Economically Optimal Timing of Insect Control in Food Processing Facilities: An Options Approach

Suling Duan, Graduate Research Assistant

and

Brian Adam, Professor

Department of Agricultural Economics, Oklahoma State University

Sylvia.Duan@okstate.edu

Brian.Adam@okstate.edu


Copyright 2015 by Suling Duan and Brian Adam. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.
Economically Optimal Timing of Insect Control in Food Processing Facilities: An Options Approach

Suling Duan, Graduate Research Assistant

and

Brian Adam, Professor

Department of Agricultural Economics, Oklahoma State University

Sylvia.Duan@okstate.edu

Brian.Adam@okstate.edu


Copyright 2015 by Suling Duan and Brian Adam. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.
ECONOMICALLY OPTIMAL TIMING OF INSECT CONTROL IN FOOD PROCESSING FACILITIES: AN OPTIONS APPROACH

Introduction
- Fumigating too early in a storage period increases the likelihood that repeat fumigation will be necessary, increasing cost
- Fumigating too late increases potential insect damage, increasing cost
- Motivation: optimal fumigation time can control insects at lowest cost

Why a Real Option?
- This approach values the decision maker's flexibility in choosing to treat insects now, wait until a later date to treat, or not to treat at all.
- Can make the assessment of the costs of failing to control insects more manageable
- Easier to evaluate, interpret, and explain, particularly focused on strategies that reduce chemical use in food processing firms.

Objectives
- Determine the optimal timing to conduct a fumigation with sulfuryl fluoride in a flour mill.
- In order to achieve this objective, the value of a real option to conduct a fumigation is estimated.

Data
The insect population dynamics are based on a simulation model of the red flour beetle in a flour mill in central Kansas.

Methods
- Using a real option concept: the optimal timing to apply fumigation is when the option value is “in the money” and the time value goes to zero.
- The value of the option to treat:
  \[ F(V,t) = \max(V - TC) - e^{-rT} \]

<table>
<thead>
<tr>
<th>Time Value &gt; 0</th>
<th>Time Value = 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the Money: ( V &gt; TC )</td>
<td>Wait to treat until time value goes to 0</td>
</tr>
<tr>
<td>Out of Money: ( V &lt; TC )</td>
<td>Treat now</td>
</tr>
</tbody>
</table>

Conclusion & Discussion
- The value of treatment and value of the option both change with time. When time value goes to zero the option should be exercised.
- A real option approach can help managers evaluate tradeoff between treating now and waiting to treat.

Result
- The optimal time to fumigate this particular year was on day 120 of the storage period

Figure 1. Simulated Insect Population without Treatment

Figure 2. The Value of Treatment and The Value of Option to Treat

Figure 3. Time Trend for Value of Treatment and Value of Option to Treat