Studies on the Nature and Extent of Damage to Mulberry Plants by *Apriona germari* Hope (Coleoptera: Cerambycidae)

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ABSTRACT

Damage caused by mulberry longicorn beetle, *Apriona germari* Hope (Coleoptera: Cerambycidae), to different mulberry varieties was assessed in terms of leaf yield per plant, leaf wood ratio, leaf moisture content and bioassay of leaves. Leaf yield per plant among infested and uninfested plants of different mulberry genotypes varied insignificantly ($P>0.05$); however, leaf wood ratio and leaf moisture content varied significantly ($P<0.05$) among infested and uninfested plants. Bioassay test showed significant differences in silkworm yield parameters like single cocoon weight, single shell weight and filament length values ($P<0.05$) whereas shell ratio of silkworms fed on leaf of infested and uninfested plants varied insignificantly ($P>0.05$).

Key words: Leaf yield, leaf wood ratio, leaf moisture content, bioassay

INTRODUCTION

Most insects continuously derive their nutrients from plants which sustain injuries to satisfy the requirements of pests and is reflected in terms of yield (economic) loss. The extent of damage caused by insect pests to their host plants depends on a number of factors such as (i) the stage or part of plant damaged (ii) the susceptibility of the plant to the insect attack, and (iii) nature of the injury inflicted by the insect.

Mulberry plants, *Morus* spp. (Urticales: Moraceae), is the sole food plant for the silkworm *Bombyx mori* (Lepidoptera: Bombycidae), is subject to the attack of a large number of insect pests which degrade its economic product, the leaf, both qualitatively and quantitatively (Khan *et al.*, 2004; Tara, 1983). Cerambycid borers form an important group of wood boring insects attacking weak, stressed as well as healthy plants (Linsley, 1959; Hanks, 1999). The damage caused by the cerambycid beetle, *Apriona germari*, to the host plants is irreparable and the attacked plants are destined to death (Hussain, 2008).

The nature and extent of damage caused by the lonhorned beetle in question to the host plants has not been studied systematically; therefore, the present investigation with an objective to quantify the damage caused by the beetle to different genotypes of mulberry in Jammu and Kashmir was carried out.

MATERIAL AND METHODS

Mulberry genotypes viz. Goshoerami, Chinese White, Chakmajra, Tr-10 and V-1 were selected for the current study. Damage caused by mulberry longicorn beetle to the host plants was assessed in terms of Leaf yield per plant (weight in Kg/plant), Leaf moisture content (%), Leaf wood ratio method, and Bioassay test.

Leaf yield per plant:

Leaf of infested and un-infested trees was harvested and weighed separately. Ten replications were maintained for each mulberry genotype. Mean leaf yield of the infested and un-infested trees were compared and the reduction in leaf yield in infested trees was ascribed to the borer infestation.

Leaf moisture content:

Leaf moisture content was calculated by:

$$\%\text{ leaf moisture} = \frac{\text{Fresh Weight - Dry Weight}}{\text{Fresh Weight}} \times 100$$

Leaf wood ratio method:

The procedure of Kasiviswanathan *et al.* (1977) was adopted to study the parameter. Three primary branches of mulberry trees (infested and un-infested) were pruned at random. Leaves were plucked and weighed. Wood of the branches was weighed separately and leaf wood ratio calculated. Five replications were carried out for 5 mulberry genotypes separately.

Bioassay test:

Bioassay was carried out using a popular silkworm hybrid SH6×NB4D2. Silkworm rearing was carried out on leaf of infested and un-infested trees separately and the parameters studied included Cocoon weight, Shell weight, Shell ratio, Single cocoon filament length.

Statistical tests, Chi square (χ^2) and Student's t-test were utilized to analyze the data and the values were considered significant at $P \leq 0.05$.

RESULTS

Mulberry longicorn beetle is a major pest of mulberry plants in Jammu and Kashmir state (India). The damage caused to the host plants was studied under two subheadings viz., (i) damage caused by adults and (ii) damage caused by grubs.

Damage caused by adults

Mulberry longicorn beetle adults debarked the primary branches of mulberry plants (Fig. 1). On an average a single beetle debarked 2.34 branches daily. The distal part of debarked branches withered and died, resulted in the stunted growth of the host plants. However, the lateral buds of the debarked branches below the scar sprouted and compensated the damage to certain extent.

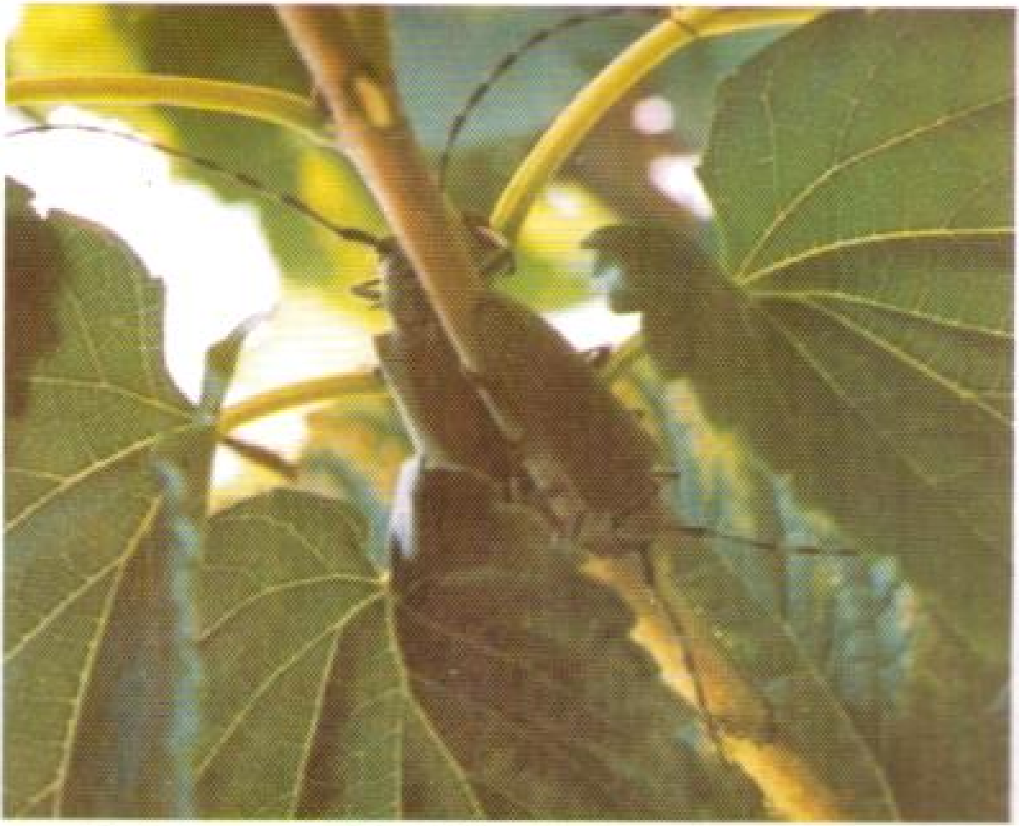

Fig. 1. *A. germari* adults feeding/debarking tender mulberry twigs.

Damage caused by grubs

Grubs caused severe damage to mulberry plants which was quantified by studying the following parameters:

Leaf yield studies

Leaf yield (Kg/plant) loss recorded due to infestation of *A. germari* varied from 6.41% to 12.78% among different genotypes of mulberry and is statistically significant in each variety ($P<0.05$; df=8) (Table 1). Difference in leaf yield reduction among different mulberry varieties is insignificant (χ^2= 2.17; df=4; $P>0.05$).

Table 1. Leaf yield of mulberry varieties (infested and non-infested)

Genotype	Leaf yield (Kg/plant; mean ±SE)		Leaf yield	t-ratio
	Non-infested	Infested	reduction (%)	
Goshoerami	7.753±0.13	7.256±0.13	6.41	2.70
Chinese White	7.504±0.20	6.669±0.19	11.13	3.04
Chak majra	7.241±0.19	6.524±0.16	9.90	2.96
Tr10	7.289±0.19	6.531±0.17	10.40	3.02
V-1	7.409±0.26	6.462±0.15	12.78	3.13

Leaf wood ratio

Leaf wood ratio revealed that the grubs caused considerable damage to the mulberry plants. Among the studied genotypes, Chinese white variety suffered the maximum loss in terms of leaf yield (10.11%), while as Chakmajra suffered least (7.48%); however, damage caused is statistically significant in each genotype ($P<0.05$; df=8) (Table 2).

Table 2. Leaf wood ratio of mulberry genotypes, (infested and non-infested)

Genotype	Leaf wood ratio (mean±SE)		Leaf yield	t-ratio
	Non-infested	Infested	loss (%)	
Goshoerami	0.887±0.010	0.816±0.015	8.03	3.87
Chinese white	0.880±0.017	0.791±0.013	10.11	4.19
Chak majra	0.868±0.008	0.803±0.018	7.48	3.20
Tr10	0.832±0.018	0.761±0.014	8.53	3.08
V-1	0.845±0.015	0.764±0.014	9.58	3.92

Leaf moisture content

The reduction in leaf moisture content of different mulberry genotypes due to the infestation of *A. germari* ranged between 2.92-6.17% (Table 3). This reduction is statistically significant ($P<0.05$; df=8) in every genotype. The maximum moisture content loss was recorded in Chinese white variety (6.17%) followed by Goshoerami (5.39%), Chakmajra (3.25%) and V-1 (3.01%) while as least loss was recorded in Tr-10 (2.92%). However, the difference in moisture content reduction among different varieties of mulberry is statistically insignificant ($P>0.05$; $\chi^2 = 2.219$; df=4).

Table 3. Moisture content of mulberry leaf (infested and non-infested)

Genotype	Moisture content (%±mean SE)		Moisture reduction (%)	t-ratio
	Non-infested	Infested		
Goshoerami	74.94±0.25	70.90±0.58	5.39	6.39
Chinese white	75.16±0.25	70.52±0.36	6.17	10.46
Chak majra	73.48±0.22	71.09±0.34	3.25	4.86
Tr10	72.94±0.43	70.81±0.33	2.92	4.65
V-1	74.36±0.31	72.12±0.33	3.01	4.76

Bioassay

Bioassay studies of infested and non-infested mulberry trees revealed that *A. germari* caused significant damage to the host plants ($P<0.05$). Silk worms reared on the leaf of infested trees showed a significant difference ($P<0.05$) in bioassay parameters viz, single cocoon weight, single shell weight and filament length from that of those fed on leaf of un-infested trees, however, shell ratio differed insignificantly ($P>0.05$) (Table 4). Single cocoon weight and shell weight of silk worms reared on leaf of infested trees is 8.39% and 14.42 % less than that of silkworms reared on leaf of un-infested trees respectively; loss in filament length attributed to the infestation of *A. germari* is 17.04%. The reduction in shell ratio (6.19%) caused due to the infestation of *A. germari* is statistically insignificant ($P>0.05$).

Table 4. Bioassay studies of mulberry plants (infested and non-infested)

Parameter	Infested	Non-infested	% loss	t-ratio
Cocoon weight (g)	1.561±0.031	1.704±0.030	8.39	3.31
Shell weight (g)	0.273±0.007	0.319±0.011	14.42	3.58
Shell ratio (%)	17.55±0.56	18.71±0.51	6.19	1.55
Filament length (m)	722.5±20	871±37	17.04	3.57

DISCUSSION

The nature and extent of damage caused by grubs and adults of *A. germari* to host plants is entirely different from each other. Grubs, being wood borers excavated tunnels in the wood and lead the infested plants to death; however, adult beetles damage the hosts by debarking tender twigs.

Damage by adults

Longhorned beetles relatively cause negligible damage to the host plants (Beeson, 1941; Beeson and Bhatia, 1939; Husain and Khan, 1940; Craighead, 1950; Linsley, 1959, 1961; Hussain, 1972; Hay, 1969; Hanks *et al.*, 1990). The current observation revealed that adults of *A. germari* feed on the tender bark and the attacked plants compensated the damage to certain extent by sprouting of secondary buds. Husain and Khan (1940) observed the same feeding behaviour in another longicorn beetle, *Batocera rufomaculata* De Geer on fig trees; Tara (1983) and Sharma and Tara (1984) also support the present finding in that the damage caused by adults of another longicorn beetle (*Batocera rufomaculata* De Geer) is negligible. Ertian (2003) reported that adults of *A. germari* debark a considerable number of primary branches of host trees, but it did not interfered in the growth of trees.

Damage caused by grubs

The larvae of mulberry longicorn beetle caused irreparable damage to the mulberry plants and repeated and heavy infestation lead the plants to death. The continuous flow of cell sap through the bores made by grubs deprived the plants from minerals/nutrients and water; altered host plant physiology and finally affected growth and yield of plants. The current observation revealed that the screened mulberry varieties are vulnerable to the attack of *A. germari* and the damage caused in respect to quality and quantity of leaf is significant in all genotypes, however, Chakmajra variety is slightly resistant to the attack of mulberry longicorn beetle and experienced least loss.

Leaf wood ratio study revealed that Chinese white variety suffered the maximum damage (10.11%) followed by V-1 (9.58%) and Tr-10 (8.53%); least damage is caused in Chakmajra variety (7.48%) while Goshoerami variety suffered a bit higher damage (8.03%) than Chakmajra. Sharma and Tara (1984) support the study in that Chakmajra variety is resistant to the attack of another longicorn beetle, *Batocera rufomaculata* De Geer.

In terms of leaf yield (Kg/plant), V-1, Chinese white and Tr-10 varieties suffered 12.78%, 11.13% and 10.40% loss respectively. Leaf yield in Goshoerami variety is least affected (6.41% damage) while in Chakmajra variety 9.90% loss in leaf yield is attributed to the borer infestation.

Leaf moisture has favourable effects on the palatability and assimilability of nutrients and serves as criteria in estimating the leaf quality (Parpiev, 1968). Continuous oozing of cell sap through the bores reduced the leaf moisture content and altered the leaf quality. Reduction in leaf moisture content is significant in all studied genotypes.

Bioassay studies reflected the leaf quality through economic characters such as single cocoon weight, shell weight, shell ratio and filament length. The loss recorded is due the inferior quality of leaf which in turn is ascribed to the borer infestation.

The damage caused by pests to host plants is a common/natural phenomenon. Borers not only consume host plant tissues, but also deprive it from nutrients, alter its physiology and finally affect the yield both quantitatively and qualitatively. The intensity of damage caused by an insect species varies among host plant species (Solomon 1974, 1995; Yang *et al.*, 1995). The damage caused by Cerambycid borers to host plants is well documented (Linsley, 1959, 1961; Sharma and Tara, 1984; Goodwin and Pettit, 1994; Goodwin, 2005). The foregoing discussion supports the present observations in that Cerambycid borers cause economic damage to the host plants.

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