Almond Board Research Progress Report
(1994/95)

Title: Occurrence, distribution and impact of MLOs on almond

Project Number: 94-BJ3

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Background:

Plant pathogenic mycoplasma-like organisms 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:

1. Occurrence and distribution of MLOs in almond trees.

During the 1994 season we collected 86 almond fruit samples from 11 orchards located in Butte, Glenn, Sutter and Yuba counties. We wanted to finish our collections from these northern counties by concentrating on samples from commercial orchards, rather than backyard or roadside trees. We acknowledge the recommendation of last year's Almond Board reviewers who suggested collecting additional samples from southern production areas. During 1993 we found that the developing nutlets were the best tissue to extract in order to obtain good quality DNA. This meant that we had a rather limited window during which we could collect and process field samples. We will complete our field collections this spring and these southern areas will be included in the final portion of this study.

Only 8 orchard trees, all located in Yuba county, tested positively for MLO during 1994 (see Table 1). These results indicate that MLOs do not cause significant tree decline problems in this portion of the state. 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 the state. In San Joaquin county the primary reservoir for the X-MLO is sweet cherry orchards which have a high incidence of cherry buckskin disease. Our earlier, and very limited, insect transmission studies suggest that 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 MLO insect vectors which migrate into orchards from distant sources.

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

All of the trees that were graft inoculated with X- and PYLR-MLOs in 1993 tested positively for these pathogen in June, 1994. 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.

Less than 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 and NePlus trees inoculated with the X-MLO were essentially defoliated by September 1, a response that was not observed in the other cultivars. The PYLR-MLO seemed to have only a mild effect on these two cultivars. If these initial observations are confirmed, this information could be useful to growers that are establishing new planting in counties where MLOs are present.

All of the healthy and MLO-inoculated trees were pruned in January, 1994 and weight of the pruned branches was determined for each tree. Table 2 shows the average weight of pruned limbs for each variety. Although data was recorded for individual trees, we did not present differences between healthy and inoculated trees because the MLO had not had sufficient time to produce any measurable effect on tree growth. Likewise, trunk diameters were determined for each tree and the average diameter of each variety, for both health and inoculated trees, is shown in Table 2. We expect that significant differences in pruning weights, and possibly trunk diameters, may be observed this year.

All of the trees produced a good set of nuts. Unfortunately, we were attending two professional meetings during the time that the nuts approached maturity. Within a two week period nearly all of the nuts from the test plot were devoured by the huge population of crows which plague Davis. In 1995 we will rent several compressed gas cannons to use as a deterrent against crow predation. We used bird-proof netting in our earlier yield studies, however the cost of netting only 8 trees was $300 which makes netting cost prohibitive for such a large scale study. The trunks of trees will also be wrapped aluminum sheeting to protect against nut predation by ground squirrels. Needless to say we are experiencing, and attempting to correct, some unexpected difficulties in obtaining meaningful nut yield data. We certainly welcome any reasonable suggestions by Almond Board reviewers or growers to help us combat nut losses to birds and squirrels.

TABLE 1

INCIDENCE AND DISTRIBUTION OF MLO-INFECTED ALMOND TREES IN NORTHERN CALIFORNIA

County	# of MLO positive samples/ # of samples tested 1993	1994
Butte		
Orchard trees	4/36	0/20
Glenn		
Orchard trees	-	0/23
Merced		
Orchard trees	4/10	-
San Joaquin		
Roadside trees	20/24	-
Orchard trees	16/36	-
Yolo		
Roadside trees	6/16	-
Yuba		
Orchard trees	3/10	8/25
Nursery trees	0/3	-

Almond Trunk Diameter and Pruning Yields (1994)

Variety	AverageTrunk Diameter/tree[1] (in inches)	Average Weight/tree of Pruned Limbs[2] (in kilograms)
Butte	4.81	5.09
Carmel	3.76	3.16
Mission	4.59	3.66
Ne Plus	4.11	6.81
Non Pariel	4.23	6.12
Padre	4.89	7.42
Price	4.22	2.76
Solano	4.60	6.20
Sonora	5.03	4.80
Thompson	4.37	2.92

[1] Average trunk diameter of both healthy and trees inoculated with MLO strains in 1993, measured in July, 1994.
[2] Healthy and MLO-inoculated trees were pruned in January, 1994, according to standard orchard practices.