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Increase in *Cladosporium* spp. populations and rot of wine grapes associated with leaf removal

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ABSTRACT

Leaf removal reduces the epiphytic populations of several filamentous fungi found on grapevine (*Vitis vinifera*). Consequently this practice is used to prevent foliar diseases of grapevines and rots of grapes. In this study, the effects of leaf removal on Cladosporium rot (*Cladosporium cladosporioides* and *Cladosporium herbarum*), which often affects 'Cabernet Sauvignon' in Chile, were characterized. The effects of leaf removal on epiphytic populations of *Cladosporium* spp. on grape berry surfaces and on Cladosporium rot development were investigated. Three leaf removal treatments were compared: (i) severe leaf removal, where leaves from two to three nodes above, opposite and from all nodes below clusters were removed; (ii) mild leaf removal, where leaves opposite each cluster were removed; and (iii) no leaf removal. Regardless of the leaf removal treatment, low population levels of *Cladosporium* spp. were detected early in the ontogenic development of grape berries which increased as the berries matured, reaching maximum populations on overripe berries. Based on our results, severe leaf removal favors the growth of *Cladosporium* spp. on grape berries and increases the prevalence of Cladosporium rot at harvest. This increase in *Cladosporium* spp. was correlated with an increase in lenticel damage in 'Cabernet Sauvignon' and 'Sauvignon blanc' vines subjected to severe leaf removal. Considering that Cladosporium rot significantly reduces yield and wine quality, farmers should avoid continuous exposure of grape clusters to sunlight in order to prevent severe outbreaks of Cladosporium rot.

1. Introduction

Cladosporium rot, caused by *Cladosporium cladosporioides* and *Cladosporium herbarum*, is a common disease of grapevines (*Vitis vinifera* L.) in Chile, particularly in 'Cabernet Sauvignon' vines that are commonly harvested very late in the season, when grapes are partially senescent (Briceño and Latorre, 2007, 2008). This delay in harvest appears to be needed to obtain a complete phenolic ripeness of the berries to ensure aroma and flavor development for optimal wine quality (Saint-Cricq et al., 1998). However, a delay in harvest favors Cladosporium rot, which reduces yield and affects the quality of wines (Briceño et al., 2009; Pszczólkowski et al., 2001).

Leaf removal has been demonstrated to be an effective canopy management strategy to reduce the incidence and severity of foliar diseases and rots of grapevines (Chellemi and Marois, 1992; Duncan et al., 1995; Gubler et al., 1987; Stapleton and Grant, 1992; Stapleton et al., 1995). Consequently, farmers normally remove leaves from the basal portion of the shoots, leaving clusters exposed to air flow and sunlight after bloom, a practice that affects the microclimate of grapevines by increasing temperature and reducing relative humidity (English et al., 1989).

Numerous fungal genera have been recovered from the surface of grape berries, including species of *Aspergillus*, *Botrytis*, *Cladosporium*, *Penicillium*, and *Alternaria* (Díaz et al., 2009; Donoso and Latorre, 2006; Thompson and Latorre, 1999). The populations of these species increase as the berry mature. This was demonstrated for a population of *Cladosporium* spp. that developed on the surface of apparently healthy grape berries (Briceño and Latorre, 2008).

This study was conducted to determine the effect of leaf removal on the epiphytic populations of *Cladosporium* spp. and on the development of Cladosporium rot on wine grape clusters.

2. Material and methods

2.1. Plant material

Leaf removal experiments were conducted in commercial 'Cabernet Sauvignon' and 'Sauvignon blanc' vineyards, in Alto Jahuel (33°43′60″S, 70°42′0″W) and 'Cabernet Sauvignon' in Alhué (33°21′00″S, 71°08′00″W). Both localities are characterized by a Mediterranean climate, with rains concentrated in winter months

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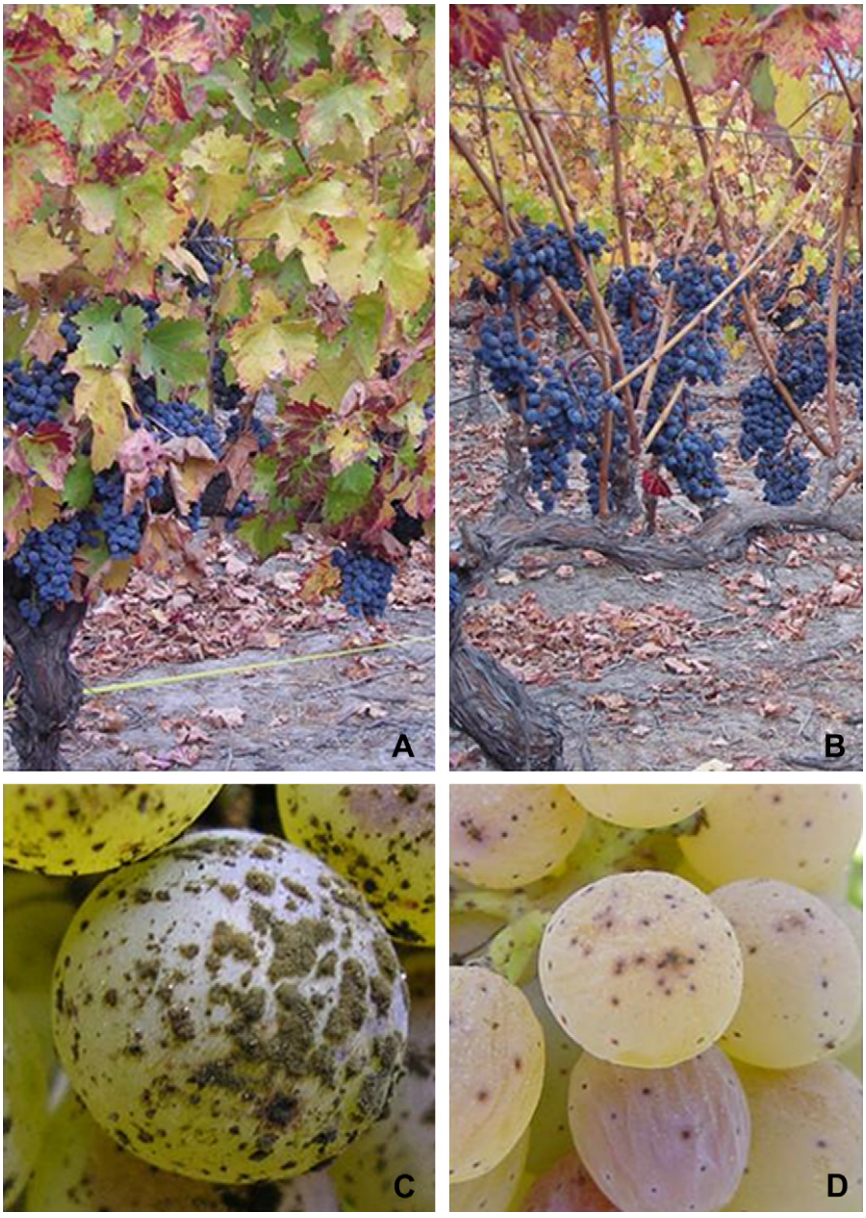

Fig. 1. Grapevine (*Vitis vinifera*) 'Cabernet Sauvignon' subjected to a non-defoliated vine treatment (A) and a severe leaf removal treatment (B). Cladosporium rot (C) and lenticel damage (D) developed on 'Sauvignon blanc' grape berries in vines subjected to a severe leaf removal treatment.

and warm summer months. The 'Cabernet Sauvignon' and 'Sauvignon blanc' vines were 7 and 15 year-old, respectively, and planted on their own roots at 2.5 × 1.2 m, with rows oriented north to south and trained in a bi-lateral cordon trellis system with three wires at 0.9, 1.2 and 1.5 cm above ground. In all experiments, grapevines were managed as is customary for wine grapes in Chile (Gil and Pszczólkowski, 2007), except that foliar fungicides were not applied.

2.2. Leaf removal

The effect of three leaf removal treatments on Cladosporium rot and lenticel damage were studied: (i) severe leaf removal, consisting of removing leaves from two to three nodes above, opposite each cluster, and leaves from all nodes below clusters, leaving them exposed to sunlight continuously from fruit set to harvest. (ii) Mild leaf removal, consisting of removing leaves opposite each cluster about 4–5 weeks after fruit set, and (iii) no leaf removal, where non-defoliated plants were left as controls (Fig. 1). In all experiments, leaves were removed manually on the east and west side of the vines. However, evaluations were made separately on each vine side, considering that light interception on the east side of vines oriented north to south varies between 8 and 10 h, in contrast to 12–19 h on the west side (Gil and Pszczólkowski, 2007; Smart, 1973).

2.3. Effect of leaf removal on the dynamic of Cladosporium ssp.

The effect of leaf removal on the epiphytic populations of *Cladosporium* spp. was monitored from the date of leaf removal (fruit set) through harvest on grapevines 'Cabernet Sauvignon', subjected to a severe leaf removal treatment in Alto Jahuel in 2007 and 2008 and Alhué in 2008. For each sample, 50 berries were randomly selected, suspended and shaken for 5 min in 50 ml of sterile 0.05% Tween-80 for 5 min. An aliquot (100 μL) of each suspension was sprayed in a 90 mm diameter Petri dish containing acidified potato dextrose agar (2% dehydrated mashed potatoes, 2% glucose and 20 g L^{-1} agar plus 0.5 ml L^{-1} 92% lactic acid added after autoclaving)