vented bottoms and fitted for either heated or ambient forced air.

In all of the bulk systems, the onions were well cured in four to six days, and careful evaluations showed that quality was equivalent to that of onions cured in burlap bags for the same period of time. It appears that a container similar to the date bin in size, shape, and venting would be very practical for bulk curing.

The results of the two-year study show considerable promise for mechanical harvest and bulk curing of fresh market onions in California. Some form of bulk curing appears to be a necessary part of mechanical harvest systems. Additional studies are planned to test equipment modifications and cultural procedures, and to further evaluate bulk curing methods.

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Fig. 4. Rod-weeder bar undercutting onions after topping by rotary blade.

Fig. 5. Overhead view of onion bulbs being pushed through mechanical trimmer by rubber-finger conveyor.

Fig. 6. 'Pronto-S' variety after mechanical harvest and trimming by experimental equipment.

Fig. 7. 'Granex' onions cured in slatted bulk bin.

Fig. 8. Onions cured in market sacks.

Fig. 1. Blast of pear blossoms caused by the blast organism.

Copper-streptomycin sprays control pear blossom blast

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Blasting of flowers is an occasional problem in California pear orchards. Three common causes of blasted blossoms are boron deficiency, lack of winter chilling, and bacterial infection caused by *Pseudomonas syringae* van Hall. Bacterial blast is the most damaging and can reduce crops so severely they become unprofitable to harvest.

Growers and researchers have had difficulty coping with bacterial blast, not only on pears but on other pome and stone fruits. Disease incidence is periodic and unpredictable, and blast symptoms appear almost overnight.

Some pear growers have observed suppression of the disease from applications of fireblight control materials, but most blast infection occurs during prebloom or early bloom before blight controls are needed. Therefore, recommendations have not been established for blast control in California or most other parts of the world, and growers generally do not attempt to control it.

Recent monitoring techniques for fireblight control delay spraying trees until the mean temperatures exceed 60°F (15°C) or until the fireblight bacteria *Erwinia amylovora* (Burill) Winslow et al. are found. This delayed timing of sprays may have resulted in more bacterial blast in recent years.

Some Oregon pear growers apply fall and/or winter copper sprays followed by streptomycin sprays during early bloom with the belief that these sprays do reduce the incidence of blast.

Critical field observations on disease development with reference to chilling and the first experimental data from California showing control of bacterial blossom blast are reported here.

Disease organism and symptoms

The bacterium *Pseudomonas syringae* van Hall attacks numerous herbaceous and woody plants, including both pome and stone fruit trees, causing one or more forms of disease expression on the aerial parts of the plant. Most common are blossom blast (fig. 1), cankers on limbs and twigs, and foliage and fruit infections.

The bacterium has been reported to be universally present on plant parts throughout the growing season, although population levels vary. Cold, wet weather favors disease development; warm, dry conditions stop disease progress. Freezing of tissue may be necessary for blossom infection to occur, and an increase in the bacterial population on these affected parts has been reported. Infections do not occur on frost nights during bloom if overtree sprinklers are properly operated to prevent freezing. But if inadequate water application rates or system failure permit freeze damage, disease incidence can be catastrophic, causing blast of

Fig. 2. Papery peeling of the surface tissue of twigs is a distinguishing feature of bacterial blast. In contrast, the fireblight organism causes bacterial ooze.

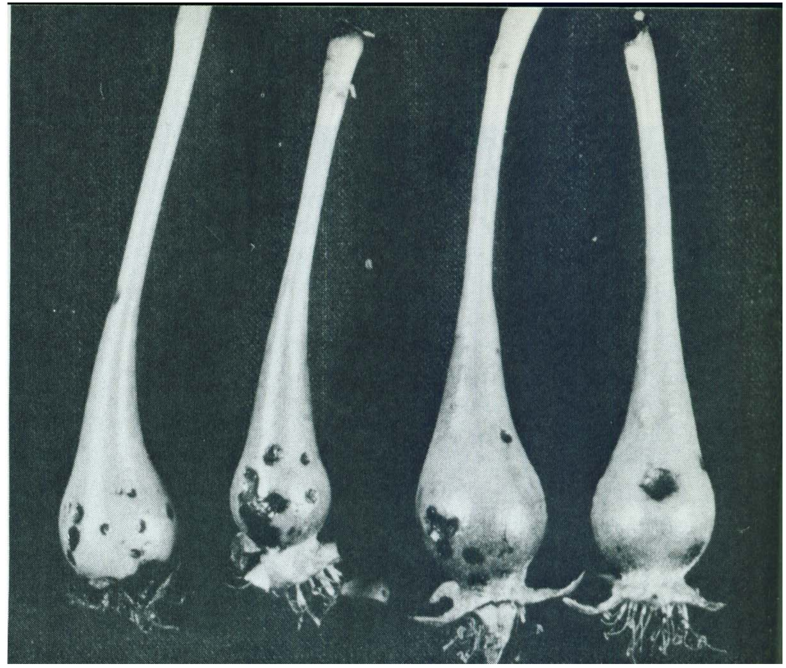

Fig. 3. Fruit infection caused by the blast organism.

nearly all leaves and open buds.

Petals, other flower parts, stems, and the fruit cluster base may turn brown or black. Sometimes only one or two flowers of a cluster become diseased. Fruit buds sometimes are infected in the green tip or tight cluster stage, cease growth, and drop prematurely. The infection usually stops above or at the base of the fruiting cluster, but sometimes the infection may move farther down the spur. Fruit spurs are often killed, which can lead to shortage of fruiting sites the coming year.

Droplets of bacterial exudate on the surface of diseased tissue are a diagnostic feature of fireblight (pear blight). They are never found in blast caused by *P. syringae*.

Experienced farm advisors and fieldmen can best determine if blossom blast has been caused by boron deficiency or by bacterial infection. Bacterial blossom blast is usually more abundant on lower limbs of the tree and more uniformly distributed in an area. Boron deficiency blast is more evident on certain branches and trees than on others. A feature that can be used to identify bacterial blast is that shortly after symptoms develop on the blossoms, the periderm (a thin layer of tissue under the epidermis) of affected spurs or shoots separates from the underlying tissue. On drying, the separated tissue has a papery appearance (fig. 2).

Blast caused by lack of chilling often can be predicted from weather data in the winter months and can be characterized by abortion or dwarfing of center flowers of a cluster or total failure of individual fruit bud growth.

P. syringae infections occurring after bloom appear as black, depressed spots on fruit (fig. 3) and leaves. Sometimes whole fruit are blackened. A red ring frequently surrounds the infected tissue, especially on leaves. After sites of leaf infections dry and darken, the dead tissue drops from the leaf, leaving small holes.

Blast control trial

Tests were conducted in 1976 in the Bodhaine Bartlett pear orchard near Camino, El Dorado County, in the foothills of the Sierra Nevada. Two chemicals reported to be effective in controlling diseases caused by *P. syringae* were selected: (1) a 50 percent copper material, COCS, applied at the rate of 5 pounds per 100 gallons of water, and (2) 17½ percent streptomycin applied at 8 ounces per 100 gallons of water.

Treatments were applied with hand-gun equipment at the rate of 400 gallons per acre. Applications were made at green tip (February 13) and at 1 percent bloom (March 26). Five treatments were evaluated: copper at green tip only; copper at green tip followed by copper at 1 percent bloom; copper at green tip and streptomycin at 1 percent bloom; streptomycin at 1 percent bloom; and a nonsprayed check.

Each plot, consisting of one tree, was replicated eight times. Disease symptoms were noticed on April 16 after a cold rain had fallen on April 5 and 6 (0.23 mm), April 8 (2.32 mm), and April 10 (0.43 mm), followed by a temperature drop to -0.6°, -2.8°, and -0.6°C, respectively. The recording instruments were located within 0.4 km from the test plot.

On April 19, the percentage of infected clusters was determined on 100 blossom clusters in each tree. Isolations were made from the infected blossoms to provide evidence of infection by *P. syringae*. The bacterial population on healthy blossoms was counted by washing the 100 blossoms with 100 ml of sterile distilled water, plating the 10-5 dilution of the suspension onto King's Medium B, and counting the number of green fluorescent colonies, many of which probably would be *P. syringae*.

Control of Bacterial Blossom Blast in Bartlett Pears with Copper and Streptomycin Sprays

Treatment*		Blossom blast†		
Green tip (Feb. 13)	1% bloom (Mar. 26)	Infected clusters	Statistical significance	
			5% level	1% level
		(percent)		
none	none	10.4	a	a
none	streptomycin	5.0	b	ab
copper	none	4.1	b	ab
copper	copper	3.1	b	b
copper	streptomycin	1.0	b	b

*50% COCS (copper) applied at the rate of 5 lb/100 gal water; 17½% streptomycin applied at the rate of 8 oz/100 gal water.
†Disease incidence evaluated on April 19, 1976; values based on 100 clusters. Percentages followed by the same letter are not significantly different.

Evaluation of control

Treatment results are shown in the table. When copper was applied at the green-tip stage of bloom followed by streptomycin at 1 percent bloom, only 1 percent of the clusters were infected, compared to 10.4 percent in the check.

Statistical analysis of the data shows that this treatment and the two-copper-spray treatment are significantly better than the nonsprayed check at the 1 percent level. This means that only one time in 100 trials could such results occur by chance. All the chemical spray treatments were significantly better than the nonsprayed check at the 5 percent level.

In another study, we found a correlation between the chemicals used and the population of fluorescent bacteria on healthy blossoms. All four of the replications of nonsprayed blossoms showed bacterial colonies, whereas the early copper spray followed by a second application of either copper or streptomycin, had, respectively, only one and two culture plates with bacteria. The single early copper spray or the bloom spray with streptomycin had three plates with bacteria. This is an indication that the sprays reduced the bacterial population and hence the number of infections.

It appears that bacterial blossom blast of pears can be effectively controlled with a copper spray applied in the delayed dormant period (green bud) followed by a streptomycin spray at the start of bloom. Two copper sprays are not suggested, because the copper spray applied at 1 percent bloom was somewhat toxic to foliage and flowers. Lower rates of copper and other timings for treatment with both materials need further testing. Control of blossom blast of almond, apple, and stone fruit trees may also be possible with comparable sprays.

Costs must be kept at a minimum if pear growers are to adopt a control program. A promising possibility would be to apply a low rate of copper in the dormant season with the pear psylla control spray. This may reduce early infection sufficiently, because not all flower clusters are needed for a full crop. If freezing temperatures are anticipated just before or during bloom, growers may apply a streptomycin spray at first bloom, just before the freeze, to provide additional protection against blast.

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The growth regulator increased yield by 20 pounds per vine, primarily by improving berry set.

Chlormequat doubles yield of Malvasia bianca grapes

William L. Peacock

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In the San Joaquin Valley, several grape varieties yield much below the vine capacity because of poor fruit set. Growth retardants and cytokinins have shown potential in improving yield of poor setting varieties in other grape-growing areas but have not been extensively tested in the San Joaquin Valley.

In 1976, trials were conducted with *Malvasia bianca*, a muscat-type wine grape variety, in a vineyard near Tulare that had never fulfilled its yield potential because of poor fruit set. Previous trials with mineral nutrients and fungicides to prevent possible nutrient deficiencies or diseases during bloom had failed to improve fruit set and yields.

The trial was designed as a randomized complete block with five replications and single vine plots. The growth regulators tested were: (1) chlormequat, also known as CCC, Cycocel, (2-chloroethyl) trimethyl-ammonium chloride, formulated as an 11.8 percent solution; (2) daminozide, also known as SADH, Alar, succinic acid-2,2 dimethylhydrazide, formulated as an 85 percent powder; and (3) Cytex, a mixed cytokinin material, mostly zeatin-like, standardized to contain 100 ppm kinetin equivalent.

Chlormequat was used at a concentration of 1 quart per 100 gallons of water and applied on May 10, seven days before the beginning of bloom. Daminozide was applied at a concentration of 1 pound per 100 gallons of water on May 18, at the 90 percent bloom stage. Cytex was also applied at 90 percent bloom using 1 gallon per 100 gallons of water. Application rate was ½ gallon of spray per vine, sufficient to cover the flower clusters and foliage. No adjuvants were employed.

The fruit from each vine was harvested and weighed on September 2. One

Effect of Growth Regulators on Fruit Characteristics of *Malvasia bianca*.

Treatment	Yield*	Lateral length*	Berries per cm of lateral*	Berry weight*	Soluble solids*	Total acidity*
	(lb/vine)	(cm)		(grams)	(°Brix)	
control	16.6 ab	6.5 a	2.5 a	3.2 a	22.2 a	.65 a
chlormequat (Cycocel)	37.3 c	6.8 a	4.7 c	2.8 b	19.8†	.70 a
daminozide (Alar)	21.0 b	6.4 a	3.2 b	3.2 a	21.7 a	.66 a
cytokinin (Cytex)	14.6 a	6.3 a	2.5 a	3.3 a	21.4 a	.66 a

*Means followed by the same letter are not significantly different, 5% level.
†Significantly different at 10% level.