Use of oregano essential oil to enhance defense of grapevine towards downy mildew

Level: BSc or MSc internship
Start: June 2022 (start of field work, preparation of project can start earlier in Nijmegen)
Duration: 12 to 36 ec
Location: Nijmegen (lab and greenhouse) with possibly field experiments in Limburg, near Maastricht
Project form: Plant work and lab work
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Grapevine (*Vitis vinifera*) is sensitive to a broad spectrum of diseases, like powdery mildew, *Botrytis* and several trunk diseases. However, for most viticulture regions, downy mildew is the most feared pathogen. At temperatures above 10 degrees C and with adequate precipitation this oomycete can destroy a complete harvest within a couple of days. On the leaves, yellow spots appear before they die off, and berries turn black and dehydrate (Gessler *et al.,* 2011 for more background info). For this reason, farmers in conventional viticulture frequently apply synthetic fungicides. Organic viticulture (outside the Netherlands) relies on the use of copper-based fungicides. Copper acts as a fungicide, but is also a heavy metal, accumulating in the soil. As such, it negatively affects soil life and also aquatic life as a consequence of leaching. During rainy summers, copper needs to be re-applied very frequently, since its mode of action is based on contact.

During the last decades there has been an intensive search to find reliable and environmentally friendly alternatives to synthetic and copper-based fungicides. Examples of products tested range from plant-beneficial microorganisms to so-called inducers of plant defense, both natural and synthetic. Additionally, essential oils, compost extracts and plant extracts for direct suppression of downy mildew have been evaluated (Dagostin *et al.*, 2011; Weltzien *et al*., 1987). Often these products seemed very promising in a controlled environment (lab and greenhouse), but were not reliable and/or successful enough in the field. This reduced effect has frequently been attributed to low rainfastness and/or rapid degradation of the product by UV, heat and moisture. Having success with these products thus is very dependent on timing and frequency of application and weather conditions.

The risk and intensity of downy mildew infestation in grapevines is dependent on a range of different factors. Apart from certain weather patterns, the immune system of the plant plays an important role. As soon as a plant is under attack, processes are initiated, which e.g. trigger apoptosis (programmed cell death) of infested tissues, thereby isolating the pathogen. The plant can also produce chemicals which inhibit the pathogens growth.

Immune response time and intensity upon pathogen attack can substantially be improved by a process called 'priming'. If the plant is being wounded or comes in contact with pathogens, plant-beneficial microbes or certain chemicals, it switches to a state of heightened alert. **Recent experiments have shown that also volatile compounds of essential oils can prime defense of grapevine (Rienth *et al.,*2019).** Short, but intense exposure of grapevines to both thyme and oregano oil proved enough to prevent 95% of downy mildew damage during at least ten subsequent days.

For more environmentally friendly viticulture it is necessary to trigger plant defense in a reliable and practical way. **Above mentioned results provide a promising basis for further research. This could focus on the underlying process (e.g. oil compositions and active substances), but certainly also on reliable and practical distribution of these volatile compounds in a (more) natural environment.**

References

Gessler *et al.,* 2011 - Plasmopara viticola a review of knowledge on downy mildew of grapevine and effective disease management

Dagostin *et al.*, 2011 - Are there alternatives to copper for controlling grapevine downy mildew in organic viticulture?

Weltzien *et al*., 1987 - Untersuchungen zur Wirkung von Kornpostextrakten auf die Pflanzengesundheit

Rienth *et al.,*2019 - Oregano essential oil vapour prevents Plasmopara viticola infection in grapevine (Vitis Vinifera) and primes plant immunity mechanisms