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Freeze Damage of Pinot noir (*Vitis vinifera L.*) as Affected by Bud Development, INA Bacteria, and a Bacterial Inhibitor

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The following abstract is from the thesis of Alfonso Gardea. Alfonso worked on a range of topics relating to frost injury of Pinot noir. His research was supported in part by the Oregon Wine Advisory Board. Some of this work will be presented in more detail in future issues of the Wine Advisory Board Research Report.

Spring freeze decreased the yield of field grown grapevines by 70%. The spring bud development of Pinot noir was characterized into seven stages after the initial budbreak, 96% of the buds attained full development in 44 days. Controlled freezing tests were used to determine bud hardiness. The T50 values (temperature when 50% of buds are damaged) for quiescent, swollen, bud urst, first, second, and third flat leaf bud stages were -14, -3, -2.2, -2, -1.7, and 1.1^{o}C, respectively. The water content increased from 57 to 84% frorn the quiescent to the swollen bud stage, thereafter little change occurred. A high correlation was found between hardiness, water content, and stage of bud development.

Genotype and culture age affected the ice nucleation activity of three *Pseudomonas syringae* strains (*P. syringae* is common bacteria found on grapevines). The cells attained stationary phase of growth after 60 hr. in culture. The INA (ice nucleation activity) of PssB15 occurred in the range of -2 to-4^{o}C throughout the 7 days of evaluation. Pss2-3RNH INA was prevalent in 3-day-old cultures only. Pss2-3 was a poor ice nucleator. The INA of bacterial suspensions was directly proportional to concentrations ranging from 10^{9} to 10^{2} cells/ ml, which nucleated ice from -2.5 to -15.1^{o}C. INA-bacteria at 10^{8} cells/ml incited freeze injury to grape leaf tissue specifically from -2 to -4^{o}C.

Frost Gard, a commercial chemical promoted as a freeze protectant, did not show antifreeze action (in water solutions) at concentrations of 0, 0.12, 0.25, 0.50, and 1%. At these concentrations, the water solutions froze at -11.6, -12.0, -11.8, -11.7, and -12.5^{o}C, respectively, suggesting that the water ice nucleation temperature depended on the amount of impurities in the solutions. Frost Gard at 0.25, 0.50, and 1% had a strong bactericide effect on a bacterial suspension of 8 X 10^{9} cells/ml. The same concentrations also lowered the nucleation temperature to -4.5, -6.9, and -5.2^{o}C compared to the control suspension at -2.5^{o}C. It was concluded that Frost Gard binds with the active site of nucleation since it strongly interacted with an inorganic ice nucleator. Frost Gard at 0.25% applied to grape leaf disks reduced the damaged area by 7% only at -2^{o}C. Phytotoxicity due to Frost Gard was observed at rates above .25%.

Grape cuttings were used to test the capacity of an antibiotic resistant strain of *Pseudomonas syringae* to

translocate through the vascular tissue. The cuttings were placed in bacterial suspensions of ca. 10^2, 10^4, and 10^6 cells/ml for 24, 36, and 48 hr. Bacterial populations recovered were inversely proportional to the length of the cutting section regardless of the time of exposure to the inoculum. It was determined that the liquids moved faster through the vascular tissue than the bacteria.