14 Protection of grapevine pruning wounds against Eutypa dieback

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• Eutypa dieback, caused by the fungus *Eutypa lata*, is a serious disease worldwide which reduces yields and shortens the lifespan of the vine. The fungus can release its spores after as little as 2 mm of rain. The spores then enter pruning wounds where they germinate and grow into the wood, eventually causing dieback. Disease symptoms include small, yellow, sometimes cupped, speckled or dead-around-the-margin leaves; stunted, zig-zag shoot growth; and cordon dieback. Wine quality often suffers due to uneven berry maturity.

• *Benomyl* was until now a relatively effective fungicide against *E. lata*, but with its recent withdrawal from the market, an alternative fungicide is needed. Still, the effectiveness of benomyl and other chemical fungicides is very dependent on rainfall. For this reason, the idea of a biological control agent able to colonize the pruning wounds and compete with *E. lata* regardless of environmental conditions is a very desirable proposition.

• In this study, researchers evaluated the efficacy of various **chemicals** and **biological agents** against *E. lata* (see below). The chemicals were first tested *in vitro*. Those products showing the highest activity (benomyl and flusilazole) were subsequently tested *in the field*. Researchers conducted two field experiments: In **Experiment 1**, the product under evaluation was sprayed on the pruning wounds, and the wounds were immediately artificially inoculated with spores of *E. lata*. This trial took place during two seasons (2001, 2002) in two Cabernet Sauvignon sites (Durbanville and Stellenbosch, South Africa). In **Experiment 2**, seeking to achieve a more realistic scenario, no artificial inoculation was conducted, and the spores were instead left to the whims of natural *E. lata* infection. This trial spanned two seasons (2005, 2006) and involved 4 vineyards planted to Cabernet Sauvigon, Sauvignon blanc, Red Globe, and Bonheur, respectively.

Chemical fungicides	*Biological agents*
• benomyl • flusilazole • myclobutanil • tebuconazo • fenarimol • trifloxystrobin • kresoxim-methyl • azoxistrobin • fenhexamid • mancozeb • pyrimethanil	• *Bacillus subtilis (EE)* • Eco77® *(Trichoderma harzianum)* • Eco77® *+ sticker* • Trichoseal-Spray® *(T. harzianum)* • Bio-Tricho® *(T. harzianum)* • Vinevax® *(T. harzianum)*

• **Results.**

1) Flusilazole, tebuconazol, benomyl, fenarimol and miclobutanil were the most effective fungicides in vitro (with EC_{50} values of 0.005, 0.01, 0.19, 0.29, and 1.48 µg/mL, respectively). *[**EC_{50} value** is the concentration of fungicide at which mycelia growth is inhibited by 50%. The lower the EC_{50} value, the stronger the fungicide].*

2) Benomyl and flusilazole were the most effective fungicides in the field, reducing *E. lata* infection by 90% and 89% respectively. The biological agents Eco77, Eco77 (+sticker), and Trichoseal-Spray were also effective in the field (34%, 28% and 28% reduced infections, respectively). Bacillus subtilis and Bio-Tricho failed to reduce infection levels, which were similar to the inoculated control.

3) Benomyl and flusilazole proved effective against pathogens other than *E. lata*, such as *Phaemoniella chlamydospora* (77% and 82% reduction, respectively); and flusilazole was able to reduce *Phomopsis* spp. infection by 53%, compared to the inoculated control.

• The authors point out that biological control agents require a period of time to colonize the pruning wound before becoming effective. For this reason, they believe that the artificially high inoculums used in some of the current trials would almost always favor chemical agents versus biological agents. Under natural conditions, however, biological control agents might be more effective than observed here.

• Some general recommendations to minimize Eutypa include: 1) pruning late in the dormant season, and 2) reducing inoculum levels by removing, burying or composting infected vine parts. Studies showed that the resulting compost is safe to spread back in the vineyard. Other factors such as age of the pruned wood, wound size, and wound position on the vine were shown to have no influence on infection susceptibility.

• **Conclusions.**

- *Benomyl*, followed by *flusilazole*, were the most effective chemical fungicides against *E. lata*. Even though benomyl is currently allowed in South Africa, it has been banned in the US;
- *Bacillus subtilis* was not effective at all against E. lata;
- *Trichoderma harzianum* products (T77, Trichoseal-Spray, Vinemax, Eco77) had variable results. In the presence of high disease pressure, they were able to significantly reduce *E. lata*, but when disease pressure was low, efficacy was inconsistent. Adding a sticker did not increase the ability of *Trichoderma* to colonize wounds. Even though Trichoderma-based products continue offering hope as biological control agents, based on what we know today their performance is still inconsistent.

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