Fig. 1. Burlap bags of onions curing in the field after hand harvest.

Fig. 2. Experimental topper-undercutter. Topped and undercut bed is on the right.

Fig. 3. Rotary blade topping head and gauge wheel.

Machine harvesting fresh market onions

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Machine components that topped, undercut, and trimmed onions gave promising results in 1975-76 studies.

Fresh market onions traditionally have been harvested by hand throughout the nation. A tractor-drawn horizontal blade severs the root system just below the bulbs; then tops and roots are clipped off with hand shears. The bulbs are stored in the field in burlap bags for a few days to cure. Many attempts have been made to mechanize topping and clipping, but, although some efforts have been moderately successful, none are used in California today. The principal reasons have been either damage to the bulbs or the inability of the equipment to remove tops and roots to market standards as capably as removal by hand.

Agricultural engineers at Texas A&M University designed and constructed prototype machinery whose principles of operation seemed well suited to the trimming requirements and California conditions. The equipment consists of two components: (1) tractor-mounted rotary-blade topping heads and rod-weeder lifting bar and (2) a mobile or stationary bulb-trimming device.

The bulb trimmer is the heart of the system, because it completes top and root removal to market standards at a practical rate of product flow with minimal damage to the onions. It consists of a series of parallel rods, spaced about 1½ inches apart, over which the onions are moved by an overhead conveyor equipped with rubber fingers. Beneath the bed of rods is a series of hydraulically operated rotary blades adjusted close enough to clip off roots and tops that project between the rods.

Arrangements were made with Texas A & M University to obtain the essential parts of an early model of this trimmer for reconstruction and testing in California. USDA and University of California agricultural engineers at the Riverside campus modified the trimmer and also constructed a sled-mounted topping and undercutting device similar to that used in Texas. Financial support for the project has been provided by growers from the Imperial Valley, Stockton, Fresno, and Bakersfield areas.

The machinery components were first tested at the Imperial Valley Field Station in the spring of 1975. The work was continued at the field station in 1976 to evaluate additional modifications, and tests have been conducted on commercial plantings near Lancaster, Edison, Fresno, Stockton, and Bakersfield over the two-year period.

In addition to experimental work with the machinery, studies have been conducted to clarify the curing process and to evaluate alternatives to the standard stub-sack (burlap) curing procedure. These included attempts to cure onions in the field without containers and studies to evaluate bulk-curing procedures with and without forced air. In these tests, the onions were picked up and placed in buckets by hand after the topping and

undercutting and manually fed into the stationary trimmer. In a commercial harvester, the onions would be picked up and fed to the trimmer mechanically.

The table shows some machinery performance examples. At harvest, the tops on all varieties were 85 to 90 percent down, and about 50 percent of the tissue was still green. The field-topper, in its present design, cannot remove tops to an acceptable market length, because the blade provides insufficient lifting action to accommodate all of the heavy green tops and those which have fallen over the side of the bed into the furrow.

Some modification may improve these results. A lifting-wheel with rubber fingers provided some assistance in lifting tops that had fallen to the side of the bed, but even with this added device, satisfactory top length rarely exceeded 50 percent. When tops were almost completely dry, as they were at Fresno, the percentage of satisfactory top length was greatly improved, because the tops responded better to the available topping lift. Even with dry tops, however, the percentage of satisfactory length obtained by the rotary topper alone did not approach market requirements.

The final trimmer accomplished what the topper-undercutter was unable to do as shown in the data for one and two times through this unit. Excellent results on top length were obtained—often exceeding 90 percent under the "good" rating. This equaled or exceeded results in several samplings of hand-clipped onions. Passing the bulbs through the trimmer a second time generally improved the percentage of satisfactory top length; however, modifications are planned to make the tops more accessible for clipping and to do the trimming in a shorter distance. The trimmer seemed equally capable of handling round, flat, and top-shaped bulbs.

Root length of the finished product was of less concern than was top length in these studies. After curing, most roots readily rub off or are reduced to an insignificant mass that would not reduce appeal to the consumer in most cases. However, the final trimmer does clip roots to some extent, although the root material is not resistant enough for as efficient, close clipping by machine as by hand.

Results of tests with bulk-curing procedures have been as encouraging as the results with the machine components. The test systems included: open-mesh market sacks stacked on a pallet in the shade in ambient air; slatted date bins (45"x20"x20") filled with onions and stored in the field for curing; a slatted potato bin used in the same manner as the date bins; and solid wood bins with

Evaluation of Machine Operation, Onion Harvest, 1976

Variety, location, and sample*	Field topper: Good	Field topper: Too long†	Field topper: Damaged‡	Final trimmer, First time: Good	First time: Too long†	First time: Damaged‡	Final trimmer, Second time: Good	Second time: Too long†	Second time: Damaged‡
	(percent)			(percent)			(percent)		
'Grano'—Imperial Valley Field Station									
1	40.0	60.0	0	72.3	27.7	0	89.2	10.8	0
2	24.3	71.4	4.3	64.3	31.4	4.3	90.0	5.7	4.3
3	21.3	76.4	2.2	67.4	30.3	2.2	93.3	4.5	2.2
4	41.4	52.9	5.7	82.8	11.5	5.7	85.1	3.4	11.5
'Dessex'—Imperial Valley Field Station									
1	35.0	61.0	4.0	70.0	22.0	7.0	79.0	9.0	11.0
2	33.7	63.2	3.2	66.3	25.3	5.3	85.3	4.2	6.3
3	39.8	60.2	0	67.0	30.1	2.9	82.5	12.6	2.9
4	35.1	64.9	0	72.1	27.9	0.9	96.4	0.9	4.5
'Pronto S'—Wheeler Ridge									
1	18.1	79.9	1.9	82.2	15.8	1.9	94.2	3.9	1.9
2	26.3	71.9	1.8	89.4	8.8	1.8	95.4	2.8	1.8
3	74.3	24.6	1.1	94.5	4.4	1.1	98.5	0.4	1.1
4	63.0	35.9	1.1	96.6	2.3	1.1	98.5	0.4	1.1
'Stockton Yellow Globe'—Fresno									
1	66.7	33.0	0	94.4	5.6	0	98.1	1.9	0
2	71.4	28.6	0	91.1	8.9	0	96.4	3.6	0
3	67.9	32.1	1.8	91.1	5.4	3.6	94.6	1.8	3.6
4	64.3	21.4	14.3	76.8	7.1	16.1	78.6	3.6	17.9

*Samples from random sections of bed: 'Grano'—10 feet, 70-80 bulbs; 'Dessex'—10 feet, 90-100 bulbs; 'Pronto S'—20 feet, approx. 250 bulbs.
†Tops over 1½ inches long.
‡Damaged by rod weeder bar, or tops cut too close.


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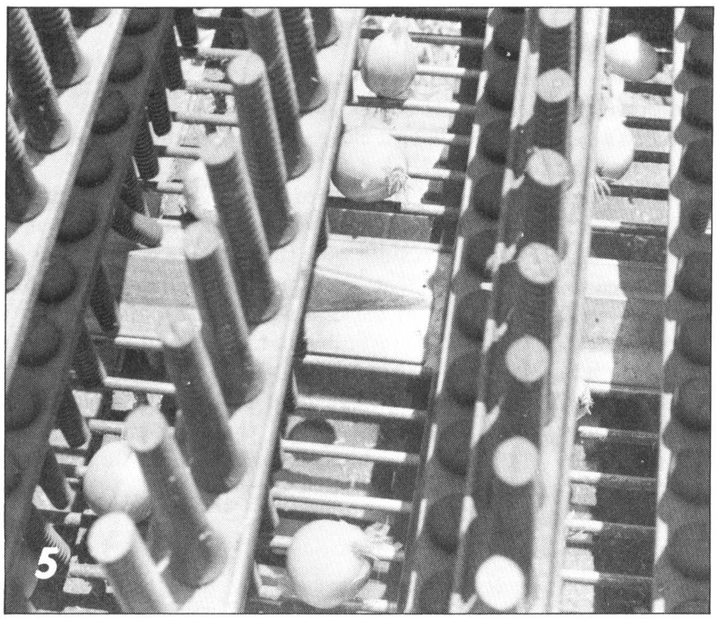
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vented bottoms and fitted for either heated or ambient forced air.

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