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What Went Wrong with Export Avocado Physiology during the 1996 Season?

F J Kruger • V E Claassens
Institute for Tropical and Subtropical Crops, Private Bag X11208, Nelspruit 1200

ABSTRACT

A physiological perspective on the high incidence of inferior internal fruit quality, encountered during 1996, is offered. The observations are primarily based on oil and moisture evaluations conducted at the Burpak packinghouse in the Hazyview district. The results indicated that, compared to the two preceding seasons, the oil content of the fruit increased at an extraordinary rapid rate at the beginning of the 1996 season. This seemed to be primarily due to the exceptionally high rainfall. In Mass which produces fast metabolising fruit, the build up of oil was more rapid than in Fuerte which produces fruit with a slower metabolism. The above trends were predictable from oil and moisture surveys conducted at Burpak and the ITSC during the 1994 and 1995 seasons. The time and incidence at which the internal disorders occurred seemed to correspond with periods of extraordinary rapid oil acquisition, following excessive rain. It is suggested that moisture content evaluations should remain the mainstay of management decisions on harvest date and storage temperature but that oil evaluations be incorporated in quality management.

At the beginning of the 1996 season producers were optimistic and expected an exceptionally good season due to the apparently favourable weather patterns. It soon became clear, however, that the exceptionally high rainfall induced considerable quality problems such as microbial spoilage, insect damage and physiological disorders. This resulted in a drastic reduction in the pack out percentage of export fruit. The fruit which arrived overseas at the beginning of the season did not attain good prices either. This was due to market related factors as well as fruit quality problems. During the latter half of the season the situation improved and good prices were attained.

Climatically, the 1996 season differed significantly from the previous two seasons. In comparison with the previous two years, considerably higher rainfall was recorded during the first half of the 1996 season (figure 1). The continuous rain gave rise to lower mean daily temperatures during the first half of the season (figure 2). Later during the season, the temperatures rose to levels which were comparable to the two previous seasons.

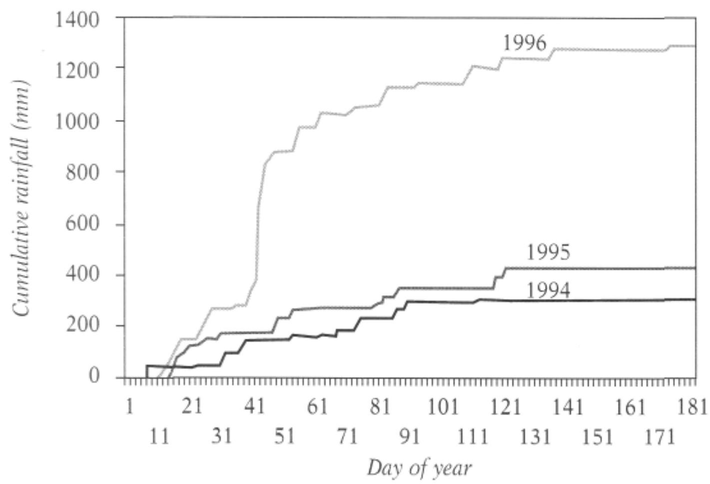

Figure 1
Cumulative rainfall patterns for the 1994, 1995 and 1996 seasons

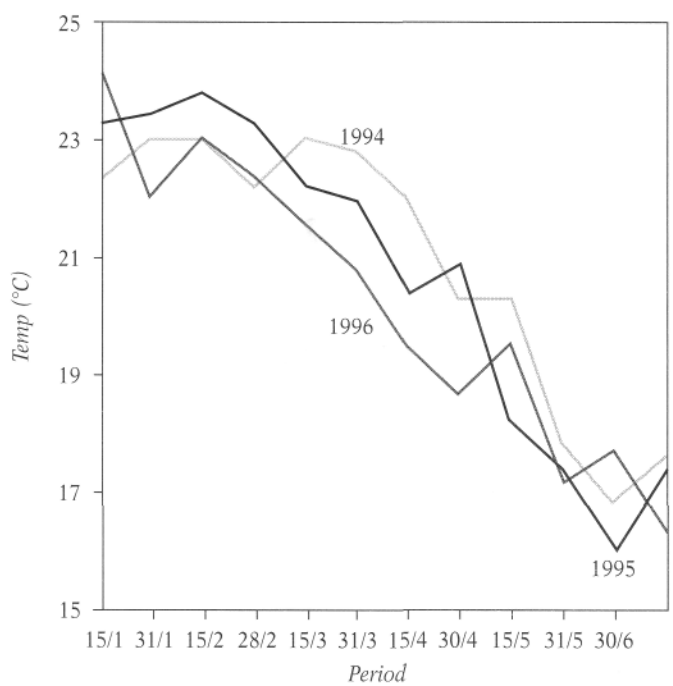

Figure 2
Daily mean temperatures recorded for the 1994, 1995 and 1996 seasons

As expected, the altered weather patterns influenced the accumulation of metabolites in the fruit. From figures 3 and 4 it is clear that the moisture content did not decrease at a significantly faster rate in 1996 than in the previous two seasons. On the other hand, the increase in dry mass based oil content was spectacular. In the case of Fuerte (figure 5), the levels attained at the end of April 1995 were already equalled during March 1996 and the levels attained at the end of May during 1994 and 1995 were surpassed at the end of April in 1996. Oil accumulation was therefore a month in advance during the 1996 season compared to the previous two seasons.

In the case of Hass, the build up of oil was even more dramatic. By the end of April, dry mass based oil levels (figure 6) were already attained which could not be equalled during the whole of the previous two seasons. Hass oil production was therefore more than two and a half months ahead of the previous two seasons. There was greater similarity between the dry mass based (figure 6) and wet mass based (figure 8) patterns of Hass than those of Fuerte (figures 5 and 7). This is due to the fact that the loss in moisture content was faster in Hass than in Fuerte when compared with the previous two seasons.

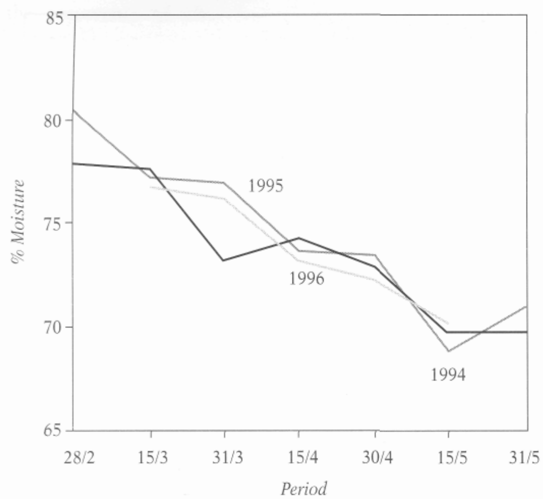

Figure 3
Mean bimonthly moisture content of Fuerte fruit evaluated at Burpak during the 1995, 1996 and 1997 seasons

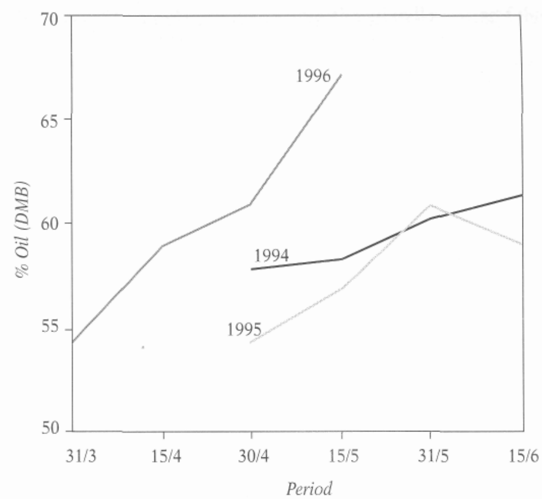

Figure 5
Mean bimonthly dry mass based oil content of Fuerte fruit evaluated at Burpak during the 1995, 1996 and 1997 seasons

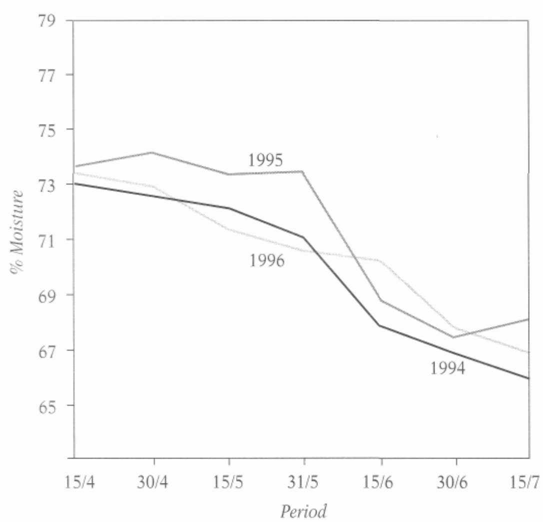

Figure 4
Mean bimonthly moisture content of Hass fruit evaluated at Burpak during the 1995, 1996 and 1997 seasons

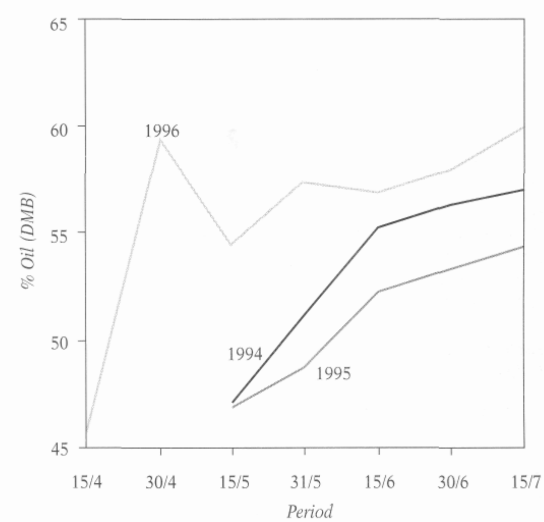

Figure 6
Mean bimonthly dry mass based oil content of Hass fruit evaluated at Burpak during the 1995, 1996 and 1997 seasons

The above results concur with the findings of Kruger and Claassens, (1996a), as well as Kruger (1996), in the following aspects:

- It was shown that an increase in soil moisture does not retard the moisture reduction rate in avocado fruit as was generally accepted at the time. In contrast, it was shown that, increased soil water levels accelerate the production of oil and the reduction in the water content of the fruit. However, the increase in oil in well watered orchards is more apparent than the concurrent decrease in the moisture content.

  - The metabolic rate of harvested Hass fruit is higher than that of Fuerte. This appears to be the case *in situ* on the tree as well (Blanke & Whiley, 1995). The effect of changes in the environment would therefore first be reflected in the physiological make-up of Hass before it will be noticeable in Fuerte.

It is to be expected that most horticultural and environmental aspects should influence oil accumulation in avocados. In our opinion, temperature and the availability of soil water are two of the most important factors. During an average season in an optimally irrigated orchard, oil accumulation patterns will mimic temperature. However, during the 1996 season the nett effect of rainfall far outstripped the effect of the lower temperature pattern.

Due to the excessive rise in oil concentration and only a slight increase in the moisture reduction rate, the 'oil + moisture' constants were higher in 1996 than in the preceding two years. This infers that the non-oil dry component, which contains the structural component of the fruit, was lower in 1996 than in 1994 and 1995 (figure 9). During all three years Hass had a greater non oil dry component than Fuerte. In addition, the non-oil dry component of Hass was at its lowest during the second quarter of the season when most physiological disorders occurred.

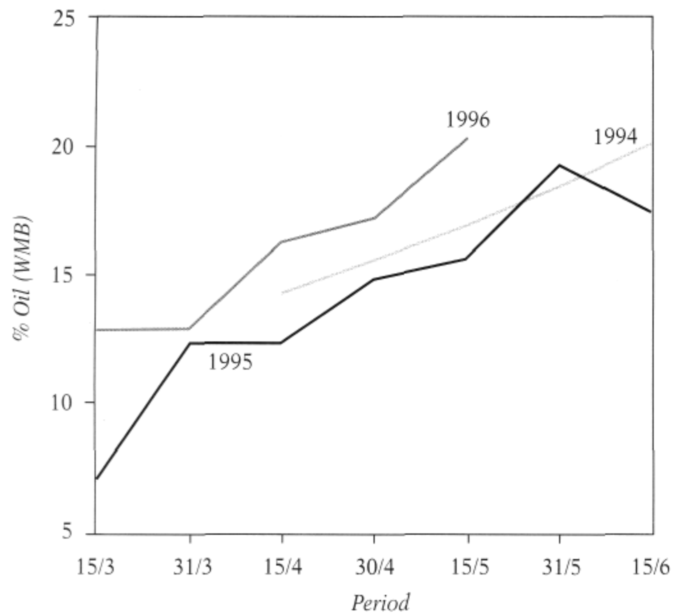

Figure 7
Mean bimonthly wet mass based oil content of Fuerte fruit evaluated at Burpak during the 1995, 1996 and 1997 seasons

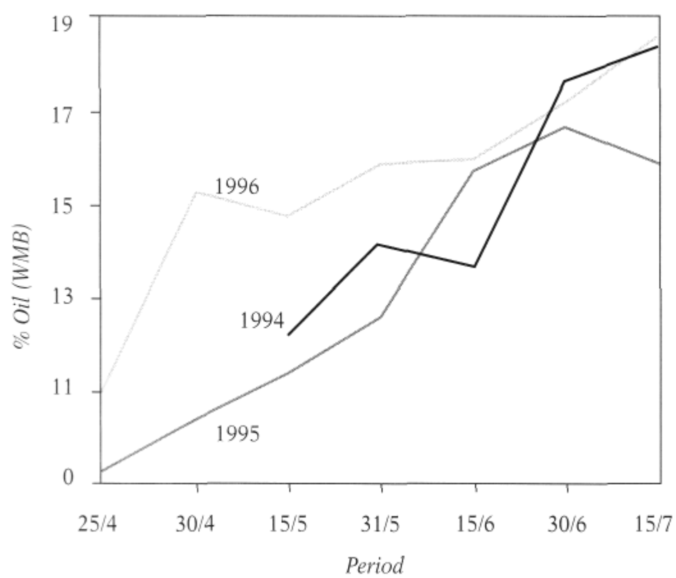

Figure 8
Mean bimonthly wet mass based oil content of Hass fruit evaluated at Burpak during the 1995, 1996 and 1997 seasons

The above observations on the non-oil dry component of the fruit are of importance with regard to the following:

- The validity of the 'oil + moisture' constants on which Swarts (1976) based the moisture maturity parameters.

• An increase in the liquid content of the fruit in comparison with the structural component may lead to physiological disorders.

When depicting the rainfall pattern of the 1996 season in terms of half month periods similar to the oil and moisture readings, a sharp peak during the second half of February is noticeable. Approximately 70 days later the characteristic steady increase in oil content of Hass is interrupted by a dramatic surge in the build-up of oil (figure 10).

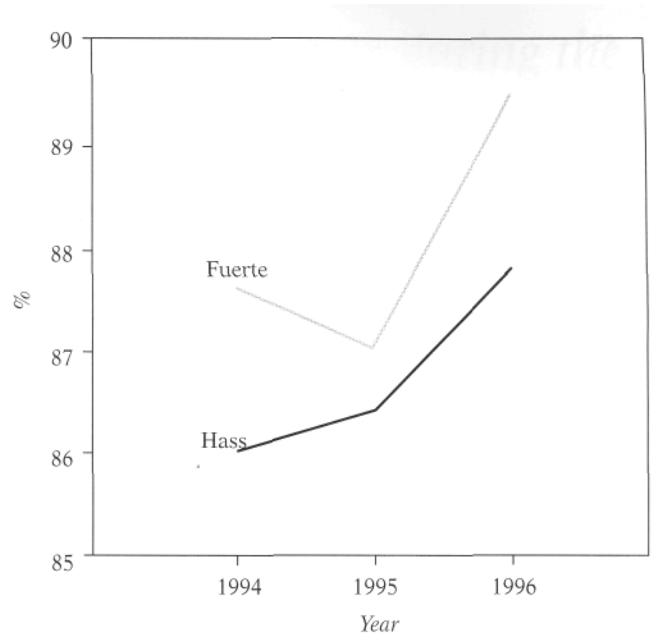

Figure 9

'Oil + moisture' constants of Fuerte and Hass as calculated for 1994, 1995 and 1996. Note that in both Fuerte and Hass the value for 1996 was higher than those of the preceding two years indicating a relatively higher liquid content at the expense of dry structural matter

Keeping the above in mind, it is appropriate to now refer to the occurrence of physiological disorders during the 1996 season. The incidence of pulpspot in Fuerte as recorded by Kremer-Köhne in samples from various farms in the Tzaneen area during the 1996 season is demonstrated in figure 11. The incidence of grey pulp in Hass is indicated in figure 12. The rainfall in the two month period preceding harvest is also indicated in each graph. In both cases the occurrences of physiological disorders seem to mimic the rainfall pattern of the period before harvest.

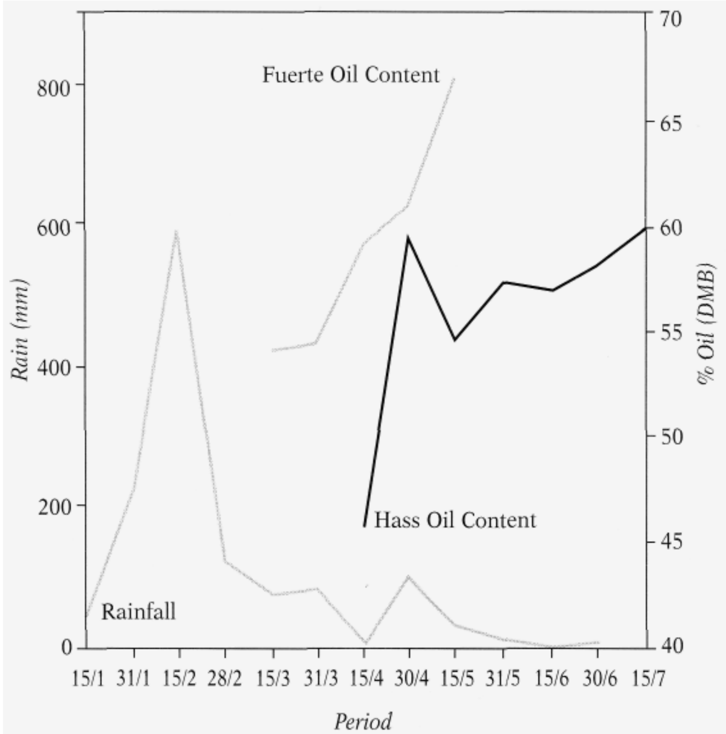

Figure 10

The rainfall at Burgershall depicted in half month periods similar to the oil and moisture readings. The sharp peak during the second half of February is echoed approximately 70 days later when the steady increase in the oil content of both Fuerte and Hass is interrupted by a dramatic surge

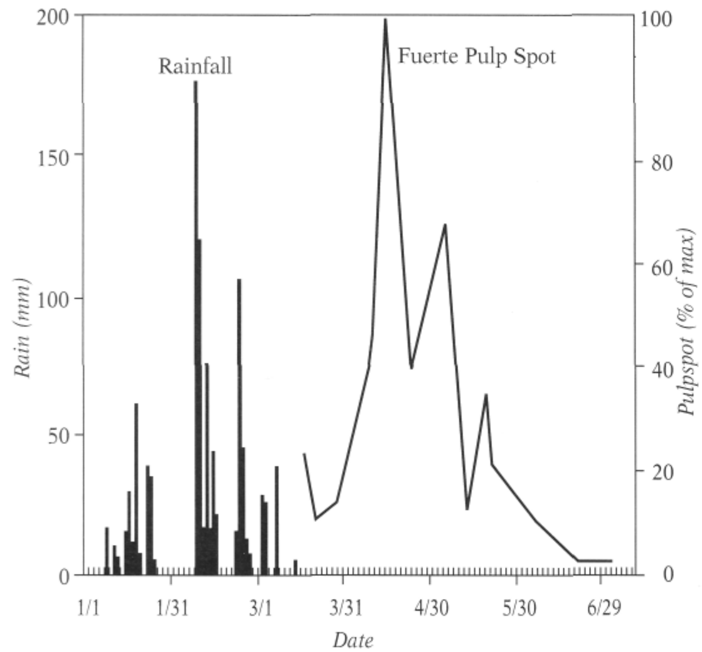

Figure 11

Incidence of pulpspot as recorded by Kremer-Köhne in stored samples of Fuerte fruit from various farms in the Tzaneen area during the 1996 season. The rainfall recorded in the area during the maturation of the fruit is also indicated. Note how closely the incidence of the physiological disorder mimic the rainfall pattern

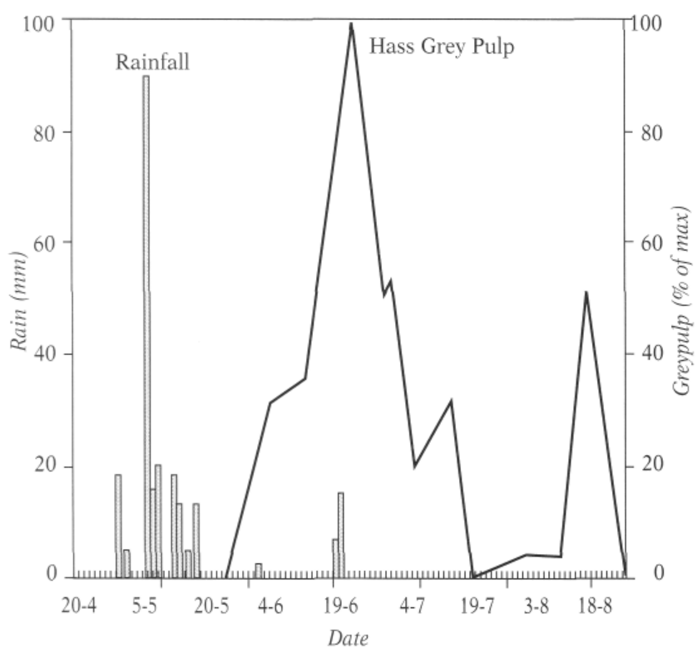

Figure 12

Incidence of grey pulp as recorded by Kremer-Köhne in stored samples of Fuerte fruit from various farms in the Tzaneen area during the 1996 season. The rainfall recorded in the area during the maturation of the fruit is also indicated. Note how closely the incidence of the physiological disorder mimic the rainfall pattern

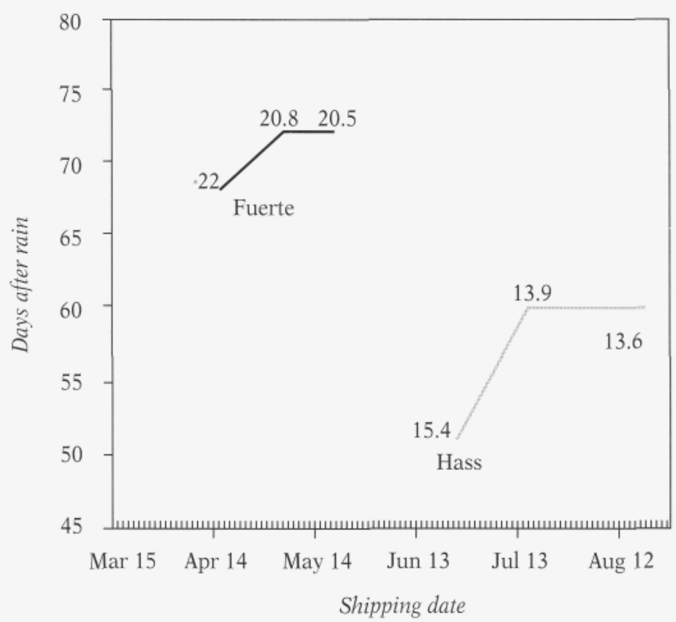

Figure 13

Period between heavy rain and the emergence of internal physiological disorders in Fuerte and Hass. The period lengthened as the mean daily temperature decreased and was shorter in Hass which metabolize at a faster rate than Fuerte

In figure 13 an attempt is made to determine the time span from heavy rains to the manifestation of the physiological disorders. From the graph it would seem that the manifestation of physiological disorders in Fuerte occurred between 68 and 72 days after the rain, the period lengthened as the mean daily temperature decreased from 22°C to 20,5°C. A similar situation existed regarding the faster metabolising Hass where the period lengthened from 52 days to 59 days as the temperature dropped from 15,4°C to 13,6°C.

In addition to the extraordinary increase in the rate of oil acquisition, the high rainfall may influence nutrient acquisition by the avocado. Bower (1987) has shown that over, as well, under irrigation tends to result in low calcium levels in the fruit. It also influenced the abscisic acid and polyphenol oxidase content of the fruit (Bower *et al,* 1986).

Kruger and Claassens (1996b) indicated that, due to less inter fruit variation, moisture content is a more appropriate parameter to determine harvesting date and transport temperature. We still endorse the above opinion but suggest that oil evaluations be used extensively for quality management, for instance, deciding when to switch to controlled atmosphere storage.

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