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Research Note

Correlating ELISA values with the growth and yield components of GFLV infected grapevines

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Summary: Growth and yield components of Cabernet Sauvignon on AXR#1 rootstock infected with grapevine fanleaf virus (GFLV) were determined and compared to enzyme-linked immunosorbent assay (ELISA) values. Negative correlations were found between ELISA values and berry weights, cluster weights, and crop yield. No correlations were found between ELISA values and pruning weights or berry numbers. The nature of the correlations suggest that virus titer is not the only factor which influences symptom expression in GFLV infected grapevines.

Key words: fanleaf, GFLV, disease expression.

Introduction: Fanleaf degeneration caused by grapevine fanleaf virus (GFLV) and vectored by the dagger nematode, *Xiphinema index*, is a serious and debilitating disease of grapevines. This disease greatly reduces crop yields due to poorly filled clusters with numerous unfertilized "shot" berries (Martelli and Savino 1988). Serological detection of GFLV using the enzyme-linked immuno-sorbent assay (ELISA) has been described (Monette 1985, Rowhani 1992, Rowhani *et al.* 1992). However, ELISA values have not been associated with disease expression. The objective of the present study was to determine if correlations could be made between ELISA values obtained from infected vines and reductions in crop yield or vine growth.

Materials and methods: Three fanleaf degeneration infected vineyard blocks in the Napa Valley of California, were selected and designated as Sites 1, 2, and 3. *X. index* was present at each of the sites and all sites were treated with a preplant fumigation of methyl bromide. Each 36 vine x 36 row site was planted with Cabernet Sauvignon on AXR#1. Both rootstock and scion sources were certified. Site 1 was planted in 1980, Site 2 in 1985 and Site 3 in 1981.

About 0.5 g of shoot tips were randomly collected from each of the vines at each site (about 3,880 samples) during April through May 1992. The plant tissue was placed into 5 ml of chilled extraction buffer diluted 1:1 with 100 % glycerin (Rowhani *et al.* 1992), transported to the lab on ice, followed by storage at -20 °C. Samples were homogenized within one week of collection.

GFLV was detected with DAS-ELISA as described by Rowhani *et al.* (1992). Reactions were evaluated after 1 h with a microplate reader at 405 nm. Healthy control ELISA values (N = 272) from microplates used to sample the three sites had a mean of 0.016 and a standard deviation of 0.014 OD 405 nm.

Twelve vines, if available, within 5 ELISA classes (<0.075, 0.075 to 0.150, 0.151 to 1.500, 1.501 to 2.500, and >2.500) were selected from each of three sites (N = 49, 58, and 39 respectively). Fruit from these data vines was collected at about 23°B and number of clusters and total yield were recorded. Three randomly chosen clusters from each vine were transported to the lab where berry counts and weights were taken. Pruning weights were collected the following winter.

Correlations between ELISA values and the yield components, and the pruning weight measurements were determined on the data vines from Sites 1, 2, and 3, as well as on the combined data.

Results and discussion: The lack of a correlation between fruit data and ELISA values at Site 1 was unexpected (Table). The vines at Site 1 were 12 years old and the effects of GFLV infection should have been evident. AXR#1 has been suggested to be more tolerant of GFLV infection than other rootstocks (Walker *et al.* 1994). This finding, in combination with relatively young vines, may have resulted in the lack of correlations. Data on nematode numbers at the different sites was not collected, although previous testing had found *X. index* throughout the three

Table

Correlations between ELISA values and viticultural parameters from vineyards at three sites in the Napa Valley, California. Site 1 includes data from 49 vines, Site 2 includes data from 58 vines, and Site 3 includes data from 37 vines. Pruning weights were not taken for Site 3.

Comparison	Site 1		Site 2		Site 3		All Sites Combined	
	r Value	P Value	r Value	P Value	r Value	P Value	r-value	P-value
ELISA vs average berry wt.	-.171	.2414	-.729	<.0001	-.416	.0097	-.486	<.0001
ELISA vs average berry number	.054	.7149	-.319	.0143	-.402	.0130	-.136	.1626
ELISA vs average cluster wt.	-.012	.9374	-.688	<.0001	-.661	<.0001	-.377	<.0001
ELISA vs crop yield	-.067	.6502	-.546	<.0001	-.154	.3665	-.251	.0089
ELISA vs pruning wt.	-.088	.5479	.127	.3438	—	—	.027	.7865

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sites. It is possible that nematode feeding was less intense at Site 1 and that this influenced symptom expression. In addition, this study examined only one year's worth of fruit and yield data, and fanleaf symptoms may vary over years depending upon environmental factors such as temperature and rainfall at bloom. However, dramatic improvements in yield from one year to the next in other fanleaf degeneration sites have not been observed (WALKER *et al.* 1994).

Data collected from Site 2 showed the anticipated negative correlation between ELISA values and average berry weight, average berry number, average cluster weight, and crop yield (Table). This supports reported effects of GFLV infection, i.e. smaller berries, scraggly clusters, reduced fruit set, and an overall reduction in yield. However, yield reduction did not approach the 80 % cited in MARTELLI and SAVINO (1988).

A reduction in average berry weight, average berry number, and average cluster weight as a result of GFLV infection was also found at Site 3, but there was not an overall reduction in yield (Table).

No significant correlations between ELISA values and pruning weights were found. This may be due to the fact that, as crop loads are reduced, vine growth should improve because of the redirected photosynthates. Fanleaf is a degenerative disease but its negative effect on overall vine growth is expected to be gradual and may not be detected on relatively young vines.

Data collected in this study indicated a negative correlation exists between ELISA values and symptom expression in GFLV infected vines. The data also imply that virus titer is not the only factor that influences symptom expression. Other factors which may have an effect on symptom expression include the rootstock and the scion variety, the length of time the vine has been infected, the number and strains of nematodes attacking the vine, GFLV strains, and cultural practices (particularly with relatively young vines). Vineyard managers knew these sites were highly infected with GFLV. As a result, vines received increased levels of fertilization and irrigation in an effort to offset the expected effects of the disease.

The effect of nematode feeding on symptom expression of GFLV infected vines is unknown. All three sites used in this study were known to be infested with *X. index*, however, the intensity of the nematode attack was not studied and may have varied. Work is needed to distinguish between the effect of GFLV and that of *X. index* feeding on fanleaf degeneration symptom expression.

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