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# Comparison of Export Avocado Maturation at Burgershall during the '94 and '95 Seasons

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## ABSTRACT

A study was made of the maturation rate of avocados harvested at Burgershall during the 1994 and 1995 seasons. The results indicated that in all cultivars the moisture content decreased and the oil content increased at a faster rate in 1994 than in 1995. Comparison of the ambient temperatures with the variation in the moisture and oil content of the fruit indicated that the shift in fruit maturation rate is primarily a reflection of temperature variation between 1994 and 1995. The relative oil, moisture and non-oil dry composition of the five major cultivars were further determined, and the sample sizes required by packhouses for accurate maturity measurements were calculated.

## INTRODUCTION

The maturity parameters applied in the South African avocado industry have been refined significantly in recent years. In 1994 the maximum allowable moisture levels were 77 % for Hass and 80 % for all other cultivars. In 1995 these parameters were altered as follows: 78 % for Fuerte and Ryan; 77 % for Hass, and 75 % for Edranol and Pinkerton. The modifications were based on quality-related observations made by various interested parties. For instance, the relatively low specifications for Edranol and Pinkerton are based on the supposed tendency of these cultivars to shrink due to dehydration during storage and on the shelf in the beginning of the season when the oil: moisture ratio is low.

In an attempt to consistently market superior products, efforts should be made to implement standards which will be mutually beneficial to all interested parties:

- the farmer with regard to harvesting date;
- the export/transport agents and the Perishable Product Export Control Board in so far as efficient cold storage is concerned;
- the wholesale and retail network where shelf life is a priority; and
- the consumer who is primarily interested in the organoleptic qualities of the product.

In order to achieve the above goals, cross-sectional surveys and structured trials are annually conducted in order to assess the current situation and to recommend improved maturity specifications and storage regimes (Mans *et al.;* 1995, Bezuidenhout *et al.,* 1995; Eksteen, 1995; Kruger *et al.,* 1995; Kaiser, 1996).

This paper reports specific maturity trends of avocados harvested during the 1994 and 1995 seasons in the Kiepersol area; comments on the relative oil and moisture composition of each cultivar; and makes recommendations as to the number of fruits to be sampled in order to obtain a correct assessment of the maturity of an orchard.

## MATERIAL AND METHODS

The oil and moisture appraisal techniques used by Kruger *et al.,* (1995) were employed in this study, and the number of measurements taken during the 1994 season at the Burpak Cooperative is listed in that paper. The number of fruits analysed for farmers during the 1995 season is presented in table 1.

## RESULTS AND DISCUSSION

All cultivars attained maturity at a faster rate in 1994 than in 1995. This trend was evident both from the decline in the moisture content and from the increase in the oil content. In some cultivars it was more obvious than in others. As the largest sample sizes were recorded for Hass and Fuerte the data for these two cultivars are used as examples.

The decrease in the moisture content of Hass during the two seasons is shown in figure 1. The increase in the oil content of the same cultivar is demonstrated on a wet-mass basis in figure 2 and on a dry-mass basis in figure 3. From the graphs it is clear that the trends in moisture and oil content are in agreement with those described above. The dry-mass-based oil recordings demonstrated the largest degree of divergence. The variation was less conspicuous in the wet-mass-based records due to the counterbalance effect of the moisture content.

The maturation rate difference between the two years was less obvious in Fuerte (figures 4-6) than in Hass. It further appeared that the oil content displayed the differences between the two years more clearly than did moisture, albeit that the records were taken over a shorter period. (Both in Fuerte and in Hass the data presented on moisture content — figures 1 and 4 — span a longer period than those on the oil content — figures 1, 2, 5 and 6 — as the number of oil content recordings at the beginning and end of the season did not allow for statistically accountable deductions.)

The mean count of the Hass fruit delivered to the laboratory is shown in figure 7. As was the case with the maturity parameters, the fruit developed faster in 1994 than in 1995. (The trends recorded for Fuerte are not shown as the figures for the 1995 season were distorted, probably due to attempts at late hanging of the fruit.)

The mean bi-monthly temperatures for 1994 and 1995 are charted in figures 1-7. From the graphs it is clear that the mean daily temperatures were generally higher in 1994 than in 1995. The variation in the mean monthly temperatures can be ascribed to higher maximum temperatures during 1994, because the minimum temperatures did not differ much from those of 1995. In certain instances, a pattern seemed to evolve. For instance, except for the last set of readings, the moisture data of Hass (figure 1) followed the relative movement of the temperature in the two weeks preceding sampling. This trend was not as apparent in Fuerte, although, there are indications that the period between variations in temperature and noticeable changes in the oil content of the fruit, may be approximately one month (figures 5 and 6).

The rate of maturation is not determined by the temperature alone, but by other factors as well. Flowering period and subsequent fruit set is one factor which may play a role. The results obtained in this study, however, indicate that variation in the maturation rate between the two years should rather be attributed to variation in temperature during fruit development, than to variation in the flowering period. For example, the dry-mass-based oil content of Hass did not differ at the beginning of March but diverged from then on (figure 3). In addition, unlike, for instance, Pinkerton which has an extended flowering period, Hass has a relatively short flowering period (Sippel, 1995). The length of the fruit set period could therefore not be considered a confounder.

Another factor which may influence the rate, at which oil is produced, is the availability of adequate soil moisture (Kruger, 1996). The rainfall measured in the Burgershall area during the two years is shown in figure 8. From the figure it is clear that 1995 was a better rain year than 1994. It should, nevertheless, be kept in mind that extensive irrigation takes place in the area and that this reduces the effect of the latter. It would be interesting to see how the current season compares with the last two seasons, because exceptionally high rainfall was recorded this season.

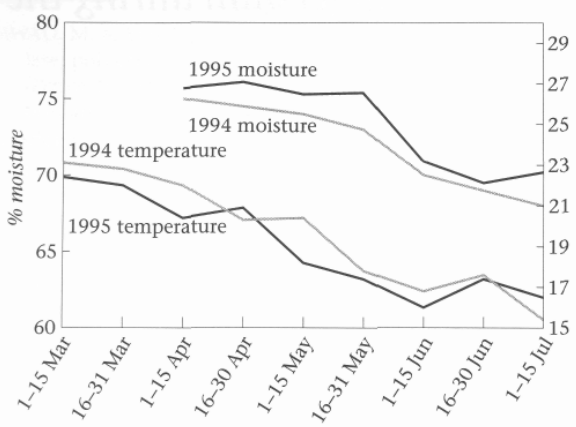


**Figure 1**
Reduction in the moisture content of Hass fruit delivered to Burpak from April to July during the 1994 and 1995 seasons. Mean bi-monthly temperatures are indicated.

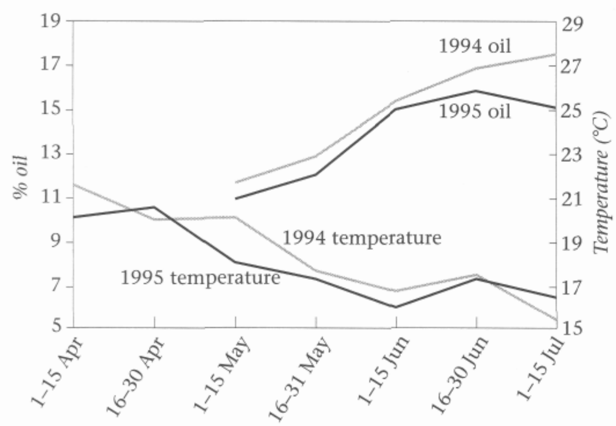


**Figure 2**
Increase in the wet-mass-based oil content of Hass fruit delivered to Burpak from May to July during the 1994 and 1995 seasons. Mean bi-monthly temperatures are indicated.

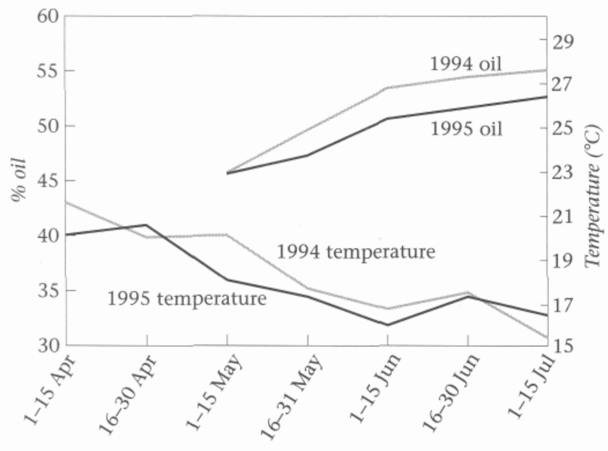


**Figure 3**
Increase in the dry-mass-based oil content of Hass fruit delivered to Burpak from May to July during the 1994 and 1995 seasons. Mean bi-monthly temperatures are indicated.

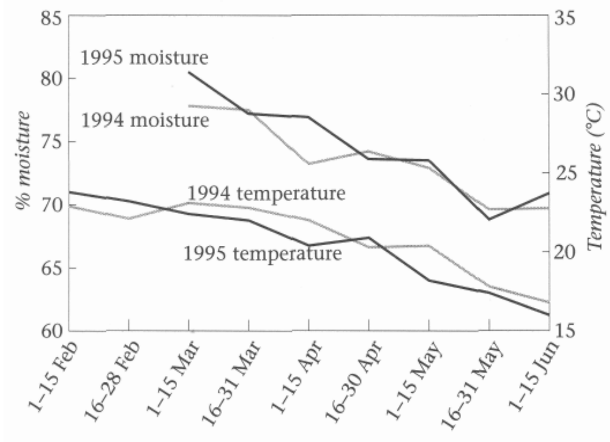


**Figure 4**
Reduction in the moisture content of Fuerte fruit delivered to Burpak from March to July during the 1994 and 1995 seasons. Mean bi-monthly temperatures are indicated

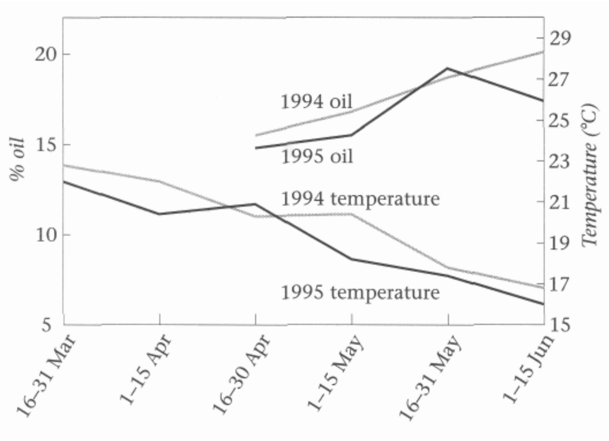


**Figure 5**
Increase in the wet-mass-based oil content of Fuerte fruit delivered to Burpak from April to June during the 1994 and 1995 seasons. Mean bi-monthly temperatures are indicated.

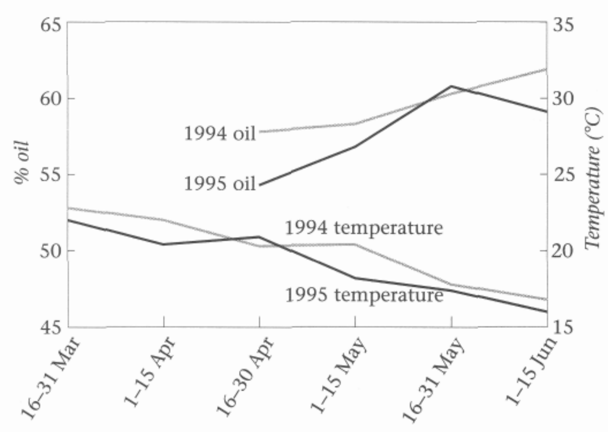


**Figure 6**
Increase in the dry-mass-based oil content of Fuerte fruit delivered to Burpak from April to June during the 1994 and 1995 seasons. Mean bi-monthly temperatures are indicated.

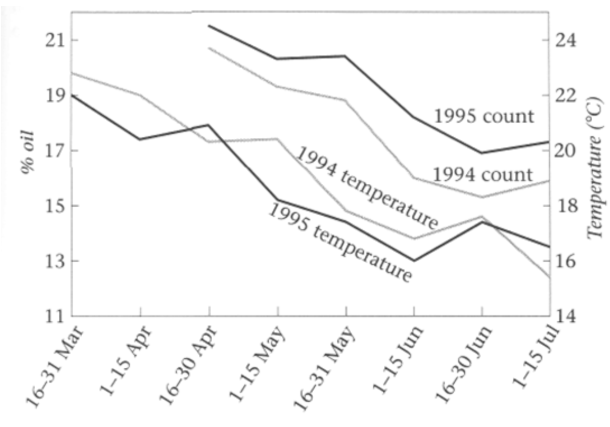


**Figure 7**
Mean count of Hass fruit delivered to Burpak from April to July during the 1994 and 1995 seasons. Mean bi-monthly temperatures are indicated.

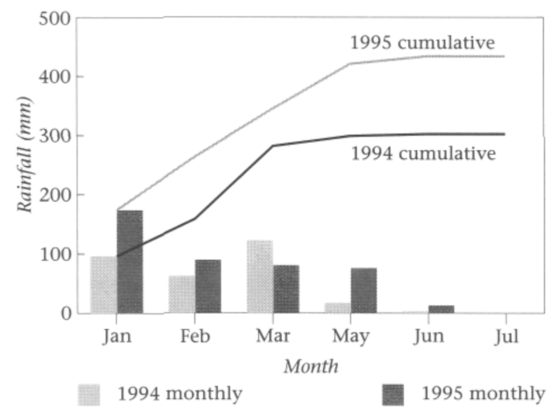


**Figure 8**
Monthly rainfall as recorded at Burgershall during 1994 and 1995

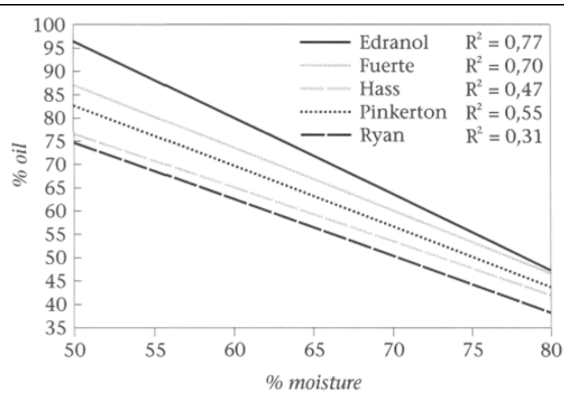


**Figure 9**
Linear regression between oil content (dry-mass basis) and moisture content based on the data accumulated during the 1995 season.

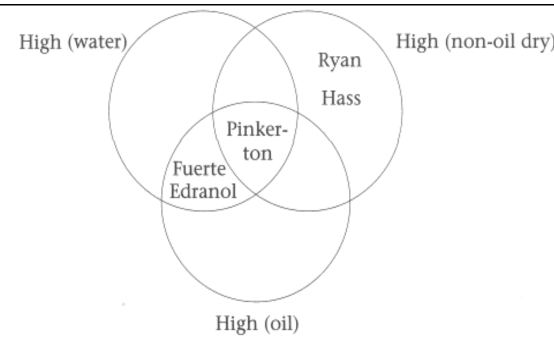


**Figure 10**
Relative status of each cultivar with regard to its oil, moisture and non oil dry component. Based on the 1995 season.

The relative oil: moisture: non-oil dry component ratios of certain cultivars varied between 1994 and 1995. The moisture: oil regressions generally displayed higher $r^2$ values for 1995 (figure 9) than for 1994 (Kruger *et al.,* 1995). Edranol and Fuerte proved to be high both in oil and in moisture, while Ryan and Hass were low in the latter components and high in the non-oil dry component (figure 10). Pinkerton seemed to be intermediately positioned in its oil: moisture : non-oil dry composition. The ratio of oil in relation to moisture and the non-oil dry component was higher in 1995 than in 1994 for Edranol, Fuerte and Pinkerton, but it did not differ much in the case of Hass and Ryan.

An important aspect to be addressed in this study is the sample size required by a packhouse so as to assess whether a specific farmer's crop is ready for harvest, and also the temperature at which the fruit is to be transported. There are specific techniques to determine sample size based on the variation in a sample (Sokal & Rohlf, 1981). In 1994 and 1995 the oil content of the fruit showed considerably greater variation than did the moisture content. This implies that considerably larger samples of fruit are required when using oil as a maturity parameter than when using moisture content. This is true for immature fruit sampled in an orchard (table 2), as well as for fruit delivered to a packhouse (table 3). Differences between the two tables can be ascribed to the magnitude of the variation at different stages of the fruit ontogeny. Because moisture content plays a role in determining of wet-mass oil content, it was to be expected that determining dry-mass oil content required more fruit per sample than did wet-mass oil content.

**Table 1**
Number of maturity evaluations conducted on behalf of producers who packed their fruit at Burgershall Packers (Burpak) during the 1995 season

| | *Erdranol* | | *Fuerte* | | *Hass* | | *Pinkerton* | | *Ryan* | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Date* | *Moisture* | *Oil* | *Moisture* | *Oil* | *Moisture* | *Oil* | *Moisture* | *Oil* | *Moisture* | *Oil* |
| *Mar 1–15* | | | 33 | 5 | | | | | | |
| *Mar 16–31* | | | 60 | 24 | | | | | | |
| *Apr 1–15* | | | 199 | 61 | 3 | 2 | | | | |
| *Apr 16–30* | | | 30 | 11 | 18 | 5 | | | | |
| *May 1–15* | 6 | 0 | 34 | 13 | 218 | 45 | 41 | 1 | | |
| *May 16–31* | 17 | 0 | 42 | 30 | 123 | 36 | 49 | 3 | | |
| *Jun 1–15* | 16 | 0 | 40 | 40 | 41 | 12 | 60 | 4 | 3 | 3 |
| *Jun 16–30* | 40 | 13 | | | 54 | 29 | 11 | 4 | | |
| *Jul 1–15* | 45 | 31 | | | 40 | 24 | 6 | 3 | | |
| *Jul 16–31* | 38 | 12 | | | | | 18 | 6 | 20 | 12 |
| *Aug 1–15* | 31 | 12 | | | | | | | 36 | 30 |
| *Aug 16–31* | | | | | | | | | 24 | 18 |

**Table 2**
Required number of fruits per parameter to be sampled in order to obtain an accurate estimation of the maturity level of an avocado orchard[1]

| *Cultivar* | *Moisture* | | *Oil (wet-mass basis)* | | *Oil (dry-mass basis)* | |
|---|---|---|---|---|---|---|
| | 90 %[2] | 95 %[2] | 90 %[2] | 95 %[2] | 90 %[2] | 95 %[2] |
| *Edranol* | 1 | 3 | 2 | 9 | 13 | 51 |
| *Fuerte* | 1 | 4 | 6 | 22 | 23 | 91 |
| *Hass* | 1 | 2 | 4 | 17 | 18 | 71 |
| *Pinkerton* | 1 | 3 | 4 | 16 | 14 | 56 |
| *Ryan* | 1 | 2 | 3 | 13 | 9 | 36 |

[1]The numbers are based on variation in maturity during the 1995 season at Burpak.
[2]Confidence level of calculation.

From the above it would appear that moisture content may be a more convenient parameter than oil content for determining the time at which a specific orchard should be harvested and the temperature at which the fruit should be transported. Nonetheless, the fact that a consignment of fruit may contain fruits with similar moisture content but with varying oil content may lead to other problems such as uneven ripening as well as inconsistent storage potential and varying organoleptic qualities. This is an aspect which certainly requires further research. The techniques used for dehydrating samples before soxlet oil analysis should also be investigated, because preliminary information (Sippel, 1995) indicates that the drying method may influence the oil determination results.

**Table 3**
Required number of fruits per parameter to be sampled in order to obtain an accurate estimation of the maturity level of avocado fruits delivered to a packhouse[1]

| *Cultivar* | *Moisture* | | *Oil (wet-mass basis)* | | *Oil (dry-mass basis)* | |
|---|---|---|---|---|---|---|
| | 90 %[2] | 95 %[2] | 90 %[2] | 95 %[2] | 90 %[2] | 95 %[2] |
| *Edranol* | 1 | 3 | 4 | 17 | 19 | 77 |
| *Fuerte* | 1 | 2 | 4 | 16 | 22 | 87 |
| *Hass* | 1 | 3 | 8 | 34 | 26 | 103 |
| *Pinkerton* | 1 | 3 | 11 | 42 | 23 | 90 |
| *Ryan* | 1 | 2 | 8 | 32 | 9 | 37 |

[1]The numbers are based on variation in maturity during the 1995 season at Burpak.
[2]Confidence level of calculation.


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