degree of crack resistance. In each cross the F_2 and backcross progenies showed a skewness of distribution of the segregating populations toward the resistant parent. These results support the partial dominance hypothesis of radial crack resistance. Ryder (7), Prashar (5), Hepler (3), Reynard (6), Thomas (8) and Nassar (4) proposed the partial dominance of genes as a mode of inheritance for the radial crack resistant character in tomato. Armstrong and Thompson (1) found that studies of F_2 populations confirmed the relative unimportance of dominance. They reported that quantitative factors controlling radial, concentric and total cracking were many and additive in nature.

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Heat and Fungicide Treatments to Control Decay of Cantaloupes

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Abstract. Cantaloupes treated with 135° F water for 15, 30, or 60 seconds had significantly less stem-scar mold and surface mold than melons treated with 71° water (wet check). A 30-sec immersion controlled stem-scar mold slightly better than a 15-sec immersion. The addition of 600 ppm captan to the water at 135° significantly reduced stem-scar mold and surface mold compared to the hot-water treatment alone. *Alternaria, Fusarium,* and *Rhizopus* spp. were the fungi most frequently associated with these infections. Quality was evaluated after holding the melons for 7 days at 46° plus an additional 3 days at 72°.

In 3 of the 6 tests, the hot-water treatments significantly increased suture browning of the melons compared to the wet check. The fungicide did not influence suture browning.

General appearance of the melons treated at 130°, 135° or 145° was significantly better than that of the wet check (71°) melons, because of mold control by the hot water.

The use of hot water, either alone or combined with low concentrations of fungicides, to control the growth of molds on fresh produce has received increasing attention in recent years (1, 2, 4, 5, 6, 7, 8, 9). Cantaloupe, *Cucumis melo* L. Var. *reticulatus* Naud., appears to be one of the commodities that can benefit from hot-water treatments (2, 9).

In previous tests (9) we studied the relative effectiveness of hot-water treatments and that of various fungicides in controlling stem scar-mold in cantaloupes. This report is on subsequent studies in which we utilized captan, the most effective fungicide tested previously by us, and approved by the Food and Drug Administration for use on cantaloupes. In these tests we studied the effectiveness of hot-water treatments alone, at different temperatures and immersion times, and in combination with different concentrations of captan.

Materials and Methods

Two tests, each with 3 replications, were conducted during 1968 with cantaloupes grown in the San Joaquin Valley of California. Each replication included 27 treatment lots of 9 melons each. The cantaloupes, 'Powdery Mildew Resistant #45' were of "hard ripe" to "eastern choice" maturity and all were size 36.

Water temperatures used in the first test were 71° (wet check), 135°, and 145°F: in the second test they were 71° (wet check), 130°, and 135°. Immersion times in both tests were 15, 30, or 60 sec and the concentrations of captan were 0, 300, or 600 ppm (0, ½, or 1 lb./100 gal, active material). The concentration of captan recommended commercially for a pre-harvest spray application is 1200 ppm, and as much as 3250 ppm have been used for experimental post-harvest applications (9).

The melons were placed in baskets and immersed in an insulated, stainless steel tank of 100-gal capacity. Water was continuously circulated by pump at 100 gal/min and the high temperatures (130–145°) were maintained at ±0.5° of set point with electric heating coils activated by a temperature controller with a thermistor probe in the water. Cold tap water was used for the wet check treatments and ranged from about 69° to 73° (average 71°) among the different tests.

After treatment, melons were held 7 days at 46° F, plus an additional 3 days at 72° to simulate unfavorable transit and wholesale conditions. The melons were covered with polyethylene bags during both holding periods to provide high relative humidity and to encourage fungal growth. The bags were left open at one end to prevent atmosphere modification. We did not inoculate the melons but relied on natural infections for stem-scar and surface molds. *Alternaria, Fusarium,* and *Rhizopus* spp. were the fungi most frequently associated with these infections.

Each melon was rated subjectively for stem-scar mold, surface mold, suture browning, and general appearance after 7 days at 46° F (first examination) and after 3 additional days at 72° (second examination). Mold, suture browning, and any other defect that developed during holding were considered together in the general appearance ratings. Only ratings at the second examination will be discussed in this report because little mold was evident at the first examination and suture browning did not change appreciably when held at room temperature.

Suture browning, a disorder first described by Lipton and Stewart (3), is a greenish-brown to dark brown discoloration that sometimes occurs on cantaloupes, usually at the sutures where there is generally little, if any netting.

The rating scale used for stem-scar mold, surface mold, and suture browning was 1, none; 2, trace; 3, slight; 4, moderate; and 5, severe. The rating scale used for general appearance was 1, unsalable; 2, poor; 3, fair; 4, good; and 5, excellent.

Data were evaluated by analysis of variance based on a split-split plot experimental design, and by Duncan's Multiple Range tests. Analysis of variance was programmed on an IBM 1130 computing system. Three separate analyses were made: one for data in the first test, a second for the data in the second test, and a third combining data for the 71° and 135° F heat treatments which were common to both tests. This provided, in effect, 6 replications for the data used in the combined analyses. Treatment differences were considered statistically significant at the 5% probability level.

Results

Comparison of 71° and 135° F Treatments

Stem-scar mold. Melons treated at 135° F with 600 ppm captan had significantly less stem-scar mold than those treated with hot water alone (Fig. 1). Melons from treatments combining any of the 3 different fungicide concentrations with 135° water had significantly less stem-scar mold than melons treated in 71° water. At 71°, no concentration of fungicide significantly affected the incidence of stem-scar mold.

Immersion times had only a slight, but statistically significant, effect on stem-scar mold. Treatments for 30 sec were significantly more effective in controlling stem-scar mold (mean rating of 3.2) than 15 sec treatments (mean rating of 3.6), and were as effective as 60 sec treatments (mean rating of 3.4).

Surface mold. Melons treated at 135° F with 600 ppm captan had significantly less surface mold than those treated in 135° water alone or in 71° water containing 300 or 600 ppm captan (Fig. 2). Both captan treatments in 71° water were as effective as 135° water treatments alone. The treatment times tested did not significantly influence the incidence of surface mold. Mean ratings for the 15, 30, and 60 sec treatments were 2.3, 2.2 and 2.1, respectively.

General appearance. The general appearance of the melons immersed in 135° F water containing either 300 or 600 ppm captan was significantly better than that of melons immersed in 71° water containing these concentrations of captan (Fig. 3). The appearance of melons

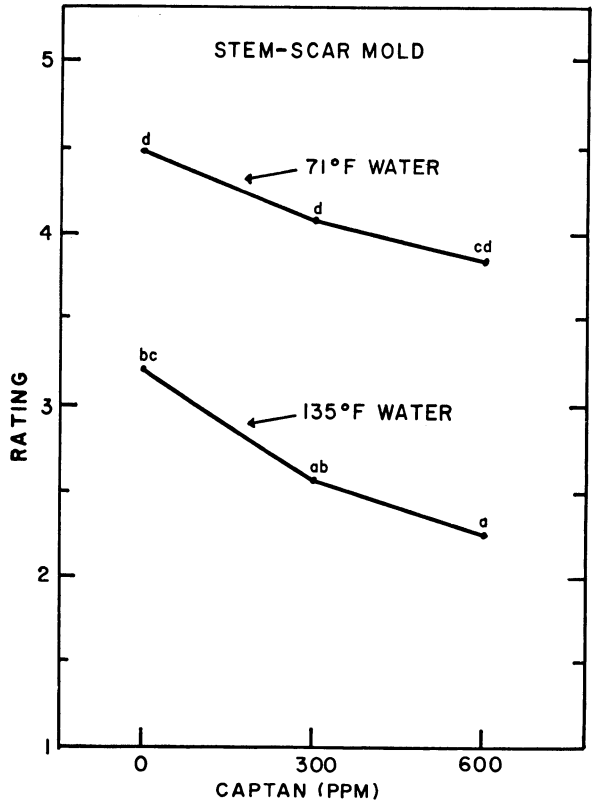

Fig. 1. Effect of water temperature and fungicide concentration on stem-scar mold of cantaloupes held 7 days at 46° plus 3 days at 72°. Data are averages of 3 immersion times (15, 30 and 60 sec) and 6 replications. Points not having the same letter are significantly different at the 5% level. Rating scale: 1, none; 2, trace; 3, slight; 4, moderate; 5, severe.

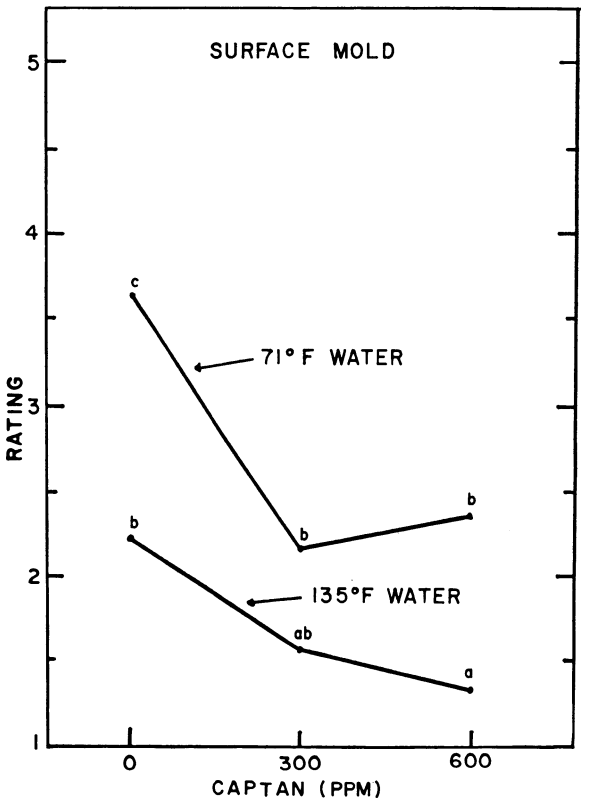

Fig. 2. Effect of water temperature and fungicide concentration on surface mold of cantaloupes held 7 days at 46° plus 3 days at 72°. Data are averages of 3 immersion times (15, 30 and 60 sec) and 6 replications. Points not having the same letter are significantly different at the 5% level. Rating scale: 1, none; 2, trace; 3, slight; 4, moderate; 5, severe.

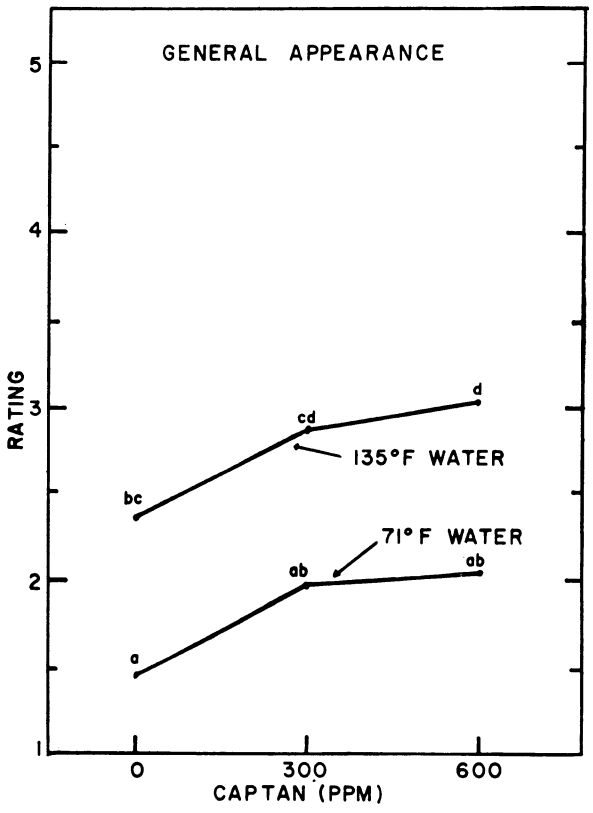

Fig. 3. Effect of water temperature and fungicide concentration on general appearance of cantaloupes held 7 days at 46° plus 3 days at 72°. Data are averages of 3 immersion times (15, 30 and 60 sec) and 6 replications. Points not having the same letter are significantly different at the 5% level. Rating scale: 1, unsalable; 2, poor; 3, fair; 4, good; 5, excellent.

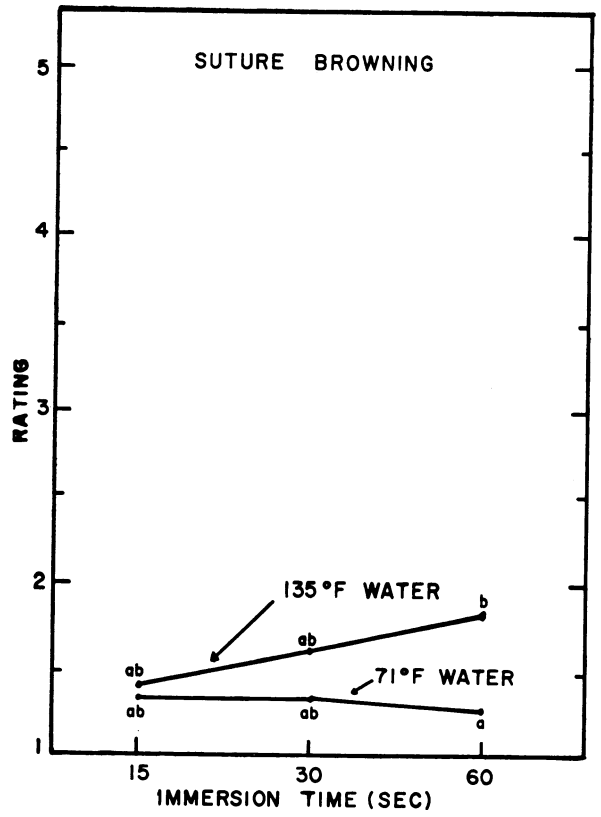

Fig. 4. Effect of water temperature and immersion time on suture browning of cantaloupes held 7 days at 46° plus 3 days at 72°. Data are averages of 3 levels of captan (0, 300 and 600 ppm) and 6 replications. Points not having the same letter are significantly different at the 5% level. Rating scale: 1, none; 2, trace; 3, slight; 4, moderate; 5, severe.

treated only with hot water was better than that of the wet check melons. These results were principally due to better mold control by the heat treatments.

Suture browning. This disorder did not occur in all the replications. Nevertheless, average values indicated that suture browning was significantly greater on melons treated for 60 sec at 135° than at 71° F (Fig. 4). There was no significant difference due to water temperature between the 15- and 30-sec treatments or to the level of fungicide at any immersion time. Mean suture browning ratings for the 0, 300, and 600 ppm captan treatments were 1.4, 1.5 and 1.5 respectively.

Comparison of 71°, 135° and 145° F Treatments

Test A. Stem-scar mold and surface mold, each significantly lower on heat-treated melons, were controlled somewhat better when melons were treated at 145° than at 135° F (Table 1A). However, melons treated at these temperatures had essentially the same general appearance rating because the significant increase in suture browning, with the 145° treatment, offset the inhibition of mold growth. Considerable suture browning occurred in all 3 replications of this test. Although the disorder also was evident in the check lots, it was significantly more severe in the melons treated at 135° or 145°, and in melons treated for 60 sec rather than for 15 or 30 sec. Mean ratings for suture browning in the 15, 30 and 60 sec treatments were 1.7, 1.8 and 2.2, respectively.

Comparison of 71°, 130° and 135° F Treatments

Test B. Stem-scar mold, surface mold, and general appearance ratings of melons treated at 130° or 135° F were not significantly different from each other, but were better than ratings of melons treated at 71° (Table 1B).

Very little suture browning occurred in this test, and there were no significant differences among the melons treated in 71°, 130°, or 135° F water.

Immersion times within the range tested did not significantly affect surface mold, suture browning, or the general appearance of the melons.

Table 1. Effect of water temperature on mold, suture browning, and general appearance of cantaloupes held for 7 days at 46° plus 3 days at 72°F.[w]

Water temperature	Mold		Suture browning	General appearance
°F	Stem-scar Rating[x]	Surface Rating[x]	Rating[x]	Rating[y]
A				
71	[z]4.1 c	2.7 c	1.4 a	1.9 a
135	2.5 b	1.8 b	1.9 b	2.7 b
145	2.0 a	1.3 a	2.4 c	2.9 b
B				
71	4.1 b	2.7 b	1.2 a	1.8 a
130	2.9 a	1.7 a	1.3 a	2.8 b
135	2.9 a	1.6 a	1.3 a	2.8 b

[w]Data for A and B are each averages of 3 exposure times (15, 30, and 60 sec) and 3 fungicide levels (0, 300, and 600 ppm) from 3 replicated experiments.
[x]Rating scale: 1, none; 2, trace; 3, slight; 4, moderate; 5, severe.
[y]Rating scale: 1, unsalable; 2, poor; 3, fair; 4, good; 5, excellent.
[z]Means within a box not followed by the same letter are significantly different at the 5% level.

Discussion

The use of relatively low concentrations of captan in hot water significantly inhibited stem-scar and surface mold of cantaloupes. From the standpoint of optimum disease control and minimum heat injury, a 30-sec immersion in 130° or 135° F water containing 600 ppm captan was the most promising of the treatments tested.

Although mean values for all replications indicated that 135° F treatments for 30 sec did not cause significant injury, objectionable suture browning did result from these treatments in some replications. Johnson (2), working with melons from Texas, stated that water at 135° to 145° for 30 sec did not cause injury. Further work with California melons is needed to determine the reasons for the sensitivity of some melons to 135° treatments, and whether these melons constitute a significant portion of commercial shipments.

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Response of Mature Avocado Fruits to Ethylene Treatments Before and After Harvest[1,2]

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Abstract. Unpicked avocado fruit showed no response to ethylene treatments given at 50 ppm for 48 hr. Picked 'Hass' fruit did not respond to ethylene treatments given immediately after harvest. A good response was observed to treatment given 25 or 49 hr after harvest. This may be explained by assuming the existence of an endogenous factor inhibiting ethylene action.

Ethylene has long been known to trigger the ripening of harvested fruit. In an atmosphere of at least 10 ppm, avocado fruit enter the climacteric phase immediately and soften within days. Raising the concentration of ethylene to 100 or 1000 ppm does not hasten the process (2, 3).

In the early sixties the development of more sensitive methods enabled the ethylene in the internal atmosphere of preclimacteric fruits to be measured. Ethylene at concentrations of 0.1–1.5 ppm was found in various fruits still on the tree. The application of similar concentration induces ripening in picked fruits (5). The inactivity of ethylene or the lack of response to it by unpicked fruit are ascribed to the presence of inhibitory substances transmitted from the tree (5, 6). Burg and Burg (4) found the concentration of ethylene in avocados at picking time to be 0.1 ppm. This concentration is sufficient to induce ripening when applied to picked fruit. Biale (2, 3) found only a partial response of avocado fruits to 0.1 ppm ethylene. The present study set out to test the effect of ethylene applied to mature fruit on the tree, and at different times after picking at an optimal concentration for triggering the ripening process in picked avocado fruits.

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Materials and Methods

Ethylene treatments were given by a constant flow of an air-ethylene mixture. The concentration of ethylene was determined by the aid of a Packard gas chromatograph. Repeated analyses during and at the end of treatment showed that the mixture remained constant.

Trials with harvested fruit. Avocados of the 'Hass' variety were picked at noon on 3 consecutive days in mid-December, 1968. Each fruit was relatively uniform in size and shape, with an average weight of 190 g and average oil-content of 12%. The fruit from each picking was divided into 4 groups of 30, each group being placed in a 10-liter glass jar. A constant flow of ethylene-air mixture, at a rate of 400 cc/min/jar was administered for a period of 24 hr. The concentrations given were 0, 10, 100, 1000 ppm ethylene. All ethylene treatments were started at the same time, 1 hr after picking on the third day, i.e. 24 and 49 hr after picking on the second and first days respectively. After treatment the fruit was transferred to 17°C. The day on which the fruit reached an edible state (hand-tested) was recorded.

Trials with fruit in the orchard. A mobile apparatus fitted with cylinders of compressed air and ethylene, was set up to supply a constant concentration of ethylene. After a 2-stage mixing of air and ethylene, the desired