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A REDUCTION OF VINE VIGOUR IN CABERNET SAUVIGNON (*VITIS VINIFERA* L.) DECREASES BUNCHSTEM NECROSIS.

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ABSTRACT

Bunch stem necrosis (BSN) is a physiological disorder in grapes, which results in unripe shrivelled berries with poor quality attributes. Past research into this area is conflicting with many different hypotheses being proposed to explain the disorder. Vines on SO4 rootstock, a high vigour rootstock, have demonstrated high incidence of BSN and the published literature has also indicated that shading of vines at a particular time may influence BSN incidence. In this study, it was proposed that there was a positive relationship between vine vigour and BSN incidence due to a shift in the source-sink relationship between the developing fruit and vine growth for key mineral elements such as calcium, potassium and magnesium. Treatments to manipulate shoot vigour and the source-sink relationship were applied to Cabernet Sauvignon grape vines growing on SO4 rootstock. Treatments included root pruning to reduce vigour, heading back of canes and the application of a reflective mulch (Extenday) to increase vigour, 50% shading for three weeks prior to flowering, and 50% shading for three weeks after flowering. A strong positive relationship between vigour and BSN incidence was determined in the first growing season. In the following season, where all treatments were reapplied except root pruning, the relationship was not as strong but was still positive. Root pruning still reduced BSN and vigour in the second season, just as heading back of the canes and the reflective mulch increased vigour and BSN incidence. Environmental conditions between the two seasons were very different and this may have influenced the observed responses. Neither shade treatment significantly changed the vigour of the vines in either season. Shade prior to flowering reduced BSN incidence in both seasons. However, shade after flowering only influenced the BSN incidence in the second season where the BSN incidence was increased. It is proposed that the shade treatments had a direct affect on the source-sink mechanism rather than manipulating the vigour of the vine. These results provide evidence that some management practices are available to manage this disorder but their effectiveness will be influenced by the prevailing environmental conditions especially around the time of flowering.

INTRODUCTION

Bunch stem necrosis (BSN) is a complex physiological problem in grapes. It results in shrivelled unripe berries which are detrimental to wine quality (Ureta *et al.*, 1981). Symptoms occur at any time after berry ripening (veraison) and include the appearance of dark necrotic spots on the pedicel, rachis or peduncle (Fig 1) which can then spread and girdle the affected area (Morrison and Iodi, 1990). Results from research into this problem tend to be contradictory and therefore no one conclusive explanation for the disorder has been found, although environmental

factors are believed to contribute. These include weather conditions (Holzapfel and Coombe 1995) as well as the nutritional status of the soil, vine or bunch (Christensen and Boggero, 1985). The objective of this study was to investigate the possible positive relationship between vine vigour and BSN incidence due to a shift in the sink-source relationship between the developing fruit and vine growth.

MATERIALS AND METHODS

Treatments

Thirteen treatments were imposed on Cabernet Sauvignon vines on SO4 rootstock on a Montana vineyard in Hawke's Bay, New Zealand in the 2002/2003 and 2003/2004 seasons (Fig 2). These included:

- Root pruning 25 cm on either side of the vine to a depth of 60 cm, prior to bud break (2002/2003 season only),
- Heading back of cordons by half prior to bud break,
- Reflective mulch (Extenday) 0.5 m wide both sides of the vines prior to bud break and left until leaf fall,
- Shade (50%) three weeks prior to full bloom (FB) for three weeks, and
- Shade (50%) post FB for three weeks.

Interactions of the main treatments were included but the number of treatments used did not allow a full factorial experimental design. The interactions were: root pruning with heading back, root pruning with Extenday, root pruning with shade prior FB, root pruning with shade post FB, heading back with Extenday, heading back with shade prior FB and heading back with shade post FB.

Treatments were arranged in a randomised complete block design, with five-vine plots in eight blocks, although only one selected vine within each bay was used for the assessments.

Harvests were carried out on the 27 March 2003 and 1 April 2004 for seasons one and two, respectively.

Assessments

Vine vigour was determined by measuring leaf layer number (LLN) of the canopy. This was measured by the point quadrant method (Smart and Robinson, 1991). Nineteen points at each of three levels (fruiting zone, middle and top wire) were assessed for each vine measured. LLN was determined four times throughout the season between flowering and harvest.

BSN severity was determined by visually estimating the percentage of BSN per bunch on each vine measured. Scores were then averaged over all bunches on individual vines to obtain an average BSN severity per vine. In season one, BSN severity was scored fortnightly from one week after 100% veraison to one week prior to harvest. In season two, it was scored weekly from 100% veraison to harvest.

RESULTS AND DISCUSSION

In season one, harvest occurred at the time of commercial harvest. This was not at normal commercial maturity due to the unfavourable weather conditions at the time and the resulting degradation of the bunches. In season two, harvest was carried out at a similar physiological stage to season one when measured from 50% veraison of the control treatment. However, due to the duration of veraison being shorter in season two, harvest in the second season was one week later

than season one when measuring from 90% veraison (data not shown). Maturity of bunches as determined by laboratory analyses also showed that bunches were more mature in season two at the time of harvest (data not shown). Commercial harvest of bunches in season two was carried out two weeks after the harvest of bunches in the respective treatments.

Vine vigour

The treatments had a significant impact on vine vigour (Fig 3). Root pruning, although imposed only at the start of the first season, markedly reduced vine vigour in both years. The reflective mulch consistently enhanced vigour, while shading had little impact. Different prevailing environmental conditions in each of the two seasons markedly impacted on vine vigour overall. In year two, where rainfall was higher between flowering and veraison, vigour was much higher and vine trimming was more severe and more frequently applied in order to contain growth.

Bunch stem necrosis

The severity of BSN varied widely amongst treatments (Fig 4) from minor amounts (<5%) to very significant amounts (>25%). Control values indicated that the amount of the disorder was typical for this variety on this vineyard. The patterns of severity amongst the treatments were generally similar between seasons.

A strong positive relationship between vine vigour (LLN) and BSN incidence was determined in the first season ($R^2=0.76$; $p>0.002$), but a weaker relationship was determined in the second season ($R^2=0.15$; $p>0.306$).

The severity of BSN was always high in those treatments that stimulated vegetative development (such as Extenday and heading) and lowest in those treatments that suppressed vigour (especially root pruning). Where interactions were studied, one factor tended to dominate the observed response.

There is strong evidence that the vigour of vines influenced the severity of BSN. It is suggested that this is due to a shift in the source-sink relationship between the vegetative canopy and the developing fruit, probably through the amount of key elements such as calcium, potassium and magnesium available to the developing berries. Management techniques that influence this source-sink relationship through suppressing vine vigour may therefore be used to reduce the BSN severity within those vines. Therefore, practices such as root pruning may be available in some vineyards to manage this disorder. However, the effectiveness will be influenced by the prevailing environmental conditions especially around the time of flowering. Further research into how vigour affects the source-sink relationship, and therefore BSN incidence, is being carried out.

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Figures



Figure 1: Bunch of healthy Cabernet Sauvignon grapes (left) and a BSN affected bunch (right).



Figure 2: Treatments applied to Cabernet Sauvignon vines at Montana vineyard, Hawke's Bay, New Zealand. Shade cloth and reflective mulch treatments are readily apparent.

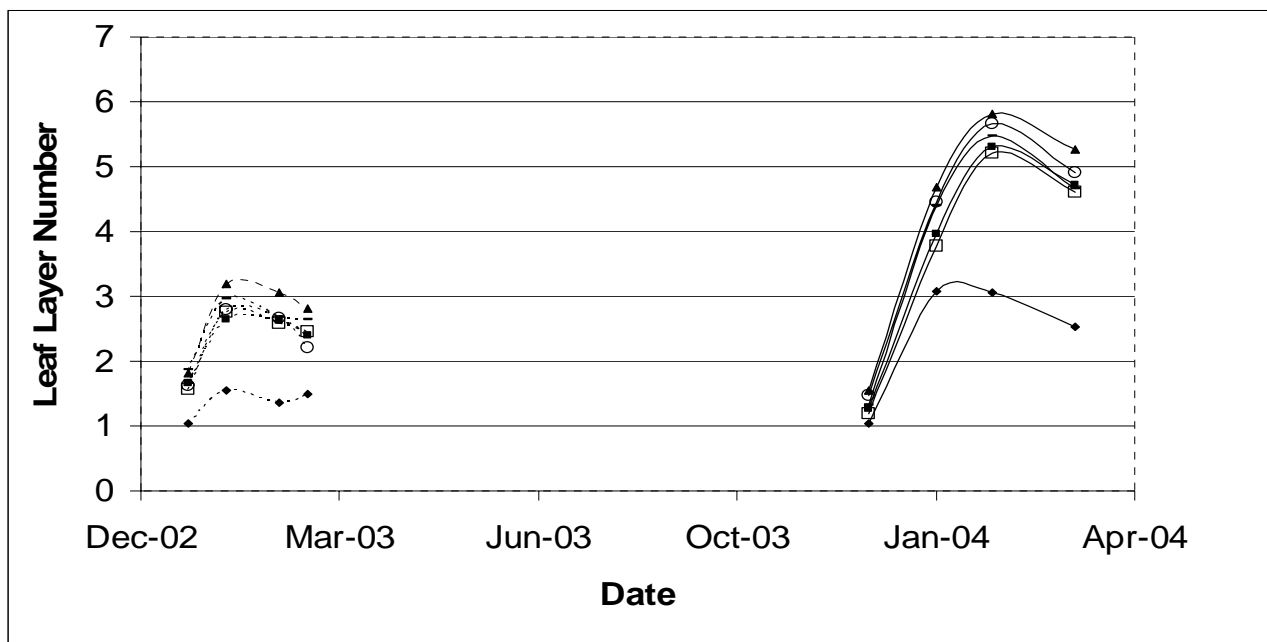


Figure 3: Average vigour of vines for seasons one (dotted lines) and two (solid lines). Treatments are control – open circle, root pruned – closed diamond, headed back – open square, Extendday – closed triangle, shade pre FB - dash, shade post FB – closed square.

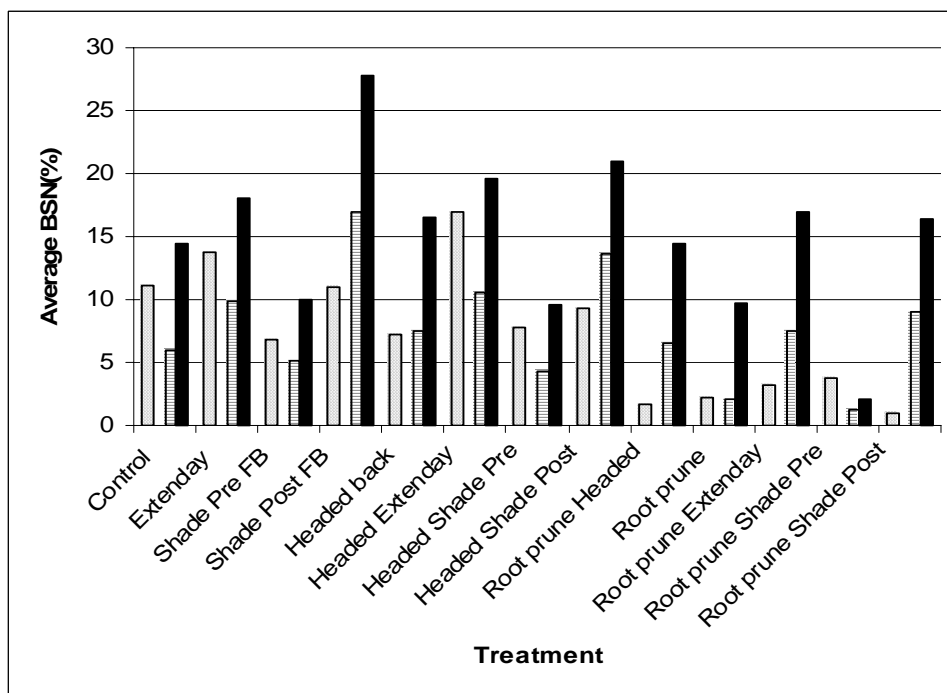


Figure 4: Average BSN severity for three different dates over two seasons. Dots, week of harvest season 1 (27/03/03); stripes, one week prior to harvest season 2 (24/03/04); filled, week of harvest season 2 (1/04/04).

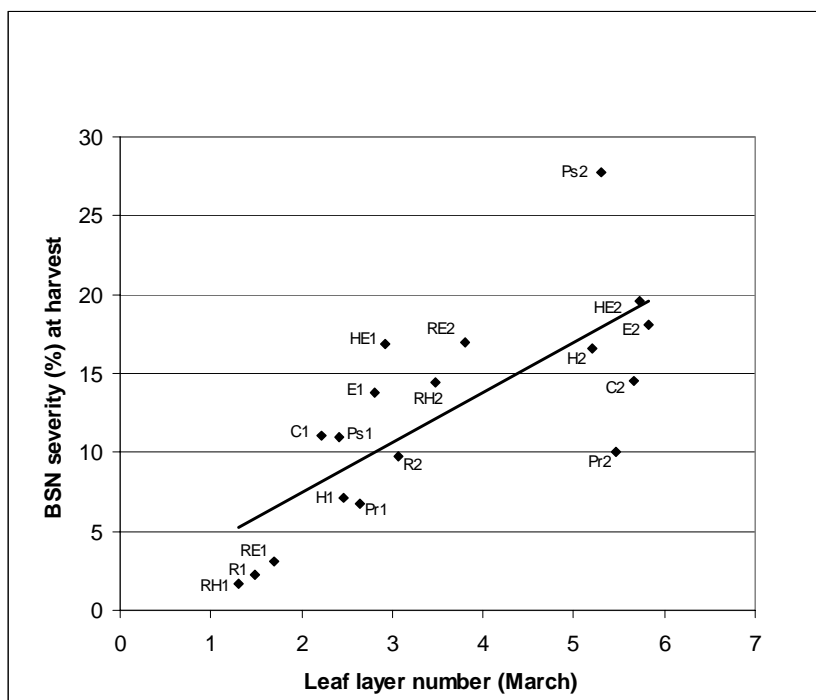


Figure 5: The relationship between BSN severity and vine vigour. $R^2=0.568$ ($p>0.0003$) for the two seasons of the study combined. 1=season one, 2=season two, C=control, E=Extenday, H=headed back, R=root pruned Pr= shade pre FB, Ps=shade post FB.