Updates:
GTDs and Grapevine Viruses

26th Annual Gulf Coast Grape Grower Field Day

February 2, 2018

Cat Spring Ag. Society Hall
13035 Hall Road
Cat Spring, TX 79833

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Professor, Dept. of Plant Pathology and Microbiology, and
Diagnostician, Texas Plant Disease Diagnostic Laboratory,
Texas A&M AgriLife Extension Service, TAMU,
College Station, TX
Impact of Grapevine Trunk Diseases
Can cause increased costs through several avenues

• Caused by fungi killing woody cordons and trunks.
• Reduced yield,
  – loss of fruiting wood,
  – decrease lifespan of vineyard,
• Costs of preventative and post-infection measures,
• Decrease efficiency of inputs,
  – fertilization, watering, etc,
• In CA, economic consequence is 14% lost revenue annually.
Causes of GTDs
Three diseases and the pathogens that cause them

• Bot Dieback, Dead Arm
  — Diplodia seriata and Lasiodiplodia crassipora
  — dieback of canes, cordons trunk caused by cankers,

• Esca, Petri Disease, Black Measles, Apoplexy
  — Phaeomoniella and Phaeoacremonium
    - vascular pathogens
  — and, Fomitiporia
    - white rot

• Eutypa Dieback, Dying Arm
  — Eutypa lata,
List of Management Practices

- Starts with diagnosis,
- Cultural practices,
- Modify pruning practices to avoid risk,
- Protect wounds,
- Surgery and re-training vines,
- Sanitation.
Protect Wounds

Barriers to infection

• Use wound paints,
  • Must be durable,
  • Effective for 2 – 12 weeks,
  • Consist of resins, essential oils, other carrier,
  • Manual application to wounds,
  • May contain boric acid or a fungicide to debilitate pathogen.

• Fungicide sprays,
  • Dormant season sprays,
  • Prevent GTDs caused by Botryosphaeria, Eutypa, Phaeoacremonium and Phaeomoniella,
  • 2017 Grape Pest Management guide (HT-085) at the website of the Texas A&M AgriLife Bookstore.
Current Recommendations for Control
Prevention – newly planted vineyards

• Treat pruning wounds with a protectant
  • NEW - Topsin M (70WP) @ 2lb/acre (FRAC Group 1 Benzimidazole, Thiophanate-methyl),
  • Rally 40W @ 4-6 oz/acre (FRAC Group 3 Triazole, Myclobutanil),
    • tractor applied post-pruning,
  • Tractor applied post-pruning
    • repeat as needed to be effective for 1 month,
    • particularly after rain.
  • Topical wound paints,
    • Vinevax (Trichoderma),
    • 5% Boric Acid paste,
    • fungicide amended wound paints.
Evidence for Use of Topsin M to Manage GTDs

Evaluation of Pruning Wound Susceptibility and Protection Against Fungi Associated with Grapevine Trunk Diseases


Philippe E. Rolshausen,1 José Ramón Úrbez-Torres,2 Suzanne Rooney-Latham,3 Akif Eskalen,4 Rhonda J. Smith,5 and Walter Douglas Gubler6*

Abstract: Trunk diseases diminish vineyard longevity and productivity in nearly every raisin, table, and wine grape production region worldwide. Fungi causing these diseases infect primarily through pruning wounds. One way to control these diseases is to protect pruning wounds with fungicide applications, which can be problematic because of the limited number of registered products; the difficulty for these products to control numerous taxonomically unrelated organisms; the challenge of these products to protect for the entire period of wound susceptibility; and the difficulties and costs associated with hand application of protection treatments. Our goal was to compare the susceptibility of grapevine pruning wounds to various fungi associated with trunk diseases and to evaluate the efficacy of selected fungicides to control these pathogens when applied as pruning wound protectants. The study was conducted over two consecutive years in two separate vineyards in Sonoma and Colusa counties, California. Nine pathogenic fungi were tested: Eutypa lata, Botryosphaeria dothidea, Diplodia seriata, Dothiorella viticola, Lasiodiplodia theobromae, Phaeomoniella chlamydospora, Pleurostomophora richardsiae, Togninia minima, and Phaeoacremonium parasticticum. Results showed differences in the infection rates of pruning wounds by these fungi. Species of Botryosphaeriaceae were the most infectious, T. minima, P. parasitica, P. richardsiae, and E. lata were less infectious, and Pa. chlamydospora was intermediate. Four selected fungicides were tested: 1% Topsin M, Biopaste (5% boric acid in a wound-sealing paste), 1% Cabrio EG, and Garrison. Although results highlight the difficulty of these products to control the entire spectrum of pathogens efficiently, Topsin M was overall the most efficacious product.

Key words: Eutypa dieback, Bot canker, black dead arm, esca, Petri disease, young vine decline
## Attributes of Three Fungicides for Control of GTDs in Texas

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Generic Name</th>
<th>Group Name</th>
<th>MOA</th>
<th>FRAC Code</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rally® 40WSP</td>
<td>Myclobutanil</td>
<td>DMI</td>
<td>Inhibits sterol biosynthesis</td>
<td>3</td>
<td>Rate = 3-5 oz/A, 24 oz/A/year max (including other diseases). Bot, Eutypa, Esca pathogens, “vinewood diseases”</td>
</tr>
<tr>
<td>Mettle 125 ME</td>
<td>Tetraconazole</td>
<td>DMI</td>
<td>Inhibits sterol biosynthesis</td>
<td>3</td>
<td>Rate = 5 oz/A, Max. 2 applications Bot, Eutypa, Esca pathogens</td>
</tr>
<tr>
<td>Topsin® M WSB</td>
<td>Thiophanate – methyl</td>
<td>MBC</td>
<td>B-tubulin assembly in mitosis</td>
<td>1</td>
<td>Rate = 3.2 oz/gal (paint), 4.8 oz/A (spray) Supplemental 24c label needed – <em>Eutypa</em> only May be mixed with other label product Need to have 24c label</td>
</tr>
</tbody>
</table>
TOPSIN® M WSB
FOR USE IN THE PREVENTION OF EUTYPHA DIEDBACK ON GRAPE VINES

This label is valid until December 31, 2021 or until otherwise amended, withdrawn, cancelled, or suspended

ACTIVE INGREDIENT: Thiophanate-methyl
(dimethyl (1,2-phenylene)-bis(3-methyloxiran-3-yl)bis(carbamate)) ........................................... 70.0%
OTHER INGREDIENTS ........................................................................................................ 30.0%
TOTAL ................................................................................................................................. 100.0%
*Also known as dimethyl 4,4'-o-phenylenebis[3-thiaaliphosphate]

EPA Reg. No. 8033-125-70506 EPA SLN No. TX-170001

ENVIRONMENTAL HAZARDS:
Do not apply directly to water or areas where surface water is present or to intertidal areas below the mean high water mark. Runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water when disposing of equipment wash water.

DIRECTIONS FOR USE
It is a violation of Federal Law to use this product in a manner inconsistent with its labeling. This label and the federal label for this product must be in the possession of the user at the time of pesticide mixing and application. Follow all applicable directions, restrictions, Worker Protection Standard requirements, and precautions on this supplemental label and the main EPA-registered label.

<table>
<thead>
<tr>
<th>DISEASE</th>
<th>APPLICATION RATE TOPSIN M WSB</th>
<th>USE INSTRUCTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eutypa Dieback</td>
<td>Paint On Applications: 3.2 oz Topsin M WSB per 1 gallon (1 to Topsin M WSB per 5 gallons)</td>
<td>Paint-On Applications: Begin application when treatment thresholds have been reached. Use the high rate under heavy insect pressure and for longer residual control. Do not apply Topsin M WSB while bees are actively visiting the treated area.</td>
</tr>
<tr>
<td></td>
<td>Spray-On Applications: 1.5 lbs. Topsin M WSB in a minimum of 50 gallons of water per acre.</td>
<td>Spray-On Applications: Apply as a directed spray with power operated ground application equipment to thoroughly wet canopies, spurs, and all cut wood surfaces within 24 hours of pruning. Topsin M WSB may be tank mixed with other fungicides registered for protection against this and similar grape canker pathogens. The addition of a labeled rate of an organosilicone, crop oil, or other.</td>
</tr>
</tbody>
</table>

United Phosphorus, Inc.
630 Freedom Business Center, Suite 402
King of Prussia, PA 19406
1-800-438-6071
List of Management Practices

- Starts with diagnosis,
- Cultural practices,
- Modify pruning practices to avoid risk,
- Protect wounds,
- Surgery and re-training vines,
- Sanitation.
Cultural Practices
Keeping vines in a good state of health

- Recognize clean propagation materials, including rootstocks and scions,
- Proper planting and training practices,
- No over-cropping or other avoidable stresses,
- Maintain good fertility,
- Scout regularly for potential problems.
Cultural Practices/Wound Management
Delay Pruning, Double Pruning

• “pre-pruning”,
• 10 – 12 inches above intended spurs,
• made during the dormant season, December – January,
  • first cut exposed to primary infections,
• Second prune, In February just before or at bud break,
  – second cut removes the primary infections,
• Advantage – vines more able to resist infections, any previous infections removed,
• Delay pruning,
• Avoid wet weather!

Double pruning can help prevent canker infection. Photo Credit: Rhonda Smith
Surgery and Re-training Vines
Extends productive lifespans of vines

• Remedial pruning,
  • late dormant season,
  • excisions made min. 4 in. below discolored wood,
  • won’t work for Esca,
  • creates more wounds!

• Renew trunks,
• Re-train cordons.
• Sanitation important!
Resources

• For assistance in diagnosing GTDs and other grapevine diseases, see the website of the Texas Plant Disease Diagnostic Laboratory to get instructions on submission of samples (http://plantclinic.tamu.edu/).

• Specific recommendations for pest management of insect and diseases with fungicides and insecticides can be obtained from the 2017 Grape Pest Management Guide (HT-085) at the website of the Texas A&M AgriLife Bookstore (http://www.agrilifebookstore.org/Texas-Grape-Pest-Management-Guide-p/ht-085.htm).

• Additional information on current research and developments on GTDs can be obtained from the project website of the USDA Specialty Crops Research Initiative on GTDs in California (http://treeandvinetrunkdiseases.org/).
Resources

- [https://www.agrilifebookstore.org/](https://www.agrilifebookstore.org/)
- Search for *Grapevine Trunk Diseases*
Grapevines Following Pruning
Apply Rally 40WSP in 50 gallons of water per acre using power-operated ground application equipment to protect pruning wounds from vine diseases.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Rally 40WSP (oz/acre)</th>
<th>Use Directions</th>
<th>Restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botryosphaeria rhodina</td>
<td>5 (2 oz a)</td>
<td>Apply as a directed spray immediately after pruning (within 24 hours). Assure thorough coverage of cords, spurs and all cut wood surfaces. For best results, make a second application two weeks later. A second application is necessary if rainfall occurs or if humid conditions persist, or if conditions favor spore dispersal and germination. If there is risk of infection moving beyond the second set of pruning cuts, apply after the first and second prunings. Double pruning involves two pruning passes. Canes first are cut non-selectively to a uniform height. Later, selective pruning reduces canes to their final spur length. When conditions do not favor infections developing beyond where the final pruning cuts will be made, the first pass pruning cuts do not need to be treated. In this case, apply Rally 40WSP immediately after the second pruning only. Lower application volumes may be used only if the spray thoroughly wets all susceptible grapevine tissue and the same ratio of Rally 40WSP to water is maintained: 4 oz of Rally 40WSP per acre in 42 gallons of water. Control may be reduced at these lower application rates. The addition of a labeled rate of a registered organosilicone spray adjuvant may increase penetration into cut wood surfaces. It is the responsibility of the user to assure that the organosilicone spray adjuvant is safe to the crop under the existing conditions of use. Add a registered spray dye to the tank mix, and visually inspect pruning cuts after application, to assure thorough coverage of all susceptible tissue.</td>
<td>Do not apply less than 4 oz of Rally 40WSP per acre per application. Do not apply more than a total of 24 oz of Rally 40WSP (0.6 lb a) per acre per year including these applications and applications for control of other diseases.</td>
</tr>
<tr>
<td>Eutypa lata</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phaeoacremonium aleophilum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phaeomoniella chlamydospore</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vinvewood diseases</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Grape
Apply uniformly in a spray volume that provides thorough coverage of the fruit and foliage. Control may be reduced at low spray volumes or if spray coverage is not adequate.

<table>
<thead>
<tr>
<th>Diseases</th>
<th>Rally 40WSP oz/acre</th>
<th>Use Directions</th>
<th>Restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthracnose (E. Elatoric spp.)</td>
<td>3 - 5 (1.2 - 2 oz a)</td>
<td>Preventative Schedule: Begin application when new shoots are 1 inches in length. Reapply on a protectant schedule that does not exceed 14 days. Use a higher rate under heavy disease pressure. Post Infection Schedule: Apply within 72 hours after the beginning of an infection period.</td>
<td>Do not apply more than a total of 1.5 lb of Rally 40WSP (0.6 lb a) per acre per year. Do not apply less than 4 oz of Rally 40WSP per acre per application.</td>
</tr>
<tr>
<td>Black rot (Guignardia spp.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powdery mildew (Uncinula spp.)</td>
<td></td>
<td>For best results, begin application before bloom (12-18 inch shoot growth). Do not extend application intervals beyond 21 days. Use higher rates and/or shorter spray intervals on susceptible varieties or under heavy disease pressure.</td>
<td></td>
</tr>
</tbody>
</table>
TEXAS STATE PRODUCT REPORT

Registration Number: 62779-410
Number of Currently Registered Products: 2

**EPA**
- View the label in the US EPA Pesticide Product Label System (PPLS)
- View the label in the Accepted Labels State Tracking and Repository (ALSTAR)

**RH-3066 40WP FORMULATION PRODUCT**
EPA Registration Number: 62779-410
TX Product Number: 0203957

- Company Number: 62779
- Dow Agriculture LLC
- 5330 ZENNIVILLE RD
- INDIANAPOLIS, IN 46263-1054
- Registration Year: 2010
- Action Ingredient: Myclobutanil (128567)
- Percent: 40.000%

**RALLY 40WP FUNGICIDE**
EPA Registration Number: 62779-410
TX Product Number: 0475059

- Company Number: 62779
- Dow Agriculture LLC
- 5330 ZENNIVILLE RD
- INDIANAPOLIS, IN 46263-1054
- Registration Year: 2010
- Action Ingredient: Myclobutanil (128567)
- Percent: 40.000%
### Management practices and estimated costs (per ha/yr) for control of grapevine trunk diseases in California vineyards

#### Preventative measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delayed pruning</td>
<td>$0</td>
</tr>
<tr>
<td>Double pruning</td>
<td>$247.00</td>
</tr>
<tr>
<td>Protect pruning wounds – hand</td>
<td>$135.00</td>
</tr>
<tr>
<td>Protect pruning wounds – tractor</td>
<td>$127.50</td>
</tr>
</tbody>
</table>

#### Post - infection

<table>
<thead>
<tr>
<th>Measure</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replant specific vines</td>
<td>$401.38</td>
</tr>
<tr>
<td>Replant whole block</td>
<td>$37,050.00</td>
</tr>
<tr>
<td>Retrain cordon</td>
<td>$277.88</td>
</tr>
<tr>
<td>Retrain trunk</td>
<td>$988.00</td>
</tr>
<tr>
<td>Sanitation</td>
<td>$222.30</td>
</tr>
</tbody>
</table>

What are Effective Products Against Canker Pathogens?

- DMIs, some have activity against Eutypa (Rally)
- Stobulurins, no activity,
- Benzimidazole – Excellent activity against all pathogens (Topsin M)
- B - excellent activity against Eutypa (B – LOCK)
- Viataseal with or w/o Rally + Topsin M
  - Paint
  - Spray (1:9 dilution)
- Biologicals- good activity if on wound 2 weeks before inoculation (Trichoderma, Cladopsorium)
ACRECIACTIV® is a new generation molecule.

Download ACRECIO specimen label, Acrecio SDS, or product brochure.

TECH-GRO B-LOCK

Vine Seal

Tech-Gro B-Lock is a specialty product produced by Nutrient Technologies for grape vines that forms a physical, impenetrable barrier on pruning wounds to speed up the plant's natural healing process and keep spores that cause eutypa dieback out.

B-Lock is a unique elastomeric "paint" with 5% Boric Acid that is liberally applied to fresh pruning wounds and stretches as the plant grows without breaking the seal. B-Lock is not a fungicide, instead it forms a physical barrier as the pruning wound heals that helps protect plants from spores and therefore infection from the fungus, which ultimately leads to a loss of the vine.

Eutypa dieback is a perennial canker disease of grapevine (Vitis vinifera) caused by Eutypa lata. The fungus produces ascospores, which infect grapevines through pruning wounds during the dormant season. Management of the disease has been achieved with fungicide applications during the dormant period. However, no effective fungicide was available for this purpose after Benlate was withdrawn from the market.

Control

• Double pruning or late pruning or late pruning has shown to be effective in significantly reducing infection by:
  • Eutypa spp., Phaeo spp., and Botryosphaeriaceae spp.,
  • B-LOCK,
  • Vitaseal,
• Currently Rally and Topsin M registered for tractor application,
• Recommend Rally + Topsin in tank with non-ionic spreader Freeway/Pentra Bark
  • Application by machine is relatively fast and highly effective in control,
  • Topsin M and Rally have been shown to be good pruning wound protectants against Botryosphaeriaceae, Eutypa lata (Diatrypeaceous), Pal and Pc infection.
Updates on Grapevine Viruses

26TH ANNUAL GULF COAST GRAPE GROWER FIELD DAY
Cat Spring Agricultural Society Hall
13035 Hall Road
Cat Spring, TX 78933
Friday, February 2, 2018
Virus Biology

- Obligate parasites - must have living host to replicate, cannot be cultured/grown in the classic way such as on growth media,
- Reproduce only inside infected cells,
- Depend on the aid of vectors (insects, nematodes, humans), propagation or the environment for their dissemination (spread).
Grapevine Leafroll Disease (GLRaVs)

- Most widespread,
- Associated with several distinct closteroviruses,
- Most GLRaVs belong to genus Ampelovirus,
- *Grapevine leafroll-associated virus 3 (GLRaV-3)* is predominant.

![Photo: Rayapati Lab]
GLRaVs Symptoms: Leaf Rolling

Merlot

Chardonnay

Photo: Rayapati Lab
‘Leafroll-like’ Symptoms

P deficiency

GLRaVs

Mechanical Injury
Transmission of GLRaVs

- Understanding of virus vector life cycle useful for disease management
GLRaVs Spread Within Vineyard

GLRaVs incidence = 20%

Photo: M. Al Rwahnih
GLRaVs Spread Within Vineyard

GLRaVs incidence 5 years later = >60%

Photo: M. Al Rwahnih
Negative Impacts of GLRaVs

- Reduced fruit load,
- Delayed and uneven ripening,
- Reduced sugar,
- Increased acidity,
- Dependent on variety, clone, rootstock, site, season, leafroll type and strain,
- Mixed infections of multiple viruses often results in enhanced negative impacts.

Photo: M. Al Rwahnih
Redblotch disease is becoming an Emerging threat to the sustainability of the US grape industry
GRBaV is widespread in the US

Source: M. Al Rwahnih
Grapevine redblotch-associated virus

- Posses a circular ssDNA genome
- Three-cornered Alfalfa Hopper, *Spissistilus festinus*, identified recently as a vector
  - Other vectors currently being investigated
Impacts of Redblotch

Source: Poojari et al., 2013
Virus Survey in Texas Vineyards

- Sample collection
  - Growers and Viticulture Specialists
- Sample preparation, ELISA and/or RT-PCR
- Gel electrophoresis
173 samples were collected in 36 vineyards during 2016-2017.

Each sample was tested for the presence of 10 major grapevine viruses by Reverse Transcription-PCR (RT-PCR):

- *Grapevine leafroll-associated virus 1* (GLRaV-1), GLRaV-2, GLRaV-3, GLRaV-4,
- *Tobacco ringspot virus* (TRSV),
- *Grapevine fanleaf virus* (GFLV),
- *Grapevine virus A* (GVA), GVB,
- *Grapevine rupestris stem pitting-associated virus* (GRSPaV), and
- *Grapevine red blotch virus* (GRBV).
Austin, Hildalgo, Gillespie, Terry, McClenann, Hockley, Walker

Austin, Hildalgo, Gillespie, Terry, Harris, Victoria, Lynn, Walker
Blanc du Bois
(GLRaV-3+)
Redblotch Symptoms on Victoria Red

Photo credit: Fran Pontasch
Top three viruses detected

- 50% GRSPaV
- 40% GRBV
- 22% GLRaV-3

n=173
Predominance of Mixed Infections

- 23% no virus detected
- 30% single virus infections
- 47% 2-4 different infections

n=173
In the 2016 survey, *Tomato ringspot virus*, transmitted by a nematode *Xiphinema americanus* was detected in vineyards near Brownfield and McAllen, TX, two widely dispersed AVA regions.

2017 Soil samples collected from the TRSV positive vines--*Xiphinema sp.* detected.

Managing Grape Virus Diseases

- Propagate clean nursery stocks
  - Buy only from certified nurseries
- Practice area-wide vector management
  - Use IPM tactics: insecticides, parasitoids, mating disruption
- Manage virus alternative hosts
  - Free-living grapes in riparian habitats
- Overall goal is to ‘Start Clean’ and ‘Stay Clean’
Possible future endeavors to collaborate on the effects of Red Blotch or Leaf roll virus infected grapevines, targeting Blanc du Bois versus uninfected grapevines with respects to yield characteristics, glucose, fructose, total acids, and pH levels in the grapes.

Select one or two vineyards (based on current survey data) for systematic survey/sampling to choose a vineyard for the research.

Determine possible vectors in Texas vineyards.
Thanks to the Senate Bill 881
And the Gulf Coast grape growers

Questions?