Final Report: Evaluation of Biological and Chemical Pruning Wound Protectants Against Selected Fungi Associated with Grapevine Trunk Diseases

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Department of Plant Pathology,
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Report Summary

Grapevine trunk diseases (GTDs) represent a major threat to the future economic sustainability of table grapes and wine grapes. Several taxonomically unrelated groups of Ascomycete fungi cause trunk diseases in grapevines including *Eutypa lata* and *Neofusicoccum parvum*. (1). Following precipitation events, fungal spores (sexual and asexual) become airborne and colonize exposed wood vessels caused by pruning. Total disease control is virtually unattainable because of the huge number of wounds made on an individual grapevine and extended period of wound susceptibility but one mitigation practice is to apply a protectant to exposed pruning wounds (2, 3, 4, 5).

This trial was conducted at the UC Davis Plant Pathology Fieldhouse Facility (38.522591, -121.760719) from March to September 2019. Treatments were a randomized block design. The trial was performed in a 8 year old Sauvignon Blanc vineyard.

Materials and Methods

A. Experimental design

<table>
<thead>
<tr>
<th>Experimental design</th>
<th>Complete randomized block design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental unit</td>
<td>2 spurs of each = 1 plot x 10</td>
</tr>
<tr>
<td>Plot area</td>
<td>110 ft$^2$ (row spacing = 11 ft, vine spacing = 7 ft)</td>
</tr>
<tr>
<td>Application method</td>
<td>Hand held spray bottle</td>
</tr>
</tbody>
</table>
B. Experimental treatments

The treatments described in this report were conducted for experimental purposes only and crops treated in a similar manner may not be suitable for commercial or other use.

<table>
<thead>
<tr>
<th>Flag</th>
<th>Treatment</th>
<th>Application rate (per acre)</th>
<th>FP/10 vines (0.6L spray bottle)</th>
<th>Pathogen interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>Untreated control</td>
<td>N/A</td>
<td>N/A</td>
<td>1 day after pruning</td>
</tr>
<tr>
<td>K</td>
<td>Spur Shield</td>
<td>1.5 qt/A</td>
<td>1.12 ml</td>
<td>1 day after pruning</td>
</tr>
<tr>
<td>RKD</td>
<td>Vitiseal</td>
<td>0.5 gal/A</td>
<td>1.5 ml</td>
<td>1 day after pruning</td>
</tr>
<tr>
<td>GKD</td>
<td>Vitiseal + EMP Polymer</td>
<td>0.5 gal/A</td>
<td>1.5 ml + 6 ml</td>
<td>1 day after pruning</td>
</tr>
<tr>
<td>KD</td>
<td>EMP Polymer</td>
<td>1%</td>
<td>6 ml</td>
<td>1 day after pruning</td>
</tr>
<tr>
<td>YKD</td>
<td>Terramera Biological</td>
<td>2.4 (%v/v)</td>
<td>14.4 ml</td>
<td>1 day after pruning</td>
</tr>
<tr>
<td>KS</td>
<td>Terramera Biological &amp; EMP Polymer</td>
<td>2.4 (%v/v) + 1%</td>
<td>14.4 ml + 6 ml</td>
<td>1 day after pruning</td>
</tr>
<tr>
<td>PU</td>
<td>Luna Sensation</td>
<td>5.0 fl oz/A</td>
<td>0.12 ml</td>
<td>1 day after pruning</td>
</tr>
<tr>
<td>P</td>
<td>Luna Experience</td>
<td>6 fl oz/A</td>
<td>0.14 ml</td>
<td>1 day after pruning</td>
</tr>
<tr>
<td>OKD</td>
<td>Rally + Topsisin M + Organosilicone</td>
<td>2.25 oz + 1.25 lbs + 2 qt/A</td>
<td>0.05 g + 0.45 g + 12 ml</td>
<td>1 day after pruning</td>
</tr>
<tr>
<td>OKS</td>
<td>Rally + Organosilicone</td>
<td>2.25 oz + 1.25 lbs/A</td>
<td>0.05 g + 12 ml</td>
<td>1 day after pruning</td>
</tr>
<tr>
<td>GKS</td>
<td>Rally + Spur shield</td>
<td>2.25 oz + 1.25 lbs/A</td>
<td>0.05 g + 1.5 ml</td>
<td>1 day after pruning</td>
</tr>
<tr>
<td>PKS</td>
<td>Rally + Topsisin M + Spur shield</td>
<td>2.25 oz + 2 qt/A</td>
<td>0.05 g + 0.45 g + 1.5 ml</td>
<td>1 day after pruning</td>
</tr>
<tr>
<td>BKS</td>
<td>Rally + Vitiseal</td>
<td>2.25 oz + 1.25 lbs + 2 qt/A</td>
<td>0.05 g + 1.5 ml</td>
<td>1 day after pruning</td>
</tr>
<tr>
<td>BC</td>
<td>BioTam + Crab Life-Powder</td>
<td>2.25 oz + 2 qt/A</td>
<td>1.43gr + 0.35gr</td>
<td>7 days after pruning</td>
</tr>
<tr>
<td>B</td>
<td>Crab Life-Powder</td>
<td>2 lb/A + 0.5 lb/100ga</td>
<td>0.35 gr</td>
<td>7 days after pruning</td>
</tr>
<tr>
<td>GS</td>
<td>BioTam</td>
<td>0.5 lb/100ga</td>
<td>1.43 gr</td>
<td>7 days after pruning</td>
</tr>
<tr>
<td>YS</td>
<td>GCM (Bacillus velezensis)</td>
<td>2 lb/100ga</td>
<td>Apply fermented product</td>
<td>1 day after pruning</td>
</tr>
<tr>
<td>BS</td>
<td>Lalitha 21</td>
<td>12 fl oz/A</td>
<td>0.28 ml</td>
<td>1 day after pruning</td>
</tr>
<tr>
<td>GD</td>
<td>Vintec</td>
<td>0.7 oz/A</td>
<td>0.3 g</td>
<td>7 days after pruning</td>
</tr>
<tr>
<td>KC</td>
<td>Vintec</td>
<td>1.4 oz/A</td>
<td>0.6 g</td>
<td>7 days after pruning</td>
</tr>
<tr>
<td>YKC</td>
<td>Vintec</td>
<td>2.8 oz/A</td>
<td>1.2 g</td>
<td>7 days after pruning</td>
</tr>
</tbody>
</table>
C. Map

D. Application calendar

<table>
<thead>
<tr>
<th>Flag</th>
<th>Treatment Name</th>
<th>March 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>Untreated control</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>Spur Shield</td>
<td>X</td>
</tr>
<tr>
<td>RKD</td>
<td>Vitiseal</td>
<td>X</td>
</tr>
<tr>
<td>GKD</td>
<td>Vitiseal + EMP Polymer</td>
<td>X</td>
</tr>
<tr>
<td>KD</td>
<td>EMP Polymer</td>
<td>X</td>
</tr>
<tr>
<td>YKD</td>
<td>Terramera Biological</td>
<td>X</td>
</tr>
<tr>
<td>KS</td>
<td>Terramera Biological &amp; EMP Polymer</td>
<td>X</td>
</tr>
<tr>
<td>Pu</td>
<td>Luna sensation</td>
<td>X</td>
</tr>
<tr>
<td>P</td>
<td>Luna Experience</td>
<td>X</td>
</tr>
<tr>
<td>OKD</td>
<td>Rally + Topsisin M + Organosilicone</td>
<td>X</td>
</tr>
<tr>
<td>OKS</td>
<td>Rally + Organosilicone</td>
<td>X</td>
</tr>
<tr>
<td>GKS</td>
<td>Rally + Spur shield</td>
<td>X</td>
</tr>
<tr>
<td>PKS</td>
<td>Rally + Topsisin M + Spur shield</td>
<td>X</td>
</tr>
<tr>
<td>BKS</td>
<td>Rally + Vitiseal</td>
<td>X</td>
</tr>
<tr>
<td>BC</td>
<td>BioTam + Crab Life-Powder</td>
<td>X</td>
</tr>
<tr>
<td>B</td>
<td>Crab Life-Powder</td>
<td>X</td>
</tr>
<tr>
<td>GS</td>
<td>BioTam</td>
<td>X</td>
</tr>
<tr>
<td>GD</td>
<td>Vintec 0.7 oz/A</td>
<td>X</td>
</tr>
<tr>
<td>YS</td>
<td>GCM (Bacillus velezensis)</td>
<td>X</td>
</tr>
<tr>
<td>BS</td>
<td>Lalitha 21</td>
<td>X</td>
</tr>
<tr>
<td>YKC</td>
<td>Vintec 2.8 oz/A</td>
<td>X</td>
</tr>
<tr>
<td>KC</td>
<td>Vintec 1.4 oz/A</td>
<td>X</td>
</tr>
</tbody>
</table>
E. Vine Management

During the application period, vines were irrigated by drip irrigation. Sucker shoot removal and leafing were done during the duration of trial.

F. Data Collection and Statistics

The efficacy of the treatments controlling the GTDs were recorded as the Mean Percentage of Infection (MPI). This was calculated by: \((\text{Number of GTD infected samples}/\text{Number of total samples}) \times 100\). There were a total of 20 repetitions per GTD per treatment. Treatments were compared against the untreated control and a standard control. Means comparisons were made using Dunnett’s test \(\alpha=0.05\).

Results

Figure 1. Evaluation of pruning wound treatments mean percent infection (MPI) rates with \(E. \text{lata}\) located at UC Davis Plant Pathology Field House, 2019. Bars represent the least mean square of percent infection. Bars with a different letter are different according to Dunnett’s test \(p = 0.05\).
Figure 2. Evaluation of pruning wound treatments mean percent infection (MPI) rates with *N. parvum* located at UC Davis Plant Pathology Field House, 2019. Bars represent the least mean square of percent infection. Bars with a different letter are different according to Dunnett’s test (*p* = 0.05).
The efficacy of the pruning wound protectants can also be reported as mean percent disease control (MPDC).

**Table 2.** Evaluation of pruning wound treatments mean percent disease control (MPDC) rates with *E. lata* and *N. parvum* located at UC Davis Plant Pathology Field House, 2019. MPDC calculated on the basis of MPI of the control treatment as \((100 \times (1 - \frac{\text{MPI treatment}}{\text{MPI control}}))\).

<table>
<thead>
<tr>
<th>MPDC</th>
<th>E. lata</th>
<th>N. parvum</th>
</tr>
</thead>
<tbody>
<tr>
<td>BioTam + Crab Life-Powder</td>
<td>100</td>
<td>3.85</td>
</tr>
<tr>
<td>Vitisel +EMP Polymer</td>
<td>100</td>
<td>16.67</td>
</tr>
<tr>
<td>Luna Sensation</td>
<td>92.31</td>
<td>48.72</td>
</tr>
<tr>
<td>BioTam</td>
<td>92.31</td>
<td>29.49</td>
</tr>
<tr>
<td>Spur shield</td>
<td>92.31</td>
<td>10.26</td>
</tr>
<tr>
<td>GCM (<em>Bacillus velezensis</em>)</td>
<td>92.31</td>
<td>35.9</td>
</tr>
<tr>
<td>Terramera Biological</td>
<td>84.62</td>
<td>3.85</td>
</tr>
<tr>
<td>Luna Experience</td>
<td>84.62</td>
<td>23.08</td>
</tr>
<tr>
<td>Lalitha 21</td>
<td>84.62</td>
<td>23.08</td>
</tr>
<tr>
<td>Crab Life-Powder</td>
<td>84.62</td>
<td>48.72</td>
</tr>
<tr>
<td>Rally + Topsin M + Spur shield</td>
<td>84.62</td>
<td>67.95</td>
</tr>
<tr>
<td>Vintec 2.8 oz/A</td>
<td>76.92</td>
<td>3.85</td>
</tr>
<tr>
<td>Terramera Biological &amp; EMP Polymer</td>
<td>61.54</td>
<td>10.26</td>
</tr>
<tr>
<td>EMP Polymer</td>
<td>61.54</td>
<td>0</td>
</tr>
<tr>
<td>Vitisel</td>
<td>61.54</td>
<td>0</td>
</tr>
<tr>
<td>Rally and Organosilicone</td>
<td>53.85</td>
<td>10.26</td>
</tr>
<tr>
<td>Rally + Spur shield</td>
<td>53.85</td>
<td>0</td>
</tr>
<tr>
<td>Vintec 1.4 oz/A</td>
<td>53.85</td>
<td>35.9</td>
</tr>
<tr>
<td>Rally and Vitisel</td>
<td>23.08</td>
<td>0</td>
</tr>
<tr>
<td>Vintec 0.7 oz/A</td>
<td>23.08</td>
<td>100</td>
</tr>
<tr>
<td>Topsin + Rally + Organosilicone</td>
<td>7.69</td>
<td>35.9</td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Acknowledgements

Thanks to the various industry donors for providing testing materials. Thanks to Bryan Pellissier and Lexi Sommers-Miller for their field support.

Appendix

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Active Ingredient</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated Control</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Spur Shield</td>
<td>Polymer of Cyclohexane</td>
<td>Miller Chemical Inc.</td>
</tr>
<tr>
<td>Vitiseal</td>
<td>Acrylic Copolymer</td>
<td>Vitiseal International LLC</td>
</tr>
<tr>
<td>EMP Barrier</td>
<td>Co-polymer emulsion</td>
<td>Gemm Ag Solutions</td>
</tr>
<tr>
<td>Terramera Biological</td>
<td>50% Neem &amp; 25% fatty acid</td>
<td>Terramera Inc</td>
</tr>
<tr>
<td>Luna Sensation</td>
<td>Fluopyram/Trifloxystrobin</td>
<td>Bayer CropScience</td>
</tr>
<tr>
<td>Luna Experience</td>
<td>Fluopyram</td>
<td>Bayer CropScience</td>
</tr>
<tr>
<td>Rally</td>
<td>Myclobutanil</td>
<td>DOW AgroSciences LLP</td>
</tr>
<tr>
<td>Topisin M</td>
<td>Thiophanate-methyl</td>
<td>Conchazul de Mexico</td>
</tr>
<tr>
<td>Crab Life-Powder</td>
<td>A blend of crab and lobster shell powder</td>
<td>Isagro USA</td>
</tr>
<tr>
<td>BioTarm</td>
<td>Trichoderma asperellum &amp; Trichoderma gamsii</td>
<td>Bi-PA, Biological Prodcucs of Agriculture</td>
</tr>
<tr>
<td>Vintec</td>
<td>Trichoderma atroviride SC1</td>
<td>GCM, South Korea</td>
</tr>
<tr>
<td>Gelatinase and chitinase producing microorganism (GCM)</td>
<td>Bacillus velezensis</td>
<td>Acela Biotek</td>
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<tr>
<td>Lalitha 21</td>
<td>Trichoderma spp., Bacillus subtilis, Azaspirillum brasilese</td>
<td></td>
</tr>
</tbody>
</table>

Literature Cited