95-BJ5

Correct Project Number: 95-BJ5

Almond Board Research Progress Report
(1995/96)

Title: Occurrence, distribution and impact of MLOs on almond

Project Number: 94-BJ3

Project Leader: Bruce Kirkpatrick, Department of Plant Pathology, UC Davis

Cooperating Personnel: Jerry Uyemoto, USDA/ARS, Davis CA

Background:

Plant pathogenic mycoplasma-like organisms (MLOs) are very small, nonculturable wall-less bacteria that are transmitted from diseased to healthy plants by certain phloem-feeding insects such as leafhoppers and psylla. Graft inoculation studies conducted in the 1950s showed that almond could be infected with the MLO that causes X-disease of cherry and peach. In 1990 we detected a large number of X-MLO infected older almond trees growing in San Joaquin county. Initial graft inoculation studies using scion wood infected with the X-MLO and the MLO that causes peach yellow leaf roll (PYLR) disease showed that the PYLR-MLO, and to a lesser extent the X-MLO, produce significant decreases in Peerless almond nut yields and tree vigor.

The objectives of this study were to expand these initial observations and determine the following:

Project Objectives:

1. Determine the prevalence and distribution of MLO-infected almond trees by collecting and testing almond samples from Northern California orchards using MLO-specific diagnostic assays.

2. Graft-inoculate 10 of the most common California almond varieties with X- and PYLR-MLOs and assess the impact of these MLO strains on nut yield, shoot production and trunk diameter over a 5 year period.

Results and Discussion:

Objective 1. Occurrence and distribution of MLOs in almond trees.

During the 1995 season, with the assistance of Farm Advisors Lonnie Hendricks and Mario Viveros, we collected 89 almond fruit and leaf samples from commercial orchards located in

Kern, Merced, Yolo and Yuba counties. During the past three years we have collected and tested a total of 267 older almond trees growing in most of the northern California almond growing districts. This nearly concludes the disease survey portion of this project, except that we will sample a few orchards in Colusa county in 1996, a suggestion that was made by last year's Almond Board project reviewers.

The results of the survey are summarized in Table 1. Nearly all of the MLO-infected almond trees were located in counties where MLOs are naturally found in other *Prunus* tree crops such as cherry and peach. The largest concentration of MLO-infected trees was found in San Joaquin county where the X-disease MLO (X-MLO) naturally infected sweet cherry and peach. In both Yolo and Yuba counties we found almond trees infects with both the X-MLO or the MLO that causes peach yellow leaf roll disease (PYLR-MLO). Except for a few X-MLO infected trees located in the Sierra foothills east of Merced, no MLO-infected almond trees were found south of Merced in the Central Valley.

These results indicate that MLOs do not cause significant tree decline problems in most almond growing districts in California. In San Joaquin county the primary reservoir for the X-MLO is sweet cherry orchards that have a high incidence of cherry buckskin disease. However, based on the results of our earlier insect transmission studies using X-MLO-infected almonds, **it appears that X-MLO-infected almond trees do NOT serve as efficient pathogen reservoirs** for further spread within a orchard. Thus it would appear that most new almond infections are primarily caused by X-MLO insect vectors which migrate into orchards from distant sources. The main PYLR-MLO reservoir in the Yuba/Sutter county area appears to be pear orchards; fortunately there are very few instances where almonds are planted near pear in this area or elsewhere in the state.

Objective 2: Graft inoculate and assess the impact of the X- and PYLR-MLOs on 10 almond varieties grown at UC Davis.

A. MLO and ILAR virus test results:

All of the trees that were graft inoculated with X- and PYLR-MLOs in 1993 tested positively for these pathogens in June, 1994 and 1995. All of the uninoculated trees tested negatively for the presence of MLOs. In March, 1994 all healthy and MLO-inoculated trees were tested for the pollen-transmitted viruses, prunus necrotic ringspot and prune dwarf; all trees tested virus free. Thus, any effects we measure on tree productivity will be the result of MLO and not virus infection.

B. Disease severity in almond cultivars 2 years following MLO inoculation:

One year following inoculation, some interesting differences were noted between the effect of the X- and PYLR-MLOs on some almond cultivars. Previous inoculations of the Peerless variety showed that the PYLR-MLO was extremely virulent, whereas the X-MLO produced only mild symptoms. This observation was again noted on Peerless trees inoculated in 1993. However, Thompson, Sonora, Carmel and Nonpareil trees inoculated with the X-MLO has severe disease symoptoms and were essentially defoliated by September 1, a response that was not observed in the other cultivars inoculated with the X-MLO.. Two years following inoculation all of the varieties that were severely affected by the X-MLO were also severely impacted by the PYLR-MLO (Table 2). In general, the PYLR-MLO

caused more severe disease symptoms that did the X-MLO. Interestingly, 2 years after inoculation there are no distinct symptoms in Butte, Mission, Padre, Price or Solano trees inoculated with the X-MLO. If these X-MLO-infected trees still produce acceptable nut yields, which will be determined in 1996, then these varieties may be desirable choices if a grower is in a high disease incidence area such as San Joaquin county.

C. Impact of MLO infection on tree growth and nut yields:

All of the healthy and MLO-inoculated trees were pruned in January, 1994 and 1995 and the weight of the pruned branches was determined for each tree. Table 3 shows the average weight of the pruning discards for each variety. To date we have not seen any significant difference in the pruning discards weight between healthy and infected trees. However, now that the MLOs have spread systemically throughout the trees that are susceptible varieties, we expect to observe significant differences in pruning weights this year. At the conclusion of the project we will also weigh the entire tree when they are removed from the project plot.

Trunk diameters were also determined for each tree and the average diameter of each variety, for both healthy and inoculated trees, is shown in Table 4. Similar to the results obtained with pruning weights, to date we have not observed any significant difference in trunk diameters between healthy and infected trees. We expect that significant differences in trunk diameters may not be observed until the conclusion of the project.

All of the trees flowered well and produced a good set of nuts. We attempted to rent a compressed gas cannon to repel foraging crows however we were not successful in locating any unit for rent. Nets were purchased to protect the trees but we did not want to put them on too early because of the chance they would be ripped by the wind. Unfortunately, I did not monitor the crow activity as closely as I should have and during a 3 or 4 day period in early June, during which the nuts were still quite green, most of the nuts on the trees were scavenged by crows. We will install the netting in the beginning of June, 1996 and hope that it will last until the nuts are harvested. We will also purchase a compressed gas cannon for the 1996 season.

In 1995 we wrapped the trunks of trees with aluminum sheeting to protect the nuts against predation by ground squirrels. It would appear that the majority of the nuts were lost to crows, rather than ground squirrels, in 1995. Needless to say we are still experiencing, and attempting to correct, significant and unexpected difficulties in obtaining nut yield data. We hope the corrective measures described above will allow such data to be obtained in 1996. Any reasonable suggestions by Almond Board reviewers or growers to help us combat nut losses to birds and squirrels are certainly welcome.

Table 1

INCIDENCE AND DISTRIBUTION OF MLO-INFECTED ALMOND TREES IN CALIFORNIA

County	# of MLO positive samples/ # of samples tested
Butte	
Orchard trees	**4/56**
Glenn	
Orchard trees	**0/23**
Kern	
Orchard trees	**0/22**
Merced	
Orchard trees	**4/26**
San Joaquin	
Orchard trees	**16/36**
Roadside trees	**20/24**
Yolo	
Roadside trees	**6/30**
Yuba	
Orchard trees	**4/35**
Roadside trees	**7/12**
Nursery trees	**0/3**
TOTAL	**61/267**

Table 2

DISEASE SEVERITY IN 10 ALMOND CULTIVARS 2 YEARS FOLLOWING MLO INOCULATION

CULTIVAR	MLO STRAIN X-DISEASE	PEACH YELLOW LEAFROLL
Butte	NS	+++
Carmel	+++	+++
Mission	NS	++
Ne Plus	+	++
Nonpareil	+++	+++
Padre	NS	+
Price	NS	+++
Solano	NS	++
Sonora	+++	+++
Thompson	+++	+++

+++ = severe symptoms; ++ = moderate symptoms; + = mild symptoms
NS = No symptoms

Table 3

Pruning Weights

(kilograms)

	1994			1995		
	WX	PYLR	Not inoc.	WX	PYLR	Not inoc.
Butte	4.10	3.75	5.72	20.10	22.75	12.85
Carmel	2.45	3.00	3.35	9.80	7.00	7.39
Mission	3.45	2.60	3.84	8.80	7.90	9.31
Ne Plus	5.75	7.85	6.82	10.50	13.55	9.55
Nonpareil	6.60	5.50	6.16	9.50	9.25	9.49
Padre	8.00	6.30	7.60	13.55	10.35	10.78
Price	1.75	3.50	2.79	4.80	10.30	9.36
Solano	6.10	5.90	6.33	9.55	11.55	10.15
Sonora	3.85	4.65	5.17	6.00	7.85	9.47
Thompson	3.55	2.95	2.70	12.65	10.70	11.72

Table 4

Trunk Diameter*

	Summer/94			Winter/95			Summer/95		
	WX	PYLR	Not inoc.	WX	PYLR	Not inoc.	WX	PYLR	Not inoc.
Butte	4.55	4.80	4.90	4.70	5.55	5.70	5.95	6.25	6.65
Carmel	3.70	3.50	3.80	4.00	4.20	4.44	4.35	4.55	5.04
Mission	4.25	4.35	4.68	4.65	4.60	5.13	5.50	5.50	6.21
Ne Plus	4.05	4.35	4.05	4.60	5.35	4.82	4.90	5.40	5.37
Nonpareil	4.30	4.05	4.28	4.70	4.50	4.75	5.40	5.20	5.47
Padre	4.95	4.70	4.93	5.85	5.40	5.77	6.55	6.65	6.48
Price	3.95	4.50	4.21	4.30	4.90	4.55	5.35	5.55	5.41
Solano	4.75	4.60	4.53	5.50	5.40	5.20	6.55	6.00	6.03
Sonora	4.80	4.80	5.18	5.50	5.65	5.95	6.00	6.55	6.78
Thompson	4.40	4.30	4.38	4.70	4.90	4.75	5.35	5.30	5.63

* In inches, measured 20 inches above the ground