Reducing bacterial canker damage in French prunes

Harley English □ James E. DeVay

Frank J. Schick □ Benjamin F. Lownsbery

Backhoe-fumigation treatments were extremely effective. Peach rootstock also was beneficial.

Bacterial canker continues to exact a toll from California almond and stonefruit orchards. Some years ago, we discovered that pre- and post-plant nematicidal soil fumigation in peach orchards provided fairly satisfactory control of this disease, which is caused by *Pseudomonas syringae* pv. *syringae* van Hall. More recently, we have found that similar treatments often, but not always, reduce the severity of this disease in prunes. The beneficial effect of soil fumigation is due, at least in part, to control of the ring nematode *Criconemella xenoplax* (Raski) Luc & Raski. Somehow the feeding of this nematode on roots increases the susceptibility of stonefruit trees to bacterial canker. Prohibition of the use of dibromochloropropane (DBCP), our most effective postplant fumigant, has markedly complicated the control program for this disease.

Several factors other than ring nematodes appear to be implicated in the bacterial canker syndrome in stonefruit trees. For example, observations and limited research indicate that plum and French prune on peach rootstocks often suffer less from this disease than when propagated on plum stocks. Factors that sometimes increase the susceptibility of stone fruits to bacterial canker are sandy soils, shallow soils above a hardpan, low tree vigor, and fall irrigation. In some sites, the use of a backhoe has been observed to increase tree vigor and decrease the severity of bacterial canker.

This report summarizes some of our recent backhoe work, with or without soil fumigation, as a means of combating bacterial canker in four Sacramento Valley French prune orchards. Also included are data on the use of peach rootstock in one of these orchards and similar data from an earlier test in Sonoma County in which French prune was grown on peach and plum rootstocks.

Severe bacterial canker in prunes on plum rootstock (right foreground) and almost disease-free trees on peach root (left).

Treatments

The orchards for the Sacramento Valley tests were selected with the aid of farm advisors from Tehama, Butte, and Yuba counties and were near Los Molinos, Chico, Live Oak, and Marysville, California. All of the orchards had suffered moderate to heavy losses from bacterial canker and, because of this disease, growers were having difficulty in establishing replanted trees. The soil varied considerably: Los Molinos — deep clay loam; Chico — deep sandy loam; Live Oak — sandy loam to clay loam over a hardpan 2.5 to 4.5 feet deep; Marysville — loam over a hardpan 2.5 to 5 feet deep. In the latter two orchards, the backhoe holes (5 feet deep) did not go through the hardpan layer. The ring nematode was found in all orchards, and pin (*Paratylenchus* spp.) and dagger (*Xiphinema californicum*) nematodes were detected in most of them.

Areas where trees had been lost were selected for the soil treatment trials; each treatment consisted of five tree sites replicated five times in each orchard. Backhoeing and backfilling, with or without fumigation, were done in autumn, and planting was in early spring. In the Marysville orchard, the backhoe holes were either 5 feet square by 5 feet deep or 2.5 feet by 5 feet, by 5 feet deep; in the other three orchards the holes were 6 feet square by 5 feet deep. The fumigants used were either Dow Telone (1, 3-dichloropropene and related hydrocarbons) or Dowfume MC-2 (methyl bromide). In two of the orchards (Chico and Los Molinos), the mycorrhizal fungus *Glomus fasciculatus* (Thaxt. sensu Gerd.) Gerd. & Trappe was added to an extra set of standard-planting holes (25 sites in each orchard).

Results

In three of the four trials, backhoeing plus fumigation (either Telone or MC-2) increased tree growth ($P = 0.05$) when compared with standard planting (tables 1 to 4). Fumigation significantly reduced the severity of bacterial canker in the Los Molinos, Chico, and Marysville orchards. In the Live Oak orchard, fumigation resulted in reduced, but not statistically different, canker development. The backhoe-fumigation treatments in the Chico orchard were extremely effective, resulting in no loss of trees over a seven-year period as compared with 50 percent mortality in the controls. The same treatments in the Marysville orchard, in either backhoe slots or square holes, also were highly effective. In none of the orchards did backhoeing without fumigation significantly increase tree growth or reduce bacterial canker. The addition of the mycorrhizal fungus to standard planting holes in the Chico and Los Molinos orchards failed to increase tree growth or decrease susceptibility to bacterial canker.

The value of using peach rootstock as a means of reducing the severity of bacterial canker in French prune is shown clearly in data from the Marysville orchard (table 3). Here, over a six-year period, standard-planted trees on Marianna 2624 rootstock had a moderately high canker rating and 12 percent mortality, whereas those on peach rootstock showed no infection and 100 percent survival. These results support those of an earlier test in Sonoma County (table 5), where French prune on plum rootstocks suffered heavy losses, whereas those on peach root were only minimally damaged. In this orchard, the combination of pre- and post-plant soil fumigation had no effect on the incidence or severity of bacterial canker.

Reducing damage

Our results suggest that French prune growers might well consider a backhoe-fumigation program in establishing new trees in sites where trees have been severely damaged or killed by bacterial canker. Both tree growth and canker resistance usually are enhanced by such a treatment. The fumigants Dow Telone and Dowfume MC-2 appear equally effective. Trees on treated sites usually are protected from canker for four to seven years, which generally corresponds to their period of greatest susceptibility. To date, backhoe holes 2.5 by 5 by 5 feet deep have been as effective as holes of approximately twice this volume. Backhoeing without fumigations has not been effective.

Although, with the abolition of DBCP, no efficient postplant treatment is known, it is hoped that an effective replacement for this fumigant will be discovered. Experience has shown that supplemental postplant fumigation usually is necessary to maintain tree vigor and canker resistance over a period of several years.

A second approach to reducing the damage from bacterial canker in French prune is through the use of peach rootstock. Our recent work in the Sacramento Valley and earlier research in Sonoma County indicate that prunes on peach rootstock are considerably less susceptible to canker than those on plum stocks. These results also substantiate data obtained from a rootstock study in Placer County in the 1950s that involved French prune and three plum cultivars.

Both Lovell and Nemaguard stocks appear satisfactory, although we have had only limited experience with Nemaguard. In sandy soils where rootknot nematode is often a serious factor, Nemaguard would appear to be the appropriate rootstock. Peach rootstocks are less tolerant than plum stocks of soil with poor drainage and should not be used in such sites. In addition, French prune on peach rootstock sometimes sets an excessive amount of fruit. However, in some areas the reduction in canker susceptibility is probably more important than problems associated with overbearing. The combined use of peach rootstocks and backhoe soil fumigations is still under investigation.

Harley English is Professor Emeritus, James E. DeVay is Professor, and Frank J. Schick is Staff Research Associate, Department of Plant Pathology; and Benjamin F. Lownsbery is Professor, Department of Nematology. All are with the University of California, Davis. *This research was partially funded by the California Prune Board. The authors thank Farm Advisors William H. Olson and Joseph Osgood, Harold Lembright of the Dow Chemical Company, and growers Mario Brusachetti, Chalmer Johnson, William D. Jones, and Walter Stile, Jr., for their cooperation.*

TABLE 1. Effect of preplant soil treatments on tree growth and bacterial canker development in French prune, Los Molinos, 1975-80*

Treatment	Trunk circumference, 1979†	Canker rating‡ 1978	Canker rating‡ 1980	Tree mortality 1978	Tree mortality 1980
	mm			%	%
Backhoe plus Telone, 1 qt	385 y	0.6 x	1.5 x	0	4
Backhoe plus MC-2, 1.5 lb	382 y	0.6 x	2.3 x	0	4
Backhoe only	351 yz	1.5 xy	2.9 xy	4	12
Control (standard planting)	327 z	2.4 y	3.5 y	12	20

* Trees on Myrobalan seedling rootstock; planted in winter, 1974-75.
† Values followed by the same letter in each column do not differ significantly (P = 0.05) according to Duncan's new multiple range test.
‡ Based on a scale of 0 to 10 (0 = no symptoms; 10 = dead tree).

TABLE 2. Effect of preplant soil treatments on tree growth and bacterial canker development in French prune, Chico, 1974-81*

Treatment	Trunk circumference, 1979†	Canker rating‡ 1979	Canker rating‡ 1981	Tree condition in 1981 Cankered	Tree condition in 1981 Killed
	mm			%	%
Backhoe plus Telone, 1 qt	356 x	0.9 x	0.1 x	5	0
Backhoe plus MC-2, 1.5 lb	355 x	1.1 x	0.1 x	5	0
Backhoe only	303 y	4.1 y	4.8 y	55	45
Control (standard planting)	290 y	5.3 y	5.7 y	65	50

* Trees on Myrobalan 29C rootstock; planted in winter, 1973-74.
† Values followed by the same letter in each column do not differ significantly (P = 0.05) according to Duncan's new multiple range test.
‡ Based on a scale of 0 to 10 (0 = no symptoms; 10 = dead tree).

TABLE 3. Backhoe-fumigation test in French prune, Marysville, 1977-82*

Treatment	Trunk circumference† 1979	Trunk circumference† 1980	Canker rating‡ 1982	Tree mortality 1982
	mm	*mm*		%
Backhoe square holes (5x5x5 ft deep)				
No fumigant	191 a	252 c	2.7 a	4
MC-2, 1.5 lb	211 b	281 a	0.6 bc	0
Telone, 1 qt	208 b	287 a	0.2 bc	0
Backhoe slots (2.5x5x5 ft deep)				
No fumigant	190 a	260 bc	1.5 ab	0
MC-2, 1.5 lb	214 b	281 a	0.9 bc	0
Telone, 1 qt	219 b	283 a	0.5 bc	0
MC-2, 1.5 lb.-Peach (Lovell) rootstock	218 b	277 ab	0.0 c	0
Standard planting				
Plum (Marianna 2624) rootstock	185 a	256 c	2.6 a	12
Peach (Lovell) rootstock	181 a	249 c	0.0 c	0

* Trees planted winter, 1976-77; all trees on Marianna 2624 rootstock except as otherwise indicated.
† Values followed by the same letter in each column do not differ significantly (P = 0.05) according to Duncan's new multiple range test.
‡ Based on a scale of 0 to 10 (0 = no symptoms; 10 = dead tree).

TABLE 4. Backhoe-fumigation test in French prunes, Live Oak, 1974-81*

Treatment	Increase in trunk circumference over control, 1979†	Canker rating‡ 1979	Canker rating‡ 1981	Trees cankered 1979	Tree mortality 1981
	%			%	%
Backhoe plus MC-2, 1.5 lb	8 a	0.9 x	2.7 x	28	10
Backhoe plus Telone, 1 qt	5 a	1.6 x	3.7 x	28	25
Backhoe only	3 a	1.8 x	2.3 x	36	10
Control (standard planting)	··· a	2.8 x	4.4 x	52	35

* Trees on Marianna 2624 rootstock; planted winter, 1973-74.
† Values followed by the same letter in each column do not differ significantly (P = 0.05) according to Duncan's new multiple range test.
‡ Based on a scale of 0 to 10 (0 = no symptoms; 10 = dead tree).

TABLE 5. Effect of peach and plum rootstocks on tree growth and canker development in French prune, Sonoma County, 1966-71

Rootstock	Mean trunk circumference	Mean disease index*	Mortality
	cm		%
Marianna 2624 plum	23.7 a†	4.5 a†	36.4
Myrobalan 29C plum	26.3 b	4.0 a	29.3
Lovell peach	26.8 b	1.4 b	1.8

* Based on a scale from 1 (healthy) to 6 (dead).
† Means followed by same letter in each column do not differ significantly (P = 0.05) according to Duncan's new multiple range test.