Relationships between vine vigour and the incidence of grey mold and powdery mildew in Aranel grapevines.

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Introduction

The extensive use of pesticide products for protecting grapevine against pathogens, such as grey mold and powdery mildew, can result in the pollution of superficial and subterranean waters. To face this problem, integrated pest management systems have been developed in vineyards. They are generally based on epidemiological models [1] and\or on observations of attacks in the vineyard. However, they do not take into account the state of the canopy, *i.e.* its growth and architecture. Nevertheless, vinegrowers and pathologists recognize the importance of the relationships between vine vegetative vigour and sensitivity to fungi attacks [2] although these relations are poorly documented in the literature. For exemple, experiments carried out in France on grapevine cv Chenin showed a high positive correlation between *Botrytis cinerea* symptoms and vine vigour (expressed as weight of pruned canes) [3]. In this context the objective of this study was to investigate the possible positive relationship between grapevine vigour and the final level of grey mold and powdery mildew.

Material and methods

The research was carried out in 2004 and 2005 on an experimental vineyard located near Montpellier (43°31' N-3°51' E) in the Mediterranean area. The soil was deep and homogeneous, classified as clay loam. The vines (*Vitis vinifera* L. cv *Aranel* grafted onto Fercal rootstock) were planted in 1998 with a density of 3333 vines ha^{-1} and common commercial practices were carried out to maintain the vineyard. In order to create different vine vigour levels, three types of cropping systems were used: i) chemical weed control all over the soil surface (D), ii) perennial cover crop sown with a mixture of tall fescue (*Festuca arundinacea* Shreb) and ray grass (*Lolium perenne* L.) in every inter-row (F), iii) semi-perennial cover of barley sown in autum and mowed at vine flowering (B). This treatment was studied only in 2005. Weeds growing under the vine rows were controlled with glyphosate. Every treatment was divided into two blocks differing by their slope (1: slope near 0 %, 2: slope near 2 %). In 2005 a new treatment, irrigated (3300 m^3 ha^{-1}) fertilized (80 Kg N ha^{-1}) and under chemical weed control (T) was added. Vine growth was measured on 20 canes per unit plot (one plot = cropping systems x soil slope) by counting leaf number by shoot from budbreak to maturity. In 2005, powdery mildew was artificially inoculated with *Uncinula necator* conidia to get a uniform intensity of primary infection [4]. For grey mold, natural infection was favoured. At maturity stage, bunches were scored to assess grey mold and powdery mildew incidences. Scores were carried out non destructively by visually estimating the incidence (%) of fungal symptoms.

Results

The rain regime differed in 2004 and 2005. In 2004, the winter and spring rains reloaded the soil water resources whereas 2005 was characterized by a strong aridity and the soil water profiles were not fully refilled. This resulted in a significant decrease in vine growth whatever in all non-irrigated plots in 2005 compared with 2004 (Fig. 1). Significant differences in vine growth were observed from full bloom onwards with vine shoots producing about 1 and 3 leaves day^{-1} $shoot^{-1}$ in 2004 for D and F treatments, respectively. In 2005, development rates were 40 to 80 % lower than in 2004 for all treatments excepted in the irrigated plot which produced a maximum of 3.4 leaves day^{-1} $shoot^{-1}$. The vine growth in treatment B was very close to that of D1 and D2 plots (Figure 1). This situation is due to a weak barley growth which did not compete with grapevine for water and nitrogen resources.
When the leaf number per shoot from all plots was plotted against the corresponding symptom level (Figure 2), a strong positive correlation was observed between grapevine vegetative vigour and incidences of powdery mildew as well as grey mold. More symptoms were observed for powdery mildew than for grey mold, because the powdery mildew fungus does not need high air humidity conditions or free water on berries for developing.

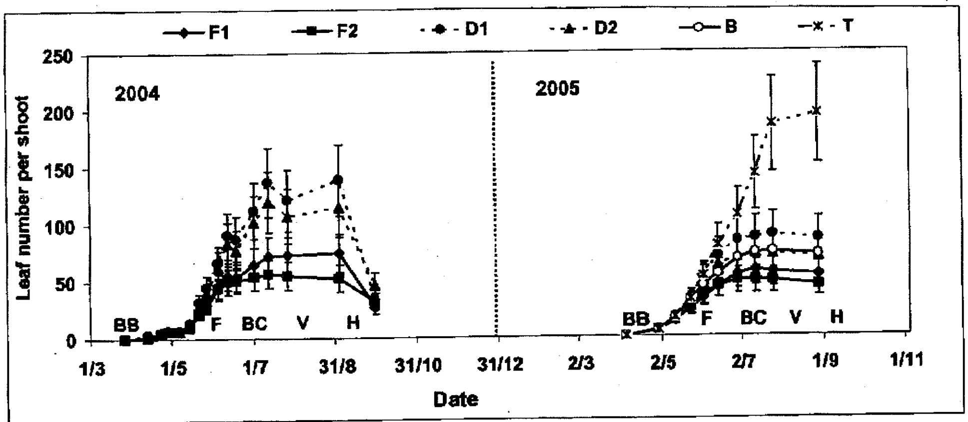

Figure 1. Time course of the leaf number per shoot in 2004 and 2005 seasons in the weed controlled (D), perennial intercropped (F), annual intercropped (B) and irrigated (T) plots. 1: slope near 0 %, 2: slope near 2%. BB=budbreak, F=vine flowering, BC=bunch closure, V=veraison, H=harvest. The bars are the standard error.

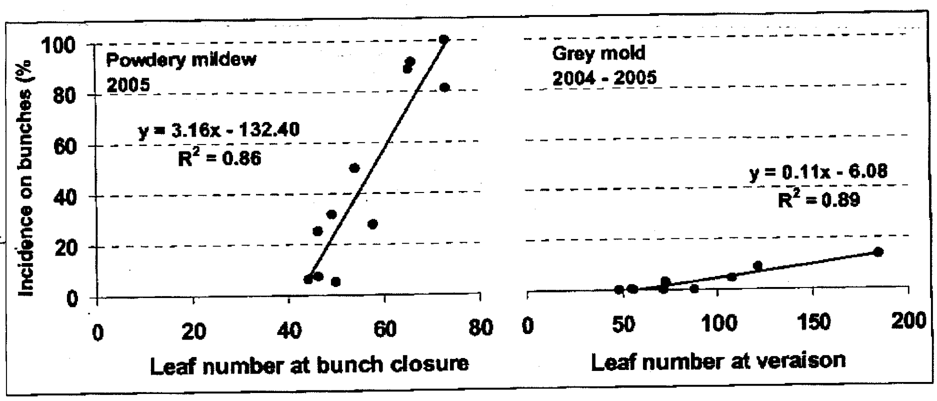

Figure 2. Correlation between leaf number per shoot and powdery mildew (PM), and grey mold (GM) incidences on bunches at harvest

Discussion and conclusion

In this experiment, the intercrop competed with grapevine for water and nitrogen resources (data not shown). This competition led to a dramatic decrease in vegetative vigour as shown by the dynamics of leaf number per shoot. This reduction in foliar canopy development hampered the development of powdery mildew and grey mold, considering the good correlations between leaf number and the incidence of both deseases. However the mechanisms that may explain these correlations are different. For powdery mildew the rate of leaf production during the grapevine flowering period is crucial. For grey mold, decreasing the foliage density during the véraison-harvest period is a very important way to make microclimatic conditions, and possibly also berry characteristics, less favourable to *B. cinerea*. These results are promising for developing integrated pest management strategies and associated decision rules based on indicators of vegetative vigour and assessments of both crop susceptibility and disease pressure.

References

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