ANATOMICAL DEVELOPMENTS AND THE ROLE OF CARBOHYDRATE OR MINERAL NUTRIENT DEFICIENCY IN BUD NECROSIS OF 'RIESLING' GRAPEVINES (*VITIS VINIFERA* L.)

by

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(ABSTRACT)

Bud necrosis (BN) is observed as an abortion and death of one or more primordia of the developing compound winter bud. Anatomical developments during the onset of BN in 'Riesling' and 'Chardonnay' grapevines were characterized. Examination of ultrathin (1μm) sections of 'Riesling' buds under a light microscope revealed a zone of compressed cells immediately beneath the primary bud axis within 60 days after budbreak. Cell rupture occurred in that zone within 90 days after budbreak. Scanning electron microscopy revealed a similar pattern of tissue destruction. Based on the hypothesis that BN was caused by essential substrate deficiency, localized carbohydrate deprivaton was attempted by shading of 'Riesling' grapevines and by shoot tip removal. In one experiment, 92% shade was applied for a three-week period at 20, 40, or 60 days after budbreak in one vineyard and at 40 days after budbreak in another vineyard. In another experiment, 92% shade was applied for a 40-day period at 25 or 65 days after budbreak. Shade reduced photosynthetic photon flux (PPF) in the fruit zone of canopies to <2% of ambient PPF. The first experiment did not increase BN. However, the second experiment increased BN in the distal nodes of the shaded vines compared to the control vines. Shoot vigor, measured as shoot diameter and internode length at season's end, was positively correlated with BN in shaded as well as unshaded vines. The frequency of necrotic buds was greater at nodes 5 through 16 than at nodes 1 to 4 in both shaded and unshaded vines. Levels of total nonstructural carbohydrates (TNC) measured spectrophotometrically, were not significantly affected by shade treatment. Levels of sucrose, glucose, fructose, and starch in bud, leaf, and stem tissues determined by HPLC, were lower in shaded vines at the point of shade removal than in unshaded vines. Therefore, although three-week periods of shade did not affect BN in 'Riesling', 40-day periods of shade increased BN in distal nodes. Shoot tip removal increased BN at nodes distal to node 12. Bud tissues of shoot-tipped vines had lower levels of sucrose, glucose, fructose, and starch than did the control vines. Carbohydrate analysis of bud, leaf, and stem tissues indicated that

‘Riesling’ vines (BN-prone) had lower levels of sucrose compared to ‘Chardonnay’ vines (BN-insensitive). Role of mineral nutrient deprivation was examined in ‘Riesling’ and ‘Chardonnay’ buds and the results indicated that BN is unlikely caused by essential nutrient deficiency. ‘Chardonnay’, the BN-insensitive cultivar had greater levels of starch deposits at 50, 60, 70, and 80 days after budbreak than did the BN-susceptible cultivars, ‘Riesling’, Syrah’, and ‘Viognier’. Starch deposits in grape buds were negatively correlated with BN incidence. From these experiments it can be concluded that a negative correlation between carbohydrate levels of grape buds and BN incidence exists.

Keywords. grape, physiological disorder, vigor, shade, shoot tipping