Survival, vertical distribution and management of *Xiphinema index*, the nematode vector of *Grapevine fanleaf virus*

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There are approximately 72,000 acres of grape production in Washington State, of which 48,000 acres is wine grapes (5). More than 70 viruses and virus-like diseases have been reported affecting grapevines; however, wine grape production in WA is mainly threatened by *Grapevine fanleaf virus* and *Grapevine leafroll virus* (8). *Grapevine fanleaf virus* (GFLV) belongs to the genus *Nepovirus* of the family *Comoviridae* (4, 9) and is a severe problem worldwide (6). The characteristic symptom is a ‘fanleaf’, which is characterized by severely distorted, asymmetrical leaves, with abnormally gathered primary veins and yellow mosaics or yellow veins (6, 9). Leaves are cupped and puckered with toothed margins and usually smaller than healthy leaves (6). The disease decreases fruit quality and weakens the vines resulting in yield losses up to 80% (8).

GFLV is transmitted by the dagger nematode, *Xiphinema index*, a migratory ectoparasitic nematode. The dagger nematode acquires the virus when feeding on roots tips of infected plants and transmits the virus when it moves to the root system of a healthy grapevine (10). *Xiphinema index* can survive under extreme temperatures by entering a quiescent phase (3, 13), in which the nematode does not reproduce or feed. The ability of *X. index* to survive and retain GFLV without host plants has been demonstrated in vineyard soils stored at 7 and 20°C for at least 4 years (1). Furthermore, the dagger nematode has been found in high densities at depths from 45 to 75 cm and 90 to 135 cm (2, 11). The inability of chemical products to reach such depths in soil explains the low efficiency in controlling *X. index* (11). Alternative methods are needed to effectively reduce the population density of *X. index* and reduce the impact of fanleaf for the grape industry in Washington.

Recent studies using plants with nematicidal properties and plant extracts have shown some potential for controlling *X. index*. Villate et al. (12) demonstrated effectiveness of plants with nematicidal properties to control *X. index* under greenhouse and vineyard field conditions. The authors showed that *Lupinus albus*, *Guizotia abyssinica*, *Tagetes minuta* and *Melilotus albus* reduced the number of nematodes in the soil compared with the control (no plants) under greenhouse conditions; similarly in vineyards fields, *T. minuta* and *Vicia villosa* reduced the number of *X. index* (12). In the same way, the application of saponins from *Gypsophila paniculata* roots had a lethal effect against *X. index* in aqueous media and in cultured-soil (7). The authors reported that a concentration of 450 µg/ml of a *G. paniculata* saponin extract was enough to kill 50% of the nematode population in aqueous media. On the other hand, in soil samples incubated at 20°C in petri dishes, 150 µg/g of soil of saponins incubated for 7 days caused 73% of mortality of the nematodes (7). These results demonstrated that high concentrations of saponins (225, 300 and 375 µg/g of soil) are not necessary to reduce the number of nematodes. Importantly, saponins did not negatively affect spore germination of *Glomus mosseae*, an arbuscular mycorrhizal fungus involved in root health (7).
References