INTERNATIONAL JOURNAL OF ADVANCED BIOLOGICAL RESEARCH

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SEASONAL INCIDENCE OF *AEOLESTHES HOLOSERICEA* FABRICIUS (COLEOPTERA: CERAMBYCIDAE) ON APPLE PLANTATIONS (*MALUS DOMESTICA* BORKH.) AND IT'S RELATION WITH IMPORTANT WEATHER FACTORS IN JAMMU PROVINCE, INDIA

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ABSTRACT
The objective of this work is to study the Seasonal variation of percentage infestation, and effect of important weather factors *viz*. rainfall, relative humidity and temperature on the population of Apple stem borer, *Aeolesthes holosericea* Fabricius in J&K State in India. Seasonal abundance of the pest was investigated monthly from March, 2008 to February, 2011 at three different stations belonging to three districts of Jammu province, India. Population of *Aeolesthes holosericea* was estimated on the basis of live holes recorded in the fields at different areas of Bhaderwah (District: Doda) by Frass indexing method. Studies revealed that the pest population disappeared during winter months and show peak from August to October months. it is being observed that minimum temperature, maximum temperature, average temperature, morning relative humidity, evening relative humidity and average relative humidity has highly significant positive correlation with the population of apple stem borer, whereas average rainfall has a an insignificant effect on the pest population

KEY WORDS: *Aeolesthes holosericea*, infestation, seasonal abundance, weather factors.

INTRODUCTION

Cerambycidae is one of the richest families in beetles, which includes 35,000 catalogued species distributed throughout the world (Bhawane and Mamalayya; 2013). The number of cerambycid species reported from India is 1,500 (Beeson 1941; Breuning 1960-62, 1963a, 1963b, 1964, 1965, 1966). *Aeolesthes* is one of the large genera of the Cerambycidae with 31 species from different parts of the world. There are 6 *Aeolesthes* species in the Indian subcontinent, *viz. Aeolesthes holosericea* Fab., *Aeolesthes basicornis* Gahan, *Aeolesthes sinensis* Gahan, *Aeolesthes induta* Newman, *Aeolesthes indicola* Bates and *Aeolesthes* sarta Solsky. *Aeolesthes holosericea* and *A. sarta* are the most injurious species in the Indian forests. Detailed information is available on the biological requirements of the *A. holosericea* along with its host range and distribution within Indian subcontinent (Gahan 1906; Stebbing 1914; Khan & Khan 1942; Gupta and Tara (2013); Tara *et al*. (2008). *Aeolesthes holosericea* (Fabr.) is recorded as a polyphagous pest infesting wide variety of forest plants and trees (Gupta and Tara, 2013; 2014). Stebbing (1914) reported it from eight host plant species and Beeson (1941) reported thirty seven species as its host plants. Rahman and Khan (1942) described bionomics of this pest on cherry plant. Ambethgar (2003) studied the infestation and development of *Aeolesthes holosericea* on neem (*Azadirachta indica*). *Aeolesthes holosericea* as a destructive pest of apple trees in Jammu and Kashmir. The grubs of *A. holosericea* are known to damage healthy green trees, sickly standing trees and even freshly felled trees (Stebbing 1914; Gupta and Tara; 2013). Gupta and Tara (2013; 2014) recorded by Khan & Khan (1942) studied the bionomics of *A. holosericea* and reported that it requires 2yr and 7½ months to 3 yr to complete a single generation. Gupta and Tara (2013) recorded a total life span of approximately two years (25.16±1.83 months) on apple plantations as host in Jammu and Kashmir. Prakash *et al*. (2010) studied its population dynamics in Arjun (*Terminalia arjuna* (Roxb.) ecosystem of Andhra Pradesh. In view of the above facts and scarcity of related information on this borer infesting apple crop with special reference, the present investigations were undertaken with the following objectives: to quantify the abundance and the seasonal dynamics of apple stem borer in relation to various weather factors on apple plantations and to make an effort to develop an integrated management programme for apple stem borer in J & K State, India.

MATERIALS & METHODS

Infestation dynamics of *Aeolesthes holosericea* Fabr.

Data on seasonal abundance and population of the pest were collected monthly for three consecutive years *i.e.* March 2008-Feb 2011 in different apple orchards located in Bhaderwah area (District Doda) of Jammu and Kashmir. For sampling, the field in each location was divided into five blocks covering all the four directions and one at the centre. From each block, five trees were randomly selected. Thus the population record was made on a total of 25 randomly selected trees of uniform spread from all the directions in a

single field. Selected trees were kept free of insecticidal treatments during the study period. Population dynamics of the beetle was studied by Frass indexing method by calculating live holes in the fields. To study the incidence and distribution of *Aeolesthes holosericea* in Jammu province, monthly survey was conducted by fixed plot method and the borer infestation and rate of incidence of borers was calculated by:

$$\text{Percent infestation} = \frac{Total\ number\ of\ trees\ infested}{Total\ number\ of\ trees\ observed}\ x100$$

Statistical analysis

Data of three years (March 2008-Feb 2011) were pooled together to get the mean population dynamics of the pest and its relation with meteorological data (*viz.* minimum temperature, maximum temperature, average temperature, morning relative humidity, evening relative humidity, average relative humidity and average rainfall) was calculated by applying mean, standard deviation, standard error, Pearson correlation, Multiple correlation and regression (both linear and multiple) analysis. 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. Multiple correlation studies were conducted to understand the influence of important weather factors on the population of apple stem borer, *Aeolesthes holosericea* Fabricius. Statistical analysis was conducted by using STASTICA R7 version.

RESULTS

Seasonal incidence

Borer infestation was recorded from April to November during all three years of the study *i.e.* 2008-2011 in apple growing areas of Jammu and Kashmir. The pest population disappeared during winter months and show peak from August to October months (Fig. 1). Highest mean infestation for all three years (pooled) was 39.44% during September when average temperature, average relative humidity and average rainfall were 17.1ºC, 72.83% and 76.26 mm respectively followed by 33.32% in August, 32.77% in October, then 31.10% in July followed by 25.55% and 17.77% in June and May. Prakash *et al.* (2010) studied its population dynamics in arjun (*Terminalia arjuna* (Roxb.) Wight & Arn.; Myrtales: Combretaceae) ecosystem of Andhra Pradesh and observed that this species shows peak abundance in the month of December which is however contrary to present study as no live holes were recorded during winter months i.e. from December to February in Jammu and Kashmir when larvae undergo winter rest to avoid harsh winters. Least infestation however was recorded during April (5.53%) and November (8.88%) respectively.

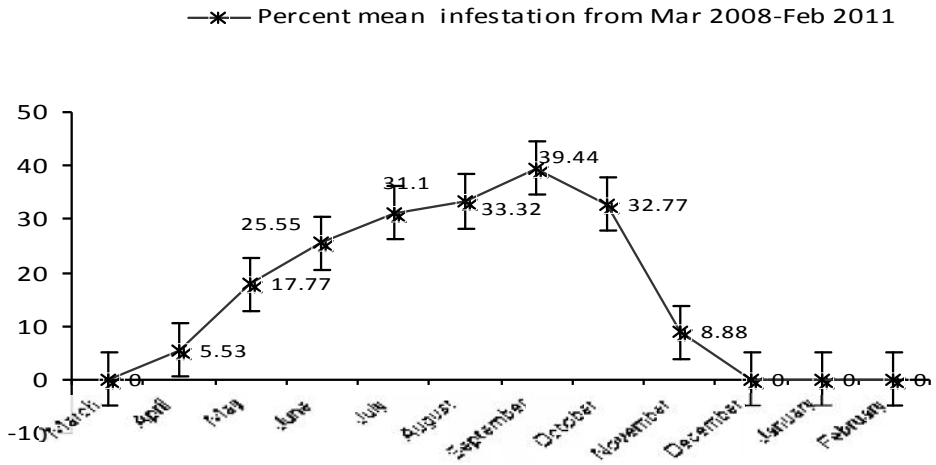

FIGURE1: Percent infestation (mean+SE) of *Aeolesthes holosericea* Fabricius on apple plantations for three years *viz.* March 2008-Feb 2011

Effect of weather factors

Correlation coefficients between population of *Aeolesthes holosericea* and weather parameters during three consecutive years revealed that population had a positive correlation with minimum, maximum and average temperatures during the years 2008-2011. During 2008, population showed a significant correlation with minimum temperature ($r=0.62$, $p=0.029$; $p\leq0.05$), maximum temperature ($r=0.69$, $p=0.012$; $p\leq0.05$) and average temperatures ($r=0.678$, $p=0.016$, $p\leq0.05$). On the contrary, morning relative humidity ($r=0.43$, $p=0.15$), evening relative humidity ($r=0.15$, $p=0.63$) and average relative humidity ($r=0.29$, $p=0.35$) showed a positive but insignificant association with the borer population. In 2008, average rainfall exerts an insignificant negative correlation with the pest population. A highly significant positive correlation at 0.01 level was observed with minimum temperature ($r=0.81$, $p=0.001$; $p\leq0.01$), maximum temperature ($r=0.88$, $p=0.0001$; $p\leq0.01$) and average temperatures ($r=0.85$, $p=0.0004$, $p\leq0.01$) during 2009. On the contrary, evening relative humidity ($r=-0.30$, $p=0.33$), average relative humidity ($r=-$

0.08, p=0.79) and average rainfall (r=-0.17, p=0.58) showed a negative insignificant association with the pest population. Moreover, a highly significant positive correlation of the population at 0.01 level was observed with all weather factors *viz.* minimum temperature (r=0.83, p=0.00075), maximum temperature (r=0.69, p=0.01) and average temperatures (r=0.77, p=0.002), morning relative humidity (r=0.77, p=0.002), evening relative humidity (r=0.80, p=0.001) and average relative humidity (r=0.83, p=0.0007) except average rainfall in 2010.

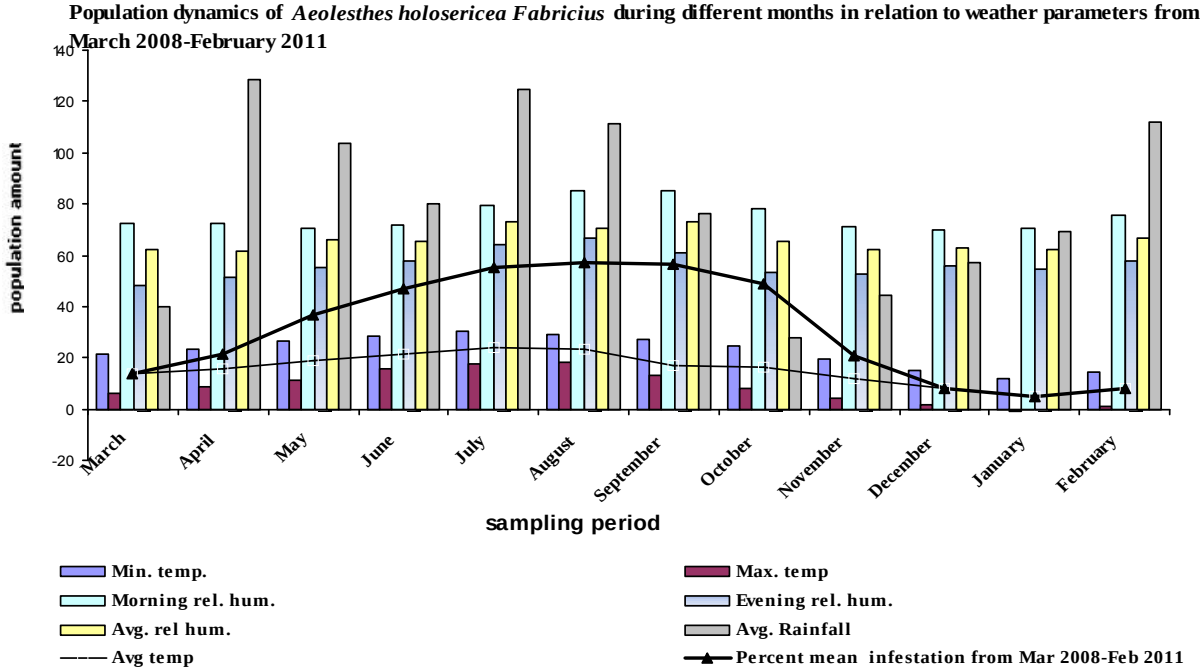

FIGURE 2: Population dynamics of *Aeolesthes holosericea* Fabricius on *Malus domestica* Borkh. with reference to important weather parameters for three consecutive years March, 2008- Feb., 2011.

TABLE 1: Regression analysis of the population of *Aeolesthes holosericea* with weather parameters at study station during March, 2008-February, 2011

Period	Minimum temp. (X_1)	Maximum temp. (X_2)	Average temp. (X_3)	Morning rel. humidity (X_4)	Evening rel. humidity (X_5)	Average rel humidity (X_6)	Average rainfall (X_7)	Multivariate factors (X_3, X_6, X_7)
2008-09	-0.36 + $1.86X_1$ (0.39)* r=0.62	-31.18 + $2.09X_2$ (0.47)* r=0.69	-16.37+ $2.06X_3$ (0.45)* r=0.67	-65.23 +$1.08X_4$ (0.19) r=0.43	-0.0002 +$0.29X_5$ (0.02) r=0.15	-27.86+ $0.67X_6$ (0.08) r=0.29	26.03- $0.12X_7$ (0.09) r=-0.30	-68.84+$01.36X_3$ +$1.24X_6$-$0.12X_7$ (0.63) r=0.79
2009-10	0.58+ $2.20X_1$ (0.66)** r=0.81	-28.96+ $2.10X_2$ (0.77)** r=0.88	-14.85+ $2.17X_3$ (0.72)** r=0.85	-13.42+ $0.43X_4$ (0.02) r=0.15	66.46- $0.880X_5$ (0.09) r=-0.30	35.34- $0.26X_6$ (0.006) r=-0.08	23.06- $0.06X_7$ (0.03) r=-0.17	$9.61+2.23X_3$- $0.32X_6$-$0.05X_7$ (0.78)** r=0.88
2010-11	-3.21+ $2.00X_1$ (0.69)** r=0.83	-25.73+ $1.79X_2$ (0.48)** r=0.69	-16.30+ $1.97X_3$ (0.60)** r=0.77	-94.18+ $1.41X_4$ (0.60)** r=0.77	-60.51+ $1.26X_5$ (0.64)** r=0.80	-86.86+ $1.49X_6$ (0.69)** r=0.83	9.37- $0.04X_7$ (0.04) r=0.21	-68.92+ $0.90X_3$+ $0.99X_6$+$0.01X_7$ (0.76)** r=0.87
Pooled mean 2008-2011	-0.95+ 00 $1.95X_1$ (0.67)** r=0.82	-31.81+ $2.11X_2$ (0.70)** r=0.83	-13.67+ $1.94X_3$ (0.61)** r=0.78	-145.1+ $2.14X_4$ (0.58)** r=0.76	-90.26+ $1.88X_5$ (0.42)* r=0.65	-180.55+ $2.98X_6$ (0.63)** r=0.79	11.77+0. $05X_7$ (0.01) r=0.12	-139.84+$1.35X_3$** +$2.24X_6$**$0.15X_7$* (0.94)** r=0.97

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

Three year pooled data reveals that minimum temperature (r=0.82, p≤0.01), maximum temperature (r=0.83, p≤0.01), average temperature (r=0.78, p≤0.01), morning relative humidity (r=0.76, p≤0.01), evening relative humidity

(r=0.65, p≤0.05) and average relative humidity (r=0.79, p≤0.01) has highly significant positive correlation with the population of apple stem borer, whereas average rainfall (r=0.12, p=0.94) has a negative insignificant effect on the pest population. When the cumulative effect of all weather factors are taken into consideration, it is observed that average temperature and average relative humidity showed a highly significant positive correlation with the population and average rainfall exhibits a negative significant effect on the population of *Aeolesthes holosericea* Fabricius. Linear regression with various weather parameters shows that the pest population has a positive significant association with minimum temperature, maximum temperature and average temperature during all the three consecutive years of study. When all the weather parameters were regressed together against the borer population, results revealed that temperature (minimum, maximum and average) showed a positive association with the pest population. Coefficient of determination (r2) as high as 0.78, 0.76 and 0.63 during 2008-09, 2009-10 and 2010-11 revealed that weather conditions had greater impact on the buildup of population of apple stem borer *Aeolesthes holosericea* in the area of investigator.

SUMMARY

Seasonal population of *Aeolesthes holosericea* and statistical analysis of its relationships with different ecological factors indicates significant relations. The cumulative effect of all weather parameters showed that average temperature and average relative humidity showed a highly significant positive correlation with the population of apple stem borer where increase in these parameters increases the infestation of apple stem borer and average rainfall exhibits a negative insignificant effect on the population of *Aeolesthes holosericea* Fabricius because it is an internal feeder. Coefficient of determination (r^2) revealed that weather conditions have a greater impact on the build up of population of apple stem borer. No other weather parameter has relationships to an extent of significance.

ACKNOWLEDGEMENTS:

The authors are highly thankful to Prof. J.S.Tara for all the help and support.

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