9. Pryor, M. J. and Cohen, M.—Journal Electrochemical Society 100, 203—1953.
10. Uhlig, H.—Corrosion Control in Water Systems—Industrial & Engineering Chemistry—July 1952.
11. Wachter, A.—Sodium Nitrite as Corrosion Inhibitor for Water—Industrial & Engineering Chemistry—Vol. 37, No. 8 (1945).

APPENDIX

The determination of Sodium Nitrite:

Reagents—

Potassium Permanganate Solution, 1065 g. per 100 ml. prepared by dissolving one grain (.065 g.) tablet in distilled water and make to 100 ml. Tablets dissolve very slowly and if possible, solution should be prepared ahead of use. The tablets can be crushed by using a stirring rod, being careful not to lose any material. Sodium Bisulfate Crystals (Sani-Flush or Bowlene is a good source).

Apparatus—

Graduate—1 - 100 ml.
1 - 25 ml.
Pipette - 1 -10 ml. Mohr Type
Flask 250 ml. Erlenmeyer

Method—

Measure 25 ml. permanganate solution into 250 ml. Erlenmeyer flask, add a few crystals of sodium bisulfate to make solution acid and titrate from the 10 ml. pipette with the sample of water to which sodium nitrite has been added until the permanganate solution is decolorized. (If a brown precipitate forms, it is an indication the acid concentration is too low.)

Results—

$$\frac{17.75}{\text{ml. Nitrite sol.}} \times 1000 = \text{PPM } Na\,NO_2$$

REDUCING LOSSES IN HARVESTING AND HANDLING TANGERINES

W. GRIERSON

Florida Citrus Experiment Station

Lake Alfred

Previous studies (3, 4) on the handling of tangerines have shown that ethylene degreening tended to increase stem-end rot and also sensitized the tangerines towards certain types of mechanical injury. In order to study these effects more closely, tangerines were separated after picking into several categories according to color, each category being handled separately through the Experiment Station packing house. The next logical step was to spot-pick into the various color categories. This was done in 1954-55. It was found that decay was least in tangerines picked full color and not degreened. Decay was excessive in tangerines picked without a good color break and heavily degreened. Severe peel injury occurred to fully colored tangerines when they were subjected to the ethylene degreening process, as would normally be the case when mixtures of green and naturally colored fruit are handled together.

METHODS

Seven pickings were made between November 4 and November 29, 1955. At each picking the tangerines were separated by the pickers into three color categories: e.g. "A", good orange color break; "B", yellow color break; "C", little or no color break. The fruit from each of the "A" and "B" categories were divided into two lots, each consisting of 100 fruit. One lot was held in the degreening room as long as the greenest fruit (Group "C") were in there, which is what happens in commercial practice. The duplicate lots within the "A" and "B" categories were removed from the degreening room as soon as they were considered to be degreened to an extent equivalent to commercial practice. After degreening, the various samples were washed, polished, waxed and stored at 70° F. for decay studies. They were examined at one, two and three weeks from date of picking, separate records being kept of stem-end rot, blue and green molds and peel injuries.

A further study was carried out which (except for the first two replications) used these same pickings of tangerines. Since it had been found previously that degreening sensitized tangerines to handling injury, particularly by the polisher brushes (4), additional samples were picked to provide further information on this point. These additional samples were washed and polished before degreening. Although not advocated for commercial practice, this provided a comparison with the samples receiving the normal treatment of washing and polishing after degreening. All samples were waxed prior to storage at 70° F. Since the prior washing and polishing impedes degreening, these samples were removed from the ethylene treatment at the same time as the regular samples, regardless of their color.

The color of samples was determined by use of the visual comparison colorimeter as developed by Rouse and Bowers (8) from an orig-

Florida Agricultural Experiment Stations Journal Series, No. 566.

inal design by Baier and Ramsey (1). In this apparatus the reflected light from the surface of the sample is focused on a ground glass plate for comparison with Munsell color plates (7).

Results

Color at Picking and Subsequent Decay — Table 1 shows the total losses from all causes presented as the averages of the seven repli-

Table 1: Total losses (all causes) in tangerines spot, picked for color between Nov. 4-29, 1955 and held after degreening at 70° F.

Treatment	Holding period *	Total percent losses (averages of 7 pickings)		
		Best possible color break (A)	Medium to poor color (B)	Little or no color break (C)
Minimum degreening period	1 week	6	6	--
	2 weeks	14	24	--
	3 weeks	26	40	--
Full degreening period	1 week	3	6	6
	2 weeks	11	26	24
	3 weeks	30	50	50

* All times are from date of picking.

Table 2: Total losses (at two weeks from picking) in tangerines picked in three color categories, all of which were given the same degreening period. Degreening considered to be equivalent to that used in commercial practice.

Date (all 1955)	Good orange color break (A)	Yellow color break (B)	Full green (C)	Degreening period (hours)
	Percent	Percent	Percent	
Nov. 4	2	2	10	72
Nov. 7	6	8	6	70
Nov. 9	10	19	12	68
Nov. 14	11	23	38	66
Nov. 15	13	45	25	91
Nov. 21	13	35	27	46
Nov. 29	20	48	48	76
Averages	10.7%	25.7%	23.7%	69.3 hours
L. S. D. (5% Level) - - - - 14.71				
Analysis of Variance = "F" values	For color categories 6.78 *			
	For picking dates 6.59 *			

* Significant at the 5% level.

cations. Table 2 presents total losses for one examination period and one treatment in greater detail. A statistically significant increase in losses with advancing picking dates was found. The same relationship prevailed in the 1954-55 experiments. Returning to Table 1, it will be noted that differences are very minor at the first examination. At the second week from picking, differences in decay between lots receiving different degreening periods are still not discernible, but losses in the "B" group are about twice those in the "A" group. At three weeks from picking the losses in the "B" group (medium to poor color break) are still considerably higher than in the well colored, "A", group. This is in line with the findings reported previously (4). Two other results are in marked contrast to the 1954-55 results. The losses in the tangerines picked with an excellent color break were not increased by a protracted degreening period. It is felt that this is understandable in view of the extremely dry season which caused a sharp reduction in stem-end rot but had little if any effect upon Penicillium (blue and green molds). Since stem-end rot is stimulated by the ethylene used in the degreening process (3) and Penicillium is sharply checked by the 85° F. degreening temperature (6) the effect of such differences is readily apparent. The other difference from the 1954-55 results was that the losses from peel injury and decay in the "C" group (picked green) was no higher than in the "B" group (medium to poor color break). In the experiments of the previous season the "C" group tangerines had broken down almost completely. In the current experiments losses were no higher than in the "B" group, but this fruit would have been largely unmarketable on the basis of grade. Table 3 shows the average colors of the various samples after degreening. On the scale used, a sample that averages "10" can (as far as color is concerned) pack out almost entirely No. 1. Samples rating higher than "20" on this scale could hardly be considered for packing as No. 1, and lower grades than No. 1 were not allowed to be shipped during the

Table 3: Final colors* after degreening. Some fruit and experiments as Table 1.

Date (1955)	(A)	(B)	(C)
Nov. 4	15	20	45
Nov. 7	10	15	30
Nov. 9	10	40	40
Nov. 14	15	15	35
Nov. 15	15	20	35
Nov. 21	5	25	40
Nov. 29	5	15	40
Averages	10.7	21.4	41.4

* Colors are from an arbitrary scale on which "0" is deep reddish orange and "100" is dark green. "Average color" is determined by means of the visual comparison colorimeter developed by Rouse and Bowers (8).

period over which this experiment was conducted (2).

Ethylene Degreening and Subsequent Peel Injury—The results of the experiments on the effect of ethylene on subsequent peel injury are shown in Table 4. This form of peel injury takes the form of "zebra" markings as described previously (4) and had previously been noted to a great extent in samples that had been degreened and subsequently dried in a polisher drier. In Table 4 it will be noted that this peel injury appeared in very considerable amounts in only three of the six pickings. In two it was virtually absent and in the sixth appeared to a very slight extent. In the three severe outbreaks, it was very much more pronounced in the samples that had been degreened before washing and drying rather than after, thus confirming the hypothesis that ethylene degreening can, in some way, sensitize tangerines to handling damage that shows up as "zebra skin" peel injury.

Fig. 1 illustrates a possible explanation of why this effect showed in only three of the six replications. Comparing the rainfall record with the incidence of peel injury it can be seen that all those samples in which washing and polishing after degreening caused increased peel injury were picked three to five days after heavy rains. Those samples in which degreening did not cause sensitivity to such damage were picked 11 to 19 days since the last heavy rain.

Discussion

It is considered that the studies on spot-picking for color have a very direct application to commercial tangerine handling. Many packers spot-pick for size and some of the more exacting operators delay picking until color break is reasonably advanced. Despite this, altogether too many tangerines leave the packinghouses as "eliminations." In the 1955-56 season tangerines picked full green, or with a very poor color break, almost entirely failed

Table 4: Effect of Washing and Polishing Before and After Degreening on Peel Injury of Tangerines.

Picking Date (1955)	Color Category *	Percent Tangerines Unmarketable Due to Peel Injury					
		1 week @		2 weeks		3 weeks	
		X	Y	X	Y	X	Y
Nov. 1	Unsorted	0	15	7	37	4	34
Nov. 9	A	0	0	0	1	0	1
	B	0	0	2	0	5	0
	C	0	0	1	1	1	2
Nov. 14	A	0	47	0	50	0	51
	B	0	32	0	32	0	32
	C	1	23	1	23	1	27
Nov. 15	A	10	38	10	40	10	40
	B	27	52	30	56	34	56
	C	9	36	13	36	13	36
Nov. 21	A	0	0	0	0	12	0
	B	0	0	0	0	6	0
	C	0	1	0	1	0	1
Nov. 29	A	0	1	0	1	0	1
	B	5	0	9	1	9	1
	C	12	2	12	4	12	4
Averages		4.0	15.4	5.3	17.7	6.7	17.9

* Color categories are identical with those in Tables 1, 2, and 3.
@ Times of examinations are as from picking date.
"X" Washed and polished before degreening.) Both waxed with Flavorseal prior to storage.
"Y" Washed and polished after degreening.)

to "color up" to the extent needed for a No. 1 pack. During the month of November, No. 2 tangerines could not be shipped (2) and the cannery price for "eliminations" was 35 to 40c per box. Taking the cost of growing tangerines as 85c per box (9), picking and hauling as 75c (10) and estimating the cost of degreening and handling through the packinghouse as 10c, then the out-of-pocket expenses on these eliminations was $1.70. Thus almost every box of green tangerines picked throughout the course of this experiment would have represented a loss of $1.30-$1.35. If these fruit had been left on the tree they would have been saleable fruit. Many of them were possibly off-bloom and if harvested later would have been available for a premium market. A double spot-picking of early tangerines for size and color would involve a higher than normal picking cost, but this would be cheaper than picking green tangerines for a $1.30 loss.

Decay studies showed that, in two successive years, decay increased as the season advanced. This decrease in keeping quality was not related to the length of the degreening period, nor to rainfall. Since the two seasons' pickings terminated on December 13, 1954 and November 29th, 1955, respectively, it is not considered that the increased losses were due to "over-maturity" in any normal use of the term.

The studies on the relationship between ethylene treatment and the "zebra skin" peel injury indicates that the previously observed sensitizing of the fruit due to ethylene degreening is a genuine phenomenon but is in some way linked to rainfall, since the effect was found only in those samples picked within five days of the last heavy rain. Commercially it is not possible to avoid this damage by washing and polishing prior to degreening as such action drastically slows up ethylene degreening (5). It is however suggested that such losses might be minimized by curtailing degreening as much as possible in the periods after heavy rain.

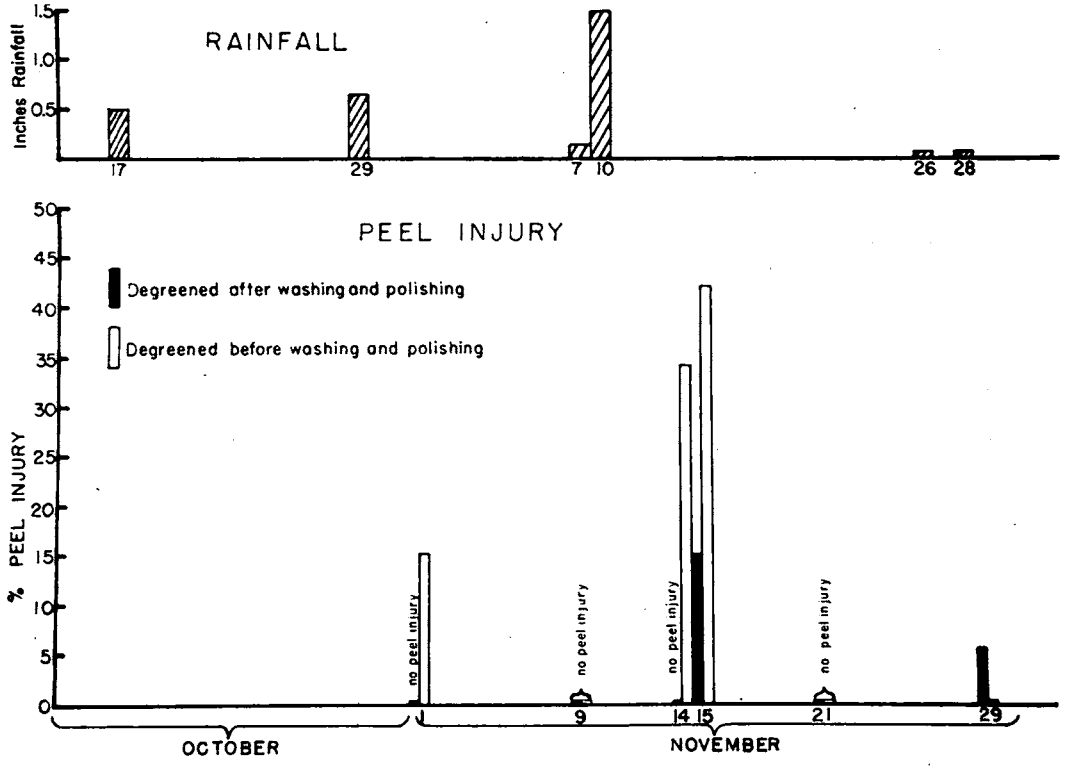

Fig. 1. Peel injury of tangerines (at one week from picking) as related to timing of ethylene degreening and to rainfall.

SUMMARY

A spot-picking program was carried out for tangerines throughout the month of November 1955. The tangerines were separated into three color categories which were handled separately throughout the experiments.

It was found that decay in tangerines picked with a good orange color break was about half that in tangerines picked with a poor color break or no color break at all.

Final color in tangerines picked too green and degreened with ethylene was so poor that it is unlikely that they could have packed enough No. 1 fruit to pay for cost of handling. The balance of this fruit would have had to be sent to the cannery or abandoned, the loss in either case being at least $1.30 per standard box of "packinghouse eliminations."

A distinctive form of peel injury, often known to the trade as "zebra skin" occurred in three pickings that were harvested three to five days after heavy rain. This form of injury was greatly aggravated when such tangerines were polished subsequent to ethylene degreening.

It is recommended that early tangerines be closely spot-picked for color-break as well as for size.

LITERATURE CITED

1. Baier, W. E., Ramsey, H. J. et al. 1932. Coloring citrus fruit. Bulletin, California Fruit Growers Exchange.
2. Daily Market Bulletin Nov. 29, 1955, No. 41. Florida Citrus Mutual, Lakeland, Florida.
3. Grierson, W. and W. F. Newhall. 1955. Tolerance to ethylene of various types of citrus fruit. Proc. Am. Soc. Hort. Sci. 65: 244-250, June.
4. ———— and ————. 1956. Reducing losses in ethylene degreening of tangerines. Proc. Am. Soc. Hort. Sci. 67: 236-243, June.
5. ———— and ————. 1956. Degreening of citrus fruits. Ann. Rept., Fla. Agr. Expt. Stn. (In press).
6. Hopkins, E. F. and K. W. Loucks. 1948. A curing procedure for the reduction of mold decay in citrus fruit. Fla. Agr. Expt. Stn. Bull. 450.
7. Munsell Book of Color. Munsell Color Co., Inc. 10 East Franklin St., Baltimore 2, Maryland.
8. Rouse, A. H. and J. C. Bowers. 1951. Packinghouse Research. Fla. Citrus Expt. Stn., Lake Alfred, Prog. Rept. Project 671.
9. Savage, Z. 1952. Profitableness of oranges, Temples and tangerines, 1945-50. Citrus Magazine 15 (4), 16-17, Dec.
10. Spurlock, A. H. 1956. Costs of picking and hauling Florida citrus fruits 1954-55 season. Univ. of Fla. Agr. Econ. Mimeo Rept. 56-6.

QUALITY OF CANNED GRAPEFRUIT SECTIONS FROM PLOTS FERTILIZED WITH VARYING AMOUNTS OF POTASH[1]

F. W. WENZEL, R. L. HUGGART, E. L. MOORE, J. W. SITES, E. J. DESZYCK, R. W. BARRON, R. W. OLSEN, A. H. ROUSE AND C. D. ATKINS

Florida Citrus Experiment Station

Lake Alfred

The Florida pack of canned grapefruit sections has averaged about 4¼ million cases (24/2's) each year during the last 5 seasons. During the 1955-56 season almost 3½ million boxes of grapefruit were used for canning about 5½ million cases of grapefruit sections and citrus salad; this corresponded to approximately 20 percent of the crop of seedy grapefruit. The quality of canned grapefruit sections, which is one factor that determines acceptability and future demand, is dependent upon the quality of the fresh fruit utilized, which in turn depends on the many factors affecting the internal quality of fruit.

The quality of citrus fruits is affected by many factors, such as fertilizer and spray practices, root stock, variety, soil and weather conditions. Various investigations have been made (1, 3, 4, 5, 6, 7, 8, 10, 12, 13) concerning the influence of variable potash fertilization on the quality and composition of citrus fruits, including grapefruit, oranges and limes. Sites (12) reported on the effect of using different amounts of potash in fertilizing on the quality of Duncan grapefruit, as indicated by changes in soluble solids, acidity, vitamin C and yield of juice.

Information is not available concerning the importance of fertilizer practices in influencing the quality of canned grapefruit sections. The purpose of this report is to present data that were obtained during three citrus seasons

[1]/Cooperative research by the Florida Citrus Experiment Station and Florida Citrus Commission. Florida Agricultural Experiment Station Journal Series, No. 560.