Microsprinklers for Management of Spotted Wing Drosophila in Mature PNW Highbush Blueberry

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Challenges

Canopy closure in mature fields at harvest.

Since 2009 SWD requires weekly protective sprays.
Fruit knock-down with ground sprayers.

Before 2009 almost no insecticide applications were made during harvest.

A non-invasive insecticide application method is needed.
Non-Invasive Insecticide Application Methods
How do You Kill a Fly Anyway?

Directly impact with droplets
Contact with wet or dry residues

SWD ovipositing in blueberry
How do You Kill a Fly Anyway?

- Directly impact with droplets
- Contact with wet or dry residues
- Droplets aspirated into the spiracles
  - Directly impacting the CNS
- Sponging mouthparts
  - Droplets aspirated into the spiracles
  - Directly impact the CNS
2 Non Invasive Methods
Microsprinkler and Aerial Applications

Helicopter Research 2011 - 2014

- Provides adequate coverage on surface but may not penetrate canopy.
- Helicopter applied insecticides - provides quick SWD knockdown.
- Expensive - only economical in large fields.
How effective are aerial applications for controlling SWD?

21 July – Percent 1.0 lbs/A Imidan 70W
Microsprinklers versus Airblast
How do aerial applications and microsprinkler applications compare?

MICROSPRINKLER

• FAST - (2016, Nelson microsprinklers treated 5 Acres in 15 minutes)
• Not as limited by weather
• Depending on product – problematic with public
• Multi-usage potential – Cooling and Frost Protection

HELICOPTER

• FAST but limited by weight – require re-loading from nurse truck
• Limited by weather
• Can be problem with public
• Challenged by location
• No help with frost or cooling
Which is more effective, airblast or microsprinklers?

Comparison of Efficacy
Airblast and Microsprinkler

Average SWD % mortality on airblast + microsprinkler leaf residues, 2013 (% mortality after 24 hours)

<table>
<thead>
<tr>
<th>Insecticide</th>
<th>1 DAT airblast</th>
<th>1 DAT microsprinkler</th>
<th>3 DAT airblast</th>
<th>3 DAT microsprinkler</th>
<th>5 DAT airblast</th>
<th>5 DAT microsprinkler</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Mustang® Maxx</td>
<td>84</td>
<td>75</td>
<td>71</td>
<td>40</td>
<td>63</td>
<td>49</td>
</tr>
<tr>
<td>Malathion 8 Aquamul</td>
<td>97</td>
<td>64</td>
<td>87</td>
<td>29</td>
<td>84</td>
<td>35</td>
</tr>
</tbody>
</table>
There are many more leaves in a field than berries. SWD spends most of its time on foliage. Residues on foliage control SWD more than berry residues.
Airblast and Microsprinkler - 28 July, 12 August
Malathion 8F (5.84 l/ha, 2.9 l/ha maximum per application)
Leaves collected from 3 canopy positions (high, mid and low)
Efficacy evaluated by leaf bioassays at 1, 2 and 5 DAT

Are laboratory bioassays relevant to field conditions?

Evaluations
Bioassays Underestimate Actual Field Toxicity

Field and Bioassay Toxicity

<table>
<thead>
<tr>
<th></th>
<th>Bioassays</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dried residues</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Wet residues</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Droplet impact</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Length of contact</td>
<td>24-48 hours</td>
<td>Constant</td>
</tr>
</tbody>
</table>
Microsprinkler Comparison
2013 WSU NWREC microsprinkler trials

Looked at 4 different nozzles

R5  R10  MR  501
Efficacy of 4 nozzles and configurations

Efficacy of Mustang Maxx on SWD over Time

The Jain 501 appears best but presented mechanical problems. Overall no statistical differences between nozzles.
How do microsprinklers differ?

Overlap, density/acre, GPM and design

2013-2014 WSU NWREC
4 Nozzle Field Comparison + Netafim

Intended for cooling
Netafim Supernet (gray # 58)
Microsprinkler
0.26 GPM/head

Nelson R-5
Rotator pop-up
0.26 GPM/head

Nelson R-10
Turbo rotator
1.08 GPM/head
Potential frost protection

Jain MR
Pop-up mini revolver
0.80 GPM/head

Jain – 501
Turbo hammer
0.38 GPM/head

Portion of heads blew off in spring
Worked well with no engineering issues
Slugs invaded
Complicated moving parts. Higher density expensive
Bridge caused some interference

Hardware Design Improvements would increase efficacy
Nozzles were designed for irrigation rather than specifically chemigation

All nozzle designs experienced some dribble

Head tips blow out 3 of 14

Insect/mollusc contaminants
Field Coverage
Water Sensitive Card Placement
#1-3 high, mid, low parallel to sprinkler row
#4-6 high, mid - low interior – perpendicular to sprinkler
2013 - 100 gals / A

Jain 501

Nelson R10

Jain MR

Nelson R5

Teejet Water Sensitive Paper
Are microsprinkler applications even?

Microsprinkler - Nozzle Configuration

Opposite

Offset
Refining the System
2015 Lynden, WA
Focused on irrigation application/design
Mustang Maxx SWD Efficacy  R-10 Microsprinklers
2015 Lynden, WA

Combined Leaf Sample Times

% Mortality SWD

TOP
MID
Mid Interior

1 DAT
3 DAT
6 DAT
Do different sprinkler heads make a difference?

Comparison – 2 Microsprinklers
Netafim Supernet (OR, 2013)
Nelson R10 (WA, 2016)
Mustang Maxx % SWD Mortality on 7 DAT leaves for 3 spacings

Spacing II appears to be the best but not statistically different
Malathion % SWD Mortality on 7 DAT leaves for 3 spacings

They system works – will improve with further refinement
Weekly applications accumulate layers of degrading residues as the season progresses. Errors in calculations and uneven or poor applications could leave illegal residues.
Improved residual activity of Malathion following a Mustang Max application – 2013

Cumulative Carryover – Increases as Season Progresses

SWD % Mortality

1 DAT 3 DAT 7 DAT

Malathion without Mustang Max
Malathion after Mustang Max
Microsprinkler Chemigation - Basics

- Chemigation must be on the label.

- Different classes of insecticides degrade at different rates regardless of application method:
  - Pyrethroids (Mustang Maxx) - long, gradual decline curve – residues last longer
  - Organophosphates (Malathion 8 Aquamul) decline steeply after 3-5 days

- Zeta-cypermethrin residues not acceptable in certain countries including Canada. Check other pyrethroids.

- Canopy density can limit droplet penetration into the bush where SWD prefer to rest.

- Insecticide applications kill insects by 1) direct contact by droplets 2) flies encounter toxic residues.

- Microsprinkler applications last longer than a quickly passing airblast application, increasing chance of droplets striking flies.

- Certain insecticides (pyrethroids) can boost efficacy of less effective products – lead off with a pyrethroid before rotating lesser efficacious products into the program to prevent control loss.

- As the season progresses, sublethal levels of the insecticides accumulate and boost activity of each subsequent application allowing.
Microsprinkler Summary

- Good SWD efficacy – no wormy fruit, grower expanding microsprinklers
- Time/labor saving
- Facilitates pick/application schedules
- Reduced berry residues compared with air blast
- Cost can be amortized over a ~ decade or more
- Requires individualized irrigation engineer design
- SWD efficacy testing can help verify efficacy
- Irrigation Companies should work on reducing cost of infrastructure

Some of the pesticides discussed in this presentation were tested under an experimental use permit granted by WSDA. Application of a pesticide to a crop or site that is not on the label is a violation of pesticide law and may subject the applicator to civil penalties up to $7,500. In addition, such an application may also result in illegal residues that could subject the crop to seizure or embargo action by WSDA and/or the U.S. Food and Drug Administration. It is your responsibility to check the label before using the product to ensure lawful use and obtain all necessary permits in advance.
Future Considerations

- Investigate residue patterns in overlapping areas
- Continue to increase speed and efficacy
- Improve nozzle design
- Determine optimum spacing
- More products with chemigation labels
- Economic analysis is needed
Thank You

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Lance Fritz, PABG
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Oregon Blueberry Commission
Washington Blueberry Commission
Washington State Commission on Pesticide Registration