Table 1. Relative toxicity of δ-endotoxins of Bacillus thuringiensis to the second instar larvae of Lecinodes orbonalis

<table>
<thead>
<tr>
<th>δ-endotoxin</th>
<th>LC50 (ng/cm²)</th>
<th>Slope (± SE)</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cry 1 Aa</td>
<td>24.62</td>
<td>1.99 (± 0.36)</td>
<td>19.01</td>
<td>32.67</td>
</tr>
<tr>
<td>Cry 1 Ab</td>
<td>14.86</td>
<td>1.56 (± 0.33)</td>
<td>12.20</td>
<td>18.20</td>
</tr>
<tr>
<td>Cry 1 Ac</td>
<td>10.99</td>
<td>2.23 (± 0.42)</td>
<td>8.08</td>
<td>14.94</td>
</tr>
<tr>
<td>Cry 1 B</td>
<td>17.32</td>
<td>2.05 (± 0.36)</td>
<td>13.57</td>
<td>22.80</td>
</tr>
<tr>
<td>Cry 1 C</td>
<td>10.86</td>
<td>2.01 (± 0.35)</td>
<td>8.06</td>
<td>14.62</td>
</tr>
<tr>
<td>Cry 1 E</td>
<td>24.92</td>
<td>1.88 (± 0.36)</td>
<td>19.01</td>
<td>32.67</td>
</tr>
<tr>
<td>Cry 2 Aa</td>
<td>3.08</td>
<td>1.42 (± 0.19)</td>
<td>2.31</td>
<td>4.11</td>
</tr>
</tbody>
</table>

LC50 denotes the concentration of the toxin causing 50% larval mortality.

The genes can be so selected that, the respective proteins bind to different receptors in the midgut epithelial membranes of L. orbonalis. Investigations to characterize the Bt toxin receptors in L. orbonalis are necessary.


ACKNOWLEDGEMENTS. We thank Prof. Donald Dean of Ohio State University, Columbus, Ohio, USA for kindly supplying E. coli clones carrying different Bt genes. We are grateful to Dr R. P. Sharma, Project Director, NRC on Plant Biotechnology, IARI, New Delhi for support and encouragement.

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Siderophore production by Aspergillus niger AN27, a biocontrol agent

Siderophores have received much attention in the past decade, largely because of their proposed role in biocontrol of soil-borne plant pathogens and as a supplier of iron nutrition to crop plants. Since plant pathogens may not have the cognate ferri-siderophore receptor for uptake of iron-siderophore complex, they are prevented from proliferating in the immediate vicinity because of lack of iron. Hence, siderophore-producing beneficial microbes can confer a competitive advantage in interactions in the rhizosphere. We report here the production of hydroxamate and catecholate groups of siderophore by a potential biocontrol agent, *Aspergillus niger* AN27 (ref. 5).

The methods of preparation of the chrome azolur S agar (CAS-A) medium was after Schwyn and Neillands. The methods of assay, viz. non-specific, hydroxamate and catecholate groups, were followed as mentioned by Haydon et al., Anson, and Holzberg and Aris, respectively. For these assays, Czapek-Dox (without iron) was used as the basal low iron medium (LIM). *A. niger* AN27 was inoculated in 250 ml flask containing 100 ml of LIM. The flasks were kept in a shaker at 150 rpm and incubated at 30°C for 7 days. The supernatants were taken by filtration through Whatman filter paper (no. 42).
Production of siderophores by *A. niger* AN27 was indicated in the blue CAS-A medium by formation of orange halo around the colony (Figure 1). Non-specific tests in the LIM were also positive (Figure 2). Specific tests for hydroxamate and catecholate groups of siderophore further confirmed that *A. niger* AN27 produced both the groups of siderophores (Figure 2).

According to Srinivasan et al., competition for iron between *Trichoderma* spp. and wood decay basidiomycetes in wood is a possible means of biocontrol of wood decay fungi. Fungistatic activity of siderophore has been reported. *Rhizopus arrhizus* produces a siderophore which is related to growth promotion in tomato. Fluorescent pseudomonads enhance plant growth and affect deleterious micro-organisms by producing siderophores. Siderophores produced by *Pseudomonas* spp. are adequate to influence microbial interaction and hence rhizosphere competitiveness. All the aforesaid attributes, viz. antagonistic activities, rhizosphere competence, and growth promotion were found in *A. niger* AN27. Therefore, it can be hypothesized that siderophore production by *A. niger* AN27 might have some role in these phenomena. This forms the first report of siderophore production by a strain of *A. niger*, an effective biocontrol agent.


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