Rapid handling and cooling to improve

Strawberry Marketability

after arrival in eastern markets

F. Gordon Mitchell, Harwood L. Hall, A. H. Holland, and A. S. Greathead

California's fresh strawberries travel for five or six days across the continent to reach eastern markets. The varieties grown are firm-fruited, but nevertheless they are an extremely perishable commodity and require great care to avoid unnecessary deterioration.

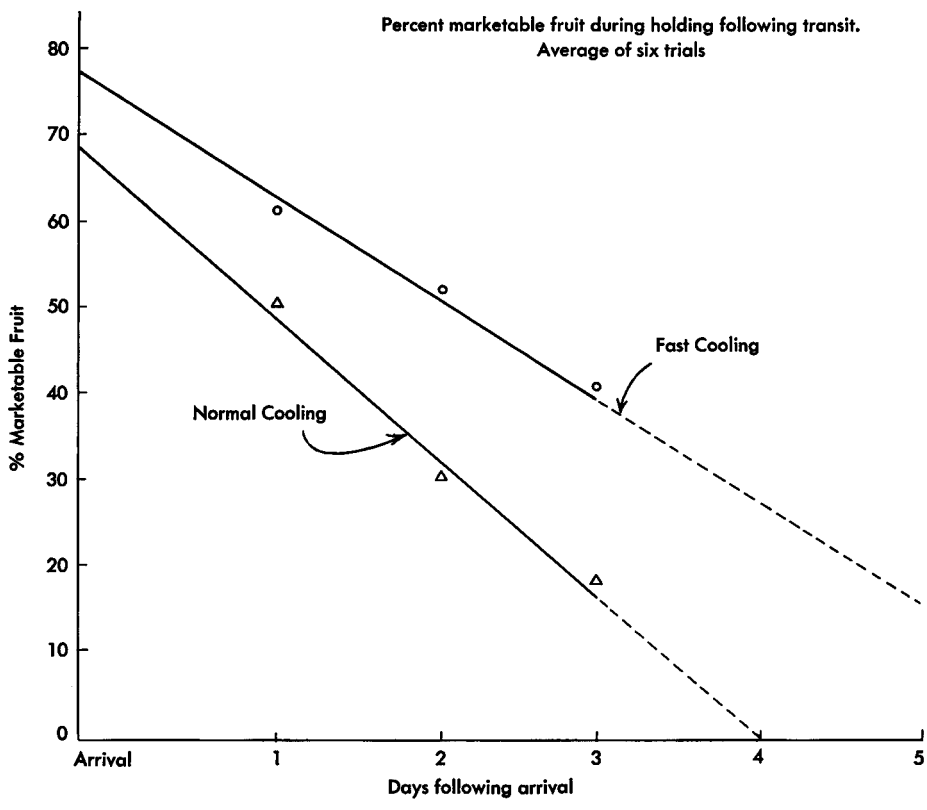
Evidence obtained in an earlier study indicated that short storage periods at moderate to high temperatures could cause serious fruit deterioration and shortened post-harvest life. Furthermore, some of the deterioration evident resulted from cooling delays arising from field handling which could be speeded.

The effect rapid and immediate cooling after harvest in California might have on strawberry fruit quality in eastern markets after transcontinental transit was studied in tests conducted during two seasons. The fruit originated in several locations in the southern and central coast areas and in all tests, fast-cooled fruit was compared to normally handled fruit. In certain tests, comparisons were made between morning and afternoon harvests and in other tests intermediate cooling procedures were used. The Shasta variety was used in all tests originating in the central coast area and Lassen was used in the southern shipments.

Effect of Cooling Treatment on Fruit Marketability

Trial No.	Variety	Origin	Destination	Pulp Temp. at Harvest	Normal Handling* Hours Delay Before Cooling Started	Normal Handling* Estimated Hours from Harvest to 40°F	Days from Harvest to Arrival	% Marketable at Arrival: Rapid cooled	% Marketable at Arrival: Normal Handling	% Increase Due to Rapid cooling
1	Shasta	San Jose	New York	80°F	4	9	5½	94	74	20
2	Shasta	Watsonville	Boston	68	7	10	6	60	52	8
3	Shasta	Salinas	Cleveland	84	5	9	5	71	60	11
4	Shasta	Salinas	Cleveland	78	4	8	6	73	52	21
5	Lassen	Orange	Toronto	77	9	14	6	86	78	8
6	Lassen	Irvine	New York	81	6	11	5½	99	88	11

* All fast-cooled lots into cooler within 1 hour and cooled to 40°F within approximately 2 hours from harvest.



In all cases the fast-cooled fruit was moved into the cooler promptly after harvest. An effort was made to limit the field-to-cooler time to one hour. The delay for normally handled fruit varied according to the practices of the growers. No effort was made to bring the fruit to a constant field temperature but instead the actual field temperatures were recorded.

All railroad cars carrying the strawberries traveled by express and were iced prior to loading, and re-iced according to the standard refrigeration schedule during transit. In addition to the usual wet ice schedule, all test cars received 1,000 pounds of dry ice in the brace at the center of the car at the time of loading. In each car the test containers were loaded so that all treatments were in identical positions, away from the outside walls of the car and not adjacent to either the ice bunker or the center brace. The elapsed time from harvest to arrival in the terminal market ranged from five to six days.

Samples of the test fruit were graded at the time of arrival and at 24-hour intervals thereafter for various periods ranging from two to five days following arrival. In grading, the fruit was divided into four grades: *1*, marketable fruit; *2*, fruit which was unmarketable from deterioration other than decay; *3*, fruit showing slight decay; and *4*, fruit showing severe decay.

The composite results of all tests, expressed in terms of percent marketable fruit, are shown in the graph on the pre-

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STRAWBERRIES

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ceding page. The fast-cooled fruit showed a higher percentage of marketability on arrival than normally cooled berries. This difference increased slightly with holding time after arrival. The normally cooled fruit showed approximately the same percentage of marketable fruit the day of arrival as the fast-cooled lot did the second day. When the lines in the graph are extended they indicate that normally cooled fruit would have completely deteriorated about four days after arrival whereas the fast-cooled fruit would have reached the same point in about six days.

The graph on this page is based on holding the fruit without refrigeration following arrival in the terminal market. With refrigeration in the market, deterioration was less rapid. Comparable fruit from another trial was held with and without refrigeration following transit. The percent marketable fruit was low —about 60%—in the test car, refrigerated in transit, but with refrigeration after arrival, more than 50% of the fruit was marketable at the end of three days. Without refrigeration after arrival, about 10% was marketable at the end of three days.

Test conditions and results at time of arrival of the six experimental shipments are recorded in the table on the preceding page. The results favored fast-cooled above normally handled fruit in each case. However, the difference, among the six shipments ranged from 8% to 21%. Also, the range in percent marketable fruit varied considerably among the six trials. The reasons for the differences in magnitude of fast cooling benefits or total marketability are uncertain and do not appear to be correlated with field temperatures at the time of harvest or with the length of delay involved between harvesting and cooling of the fruit. Possible causes might be differences in: *1*, age of planting; *2*, cultural practices; *3*, growing temperatures; *4*, care in harvesting or culling; or *5*, differences in transit conditions.

A Comparison of the Effect of Morning and Afternoon Harvest of Strawberries on Marketability.—One Trial

Treatment	Time	A.M. Harvest	P.M. Harvest
Normal	Arrival	82%	74%
	Plus one day	38	44
Fast-cooled	Arrival	81	92
	Plus one day	45	52

A comparison between morning and afternoon harvested fruit was made in Trial No. 5. Fruit was either immediately cooled or delayed for the normal grower handling period. The results indicated there were no real differences due to the time of harvest. However, the trial was conducted with morning and afternoon temperatures approximately equal. Thus, the effect of temperature differences which sometimes occur between morning and afternoon harvests was not determined.

An intermediate cooling treatment was included in Trial No. 6. Fruit was moved rapidly from field to cold room but was cooled slowly rather than rapidly. The results were intermediate between fast and normal cooling treatments.

The results of the six trials demonstrate that rapid handling and cooling after harvest result in a substantial increase in the percent marketable fruit following transcontinental shipment. Also, there are strong indications that differences in degree of speed of handling and cooling result in comparable differences in percent marketable fruit and that rapid deterioration can be substantially reduced by adequate refrigeration after arrival at the market. In addition, there were indications that factors not studied were exerting an important influence on the deterioration of the fruit. A study of such factors may be warranted.

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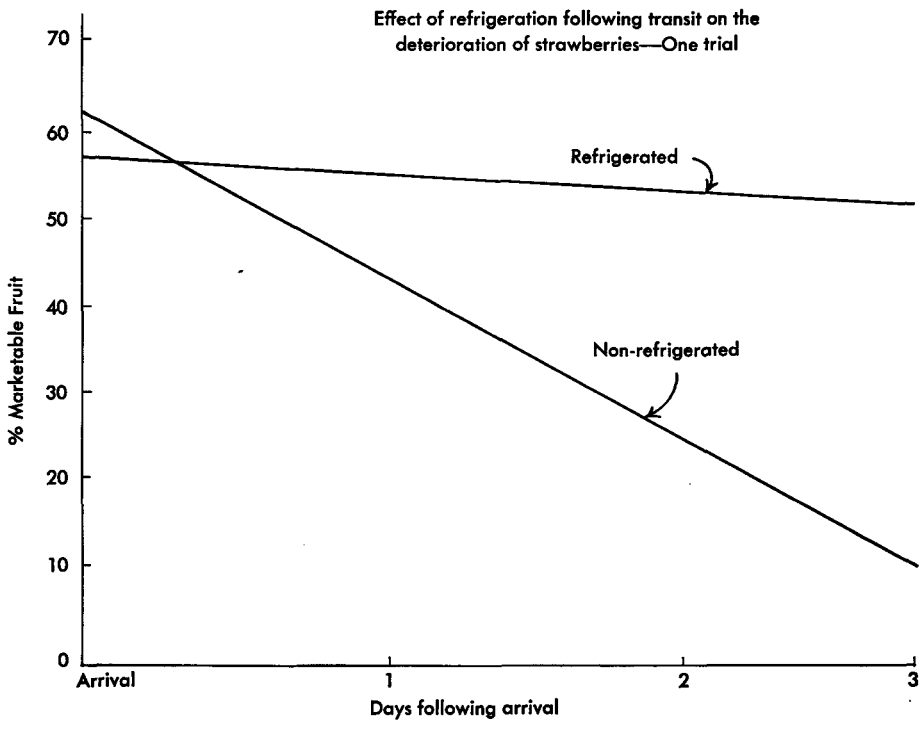

Insects to

TRANSMIT OWN DISEASES

Insect viruses can be transmitted from parents to offspring through the egg. Certain viruses are inherited as part of the genetic system. However, some important groups of insect viruses are not transmitted as genic characters, but are passed to the offspring by other mechanisms. In come cases, the passage of the virus from female to egg is direct, by contamination of the egg contents or of the chorion in the ovary of the mother, or in the genital ducts during oviposition.

Virus carrying females could be used for the control of injurious insects because they can transmit the virus to their eggs and thereby spread the disease within an insect population. With this method of spread of virus diseases hard-to-reach insects such as leaf miners and bark-beetles could be controlled.

Use of virus carriers should prove advantageous when only limited amounts of virus are available. Current work is with a highly virulent pathogen, the nuclear polyhedrosis virus of the alfalfa caterpillar.— *Mauro E. Martignoni and J. E. Milstead, Dept. of Biological Control, Berkeley.*