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Kern Pistachio Notes

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Winter Juvenile Tree Dieback (WJTD) – a Continuing Problem in Pistachio in the San Joaquin Valley

Winter juvenile tree dieback (WJTD) is a problem of juvenile pistachio trees (one to six years old) in the San Joaquin Valley. WJTD symptoms range from mild to severe. Usually, severe WJTD damage to trees is not obvious until May, when trees begin to leaf out after the first run of warm to hot spring temperatures. Damage to the upper branches may be apparent earlier when the trees are pruned during the dormant season. In affected trees, the new spring growth, typically, may push only from the lower scion or rootstock and this growth occurs later than in unaffected trees (see photos 1 and 2).

Photos 1 and 2. Severely affected juvenile trees at leaf-out in spring or later in the summer. Note extent of dieback of branches and areas of regrowth.

Some affected trees show minimal dieback, while many trees in the worst affected blocks die back to the rootstock, or the entire tree is killed. Kerman, Peters, Kalehghouchi and Golden Hills cultivars growing on UCB1, UCB1-clonal material, and PGI rootstocks have been affected. Affected 1st and 2nd leaf trees may die without pushing any new growth.

Additional Observations of severe WJTD are as follows:

a) trees go into dormancy apparently vigorous and healthy;
b) topographically low-elevation orchards (elevation above sea level of less than 300 feet, or which have areas that pond cold air) have most of the WJTD, but damaged trees are often not in the lowest areas of a given orchard;
c) high sodium levels in the soil and water, and soil characteristics such as presence of hardpans, appear to increase WJTD;
d) the scion is usually more adversely affected than the rootstock, but the entire tree may be killed;
e) A tree with WJTD is often immediately adjacent to an unaffected tree, although typically, affected trees appear in clumps;
f) Trees uninjured the previous year may be injured the subsequent year.
g.) juvenile trees are much more susceptible to WJTD than are bearing trees, and usually third, fourth, and fifth leaf trees appear most at risk.
h.) the most vigorous rootstocks, cultivars and growth stages of the pistachio tree appear most susceptible to WJTD.

Cause of WJTD

Currently, the cause of WJTD is thought to be sudden drops in temperature occurring in mid to late fall. The trees are not yet fully dormant and are freezing. Observations to date suggest the plant tissue most at risk is the vascular tissue (the tissue that conducts water up the tree and carbohydrate to the roots). The most exposed vascular tissue is at the graft union appears to be where the scion (the nut producing part of the tree) and the rootstock join.

Reducing damage from frost

Reducing the vigor of a tree in late summer and fall may reduce WJTD. Based on observations made over the last few years, we have suggested that in low-elevation juvenile orchards, many of which have salt-affected and layered soils with hardpans, that irrigation water is turned off for the season at the end of August. Many of these at-risk areas have deep, heavy soils, with considerable water-storing potential, so water must be withheld early, for any significant reduction in vigor to occur. Rootstocks having *P. integerrima* heritage, which the industry in California currently relies on, such as UCB-1, do not appear to become fully dormant until the end of December. Irrigation water, for example, for leaching purposes, should not be restarted until early January. It may also be beneficial to defoliate the trees in late-October with any one of various foliar sprays containing zinc, as another option to reduce vigor. These young trees are much easier to defoliate it they are also subject to fall water stress. Avoiding excessive and late nitrogen applications can also discourage late-season vegetative growth.

Over the past few years, increasingly, growers and researchers have been installing temperature recorders in these at-risk orchards. These recorders have allowed us to begin to make correlations of low temperatures that should begin to cause concern for growers that have made the effort to harden-off their trees prior to winter. These results are very preliminary (see Figure 1). Trees which have not been hardened off may freeze at considerably higher temperatures than those that appear in Figure 1.

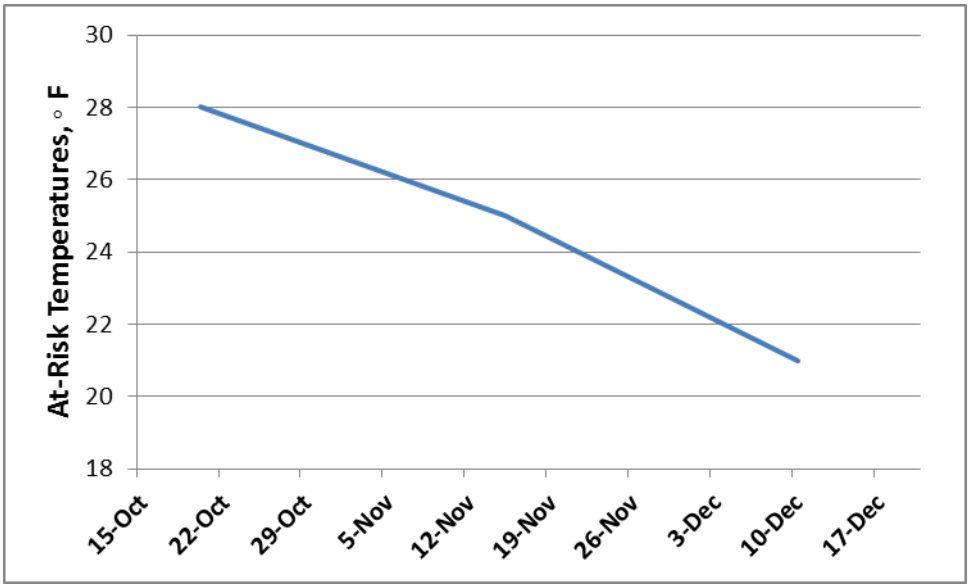

Figure1. Low temperatures (measured at a height of 4 ft. above the ground) on various dates where severe WJTD occurred to moderately hardened-off juvenile pistachio trees in various low-elevation, salt-affected orchards in the southern San Joaquin Valley.

Note in Figure 1, that the temperature at which severe WJTD may occur appears to become increasingly colder as the trees become more dormant. Thus while a 25-degree F. freeze event may cause no damage in early December, it may cause severe damage in mid-November.

Reasons that we are seeing more severe WJTD dieback in recent years may be a combination of increases in planting taking place in very low-elevation areas having salty and layered soils, and the drought, which has reduced fog and dew points. Air that contains a large concentration of water vapor cools much more slowly than dry air. Temperatures can fall drastically on still, clear nights, with air that has very little moisture in it, especially in an area where cold air ponds such as sloughs and old lake beds. In the San Joaquin Valley, a freeze can be especially damaging in early fall, when daytime temperatures can be in the 80s, and night time temperatures can fall suddenly to below freezing.

Leaf Age Effects Leaf Concentration of Some Nutrients in Fully-Expanded Pistachio Leaves

I am limiting this discussion to trees that have not been foliarly sprayed with nutrients because it is very difficult to be sure if the tissue analysis from sprayed trees reflects the true nutrient content of the leaf, or if applied chemicals are merely adhering to the leaf.

It is well documented that leaf nitrogen concentration, for example, will be higher in leaves not yet fully expanded located near the tip of a shoot. I have found this to be true over the course of sampling many juvenile and mature pistachio trees. Also, I have observed that the relative age of what appear to be fully-expanded pistachio leaves can vary considerably along a given branch. If I compare the nutrient concentration of leaflets from recently fully-expanded leaves, with those of older fully-expanded leaves on the same branch or older branches, the concentration of nitrogen (N), phosphorous (P) and potassium (K) are similar, suggesting, indeed, that these younger leaves are mature and close to being fully expanded. The stability of N-P-K, (i.e. the macronutrients), among differently-aged fully-expanded leaves is reassuring. However, if I compare the concentration of many of the secondary and micronutrient cations, between recently fully-expanded and older fully-expanded leaves, I find that the leaflet concentrations of calcium (Ca), magnesium (Mg), boron (B), manganese (Mn) and copper (Cu) can vary significantly based on leaf age. Younger fully-expanded leaves have a reduced concentration of these cations compared to older leaves. Leaves a few inches apart on a branch can vary by a magnitude of 2 or more for these elements. On the west side of the San Joaquin Valley, winds often tatter older leaves, and the tendency is to sample undamaged younger leaves. As one example of differences in cation concentrations based on leaf age, I have copied the tissue analysis reports from two respected laboratories below (entitled Lab 1 and Lab 2). As a matter of note, I did not request the analysis of elements other than those shown from Lab 2.

The separate leaf tissue samples shown below, for the newer and older fully-expanded leaves, were prepared by cutting each sampled leaflet into two parts along the midrib. Values for nutrient concentrations, whether we look at the results between labs for the older or newer leaf samples, were comparable for the common elements analyzed. However, each lab found considerable difference in some of the nutrient concentrations between the older and newer leaves, notably for Ca, Mg, B, Mn and Cu. The obvious concern is that with pistachio, the relative age of the fully expand leaf appears to be an important variable in determining the complete nutrient status of the orchard, and one that I don't think has been fully quantified for the purposes of comparative sampling and determining possible nutrient deficiencies and excesses. I think this observation helps explain the wide swings we see in leaf tissue samples with these cations between years in some orchards. What is noteworthy is that these differences appear to be much more related to the age of the leaves sampled, than to any changes in the soil or general nutrient status of the trees.

Lab Number 1 results for split leaf samples

		----------%----------						----------PPM--------				
		N	P	K	Ca	Mg	Na	Zn	Mn	Fe	Cu	B
1.	Older Leaves	2.51	0.17	1.82	3.21	0.43	0.02	24	33	48	22	145
2.	newer Leaves	2.59	0.17	1.95	1.22	0.20	0.02	21	14	45	13	102

Lab Number 2 results for split leaf samples

SAMPLE #	DESC	S (Total) ppm	B (Total) ppm	Ca (Total) %	Mg (Total)] %
1	older leaves	1570	132.7	2.952	0.385
2	newer leaves	2000	94.6	0.963	0.176

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