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Temperature Regimes for Avocados Grown In Kwazulu-Natal

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ABSTRACT

This was the third year that specific temperature regimes were tested for the storage of avocado fruit in KwaZuIu-Natal.

In the 1995 season KwaZulu-Natal fruit was not as susceptible to cold damage as in previous years. Physiological and pathological disorders increased sharply in the beginning of the Fuerte season but dropped and nearly disappeared towards the end of the season.

Based on the three year's data (1994-1995) recommendations are made for storage temperature regimes that should give the best results. Temperature regimes are correlated with the moisture content of the fruit.

INTRODUCTION

It is important to use the correct storage and shipping temperatures in order to land fruit hard and in a good quality in Europe.

It was shown by McOnie & Wolstenholme (1982) and by Kaiser *et al.,* (1992) that the physiology of avocado fruit grown in KwaZulu-Natal differs from that grown in the warmer Transvaal regions. Voster *et al.,* (1990) found that temperatures stepped down from warmer to cooler during transportation on the vessels tended to reduce physiological disorders.

Six stepped down temperature regimes were evaluated for the last three years to determine appropriate regimes whereby KwaZulu-Natal fruit can be exported.

Although the work was done on Fuerte and Hass, the report concentrates on Fuerte because it is the more sensitive fruit. The recommendation though, is for both cultivars. The results for the first two years have already been reported on (Mans *et al.,* 1995). This report will concentrate on the results for 1995 and recommendations made after taking all three years' data into consideration.

MATERIALS AND METHODS

The same six temperature regimes as in the previous two years were used (table 1). Each treatment consisted of ten cartons (4 kg) of count 14 fruit taken weekly from the commercial pack line at Everdon Estate. The first week's cartons (week A) were put into cold storage on 23 April 1995.

After four weeks of storage the firmness of the fruit was determined using a firmometer as described by Swart 1981.

Other disorders evaluated were:

- Cold damage (black cold, brown cold and lenticold)
- Pathological disorders (anthracnose and stem-end rot)
- Physiological disorders (pulp spot, grey pulp and vascular browning)

The above-mentioned disorders were rated on a scale from zero to ten according to the severity of the symptoms, zero being no symptoms at all and ten indicating totally affected fruit. The average rating of cold damage and the different pathological and physiological disorders respectively, were added (totalled).

Statistical analysis was done using Duncan's multiple range test.

RESULTS AND DISCUSSION

Firmometer

In figure 1 the firmness of the fruit after four weeks of storage is shown for the warmest temperature regime (temp. 1) and the coldest regime (temp. 6). Both temperature regimes resulted in hard fruit except the last four weeks of the season when the firmness of the fruit stored at the warmer regime became unacceptably soft (hard fruit below 25 and firm fruit below 30).

Table 1
Temperature regimes used for cold storage

Regime	*Week 1*	*Week 2*	*Week 3*	*Week 4*
1	8,5	8,5	7,5	6,5
2	8,5	7,5	6,5	5,5
3	8,5	7,5	5,5	4,5
4	7,5	7,5	6,5	5,5
5	7,5	7,5	5,5	4,5
6	5,5	5,5	5,5	5,5

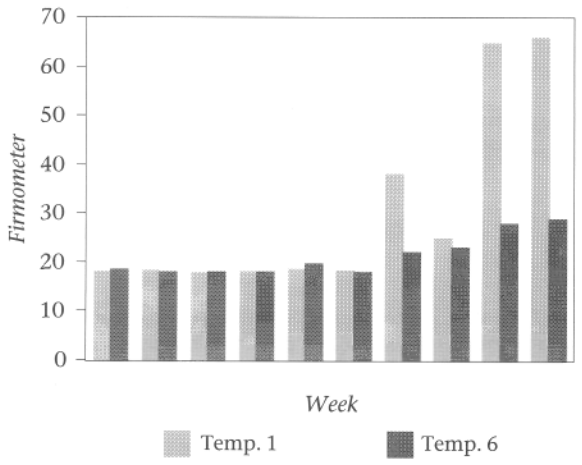

Figure 1
The firmness of fruit after four weeks of storage at the warmest temperature regime (temp. 1) and the coolest temperature regime (temp. 6)

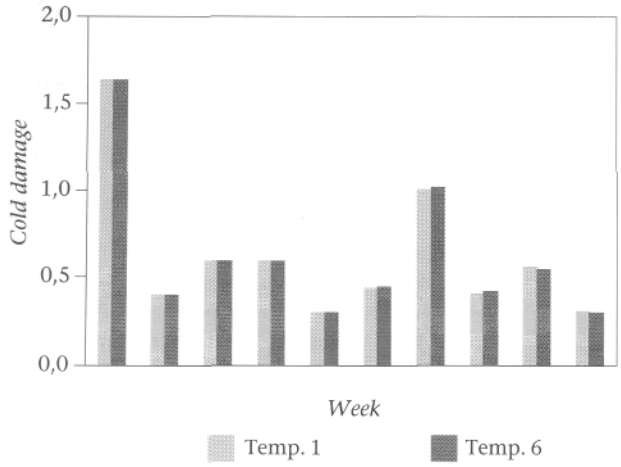

Figure 2
Cold damage on Fuerte fruit after four weeks of storage at the warmest temperature regime (temp. 1) and the coolest temperature regime (temp. 6)

Up to week F (fruit picked and packed on 27 June 1995) the warmest temperature regime resulted in hard fruit. The warmest temperature regime also has the lowest risk of cold damage and for that reason it would be the better regime to use for storage of fruit in the beginning of the season. During the later part of the season the warm temperature regime (temp. 1) gave unacceptably soft fruit and a colder temperature regime should rather be used.

Cold damage

In figure 2 the cold damage seen on the fruit stored at the warmest temperature regime (temp. 1) and the coldest temperature regime (temp. 6) is shown. There is no difference between the incidences of cold damage resulting from the two temperature regimes. The relatively high cold damage in week A is as a result of rough handling in the beginning of the picking season.

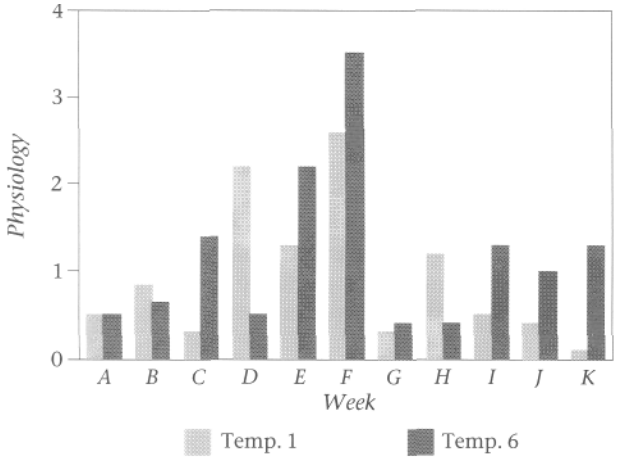

Figure 3
Effect of the warmest temperature regime (temp. 1) and the coolest temperature regime (temp. 6) on physiological disorders during 1995

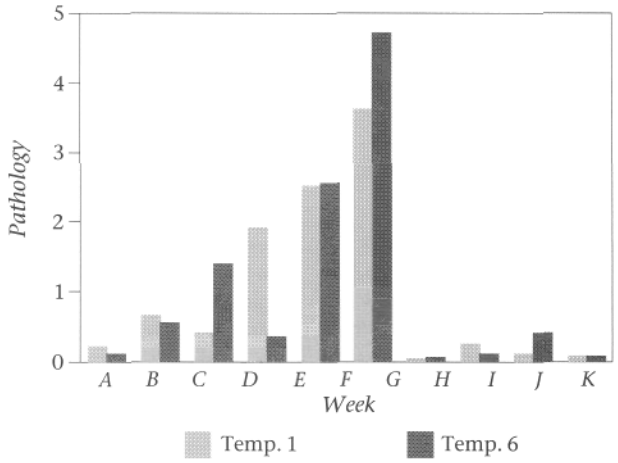

Figure 4
Effect of the warmest temperature regime (temp. 1) and the coolest temperature regime (temp. 6) on pathological disorders during 1995

Although the colder temperature regime did not result in cold damage on the fruit this season, more cold damage was seen at the colder temperature regimes during the previous two years.

Physiological disorders

There is no clear trend to show that the temperature regime at which the fruit is stored has any influence on the amount of physiological disorders. This can be seen in figure 3 where the comparison between the warmest and coldest temperature regime is shown.

The incidence of physiological disorders increased from week A to week F. From week G it nearly disappeared for the rest of the season. The reason for this is not clear. No correlation with climatical conditions could be found.

Pathological disorders

In figure 4 it can be seen that the pathological disorders follow the trend of the physiological disorders increasing from week A to week F, and decreasing from week G.

This can be because fruit that is sensitive to physiological disorders is also more susceptible to pathological infections.

There is no indication that any one of the temperature regimes gave better results than the others in reducing the incidence of pathological disorders.

The average physiological and pathological incidence for all six treatments for the three years is shown in figure 5.

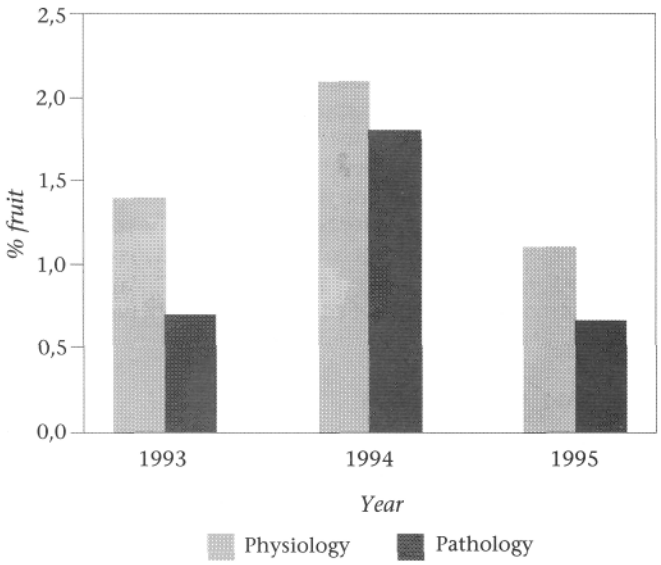

Figure 5
Comparison of the three years' incidence of physiological and pathological disorders

In the 1994 season the incidence of physiological and pathological disorders is higher than in the 1993 and 1995 seasons. This corresponds with the average yield of the orchards. The 1993 and 1995 seasons were 'on' seasons with the yields higher than in the 1994 season. It seems as if there might be a correlation between yield and the severity of physiological and pathological disorders.

The summarized results of the individual weeks for the 1995 Fuerte season are reflected in table 2. The treatments (temperature regimes) which produced the worst results ($p = 0,05$) are not included.

Table 2

Effect of temperature regimes (arranged from best to worst) on firmness, cold damage, pathological and physiological disorders observed in the 1995 season[1, 2, 3]

Week & moisture content	*Firmometer*	*Cold damage*	*Pathological disorders*	*Physiological disorders*
A (78 %)	4,2,3,1	5,6,3,2	1,2,3,4,5	4,6,1,3,2
B (75 %)	1,2,3,4,5	3,6,1,5,4	3,4	6,1,5,3
C (75 %)	1,2,3,4,5	4,1,2,6,5	1,4,3,2	1,2,4,3
D (74 %)	2,1,3	4,5,2,1,3	6,5,4,3	6,2,3,5
E (73 %)	3,1,6,4	2,1,6,5	4,1,6,2	1,4,5,6,2
F (72 %)	3,4,5	6,3	1,2,6,5	1,6
G (72 %)	6,3,5	5,3	1,5,4,6,2	1,6,4,2,3
H (67 %)	6,5,1,3	1,3,2,4	1,2,3,4,5	6,3,5
I (74 %)	2,3,1,5	1,6,4,2	1,2,3,4,5	6,3,2,5
J (66 %)	6,3,2,5	1,2,3,4,5	1,2,3,4,5	1,2,4
K (67 %)	6,5	1,2,3,4,5	1,2,3,4,5	1,2,4

[1]Weeks
A = 23/5/95–20/6/95
B = 01/6/95–27/6/95
C = 06/6/95–04/7/95
D = 13/6/95–11/7/95
E = 20/6/95–18/7/95
F = 27/6/95–25/7/95
G = 04/7/95–01/8/95
H = 10/7/95–08/8/95
I = 19/7/95–16/8/95
J = 27/7/95–24/8/95
K = 02/8/95–30/8/95

Temperature regimes
1 = 8,5, 8,5, 7,5, 6,5.
2 = 8,5, 7,5, 6,5, 5,5.
3 = 8,5, 7,5, 5,5, 4,5.
4 = 7,5, 7,5, 6,5, 5,5.
5 = 7,5, 7,5, 5,5, 4,5.
6 = 5,5, 5,5, 5,5, 5,5.

[2]The moisture content of the fruit is given in brackets next to the letter representing the week.

[3]There is no statistical difference between the temperature regimes listed in table 2. The treatments for a specific aspect have been arranged according to trends from the best to the worst.

Table 3

The best temperature regimes for specific moisture contents for Fuerte in the 1995 season

Moisture content (%)	*Week: 1995*	*Best regimes*
78	A	1,2,3
77		
76		
75	B, C	1,2,3,4
74	D, I	2,3,4
73	E	1,2, 4, 6
72	F, G	
71		
70		
69		
68		
67	H, K	3
66	J	3,4,5

Table 3 shows that there is a tendency for the warmest regimes to be better at the beginning of season and the cooler regimes to be better at the end of the season.

RECOMMENDATIONS

It can be seen that the warmer temperature regimes tend to give the better results while the moisture content is still relatively high. As the moisture content declines with increasing maturity of the fruit, the cooler temperature regimes give the better results.

Table 4
The best temperature regimes for specific moisture contents

Moisture content (%)	*Week: 1993*	*Week: 1994*	*Week: 1995*	*Best regimes*
78		A	A	1
77	A			1,2
76		B		1
75			B, C	1,2, 4
74	B, C, D	D, G	D, I	1,2,3,4
73	E	F	E	2,3,4
72		E	F, G	2, 4
71				
70	F			3
69	G			3, 6
68		H		3, 6
67		I	H, K	3,4
66	H		J	3,4
65	I			4

Table 4 shows the best temperature regimes, as correlated with the moisture content, for the three years.

Table 5
Recommended temperature regimes for KwaZulu-Natal

Moisture %	*Regime*	*Week 1*	*Week 2*	*Week 3*	*Week 4*
75–78	1	8,5	8,5	7,5	6,5
72–75	2	8,5	7,5	6,5	5,5
67–71	3	8,5	7,5	5,5	4,5
66 and less	4	7,5	7,5	6,5	4,5

Table 5 shows the recommended temperature regimes as correlated to the moisture content for fruit grown in KwaZulu-Natal

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