Preliminary Phytochemical Investigation on the Bark of Some of the Important Host Plants of Kerria lacca-The Indian Lac Insect

A.K. Pushker, S. Kaushik, S. Lakhanpaul, K.K. Sharma and R. Ramani

Abstract: For the phytophagous insect such as Kerria lacca-the Indian lac insect, the bark tissue of host plant is the first major structural barrier. Differential insect settlement has been observed on various host plant taxa. A number of phytochemicals are found to be present within the bark of host. Keeping this in view a preliminary phytochemical investigation was made on the bark of the eleven different host plants of Kerria lacca for the presence of major phytochemicals namely alkaloids, tannins, saponins, steroids, terpenoids and flavonoids. An attempt to elucidate the probable role of the various phytochemicals present in the bark with respect to the host selection or acceptance by the Lac insect has been made here. Preliminary investigations depicted the non-dependence of insect settlement event on the phytochemical constituents of bark.

Key words: Kerria lacca • Phytochemicals • Host selection • Phytophagous

INTRODUCTION

Kerria lacca, a scale insect of the order Hemiptera, superfamily Coccoidea is primarily a parasite on its host plant. It feeds upon the phloem sap of the host plant. In early stage of its life cycle viz. at crawler stage the insect is motile and selects the host plant as well as the host site to feed upon. Upon successful penetration of host tissue, the lac insect switches over to sedentary and gregarious habit for rest of its life cycle [1, 2]. The insect starts secreting lac, the only known resin of animal origin. It acts as a protective coating for the fragile insect body. Lac has an immense economic importance as a large number of commercially important compounds are obtained from it [3].

Selection of the appropriate host plant by the insect in very early stage of its life cycle is one of the most intriguing aspects of Lac insect-host interaction. The Lac insect penetrates the bark of the plant with its proboscis in order to reach up to the phloem tissues. Various classes of phytochemicals are known to be present within the bark of the plant [4].

The present study was conducted with the objective of finding the importance of bark phytochemicals in the initial settlement of lac insect viz. crawlers. Scanty literature on the phytochemicals present in the bark in relation to insect-host interactions strengthened the aim of carrying out this study. Eleven plant species were chosen and preliminary photochemical analysis was done on bark tissues.

MATERIALS AND METHODS

Collection and Identification of Plant Material: Eleven plant taxa were identified on the basis of their differential preference as hosts of the Indian lac insect [1]. Proper observations were made and the plant materials were documented thereof. Out of the eleven species chosen, three namely Butea monosperma, Schleichera oleosa and Zizyphus mauritiana are known to be good host [5] and are commercially exploited for Lac cultivation in Indian sub-continent [6-8]. Flemingia macrophylla is a proposed model host plant species for Lac cultivation in India. Prosopis juliflora, Ficus elastica and Cajanus cajan are less preferred host for Lac insect [6-8]. In contrast, Azadirachta indica, Citrus medica, Eucalyptus globulus and Ricinus communis are not considered as host for the Lac insect as infestation and completion of life cycle is rarely seen on these four plant species.

Sampling of Plant Material: Bark of the stem was taken from disease free plant material during the month of January for Jethwi crop. Only those plant material having settlement of approximately 120 crawlers per square inch
of the surface were chosen for analysis. Bark material was air dried under shade and thereafter finely powdered and stored at 4°C till further use.

**Extraction of plant Material [9]**

**Aqueous Extract:** 50 g plant material was taken and dissolved in 250 ml of distilled water. The homogenate obtained was kept at 50°C for 12 hours. The extract thus obtained was filtered using Whatman filter Paper No 42 (125mm). Finally the filtrate was centrifuged at 2500 rpm for 15 minutes and the supernatant thus obtained was collected in sterile bottle and stored at 4°C till further use.

**Methanolic Extract:** 50 g plant material was taken and was refluxed with 250 ml of methanol in Soxhlet’s apparatus for 6 hours. The extract obtained was evaporated on a rotary evaporator. The residue obtained was dissolved in minimum amount of methanol. Extract thus obtained was collected and stored in sterile bottle at 4°C till further use.

**Phytochemical Screening:** Screening of various phytochemicals was carried out according to the following methods [10-12]:

**Test for Alkaloids:** 2 ml methanolic filtrate was taken and 1 ml HCl (1%) was added to it. Few drops of Mayers Reagent were added to it. Appearance of Creamish Brown precipitate indicated the presence of Alkaloids in the sample.

**Test for Tannins:** To the 2 ml aqueous extract was added few drops of 0.1% FeCl₃. Appearance of blue black precipitate confirmed the presence of tannins.

**Test for Saponins:** 10 ml aqueous filtrate was mixed with 5 ml water and shaken vigorously for formation of persistent froth. Persistency of froth indicated the presence of Saponins.

**Test for Steroids (Liebermann Burchard Reaction):** 2 ml methanolic extract was taken and to it was added 2 ml acetic anhydride and then 2 ml of conc. H₂SO₄. Formation of Blue or Green ring indicated the presence of Steroids in the extract.

**Test for Terpenoids (Salkowski Reaction):** To 5 ml aqueous extract was added 2 ml chloroform and further 3 ml of conc. H₂SO₄ was added along the sidewalls to form a layer. Formation of reddish brown inter-phase indicated the presence of terpenoids.

**Test for Flavonoids:** To 5 ml aqueous extract was added 5 ml dilute ammonia followed by the addition of conc. H₂SO₄. Formation of Yellow coloration indicated that the flavonoids are present in the sample. The yellow color thus formed disappears after sometime on standing.

### RESULTS AND DISCUSSION

Out of six secondary metabolites tested, three metabolites namely tannins, saponins and flavonoids were found to be almost uniformly present in the eleven taxa tested. Amongst these tannins [13] and saponins [14] are known to play negative role with reference to plant insect interaction as they are important in defense against insect and pathogens. In due course of evolution,

<table>
<thead>
<tr>
<th>Plant Material</th>
<th>Plant Family</th>
<th>Alkaloids</th>
<th>Tannins</th>
<th>Saponins</th>
<th>Steroids</th>
<th>Terpenoids</th>
<th>Flavonoids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butea monosperma (Lam.) Taub.</td>
<td>Fabaceae</td>
<td>++</td>
<td>+</td>
<td>+++</td>
<td>-</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Schleichera oleosa (Lour.) Oken.</td>
<td>Sapindaceae</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Zizyphus mauritiana Lamk</td>
<td>Rhamnaceae</td>
<td>++</td>
<td>+++</td>
<td>++</td>
<td>+</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Flemingia macrophylla (Wild.) Kuntze.</td>
<td>Fabaceae</td>
<td>++</td>
<td>++</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Azadirachta indica Linn.</td>
<td>Meliaceae</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Prospis juliflora (Sw.) DC.</td>
<td>Fabaceae</td>
<td>+++</td>
<td>++</td>
<td>++</td>
<td>-</td>
<td>-</td>
<td>+++</td>
</tr>
<tr>
<td>Ficus elastica Roxb.</td>
<td>Moraceae</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Cajanus cajan Linn.</td>
<td>Fabaceae</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+++</td>
<td>-</td>
</tr>
<tr>
<td>Citrus medica Linn.</td>
<td>Rutaceae</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Eucalyptus globulus Labill.</td>
<td>Myrtaceae</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Ricinus communis Linn.</td>
<td>Euphorbiaceae</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

‘+’ / ‘-’ indicates the presence/absence of a particular phytochemical respectively.
insects however have developed detoxification systems and may even be able to use such toxic constituents. Flavonoids are known to act as an insect attractant as well as phagostimulant [15,16]. Although terpenoids have been reported as insect deterrents [17], they were found to be present almost uniformly within the host taxa studied. Therefore, its presence did not interfere in the initial crawler settlement. Alkaloids were found to be randomly present though they act as attractants [18, 19] as well as deterrents [19] for different insects. In fact, they showed variable presence within the four fabaceae members analyzed, indicating towards their non-significance in the initial settlement of insect. Like wise saponins reported to be deterrents [20] were also not uniformly present in the plant species studied.

Preliminary investigations on the eleven host plant species have not revealed a clear cut trend for the presence or absence of a particular phytochemical. The Lac insect is a sap feeder and it does not feed upon the plant tissues like other insect herbivores. Therefore, the presence or absence of a particular phytochemical in the bark tissue does not seem to play a significant role in the initial settlement of the Lac insect on the host plant surface. Hence it appears that structural parameters of the host viz. appropriate girth (secondary growth) and stiffness of the stem (moisture content), presence or absence of the trichomes etc. may be important in host selection. Furthermore, host selection and sustained growth of the insect for rest of its life cycle may be more or less dependent upon the qualitative aspects of the phloem sap viz. sugars, amino acids etc.

In conclusion, none of the major phytochemicals tested was found to play a significant role in initial insect settlement on host plant surface viz. bark. Therefore other parameters such as morpho-anatomical characters and biochemical constituents of the sap might be important in this context and need to be investigated.

ACKNOWLEDGEMENT

Authors are grateful to the Council of Scientific and Industrial Research (CSIR), New Delhi and National Agricultural Innovation Project (NAIP)-ICAR, New Delhi for the financial aid provided. Authors are also thankful to the reviewer Prof. N.Z. Dimetry, National Research Center, Egypt for the valuable suggestions and comments.

REFERENCES