Carboxylesterase activity associated with organophosphate resistance in *Helicoverpa armigera* (Lepidoptera: Noctuidae) in Tamil Nadu

*Helicoverpa armigera* is a serious pest of several economically important crops, including cotton and legumes, in most regions of the Indian subcontinent. Consistent use of insecticides for the control of this insect has resulted in the development of resistance to a number of these. This resistance has been characterized as being due to target site insensitivity, penetration resistance, and enhanced metabolic detoxification. The enzymes involved in metabolic resistance include three major groups: mixed function oxidases, glutathione-S-transferases, and esterases. Several reports indicate that carboxylesterase is the major enzymatic factor for organophosphate resistance.

The present study was undertaken to examine the relationship between carboxylesterase and organophosphate resistance in populations of *H. armigera* collected from different areas of Tamil Nadu. Such information could be used in the management of *H. armigera* control programmes enabling development of strategies for overcoming resistance to insecticides.

*H. armigera* larvae were collected from bhendi fields at Coimbatore, Erode, Dindigul, and Madurai districts of Tamil Nadu state. These larvae were cultured in the laboratory on bhendi fruits for two generations. Bioassay and enzyme activity were carried out from these larvae.

The resistance levels were estimated by determining the LC50 values of monocrotophos and quinaprophos for different populations separately by standard bioassay methods and then comparing the LC50 values of the most susceptible populations with those of other populations (LC50 of Erode-Dindigul-Madurai population/LC50 of Coimbatore population).

Fourth instar larvae of same size and age taken from different populations were homogenized individually with 20 mM phosphate buffer (pH 8.0), using a homogenizer and centrifuged at 10,000 g for 10 min. The carboxylesterase activity was spectrophotometrically assayed by the method of Van Asperm and Devonsion.

The carboxylesterase activity was also observed to be highest (3 fold) in the populations collected from Madurai and it was at a moderate level in the populations collected from both Dindigul and Erode areas. The difference between the recorded values is statistically significant (ANOVA at 5% level) and this may...
Table 1. Resistance level and carboxylesterase activity of *H. armigera* populations collected from various locations in Tamil Nadu

<table>
<thead>
<tr>
<th>Population</th>
<th>Coimbatore</th>
<th>Erode</th>
<th>Dindigul</th>
<th>Madurai</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC₉₀ value (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monocrotophos</td>
<td>0.00181</td>
<td>0.00300</td>
<td>0.00356</td>
<td>0.00817</td>
</tr>
<tr>
<td>Quinalphos</td>
<td>0.00151</td>
<td>0.00428</td>
<td>0.00514</td>
<td>0.00528</td>
</tr>
<tr>
<td>Resistance level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monocrotophos</td>
<td>–</td>
<td>1.66</td>
<td>1.97</td>
<td>4.51</td>
</tr>
<tr>
<td>Quinalphos</td>
<td>–</td>
<td>2.83</td>
<td>3.40</td>
<td>3.50</td>
</tr>
<tr>
<td>Level of carboxylesterase Specific activity</td>
<td>20.2 ± 0.84[^a]</td>
<td>24.9 ± 1.12[^b]</td>
<td>45.7 ± 1.11[^c]</td>
<td>61.9 ± 0.5[^d]</td>
</tr>
</tbody>
</table>

LC₉₀ = Lethal concentration to give 50% mortality.
Resistance level = L.C₉₀ of resistance population/LC₉₀ of most susceptible population (Coimbatore population).
Specific activity = nm/min/mg protein. [Mean values followed by different letters are significantly different (P < 0.05: SNK test)].

be possibly due to the occurrence of variable biotypes in different regions and the variation in resistance/susceptibility status of these populations. Carboxylesterases have been shown to be implicated in the metabolism of organophosphates.

The results demonstrate that the populations collected from Madurai had higher level of resistance to both the moncrotophos and quinalphos, and also show an increased degree of carboxylesterase activity, thereby indicating a close association between resistance to organophosphate and elevated level of carboxylesterase.


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Detection of antibacterial activity in the floral petals of some higher plants

Resistance towards prevailing antibiotics having become widespread among bacteria and fungi, new class of antimicrobial substances are urgently required. It is well known that plants, although lacking the typical immune response, have an in-built system for protection against biotic and abiotic stress conditions. Since plants have co-evolved with pathogens, they understandably have also developed the chemical protection pathways against the parasitic organisms. Therefore, it is reasonable to expect a variety of plant compounds with specific as well as general antimicrobial activity and antibiotic potential. In fact, there are several studies which reveal the presence of such compounds with antimicrobial properties in various plant parts.

The bioactive substances in plants are produced as secondary metabolites, which may not only be developmental stage-specific but also organ and/or tissue-specific. While plant leaf, stem and root extracts have been widely evaluated for bioactive compounds, screening of plant flower and seed has not been extensive. Earlier in a study, we reported detection of antibacterial activity in the seeds of some cuprophilous plants. The