ADDING WATER TO BOX SHOOK - A POSSIBLE METHOD OF REDUCING MOISTURE LOSS IN STORED GRAPES

Recent work has shown that humidities in cold storage rooms cannot be maintained high enough to prevent moisture loss from the grapes regardless of the refrigeration method. These losses are high during the pre-cooling and early storage phases. During a three-month storage period, the boxes gain a total of 14-20% in weight at the expense of the fruit. One method to prevent this loss, and probably the most practical one, is to humidify with a fog-spray system.(1) Another possible alternative is the addition of water to the boxes or box shook just before the packing operation.

The trials reported here were all performed with export chest shook. The sides, bottoms, and tops are all similar. They measure 20" x 7 5/8" x 5/16" and come 50 per bundle. The sides consist of a single piece, the top and bottom of two pieces each. The heads measure 14 15/16" x 7 3/4" x 5/8" and come 25 pieces per bundle.

The first trials were run with five single side and head pieces, totally immersed in water, to gain some idea of the length of exposure necessary. The results were:

	PER CENT WEIGHT GAIN			
	10 min.	20 min.	30 min.	60 min.
Heads	6.5	8.5	10	11
Sides	20.5	23	24	--

The desired gain is in the order of twenty per cent. The preliminary test showed that single sides reached this level in ten minutes but that the heads gained only half this amount in thirty minutes. Because of the time involved in obtaining this moisture gain, treatment of shook rather than made-up boxes appeared the only practical method.

Trials with bundles of shook were then undertaken. Five types of exposure were employed, (1) complete submergence, (2) floating and sprayed, (3) floating and turned over at stipulated intervals, (4) same as (3) except one or two pieces removed, and (5) sprayed only. Each trial reported consisted of five bundles of heads or sides.

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1. Sides - Full Bundles - Completely Submerged

TRIAL	% WEIGHT GAIN		
	10 min.	20 min.	30 min.
1	19	22	23
2	17	20	21
3	19	23	24
4	19	22	23
Average	19	22	23

2. Sides - Full Bundles - Floating and Sprayed

TRIAL	% WEIGHT GAIN			
	5 min.	10 min.	20 min.	30 min.
1	12	15	19	21
2	14	17	23	--
Average	13	16	21	--

3. Sides - Full Bundles - Floating and Turned Over

TRIAL	% WEIGHT GAIN		
	10 minutes (5 min. each side)	20 minutes (10 min. each side)	40 minutes (20 min. each side)
1	15	19	21
2	16	20	24
3	--	22	25
4	--	20	24
Average	--	20	24

4. Sides - Bundles with two pieces out - Floating and Turned Over

% WEIGHT GAIN		
10 minutes (5 min. each side)	20 minutes (10. min. each side)	40 minutes (20 min. each side)
17	20	24

5. Sides - Full Bundles - Sprayed Only

TRIAL	% WEIGHT GAIN		
	10 minutes	20 minutes	30 minutes
1	10	15	18
2	13	20	24
3	8	13	16
4	11	17	21
Average	10	16	20

1A. Heads - Full Bundles - Completely Submerged

TRIAL	% WEIGHT GAIN		
	10 minutes	20 minutes	30 minutes
1	9	10	12
2	9	12	14
3	8	10	12
Average	9	11	13

2A. Heads - Full Bundles - Floating and Sprayed

TRIAL	% WEIGHT GAIN		
	10 min.	20 min.	30 min.
1	10	12	13
2	11	14	17
Average	10	13	15

3A. Heads - Full Bundles - Floating and Turned Over

TRIAL	% WEIGHT GAIN		
	20 minutes (10 min. each side)	40 minutes (20 min. each side)	80 minutes (40 min. each side)
1	5	7	8
2	11	15	18
Average	8	11	13

4A. Heads - Bundles with one piece out - Floating and Turned Over

% WEIGHT GAIN		
20 minutes (10 min. each side)	40 minutes (20 min. each side)	80 minutes (40 min. each side)
8	11	12

5A. Heads - Full Bundles - Sprayed Only

TRIAL	% WEIGHT GAIN		
	10 minutes	20 minutes	30 minutes
1	7	9	11
2	7	9	11
3	9	11	12
4	8	10	12
5	8	12	14
Average	8	10	12

SIDES GAIN WEIGHT RAPIDLY

The sides gained weight rather rapidly. A weight gain of about twenty per cent was obtained with (1) ten minutes of complete submergence (2) twenty minutes if floating and turned over (3) twenty minutes if floating and sprayed or (4) thirty minutes if sprayed only.

Because the bundles, bound with wire, are fairly tight at the beginning and swell in the water, two sides were removed from each bundle in one trial to determine whether these looser bundles would gain moisture more rapidly than full bundles. There appears to be little if any benefit in this rather time consuming procedure. Examination of full bundles at the conclusion of the trials showed that the sides were wetted except where two smooth surfaces coincided. In these cases, which occur 10 - 12 times in each bundle of fifty, a few dry spots were seen. The sprayed bundles, however, did not become as uniformly wet as they did with the other treatments.

RATE OF GAIN FOR HEADS HALF THAT OF SIDES

The heads, for similar treatments, gained weight at about half the rate of the sides. The rate of gain appears proportional to the surface. Since they are twice as thick as the sides, they gain weight at half the rate.

The one exception is that the sprayed sides failed to gain weight twice as rapidly as did the heads. The weight gains of the sprayed sides shows an almost lineal relationship to time of exposure. As compared to the other treatments, this must mean that the coverage was poor. Only the most rudimentary equipment was available for spraying, so the figures shown probably represent the minimum possible with this system.

The chest side and bottom present over $2\frac{1}{2}$ times as much adsorptive surface as do the heads. They therefore probably remove moisture rapidly during pre-cooling and the early storage season. The heads make up about 45% of the total weight

of the chest (without top) so that for long term storage, they may take up almost as much water as the sides and bottom but at a slower rate. However, there seems to be no practical way to get more than about half of the desired water in the heads.

DRAINAGE FROM TREATED BUNDLES

The moistened bundles drain for a short time after being wetted. Bundles placed at any angle drain in about three minutes. With flat placement, drainage takes twice as long. The wood looks moist for only an hour or two after treatment.

TREATED WOOD SWELLS

One problem involved with moisture gain is the attendant swelling. If the box making process is delayed too long after the moisture treatment, the heads and sides won't fit. If the boxes are made up before too much swelling takes place, the nails hold the pieces in place. The time limit between the moisture treatment and making up the chests is about half an hour. Since swelling begins immediately and continues for at least two days, the sooner the boxes are made up, the better. Trials with the swelling of chest sides are shown below. Each trial consisted of five full bundles of sides. In each bundle, twelve of the 50 pieces were measured, for a total of 60. The pieces were measured at the end and probably represent the maximum swelling. Those measuring 7 13/16" or less fit the heads; those above 7 13/16" overlap. A small percentage of sides overlapping can be tolerated but not more than 10 - 15%.

1. Full Bundles of Sides, Floating and Turned Over - 10 minutes each side.

		Start	40 min.	100 min.	160 min.	1140 min.	2880 min.
Per Cent of Sides	7 13/16" or less	100	95	82	63	42	42
	over 7 13/16"	0	5	18	37	58	58
Average Width in Centimeters		19.46	19.63	19.71	19.78	19.92	19.93

Weight Gain at end of 20 minutes - 17.1%

Weight Gain at conclusion - 15.1%

(Bundles of sides stored in 85-87% relative humidity from 160 min. to 2850 min.)

2. Full Bundles of Sides, Floating and Turned Over - 20 minutes each side.

		Start	40 min.	100 min.	160 min.	1110 min.	2850 min.
Per Cent of Sides	7 13/16" of less	100	93	43	43	50	47
	over 7 13/16"	0	7	27	27	50	53
Average Width in Centimeters		19.38	19.61	19.69	19.74	19.86	19.88

2. continued -

Weight Gain at end of 40 minutes - 18.5%

Weight Gain at conclusion - 16.8%

(Bundles of sides stored in 85-87% relative humidity from 160 minutes to conclusion.)

SPRAYING MOST SIMPLE SYSTEM

Of the four possible moistening systems tested, spraying seems the most practical, although not the most rapid. Bundles of single-depth shook could be placed on a conveyer, run through a series of spray nozzles, allowed to drain, and go on to the box-making machine. A conveyer, sump for collecting excess water and a recirculating pump are the only requirements.

Total immersion could be accomplished with equipment similar to that used for hydrocooling fruits and vegetables.

MOISTENING SHOOK ONLY POSSIBLE FOR SHED PACKING

Adding moisture to the shook could only be used for shed packing operations and even here, those who make up boxes ahead of current use would find that loss occurs quite rapidly. Ten chests that had been exposed to an 85-87% relative humidity for two weeks and which had gained about 10% of their original weight, lost 8% of this weight in four hours of outside exposure one afternoon when the maximum temperature was 98° F.

BOX SHOOK EASIER TO WET

All the work reported deals with export chest shook. Regular box shook should give comparable results with the heads, and more rapid gains with the sides and bottoms because they measure 1/4" or slightly less in thickness, compared to 5/16" for chests. Swelling after treatment would constitute less of a problem because of larger tolerances.

REFERENCE

(1) Nelson, K. E. and Guillou, Rene "Highly Marketable Table Grapes Maintained by Controlled Humidity." Amer. Soc. Heating, Refrigerating and Air-Conditioning Eng. Journal, April, 1960.

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