NOTE

Lethal Ratios: An Optimized Strategy for Presentation of Bioassay Data Generated from Genetically Engineered Baculoviruses

Baculoviruses are the subject of increasing interest with respect to their potential as insect pest control agents. A number of baculoviruses are already in use against pests on crops for which some cosmetic damage has minimal impact on the product (P. F. Entwistle and H. F. Evans, "Comp. Insect Physiol. Biochem. Pharmacol." (G. A. Kerkut and L. I. Gilbert, Eds.), Vol. 7, pp. 347–412, Pergamon Press, New York). However, for application against most crop pests, the time taken to kill needs to be reduced. A baculovirus may take 4 to 9 days at 20 to 25°C to kill its host.

Genetic engineering enables insertion of foreign coding sequences into the baculovirus genome to speed the time of kill and provide an alternative means of insect pest control. To date, the nuclear polyhedrosis viruses of Autographa californica (AcNPV) and Bombyx mori (BmNPV) have been the prime candidates for engineering. AcNPV is of particular importance as its host range includes some major pest species in the genera Heliothis, Trichoplusia, and Spodoptera.


Lethal times and lethal doses (or survival times and survival doses, "The Biology of Baculoviruses," (R. R. Granados and B. A. Federici, Eds.), Vol. 2, CRC Press, Boca Raton, FL, 1986) are generally determined to evaluate the effectiveness of any new recombinant. However, the absolute numbers for LT50 and LD50 may be misleading. Situations have arisen where the efficacy of viruses from different laboratories have been compared based on time to death. Since LT50 and LD50 vary dramatically among bioassays run in different laboratories, one could use ratios of the test virus to the wild-type virus as shown below to determine lethal ratio for time (LRT) or lethal ratio for dose (LRD) at the 50 and 90% levels. When such ratios for bioassay data are presented in addition to primary data, comparison of different viral constructs will be simplified since they take into account the relative potency of the wild-type virus (Table 1). Ratios have also been used for comparison of the relative toxicities of different chemicals, the relative susceptibilities of populations, and in pesticide resistance (J. L. Robertson and H. K. Preisler, "Pesticide Bioassays with Arthropods," CRC Press, Boca Ra-

<table>
<thead>
<tr>
<th>Insect species</th>
<th>Temp (°C)</th>
<th>Wild-type virus*</th>
<th>Scorpion toxin virus</th>
<th>LRT50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trichoplusia ni</td>
<td>23</td>
<td>113</td>
<td>86</td>
<td>0.761</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(112–115)</td>
<td>(85–87)</td>
<td></td>
</tr>
<tr>
<td>Heliothis virescens</td>
<td>27</td>
<td>125</td>
<td>88</td>
<td>0.704</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(117–134)</td>
<td>(82–95)</td>
<td></td>
</tr>
<tr>
<td>Heliothis virescens</td>
<td>30</td>
<td>81</td>
<td>62</td>
<td>0.765</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(79–82)</td>
<td>(59–64)</td>
<td></td>
</tr>
</tbody>
</table>

*Autographa californica nuclear polyhedrosis virus strain C6 (AcNPV C6)


b M. D. Betana and B. F. McCutchen, unpublished data for AcAAIT.
ton, FL, 1992). Of course, even when using the ratio method, standardized assay conditions will increase the reliability of the comparison.

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\text{Lethal ratio for time 50\% (LRT}_{50}) = \frac{\text{LT}_{50} \text{ test virus}}{\text{LT}_{50} \text{ wild-type virus}}.
\]

\[
\text{Lethal ratio for dose 50\% (LRD}_{50}) = \frac{\text{LD}_{50} \text{ test virus}}{\text{LD}_{50} \text{ wild-type virus}}.
\]

**Key Words:** Bioassay; genetically engineered baculovirus; lethal ratio.

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