was recorded in the year 2013[13] for the first time in Jammu and Kashmir, India.

The objective of this study was to obtain information on seasonal variation and population dynamics of *E. scintillans* walker on apple plantations maintained under laboratory conditions. Information on the peak infestation of the pest on apple plantations could thus be helpful for timely management strategies as it is an important pest of apples in Jammu province of J&K State. In the near future this pest may assume more serious and destructive position if adequate control measures are not undertaken immediately. This warrants attention of the orchardists of the region for its timely and proper control. Keeping in view, the importance of the pest, the information on seasonal incidence of leaf miner in Jammu is not available and the studies were undertaken.

2. Materials and Methods

2.1 Population dynamics of *Euproctis scintillans* Walker

Data regarding seasonal abundance and population of the pest was collected monthly from different apple growing areas of the three selected stations viz. Bhaderwah (32.53º N and 76.47ºE, Batote (33.25° N and 75.25°E) and Kishtwar (33.32° N and 75.77°E) of Jammu province having different apple cultivars in a randomized block design for three consecutive years i.e. March 2008-Feb 2011. For the purpose of sampling the field in each location was divided into five blocks covering all the four directions in the field and one from the centre. From each block, two trees were randomly selected. Thus the population record was made on a total of 10 randomly selected trees of uniform spread from all the directions on monthly basis. Four branches each from upper, middle and lower strata of each apple tree were selected at random for recording the prevalence of larval population. Thus a total of 12 branches were selected from each tree. Number of larvae was counted. Selected trees were kept free of insecticidal treatments.

Mean percent infestation of *Euproctis scintillans* Walker was recorded by

$$\text{Mean percent infestation} = \frac{\text{No. of larvae per plant}}{\text{Total no. of plants examined}} \times 100$$

Meterological data with regard to weather conditions (minimum temperature, maximum temperature, average temperature, morning relative humidity, evening relative humidity, average relative humidity and average rainfall) was obtained from Indian Meterological Department, Rambagh, Srinagar, India.

2.2 Statistical analysis

For analyzing the relationship between population of the pest with weather conditions (minimum temperature, maximum temperature, average temperature, morning relative humidity, evening relative humidity, average relative humidity and average rainfall), the data was subjected to Pearson correlation, Multiple correlation and regression (both linear and multiple) analysis. Infestation among different stations was worked out by applying ANOVA and mean difference between stations were compared by student's t-test. Differences among the means were considered significant at a probability level of 5 percent ($p<0.05$). Square root transformations were applied to reduce heterogeneity of variances before applying correlation and regression on pest population but untransformed means are presented in tables. Statistical analysis was conducted by using STASTICA R7 version.

Table 1: Regression equation and coefficient of determination (r^2) of population data of *Euproctis scintillans* Walker on apple plantations (*Malus domestica*) at Jammu province (J&K), India during March 2008-February 2011

Regression equation

Period	Minimum temperature (X1)	Maximum temperature (X2)	Average temperature (X3)	Morning Rel. Humidity (X4)	Evening Rel. Humidity (X5)	Average Rel. Humidity (X6)	Average rainfall (X7)	Multivariate factors (X3, X6 and X7)
Mar 08-Feb 09	$-2.51+0.81X_1$ (0.69)	$-12.09+0.74X_2$ (0.56)	$-8.11+0.81X_3$ (0.65)	$-30.2+0.46X_4$ (0.32)	$-9.48+0.25X_5$ (0.16)	$-20.24+0.38X_6$ (0.25)	$6.34-0.01X_7$ (0.02)	$-31.58+0.56X_3$** $+0.49X_6$*$-0.06X_7$* (0.85)
Mar 09-Feb 10	$-0.54+0.55X_1$ (0.59)	$-7.14+0.49X_2$ (0.59)	$-4.10+0.525X_3$ (0.59)	$-12.1+0.21X_4$ (0.08)	$1.46+0.04X_5$ (0.003)	$-6.4+0.16X_6$ (0.03)	$4.58-0.008X_7$ (0.008)	$-14.32+0.51X_3$** $+0.18X_6-0.02X_7$ (0.85)
Mar 10-Feb 11	$-3.72+0.82X_1$ (0.39)	$-7.9+0.65X_2$ (0.18)	$-7.25+0.80X_3$ (0.36)	$-18.55+0.37X_4$ (0.43)	$-18.29+0.41X_5$ (0.58)	$-19.01+0.39X_6$ (0.52)	$-0.35+0.05X_7$ (0.15)	$-25.65+0.67X_3$* $+0.396X_6$*$-0.03X_7$ (0.72)
Pooled (Mar 08-Feb 11)	$-0.46+0.39X_1$ (0.42)	$-8.35+0.53X_2$ (0.72)	$-2.64+0.36X_3$ (0.34)	$-45.95+0.65X_4$ (0.84)	$-24.41+0.48X_5$ (0.44)	$-47.43+0.76X_6$ (0.65)	$2.72+0.002X_7$ (0.00)	$-48.02+0.13X_3$ $+0.79X_6$**$-0.04X_7$* (0.80)

*Significant at 0.05 level; **Highly Significant at 0.01 (2 tailed) level; Figures in parentheses are r^2 values.

3. Results

3.1 Infestation dynamics

Results revealed infestation of *E. scintillans* on apple trees for a period six months. The results have been expressed in Table 1. During 2008, infestation of caterpillars was recorded for the first time in the month of June (10.0 larvae/ plant) when the average temperature, morning relative humidity and evening relative humidity were 23.35̊ C, 79.0% and 63% respectively. The mean population of the caterpillars then showed an enormous increase during July (13.40 larvae/ plant), August (13.60 larvae/ plant) and September (13.10 larvae/ plant) months in the year 2008 followed by a gradual decline afterwards leading to final disappearance from December to May during studied years.

Mean population of *E. scintillans* from June, 08 to November, 08 was recorded to be 10.0, 13.40, 13.60, 13.10, 6.0 and 3.20 larvae/plant respectively. Highest population build up of the caterpillars was recorded in August, 2008 (13.60 larvae/ plant). During this period the population varied from a minimum of 1 larva/tree to a maximum of 45 larvae per tree.

In the year 2009, the maximum mean population during July, August and September was recorded as 10.80, 9.00 and 11.40 larvae/plant respectively. However the peak mean population in 2009 was observed in September (11.40 larvae/ plant) which ranged from a minimum of 0.0-28.0 larvae/tree, whereas the maximum mean population of the caterpillars in 2010 was recorded in September (20.90 larvae/tree) that ranged from a minimum of 11.0 to 31.0 larvae per tree. The maximum mean population of the pest was observed in September, 2010 (20.90 larvae/tree) followed by year 2008 (13.10 larvae/tree) and then 2009 (11.40 larvae/ plant). During all the three years the pest population was observed to disappear by the end of November and again reappeared in June in the study area.

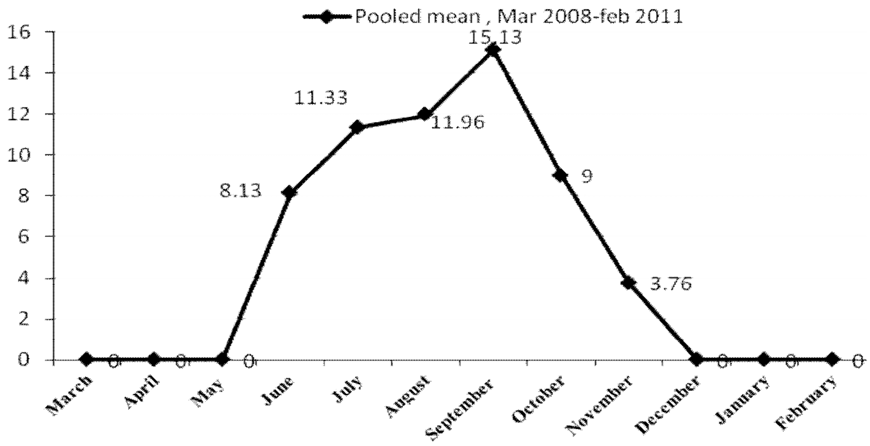

Fig 1: Mean (Pooled) Percent infestation of *Euproctis scintillans* Walker on *Malus domestica* Borkh. In Jammu, India during March 2008-Feb. 2011.

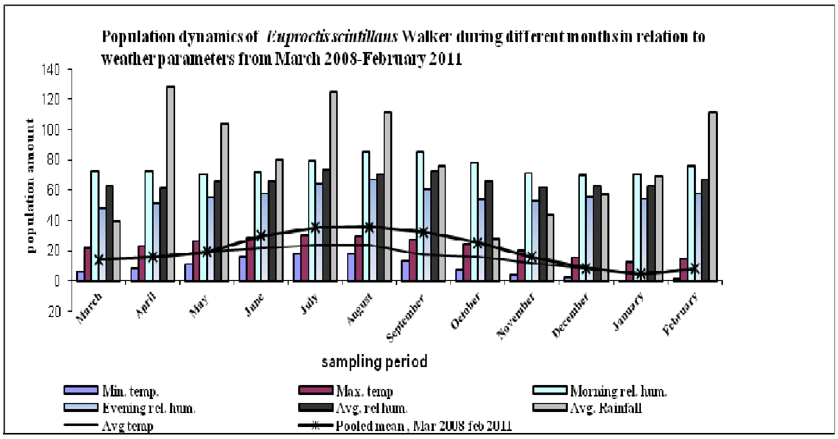

Fig 2: Population dynamics of *Euproctis scintillans* Walker during different months in relation to weather parameters from March 2008-February 2011.

3.2 Impact of weather factors

Results on Correlation analysis for the pest population with weather parameters have been depicted in Figure 1. Pest population showed an insignificant negative correlation with rainfall during the year 2008 ($r=-0.19$, $p=0.54$) and 2009 ($r=-0.09$, $p= 0.77$). However the population showed a highly significant positive correlation with maximum temperature ($r=0.75$, $p\leq0.01$), minimum temperature ($r=0.83$, $p\leq0.01$) and average temperature ($r=0.81$, $p\leq0.01$). The pest population possessed an insignificant correlation with morning relative humidity ($r=0.57$, $p=0.052$), evening relative humidity ($r=0.41$, $p=0.190$) and average relative humidity ($r=0.51$, $p= 0.09$). During the year 2009, highly significant positive correlation with maximum temperature ($r=0.77$, $p\leq0.01$), minimum temperature ($r=0.76$, $p\leq0.01$) and average temperature ($r=0.77$, $p\leq0.01$) was observed. During the year 2010, however, maximum temperature exhibited an insignificant correlation ($r=0.50$, $p= 0.09$) with the pest population. Minimum temperature ($r=0.62$, $p\leq0.05$)) and average temperatures($r=0.60$, $p\leq0.03$) showed a positive significant correlation with the pest population in the year 2010, while average relative humidity and rainfall had no significant correlation with the pest population.

Multiple regression models show that average temperature indicates a positive association with the population during all studied years, whereas average relative humidity during the years 2008 and 2010 was significantly correlated to the pest population. However the relative humidity during 2009 did not show significant relationship with the pest population.

Moreover average rainfall during 2008 and 2009 exhibited a negative association with the population, whereas in 2010 average rainfall had an insignificant effect on the population.

Coefficient of determination (r^2) value for various weather factors was 0.85 during 2008, 0.85 in 2009 and 0.72 during 2010 respectively, thereby showing a fairly good account of variability by various factors.

When the cumulative effect of average temperature, average relative humidity and average rainfall for the three studied years was taken into consideration, it was observed that average relative humidity had a significant positive association ($p \leq 0.01$) with the population whereas average rainfall showed a significant negative correlation ($p \leq 0.05$) with the pest population.

Coefficient of determination (r^2) value of 0.80 revealed that as much as 80% variation in the population of larvae of *Euproctis* is determined by these weather factors.

4. Conclusion

Seasonal population of *E. scintillans* studied from March, 2008-Feb, 2011 revealed that the pest remain active in the orchards from June to November. Larval counts of *E. scintillans* at three different stations viz. Bhaderwah, Batote and Kishtwar revealed that pest population disappeared during winter and show peak from August to October. Pest population also varied in different locations due to different weather factors.

Studies undertaken on seasonal population of yellow tailed tussock moth and statistical analysis of its relationships with different ecological factors indicated significant relations with temperature (minimum, maximum, average) and relative humidity (morning, afternoon and average). In all the three consecutive years, minimum temperature, maximum temperature and average temperature revealed a highly significant positive correlation with the infestation of the pest whereas relative humidity showed variation in its correlation with the population.

Partial correlation coefficients worked in terms of regression equation for prediction of the population indicated that average temperature had significant and positive association with the pest population, whereas average rainfall had no association to an extent of significance.

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