Lower Limb Dieback in Almond

Project No.: **07-PATH6-Lampinen**

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Objectives:

Growers in the Sacramento and San Joaquin Valleys have been noticing increasing dieback of lower limbs on almond trees. Beginning in late April, lower canopy leaves on affected trees begin to yellow and eventually turn brown and some drop off while others dry and remain hanging on the affected shoots. Eventually, entire limbs dieback and by late summer significant death of lower canopy wood can occur. Necrotic brown lesions can occur under the bark, primarily on the tops of the limbs around lenticels. Sometimes wedge shaped cankers are also visible on cross sections of affected limbs. Isolations for samples collected for two years (2005 and 2006) from these limbs have indicated the presence of both *Botryosphaeria dothidea* and *Phomopsis* spp. Both these fungi have been reported to cause canker diseases on almond in California and in Europe, Australia, and South America. Although both these fungi have been isolated at incidences up to 50 to 70%, isolations from lower limb dieback-affected shoots were not consistent from all of the almond samples collected in several counties.

Lower limb dieback (LLDB) seems to be most pronounced on the Butte and Padre varieties but has also been observed on Aldrich, Fritz, Neplus, Nonpareil, Sonora and other varieties to a lesser degree. Growers in Stanislaus County suggest the problem usually starts when Butte/Padre orchards reach about 7 to 8 years of age and continues to get worse as the orchard ages. Several growers have indicated the problem is worse in heavily shaded blocks although this does not always seem to be the case, particularly in Butte County orchards.

The objectives of the current study are to investigate the phenomena of lower limb dieback, determine the causative factors and develop methods to overcome the problem.

Interpretive Summary:

Three orchards in Stanislaus County with a history of lower limb dieback were chosen for detailed study in 2007. Orchard #1 and orchard #2 are both flood irrigated Butte/Padre plantings. Orchard #3 is a microsprinkler-irrigated Butte/Padre/Ruby planting. Initial observations and limb sampling were done in early May 2007 in all three orchards. Samples for disease isolations were taken from symptomatic limbs on Butte and Padre trees from all three orchards on May 9, 2007. Midday stem water potential and canopy light interception for the overall orchard and under the tree canopy were measured approximately weekly early in the season when symptoms were increasing and approximately monthly later in the season when symptoms were subsiding. Fungicide treatments were applied in two LLDB orchards in Stanislaus County. The treatments included eradicant and protective treatments.

Results from isolations taken from symptomatic Butte and Padre branches from the three orchards on May 9, 2007 did not produce as much *Botryosphaeria* or *Phomopsis* spp. (Table 1) as the isolations done in 2005 and 2006 when up to 50 to 70% of isolations were positive. No *Phytophthora* species were isolated either (Table 1). Because the symptoms during the 2007 season were mild and decreased over the summer, further isolations were not done during the season.

Table 1. Fungi isolated from almond shoots with LLDB symptoms collected on May 9, 2007

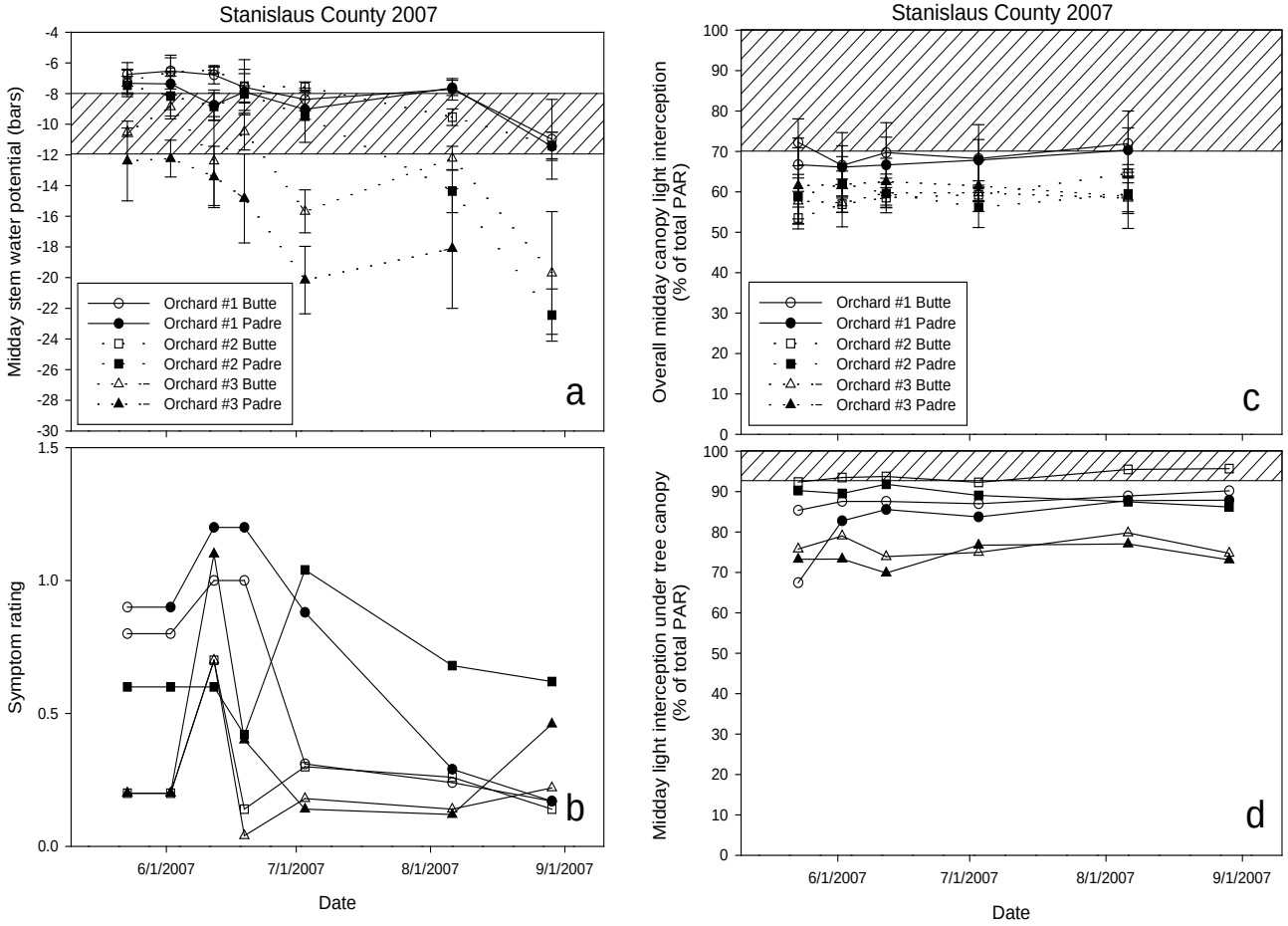
Orchard	Cultivar	Number of diseased limbs yielding pathogen / number of limbs sampled		
		Botryosphaeria spp.	***Phomopsis***	***Phytophthora***
1	Padre, Butte	0/5	2/6	0/5
2	Padre, Butte	0/5	1/6	0/7
3	Padre	1/3	4/4	0/2

Midday stem water potential and light interception

Midday stem water potentials in Orchard #1 and Orchard #2 tended to be wetter than the normal range of water potentials we would expect (shown as crosshatched area on Graph 1a). Auger holes were dug in all three orchards in mid-June. Orchards #1 and #2 had uniformly wet soil down to 5 feet. This information is consistent with the water potential data (Fig. 1a). Orchard #3 had uniformly wet soil to about 4 feet and standing water filled hole at about 5 feet. These data are not consistent since the wet soil would suggest that water potentials should be in the wet range, but the trees were actually mildly water stressed (Fig. 1a). This suggests that the roots may be damaged due to excessively wet conditions, although we would have to monitor soil and plant water

potential earlier in the season next year to confirm this. Lower limb dieback symptoms increased until mid-June and then began to decrease as mid-day stem water potentials fell into the normal range (Fig. 1a, 1b).

Overall canopy light interception was generally not above the 70% level (indicated by shaded area in Fig. 1c) where past experience tells us shading related dieback is likely to occur. Orchard #1 is approaching this level and some parts of the orchard were actually intercepting above 80% of the incoming light (data not shown). Orchards #2 and #3 were well below the light levels where extensive shading related dieback might be expected to occur. In order to check if the tall stature of Butte and Padre were



exacerbating shading related dieback, light interception underneath the tree canopy itself was also measured (Fig. 1d). Only the Butte variety in orchard number 2 was approaching the 92 percent under canopy light interception level where we have observed shading related dieback in previous work (Fig. 1d).

Fungicide Trials. In one orchard, foliar sprays of Pristine or Captan fungicides with or without the addition of a bark penetrating surfactant (Pentra-bark) were applied to the lower canopy in early May, just prior to the expected onset of symptom expression. In this orchard, very few LLDB symptoms developed throughout the summer and there were no differences among treatments. It was interesting to note that the application of

Captan plus the bark penetrating surfactant caused fairly severe leaf necrosis, while very few symptoms were observed in the surfactant plus Pristine treatment or Captan with no surfactant.

In a second experiment, Pristine, Captan or Agri-fos (mono and di-potassium salts of phosphorous acid) plus a bark penetrating surfactant were applied to the trunks and lower scaffolds (not the foliage) in a Butte & Padre orchard with fairly severe LLDB symptoms. Treatments were applied June 22. Prior to application of the treatments, all symptomatic limbs were pruned off. Trees were rated for severity of LLDB symptoms on August 17 on a scale from 0 (no LLDB symptoms) to 4 (severe symptoms, including limbs over one inch in diameter affected). Limb dieback symptoms were severe and significantly higher than untreated trees in the Agri-fos + surfactant treatment (Table 2). Other fungicide treatments were similar to untreated trees.

Table 2. Lower limb dieback symptoms on almond trees treated with a fungicide plus a bark penetrating surfactant.

Treatment	LLDB Symptoms (Rating 0-4)
Agri-fos @ 1.5 qt. in 1 gal. solution + 3 oz penetrant	3.6 a
Captan 80 WDG @ 5.66 lb + 3 oz penetrant	2.3 b
Untreated	2.0 b
Pristine @ 14.5 oz + 3 oz penetrant	1.6 b

These results suggest that excessively wet conditions early in the season could potentially have played a role in lower limb dieback. It is unusual to see orchards in the -6 to -7 bar midday stem water potentials that we observed in Orchards #1 and #2 in this study. It should also be noted that these are both flood irrigated orchards and water potential was measured at some point in between irrigation events. The initial measurement in Orchard #1 was done about 10 days after the first irrigation had occurred suggesting conditions would have been much wetter immediately following irrigation. The symptoms also tended to get less severe as the season progressed and midday stem water potentials dropped into, and eventually below, the normal expected range (Fig. 1a, 1b). Although shading was not severe enough to cause dieback directly, there was likely an interaction of shading and irrigation problems.

A goal of this project next year will be to work with the growers to improve water management, particularly in the April-June period.