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Effects and Controls of Downey Mildew of Grapes

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***Abstract*— Downey Mildew is important disease in commercial grapes in India. Downy mildew is an extremely serious fungal disease of grapes that can result in severe crop loss. It is caused by the fungus Plasmopara viticola. The pathogen attacks all green parts of the vine, especially the leaves. Lesions on leaves are angular, yellowish, sometimes oily, and located between the veins.This disease causes direct yield losses when flowers, fruit, and shoots become infected. Indirect losses result when premature defoliation impacts fruit quality, predisposes vines to winter injury, and reduces fruit set in the season.**

***Index Terms*— Downey Mildew, Disease, yield, fruit, losses, etc**

I. INTRODUCTION

Just like all plants that grow in a natural environment, grapes and their development are highly dependent on the weather. Sufficient rainfall, good soil quality and moderate sunlight are a guarantee for optimal plant growth - and make the vintner happy. But, unfortunately, not only the grapes is strongly dependent on the weather, but also its worst enemies are: fungal diseases. This article is about the fungal disease Downy mildew. Many german farmers may remember 2016, when one of the most common fungal diseases, Downy mildew (Pathogen: Plasmopara viticola) , destroyed up to 50% of the yield in some vineyards. A catastrophe. What had happened? After a mild winter, enormous amounts of precipitation, up to 430 liters in January, pelted the vineyards. In addition, there were fewer hours of sunshine than at any time in the last 35 years. The result: perfect weather conditions for the infection and spread of downy mildew on grapevines. But how exactly does this fungal disease behave, how does the weather favor the spread of this fungus, and how can it be predicted?

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Among the low rate copper formulations, copper hydroxide and copper sulphate have been tested.

Among the natural substances alternative to copper formulations we have tested: phytostimu-lant, homeopathic products, acid clay-based products (bentotamnio), resistance promoters (chitosan and lignosulfonate), plant extracts (orange extract, propolis and equisetum) and potassium bicarbonate. All natural substances, with the exception of plant extracts and po-tassium bicarbonate, were tested in association with low rate copper formulations.

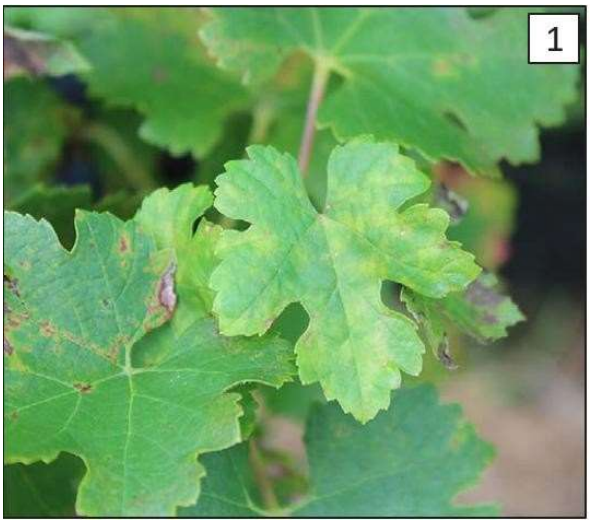

Figure 1. Downey Mildew begins as yellowish green lesions that developr on upper leaf surfaces

Figure 2. Expanding Lesions can appean shiny & are often referred to as Oil Spots.

II. Symtoms and Sign

A. Leaves

Early in the season, infected leaves develop yellowish-green lesions (FiGURe 1) on their upper surfaces that can appear shiny (often referred to as "oil spots") (FiGURe 2). As lesions expand, the affected areas turn brown (necrotic) or mottled. Severely infected leaves may curl and prematurely drop from vines. The disease also affects older leaves in late summer and autumn, producing a mosaic of small, angular, yellow to red- brown spots on the upper leaf surface that become necrotic (FiGURe 3). Lesions are commonly limited by leaf veins. The pathogen sporulates on the underside of foliar lesions, producing the white, downy fungal-like growth that is characteristic of this disease (FiGURe 4).

B. Fruit

Infected green fruit turn light brown to purple, shrivel, and detach easily. White, downy sporulation is abundant on diseased berries during humid weather (FiGURe 5). Diseased berries are easily detached from their pedicels leaving a dry stem scar. Fruit become resistant to downy mildew infection about 3 to 4 weeks after bloom, but cluster stems (rachis), fruit stems (pedicels), and leaves remain susceptible throughout the growing season.

C. Shoots

When young shoots, petioles, tendrils, or cluster stems are infected, they frequently become distorted, thickened, or curled (FiGURe 6). White, downy sporulation can be abundant on the surface of infected areas. Eventually, these tissues wither and die.

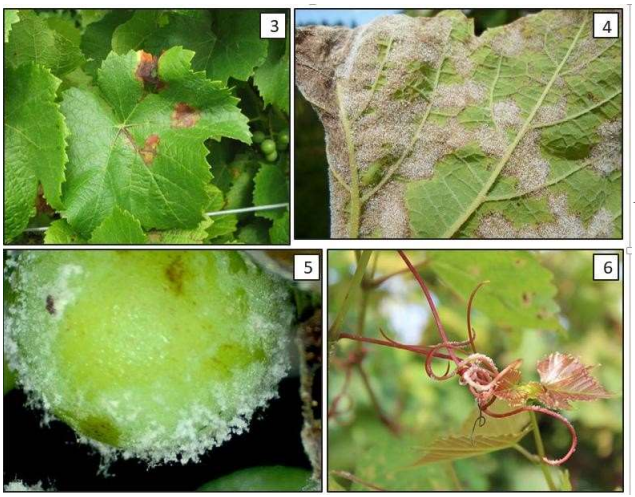

Figure 3. Advanced lesions develop a mosaic of yellow to red brown spots limited by leaf veins

Figure 4. White, Downey Pathogen sporulation that is characteristic for downey mildew develops on the underside of foliar lesion

Figure 5. The Downey Mildew Pathogen sporulates on infected fruit when weather conditions are wet or humid.

Figure 6. Downey Mildew infected shoots and tendrils become thickened and distorted.

III. CAUSE & DISEASE DEVELOPMENT

Downy mildew is caused by the fungus-like organism (oomycete, water mold) Plasmopora viticola. This organism overwinters as thick-walled oospores in leaf debris on vineyard floors. During wet periods in spring, oospores germinate to form sporangia. The sporangia, which are disseminated by wind or rain-splash, release small swimming zoospores when free water (e.g., rain or dew) is present. Zoospores are disseminated by rain splash to grape tissues, where they swim to the vicinity of leaf stomata (tiny natural pores mainly located on leaf undersides). Infection occurs when zoospores form germ tubes that invade the inner plant tissues through stomatal openings.

The pathogen can infect all green, actively growing parts of the vine that have mature, functional stomata. Visible lesions can develop in about 5 to 7 days after infection, depending on temperature and relative humidity. At night, during periods of high humidity and temperatures above 55oF, the pathogen produces sporangia (capsules containing zoospores) capable of initiating secondary infections. These sporangia are produced on numerous branched structures that protrude out through stomata and give the leaf its typical downy appearance.

IV. DISEASE MANAGEMENT

A. Planting Site

Establish a new vineyard in a site with full sun, particularly in the morning, to encourage drying.

Orient vineyard rows toward the prevailing winds in order to provide good air circulation to facilitate drying. Avoid low lying, poorly drained sites.

B. Cultivar & plant selection

Avoid planting highly susceptible grape cultivars. In general, vinifera (*Vitis vinifera*) cultivars are much more susceptible than American types, with French hybrids somewhat intermediate in susceptibility. A list of cultivar susceptibility is available in the *Midwest Fruit Pest Management Guide* (ID-232).

Purchase disease-free planting material from a reputable nursery.

C. Cultural practices

Follow a training system and leaf removal practices that promote rapid drying of plant tissues (good air circulation) and increase sunlight penetration. Opening the canopy also improves fungicide spray penetration. Manage weeds to aid in improving air circulation and drying.

Avoid use of overhead irrigation; opt for soil-directed irrigation. Prune and destroy (remove from the vineyard) diseased plant material during the dormant season. Use a cart or tarp to load and haul debris; avoid dropping

D. Fungicides

Follow a full-season fungicide program when producing susceptible cultivars. The period from pre- bloom through 3 to 4 weeks after bloom is critical for controlling fruit or cluster infections. However, additional sprays may be necessary post-harvest to protect foliage from infections that cause premature defoliation late in the season.

Commercial growers should refer to the *Midwest Fruit Pest Management Guide* (ID-232) for specific fungicide names, timing, and applications rates.

V. Disease Forecasting

Utilize disease prediction models, which analyze local weather data and help growers determine risk for infection. Using prediction models, growers apply fungicides only during periods of high risk, resulting in fewer applications when compared to calendar-based spray programs.
Kentucky growers should refer to the UK Ag Weather Center site for disease prediction models related to grape.

VI. Conclusions

The results of the field trials showed that, in condition of high pressure of P. viti-cola (2004), only the copper formulations guaranteed a good downy mildew con-trol, while the substances alternative to the copper were not able to ensure a satisfactory protection. In conditions of low infection of P. viticola, (2005 e 2006) the symptoms of the disease appeared only on the leaves and both the copper formulations and the alternative substances showed an anti-downy mildew capability; in these conditions it has not been possible to draw exhaustive conclusions because of the low infec-tion of P. viticola. In conditions of middle-low infection of P. viticola, that charac-terized the trial carried out in 2007, the formulations alternative to the copper were able to guarantee a satisfactory protection, especially on bunches. No phototoxic effects has been found, during the four-year of field trials, in the different theses. Further studies are needed to test the anti-downy mildew effectiveness of other natural substances and to verify if the formulations alternative to the copper, that have resulted to be effective in condition of low and middle infection of P. viti-cola, are able to guarantee satisfactory results even in conditions of high pressure of diseases

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