Biological control methods in *Piper nigrum* Linn. leaves infected with galls caused by *Liothrips karneyi*

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**Abstract**

*Piper nigrum* Linn. (*Black pepper*) belongs to the family Piperaceae and an economically and medicinally important spice and is a native of Southern India. Leaf marginal gall is transmitted by *Liothrips karneyi* belonging to family Phlaeothripidae of order Thysanoptera (Thrips). Insect induced galls arise due to growth reaction of plants due to the attack of cecidozoa, also known as zocecidia. The growth and development of the host plant alter due to the infestation of the insect, which involves certain complex phenomena. The different groups of cecidozoa influence the plants in such a way as to produce galls at different stages in their life history. Most of the cecidozoa cause galls only in their developmental stages, but some of them are capable of inducing galls both in larval as well as adult stages. The crop production in India has been adversely affected due to the infestation of pests. And it is necessary to use different approaches of disease management to curb the infestation, and significant researchers have shown progress to protect the crops in an eco-friendly manner. Piperine exhibits diverse pharmacological activities like antihypertensive, antiplatelets, antioxidant, antitumor, antipyretic, analgesic, anti-inflammatory, anti-diarrheal, antibacterial, antifungal, anti-reproductive, insecticidal activities. In the present investigation, the biological method of disease management of marginal leaf gall transmitted by *Liothrips karneyi* has been undertaken. The biological control of leaf diseases has been significant on the increased reflection of environmental problems over pesticide uses.

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**INTRODUCTION**

*Piper nigrum* Linn. (*Black pepper*) grows mostly in the Malabar coast, growing in rich soil in the shade of trees. It adheres to the trunks through ivy-like rootlets. Coconut, areca nut, jack fruit, mango, subbul are the other supports used in homestead gardens. From its climbing habit, it has received the name of Pepper Vine, and in cultivation, the plants are often trained on artificial supports. Black pepper is an economically significant plant with medicinal properties, principally being used as a condiment, partly for its flavor, and partly on account of its stimulant influence over the stomach, by which it assists digestion; it is of unique medicinal value for persons suffering from atonic or torpid conditions of the stomach and also for curing ailments like tonsilitis, toothache, sore throat, migraine, throat infection, bronchitis etc. ([Bentley et al., 1880](https://www.jstor.org/stable/27507185)). One of the significant problems controlling this crop production is the leaf galls caused by the *Liothrips karneyi*. In the present investigation, biological control methods, using leaf extracts of neem leaves, calotrophis...
Table 1: Plant galls studied in the present investigation.

<table>
<thead>
<tr>
<th>S No</th>
<th>Host Plant</th>
<th>Organ Affected</th>
<th>Gall incitant</th>
<th>Place of Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><em>Piper nigrum</em> Linn.</td>
<td>Leaf</td>
<td><em>Liothrips karnyi</em> (Bagnal)</td>
<td>Thiruvananthapuram, Idukki, Quilon, Calicut, Kottayam</td>
</tr>
</tbody>
</table>

Table 2: Effect of plant extract and soap solution in management of marginal leaf gall.

<table>
<thead>
<tr>
<th>S No</th>
<th>Days after transplanting</th>
<th>By using the extract of neem</th>
<th>By using the extract of <em>Calotropis</em></th>
<th>By using a soap solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
<td>75%</td>
<td>62%</td>
<td>72%</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>78%</td>
<td>63%</td>
<td>72%</td>
</tr>
<tr>
<td>3</td>
<td>45</td>
<td>79%</td>
<td>65%</td>
<td>73%</td>
</tr>
<tr>
<td>4</td>
<td>60</td>
<td>80%</td>
<td>70%</td>
<td>73%</td>
</tr>
<tr>
<td>5</td>
<td>75</td>
<td>81%</td>
<td>71%</td>
<td>73%</td>
</tr>
</tbody>
</table>

RESULTS AND DISCUSSION

The results of the experiments indicated that highest reduction to control leaf marginal roll galls of *Piper nigrum* Linn. induced by *Liothrips karnyi* (Bagnall) with extract of *Azadirachta indica* and followed by soap solution and Calotropis respectively. (Table 2). The effect was duration dependent. However, 100 % control of the leaf galls could not be obtained even up to 75 days of the treatment period. 10% Plant extract of *Azadirachta indica* and soap solution were very effective in controlling Marginal leaf gall transmitted by *Liothrips karnyi*.

Infection of gall thrips generally occurs in the early stages of host plant development when young leaves are more and primarily affect the leaves (Varadarasan and Ananthakrishnan, 1981, 1982). Majority of the economic plants are affected by leaf galls caused by mites of Eriophyes Sp. (Rogerson and Mani, 1965; Channabasavanna and Nangia, 1984), leading to severe damages to their production and causing greater economic loses (Balasubramanian and Purushothaman, 1972; Purohit et al., 1979). For the control of diseases, mainly, the leaf galls, although several controlling mechanisms have been employed, viz., physical methods, chemical methods, disease-resistant plant cultures etc., the biological control methods are considered to be more valuable, cost-effective and free of side effects.

Biological control methods are more preferred, for the reasons that it causes fewer damages to crops, eliminates or reduce the safety hazards of harmful chemicals or insecticides, and protects the environment and water quality. Beneficial insects as predators, beneficial parasites as plant cultures and plant extracts as insecticides are the most pre-
ferred biological control methods (Mukherjee et al., 1994). Among the plant extracts, the leaf extracts of Azadiracta indica, Calotropis procera, Mirabilis jalapa, Dianthus caryophyllus, Clerodendrum aculeatum, Amaranthus Viridis have been widely used. Reduction of foliar infection caused by Phytophthora capsici through biological control measures using Pasteuria fluorescens. Biological control of Meloidogyne incognita, a Root-knot nematode in black pepper, Piper nigrum L. using an endospore-forming bacteria, Pasteuria penetrans, and a parasitic fungus on eggs, Paecilomyces lilacinus, have also been reported (Anith et al., 2003; Paul and Sarma, 2006).

In the present investigation, biological control measures using 10% plant extracts of Azadiracta indica and Calotropis procera and soap solutions have been investigated in control of leaf galls of black pepper caused by Liothrips karnyi. The investigation showed promising results in controlling the leaf galls in a duration-dependent manner. The method is easy to use, cost-effective, and above all, safety to the environment and water resources. 10% leaf extract of Azadirachta indica and soap solution were found to be more effective in controlling up to 80% of the disease. A little higher percentage, viz., 15 to 20% leaf extract is expected to control 100% diseases.

CONCLUSIONS

In control of marginal leaf galls of Piper nigrum Linn. induced by Liothrips karnyi (Bagnall), 10% leaf extract of Azadirachta indica and soap solution are considered to be more effective in controlling up to 80% of the disease. A little higher percentage, viz., 15 to 20% leaf extract is recommended for a 100% disease control. The effect could be dose and duration dependent.

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Conflict of interest

The authors declare that they have no conflict of interest for this study.

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