Comparison Test Between a Hydraulic Sprayer and an Airoblast Sprayer for Insect Control

Officer i/c: D. Summers

Location: Snowdon Seed Orchard

Region/District or Nursery: Vancouver/Campbell River Forest District

Objective: To compare the Girette-mounted hydraulic sprayer with the Hardi Mistblower Model 600 Combi 2 in terms of:
A. Operational speed and effectiveness (cost).
B. Biological effectiveness in reducing insect damage to seeds and cones (benefit).

Progress: Part A, Time Study - Six replicates of five trees each were sprayed first by the Hardi Mistblower, then, later, by the hydraulic sprayer. To eliminate uncontrollable differences between tree shapes and distances between trees, the same trees were sprayed by each machine. Water containing soluble dye was sprayed on the trees to the runoff point using the Hardi Mistblower. Trees were allowed to dry and spraying was repeated using the hydraulic sprayer. Spray cards were placed systematically throughout the trees crowns, before each machine passed, to assess spray distribution. Completed 1982.
No progress in 1983 due to lack of insects in cones.

Part B - Attempted in 1984 but abandoned because of crop abortion. Some preliminary information being analysed over Winter 1984-85.

Next Scheduled Assessment/Treatment: In question.

Report Distribution:
Incomplete - Abandoned
WORKING PLAN

for

COMPARISON TEST

between

HYDRAULIC SPRAYER and HARDI MISTBLOWER

FOR CONTROLLING CONE/SEED INSECTS IN COASTAL SEED ORCHARDS

SX 82605

R. Currell

THE PROBLEM:

Insect control is a high priority in Douglas-fir seed orchards where 50% losses in seed, due to insect attack, have been recorded.

Currently we spray seed orchard trees with Dimethoate, where warranted, to protect primarily against attack from Douglas-fir cone gall midge (Contarinia oregonesis. Foote)

The most successful spray equipment used to date has been a hydraulic sprayer mounted on a Girette manlift. This sprayer was designed and constructed specifically for the Coastal Seed Orchards.

Recently, a Hardi Mistblower Model NK 600-Combi 2 was purchased. The purpose of this trial is to compare the cost effectiveness of the mistblower with the hydraulic sprayer.

The hydraulic sprayer works very efficiently on single groups of flowers on a tree. Spray is applied using a hand-held gun approximately 2 feet from the flowers. Potential operational problems with the hydraulic sprayer include: the possibility of spray drifting over the applicator, the difficulty spraying trees whose height exceeds the reach of a Girette, the slow ground speed of the Girette and the possibility of the applicator missing groups of flowers on the target tree.

It is recognized that these may not be significant problems, however, a cost-benefit test of the Hardi Mistblower versus the hydraulic sprayer appears warranted. This analysis will aid us in determining the following: should we buy more Hardi Mistblowers or develop more hydraulic sprayers on Girettes for insect control work in our other orchards? If a heavy cone crop year occurs, we will need every piece of equipment that will do the job.

OBJECTIVES:

To compare the Girette-mounted hydraulic sprayer with the Hardi Mistblower Model NK 600-Combi 2 in terms of:

a) Operational speed and effectiveness (cost).

b) Biological effectiveness in reducing insect damage to seeds and cones (benefit).
TREATMENTS:

This study will be conducted at Snowdon Seed Orchard and will be comprised of two parts.

PART 1 - Time Study

We will carry out a time study simulating the time and amount of spray required to operationally treat a block of cone bearing trees. Trees will be sprayed to runoff with each machine.

Variables which would influence these two factors include: size and shape of trees to be sprayed, distance between target trees, travelling speed of the sprayer, time required to spray a set volume of branches, and spray quantity required to cover those branches.

To eliminate uncontrollable differences between tree shapes and distances between trees, we will spray the same trees twice, once with the hydraulic sprayer, once with the Hardi Mistblower.

In order not to waste chemical or overspray, water will be used in this segment of the trial. Water soluble dye or some non-active agent apparent on spray cards will be used. Spray cards will be placed throughout target trees, thus enabling an observation of spray coverage. Time will be left between treatments to allow the sprayed trees to dry.

PART 2 - Spray Effectiveness

Testing of spraying effectiveness will be carried out in Part 2 of the trial if insect egg counts made in early April show a significant potential for insect damage. Ten trees of the same relative size, shape, crown density and cone crop rating will be sprayed by each applicator. Dimethoate in a 1% solution (recommended formulation) will be applied to these trees to the runoff point.

A record of trees sprayed will be kept. At the time of cone harvest, twenty well distributed cones from each of the twenty trees sprayed will be sampled, as well as twenty cones per tree from the control group of ten unsprayed trees; these cones will have their seed extracted and seed damage assessed by Pacific Forest Research Centre entomologists.

A comparison of the intensity of insect damage will be made between the three groups making use of an equation developed by G. Miller of PFRC, which given initial egg counts shows the intensity of seed damage expected if no spraying were done.
EXPERIMENTAL DESIGN:

PART 1 - Simulated Spray Test

<table>
<thead>
<tr>
<th>Treatment</th>
<th># of Trees Treated/Rep.</th>
<th>Replicates</th>
<th>Total Trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic</td>
<td>5</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>Mistblower</td>
<td>5</td>
<td>6</td>
<td>30</td>
</tr>
</tbody>
</table>

PART 2 - (Actual Dimethoate Spray Applied)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number of Trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic</td>
<td>10</td>
</tr>
<tr>
<td>Mistblower</td>
<td>10 Single tree plots will be used, thus 10 replicates are present.</td>
</tr>
<tr>
<td>Control</td>
<td>10</td>
</tr>
</tbody>
</table>

MEASURES AND RECORDS:

PART 1

Records will be kept as the trial progresses, they include:
- Total time to spray 5 well distributed trees.
- Moving time between trees (cumulative and individual).
- Spraying time per tree.
- Spray distribution.

Spray cards (4" x 4") will be used to estimate spray distribution in positions simulating flowering sites. Three cards will be placed in the upper crown, three in mid-crown, and three in the lower crown. Spray coverage will be rated low, moderate, or heavy, as estimated on a 10 cm² square in the centre of each card. Results from Part 2 of the study will help us determine adequate spray distribution.

PART 2

Trees treated will be recorded by family, block, position and application method. Insect damage will be assessed and recorded for each tree (by PFRC), an ANOVA will determine whether these are significant differences between treatments.
MATERIALS AND LABOUR:

The Girette-mounted hydraulic sprayer currently is stationed at Snowdon Orchard. The Hardi Mistblower, after modifications, will be transported to Snowdon. Prior to the trial, calibrating tests and consultation of the operating manual will be carried out to determine which nozzle set and what nozzle size to use in order to apply a suitable and known volume of spray per minute, assuming a set spraying pressure and tractor speed. Additional pretests will show us how best to control nozzle set oscillation to ensure complete coverage of orchard trees.

Materials Needed -
- 200 spray cards
- 200 clothes pins (to attach cards)
- water soluble dye
- Dimethoate spray for 20 trees (½% solution)

The seed orchard projects coordinator will be on site during this trial to conduct all measurements and set up the trial. An orchard technician will be required on two days to operate both the Girette-mounted hydraulic sprayer and the Hardi Mistblower.

INSTRUCTIONS:

PART 1

Five well distributed trees in one orchard block will constitute one replicate. Six replicates will be used. Machine A will spray 5 trees. Total time, moving time, and actual spraying time will be recorded, both for individual trees and for the group as a whole. Spray distribution will be checked and noted. After the machine is returned to a central location, the process will commence on rep 2. This will be repeated until the sixth replicate is sprayed.

After the trees have dried and presuming similar gross weather conditions (wind or rain would alter spraying times) the trial will be repeated using machine B.

All trees to be sprayed will be chosen prior to the commencement of the trial and conspicuously flagged; only trees not carrying significant flower crops will be chosen.
PART 2
Trees to be sprayed (medium or heavy flowering individuals) will be chosen prior to the commencement of the trial and flagged. A standard spring count of insect eggs will have been carried out (PFRC entomologist) in early April on numerous potential candidate trees and those trees which have significant insect egg counts and similar in size will be chosen as candidates for treatment.

PROPOSED ANALYSIS

Statistical analysis for this trial was prepared by H. Stauffer, B.C. Ministry of Forests, Research Branch.

PART 1 (Assumes the averaging of data for each replicate)
Randomized Block Design

<table>
<thead>
<tr>
<th>Source</th>
<th>Degrees of Freedom</th>
<th>Expected Mean Squares</th>
<th>F-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>1</td>
<td>$\sigma^2 + \sigma^2_{TB} + 6\phi_T$</td>
<td>with TB</td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>$\sigma^2 + 2\sigma^2_B$</td>
<td>with TB</td>
</tr>
<tr>
<td>TB</td>
<td>5</td>
<td>$\sigma^2 + \sigma^2_{TB}$</td>
<td></td>
</tr>
</tbody>
</table>

| T = treatments (2) |
| B = replicates (blocks) |

PART 2

Nested Factorial Design: fixed treatment levels

<table>
<thead>
<tr>
<th>Source</th>
<th>Degrees of Freedom</th>
<th>Expected Mean Squares</th>
<th>F-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Si</td>
<td>$s-1$</td>
<td>$\sigma^2 + tn\sigma^2_B + 6tn\sigma^2_S$</td>
<td>with B</td>
</tr>
<tr>
<td>Bj(i)</td>
<td>$s(b-1)$</td>
<td>$\sigma^2 + tn\sigma^2_B$</td>
<td>with BT if interaction insignificant</td>
</tr>
<tr>
<td>Tk</td>
<td>$t-1$</td>
<td>$\sigma^2 + tn\sigma^2_{BT} + 6tn\sigma^2_{ST} + 6bn\phi_T$</td>
<td>with ST</td>
</tr>
<tr>
<td>ST_{ik}</td>
<td>$(s-1) (t-1)$</td>
<td>$\sigma^2 + n\sigma^2_{BT} + bn\sigma^2_{ST}$</td>
<td>with BT</td>
</tr>
<tr>
<td>BTJk(i)</td>
<td>$s(b-1) (t-1)$</td>
<td>$\sigma^2 + n\sigma^2_{BT}$</td>
<td></td>
</tr>
</tbody>
</table>

Assumes no interaction and thus $n\sigma^2_{BT}=0$

$\xi = \text{samples}$
$\sigma^2 = \text{random variance}$
$\phi = \text{fixed variance}$
$S = \text{replicates}$
$B = \text{nested blocks (each tree a block)}$
$T = \text{treatments (3)}$