CHAPTER 5
CONCLUSIONS

Anatomical observations by light and SEM revealed that BN usually occurred at nodes distal to node 5 on current season shoots. The first visual appearance of BN was occurrence of distorted cell walls approximately 60 days after budbreak in 'Riesling' vines. BN was first observed as localized groups of cells with distorted cell walls, followed by apparent compression and pleating of cell walls ultimately leading to cell wall collapse. In the preliminary stages of BN, the compressed zone of cells was observed at the base of the primary axis, but as the season progressed, the compression zones advanced to the nodes of the primary axis. Vascular bundles were also affected in some cases. Very few 'Chardonnay' buds showed distorted cells. Furthermore, 'Riesling' vines of Willowcroft, Virginia and New York had less BN compared to 'Riesling' vines of Somerset, Virginia and Prince Michel, Virginia suggesting an environmental effect on BN occurrence and intensity. Cell wall pleating and collapse indicates the involvement of carbohydrate or mineral nutrient deprivation in BN incidence.

Effect of localized carbohydrate and mineral nutrient deprivation on BN occurrence was also studied. Changes in localized carbohydrate levels was attempted by artificial shading and shoot tipping. 'Riesling' and 'Chardonnay' vines from Prince Michel Vineyard, Virginia were surveyed to determine mineral nutrient and carbohydrate levels in bud, leaf, and stem tissues. Shade studies indicated that a three-week period of artificial shade applied either 20, 40, or 60 days after budbreak did not increase BN in 'Riesling' while a 40-day period of shade applied 25 or 65 days after budbreak increased BN in distal nodes (9-20) of 'Riesling' vines. Lack of sunlight over long periods of time did appear to be involved in BN incidence. A positive correlation between BN of 'Riesling' and shoot vigor, expressed as shoot diameter or average internode length, was observed. Basal nodes of shoots had less BN than the more distal (5 - 16) nodes. Therefore, as suggested by Wolf and Warren (1995) management practices that regulate vigor as well as spur pruning might be effective as compensatory practices. Analysis of TNC levels did not reveal any significant difference between shaded and non-shaded vines. Shade caused a significant decrease in sucrose, glucose, fructose, and starch levels (analyzed by HPLC) in bud, leaf, and stem tissues at the point when shade was removed. However, at subsequent samplings the carbohydrate concentrations in tissues of shaded vines were comparable to control vines. Rate of net photosynthesis was lower in shaded vines compared to the control vines. High BN incidence in the distal nodes might have been caused by an apparent carbohydrate deprivation in the young distal buds.

Shoot tipping was done 40 days after budbreak leaving ≈ 18 nodes on shoots. BN was higher at nodes distal to node 12 in shoot-tipped vines than in non-shoot-tipped vines. Lower levels of sucrose, glucose, fructose, and starch were observed in the bud tissues of shoot-tipped vines than in the control vines. Therefore, a negative relationship between sucrose, glucose, and starch and BN incidence is indicated to some extent.

Results of the mineral nutrient survey in 1995 suggested that BN is not caused by whole vine or localized deficiency of an essential element. The nutrients examined decreased in the bud tissue as the summer progressed in both 'Riesling' and 'Chardonnay' vines. Carbohydrate analyses indicated that sucrose levels might be related to BN incidence as levels of sucrose was lower in 'Riesling' vines which had higher BN compared to 'Chardonnay' vines. However, sufficient evidence to prove causality is not present.

Visual starch staining studies revealed an increase in starch deposits in grape buds as the summer progressed. The BN-tolerant cultivar 'Chardonnay' had significantly higher levels of starch compared to the BN-sensitive cultivars, 'Riesling', 'Viognier' and 'Syrah'. There was a node position effect as well in 'Chardonnay' and 'Riesling' cultivars, in that the basal six nodes had a higher quantity of starch than did nodes 7-13. However, there was no node position effect for starch in 'Viognier' or 'Syrah'. BN incidence was the highest for 'Viognier' followed by 'Syrah', 'Riesling', and 'Chardonnay'. A node position effect for BN was also observed in 'Riesling' and 'Chardonnay' wherein both cultivars had higher BN in the distal 7 to 13 nodes than in the basal six nodes. From this study, it can therefore be concluded that there is a negative correlation between BN susceptibility and level of starch in the buds.

But it should be emphasized that this study only shows correlations with BN incidence, and cause and effect relationships are lacking. Therefore, since fundamental causes of BN remain elusive further research in this field is required. Nevertheless, proper management and pruning practices can help to minimize the yield losses due to this disorder.