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Preventing Vineyard Frost Damage

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Proper soil preparation and irrigation can save your crop from frost damage. Two-thirds of the damage that resulted from the spring frost of 1972 could have been avoided with proper cultural practices. For maximum protection, the soil should be moist, firm and weed free.

Weather patterns often shift in the early spring months creating rapid temperature changes in valley vineyards and predictions of a spring freeze are sometimes possible only a day in advance. Therefore, have your soil prepared for frost protection and when frost damage is forecast, start running water.

Hazards of Spring Freeze

Vines are susceptible to frost after budbreak in mid to late March. Weather records indicate a good chance of frost on March 25, but by mid-April the risk of frost is much less. The critical frost danger period is from bud-break until late April.

Susceptibility: Frost injury to green grapevine tissue begins to occur at 31o F after about 30 minutes. The longer the duration and the lower the temperature the greater the damage will be. After several hours at 26 to 28^{o} F, even swelling buds can be damaged.

The youngest tissue is most susceptible. Damage occurs first at the shoot-tip and progresses downward. There are variations in tissue susceptibility since shoots adjacent to one another may show differing degrees of damage after a frost. Some leaf cells can be killed while others remain healthy.

This variation may be explained by the presence or absence of the ice-nucleating bacteria, *Pseudomonas syringue*. Research on citrus and other crops has shown that presence of this bacteria in sufficient number will increase tissue susceptibility to freezing temperatures. Lowering the number of ice-nucleating bacteria with an appropriate bacteriacide can reduce susceptibility.

Soil Preparation: The warmest vineyards have soil that is moist, firm and bare. Moist soil stores much more heat from the sun during the day than dry soil. The heat stored in soil moisture during the day gives off heat slowly at night. Pores in dry soil are mostly filled with air, which is a poor conductor and storer of heat.

Newly cultivated soil is cold primarily because the cultivated surface contains much less moisture reducing the amount of heat stored during the day. After cultivation, soils must be firmed by rainfall or irrigation. If you must cultivate during the frost danger period, disc only as much area as can be furrowed out and irrigated rapidly.

Cover crops, weeds or trash insulates the soil surface from absorbing heat energy during the day. A bare soil surface allows maximum absorption of daytime heat energy. If a ground cover is kept it should be mowed as low as possible.

Soil Surface Guide to Freezing Hazard

This chart compares minimum air temperatures 4 feet above various surface conditions using a sheltered thermometer.

Bare, firm moist ground	warmest
Shredded cover crop, moist ground	1/2^{o} F colder
Low cover crop, moist ground	1-3^{o} F colder
Dry, firm ground	2^{o} F colder
Freshly disced ground	2^{o} F colder
High cover crop	2-4^{o} F colder

Irrigating During Frost Forecast

Irrigating during the freeze can give an additional 1/2^{o} - 1-1/2^{o} F of protection over firm moist soil depending on water temperature. East side well waters are typically 68^{o} - 70^{o} F and canal waters are 40^{o} - 50^{o} F in the spring.

For Greatest Protection: For maximum protection in the spring, cultivate the vineyard before the buds push. Then immediately irrigate to settle the ground and store as much moisture in the soil as possible. Reirrigate as necessary to keep the ground moist. If freezing temperatures are forecast, begin running water to cover as much of the vineyard as possible concentrating on the most susceptible areas.

Drip Irrigation: Cultivating drip irrigated vineyards can be risky in the spring if rainfall is not sufficient to rewet and firm the soil before frost. However, allowing a weed cover to develop also creates a cold condition.

There are several options around this dilemma. Cultipacking or rolling freshly cultivated soil will help firm the ground but replenishing moisture loss can only occur with significant rainfall. Another possibility is to mow the grass cover as close as possible and not cultivate. This will be a warmer condition than high cover crop or freshly cultivated soil. Another possibility is to use a contact herbicide and spray the vineyard solid in January or February. This will result in a weed-free condition during the frost danger period and the soil will remain firm and moist. A drip irrigated vineyard under noncultivation would be an excellent program for maximizing frost protection.

After bud-break and during the critical frost-danger period, running the drip system periodically to thoroughly wet as much soil as possible down the driplines may be beneficial. This maximizes the amount of soil moisture available for storing daytime heat energy. Start the drip system immediately when freezing temperatures are forecast and keep it running until the danger has past.