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HAIL NETTING FOR VINEYARDS

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PROBABILITY/INCIDENCE OF HAIL IN TEXAS

Hailstorms are simply defined as "thunderstorms that contain balls of ice or hailstones that fall from the sky." Hailstones are formed when raindrops are carried upward by thunderstorm updrafts into extremely cold areas of the atmosphere and freeze. Hailstones then increase in size by further colliding with liquid water drops that freeze onto the hailstone's surface. When the thunderstorm's updraft can no longer support the weight of the hailstone—which may occur if the stone becomes large enough or the updraft weakens—hailstones will fall to the Earth's surface. Smaller hailstones can be blown away from the updraft by horizontal winds. Therefore, larger hail typically falls closer to the updraft than smaller hail. For small hailstones (e.g., <1-inch diameter), the expected fall speed is between 9 and 25 mph. For hailstones typically seen in a severe thunderstorm (e.g., 1 to 1.75-inch diameter), the expected fall speed is between 25 and 40 mph. In strong supercells that produce some of the largest hail (e.g., 2- to 4-inch diameter), the expected fall speed is between 44 and 72 mph (*National Oceanic and Atmospheric Administration*).

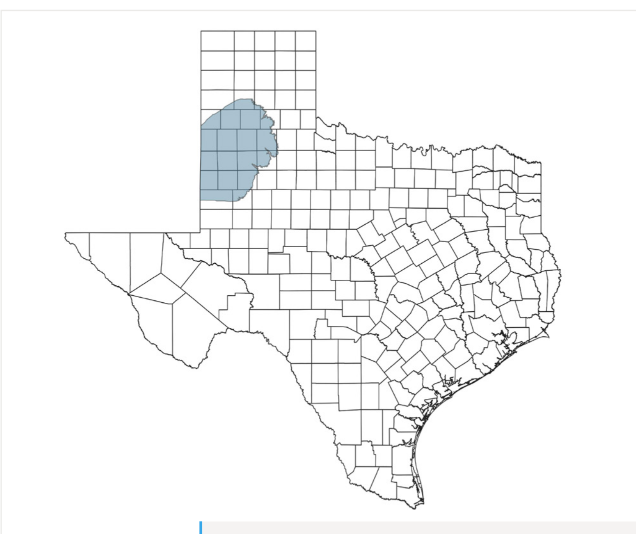

Figure 1. The Texas High Plains American Viticultural Area is highlighted in blue.

The Texas High Plains are higher in elevation (i.e., approximately 3,200 feet) than most of the Central and Eastern thirds of Texas (Fig. 1). This higher elevation positions the freezing point for rain in the atmosphere closer to the ground, which allows for hail to form in less intense thunderstorms than in other parts of Texas. The unique characteristics of the Texas High Plains' geography increases the overall incidence of hail in every rain event that occurs when compared to in other regions of Texas (Fig. 2).

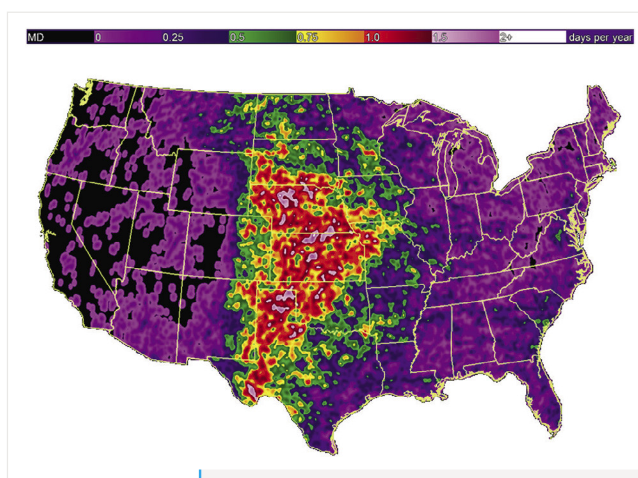

Figure 2. Annual hail days per year during 2007 to 2010 (Brooks and Ortega, 2012).

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HAIL DAMAGE TO VINEYARDS

A major challenge faced by grape producers in the Texas High Plains is the constant threat of hail. Damage from hail can range from small, random spots on leaf blades, impact scars on vine shoots (Fig. 3), complete canopy leaf defoliation (Fig. 4), and to total crop loss (Fig. 5). Hailstorms during the growing season can have a significant effect on the current fruit crop, and even potentially affect the crop in following seasons.

After a hail event, it is important for growers to visually inspect for damage to vines immediately. Even if damage appears to be extreme, vines typically have the ability to recover by regrowing from secondary buds, and impact wounds can "heal" over time. However, the degree of recovery depends on vine health and vigor, the growth stage at which the damage occurred, and the severity of the damage to the fruit and vine itself.

Figure 3. Visible impact scars on grapevine shoots after a hail event.

Figure 4. A young vineyard completely defoliated by hail.

Figure 5. An example of hail damage to grapes, resulting in serious crop loss.

If hail damage is extensive early in the growing season (i.e., between budbreak and bloom), retraining of damaged shoots may be necessary—and pruning may be needed to obtain healthy canes and sufficient bud numbers for the following growing season (Fig. 6). If hail damage occurs later in the season (but before veraison), injured berries may scar-over and continue to develop, or shrivel and drop to the ground prior to the occurrence of rot. At this stage, crop thinning damaged fruit may be an appropriate option for maintaining a homogenous ripening pattern, as new shoots and fruit emerge from secondary buds (Fig. 7).

Figure 6. A vineyard defoliated by hail prior to bloom.

Figure 7. Uneven fruit development from primary and secondary buds.

It should be noted that the fruitfulness of secondary buds is significantly lower than on primary buds, but the magnitude is variety-dependent. For example: Varieties such as Cabernet Sauvignon and Syrah have a relatively greater percentage of fruitful secondary buds when compared to varieties like Riesling or Chardonnay. However, the clusters that form from secondary shoots generally require more time to ripen than the fruit borne on primary shoots. This may ultimately delay harvest and increase the risk of damage from a winter freeze event, particularly on late ripening varieties.

In a mid to late season hail damage scenario (i.e., post-veraison to harvest), retraining vines that have been damaged is not recommended. Shoot loss may stimulate additional new canopy growth from dormant buds. However, fruit ripeness of a second crop will be greatly delayed, and likely not fully ripen. Overall, fruit quality will be severely affected and vine health may be severally impacted. Depending on the severity of the damage, management options range from thinning fruit that has been damaged to completely removing the current crop, allowing vines ample time to recover before dormancy.

Large hail stones have the ability to damage irrigation valves, emitters, tubing, and pipe(s) (Fig. 8). Therefore, growers should carefully inspect their irrigation system following a hail event.

Figure 8. Broken PVC irrigation pipe from a hailstorm.

HAIL NETTING

Hail netting is the most commonly used strategy in the Texas High Plains for mitigating the damaging effects of hailstorms to vineyards. Hail netting is a high-density polyethylene fabric, woven to specific mesh sizes that generally consist of a range of 0.12-inches × 0.35-inches for optimal protection against both small and large hail stones (Fig. 9). This type of netting is available in multiple widths (ranging from 12 to 48 inches) and comes in a variety of colors. Hail netting is generally attached to a guide wire above the canopy. The hail netting is also secured below the canopy to encase the fruiting zone—or entire canopy in a protective mesh layer. The mesh layer is generally flexible enough to absorb the energy from falling hailstones and prevent damage to fruit and the canopy itself.

Once applied in a vineyard, hail netting is rolled up and secured to the top guide wire above the canopy for ease of movement for workers and mechanical implements. After final pruning has occurred, netting is secured into a position around the new growing canopy shoots to prevent damage from early season hailstorms (Fig. 10).

Figure 9. Hail netting is made of a high-density polyethylene fabric.

Figure 10. Hail netting deployed early in the growing season to protect young shoots.

Hail netting can be a large, initial investment, but the material is extremely durable and will usually last for 5 to 10 years. Although the price of hail netting materials varies by size and type (in 2022), the cost of 43-inch wide double woven, non-welded hail net material with 0.16 × .24-inch mesh size was approximately $0.21 per linear foot. Thus, the price per acre cost for a vineyard with 10-foot spacing between rows would be $1,830.

Another strategy that may be used by growers that are unable to make the investment in hail netting is simply planning for a certain degree of damage from hail and adjusting vineyard management practices accordingly. For example: Growers can increase the number of buds left on each vine at pruning, as well as increase the overall vine vigor through increased fertilization. Eventually, hailstorms may thin or reduce the canopy, which may include fruit. If the grower is fortunate and manages to avoid hail, any excessive crop and shoots may be thinned or hedged later in the growing season.

HAIL NETTING AND MECHANIZATION

Most vineyard practices can be carried out as normal when hail netting is deployed. However, to mechanically harvest grapes, hail netting must be relocated to a position that is clear of the fruit zone (Fig. 11). Once rolled out of the fruit zone for harvest, netting is then generally secured and left in place until after final pruning the following winter—until the hail netting is required again. Generally, hail netting within the Texas High Plains region is installed and moved on the trellis by hand labor (Fig. 12). However, hail netting may be moved and secured mechanically.

Figure 11. Mechanically harvesting a vineyard with hail netting.

Figure 12. Hail netting is most commonly applied by hand labor.

IMPACT OF HAIL NETTING ON GRAPEVINE CANOPY MICROCLIMATE

When deployed, hail netting facilitates upright shoot growth but may narrow or compress a grapevine's canopy, reducing spray penetration into the interior of the canopy (Fig. 13). However, a 3-year study conducted in a Malbec and Pinot Gris vineyard in the Texas High Plains revealed no differences in canopy temperature and relative humidity between vines with hail nets and those without netting. Sun light levels beneath hail netting were reduced by approximately 10 percent, but hail netting did not influence vine yields, crop load measured as the Ravaz Index, cluster weights, or berry weight. At harvest, the fruit on vines with hail netting had slightly lower soluble solids than vines that were not netted.

Figure 13. Hail netting can compress the canopy of grapevines, reducing light penetration to the interior.