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FURTHER STUDIES ON AVOCADO FRUIT GROWTH AND MATURITY IN INLAND NATAL

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OPSOMMING

Vruggroei en vrugvolwassenheid is vir vier kultivars en twee lokaliteite vir 'n tweede seisoen ondersoek. Die uitvoerstandaard van 80% of minder voginhoud was nie 'n betroubare indeks van vrugvolwassenheid nie. Tentatiewe standaarde vir Natal kwekers op grond van verskeie eienskappe word aanbeveel. Daar is 'n goeie potensiaal vir laat hang van vrugte in koel areas van Natal. Selektiewe oes op die basis van

vruggrootte is voorgestel.

SUMMARY

Fruit growth and maturity of four cultivars were investigated for a second season at two localities from February through October, 7982. *The legal maturity standard of 80% moisture or less was inadequate as a guide to fruit harvesting. Based on various criteria, new standards for each cultivar are tentatively suggested for Natal growers. Considerable scope for late hanging is indicated, and selective picking by size is suggested.*

INTRODUCTION

Relatively large plantings of avocados have been made in inland Natal since 1977 in areas such as Baynesfield, Richmond, Ottos Bluff, Karkloof, Crammond, Wartburg, Sevenoaks, Greytown, Kranskop and Eshowe/Ntumeni. Interest continues and further substantial plantings are in prospect. The main objective has been to capitalize on the advantages of latitude and climate which make for relatively late fruit maturity. There is also a proven potential for late hanging of fruit into high local market price periods, and lower incidence of *Phytophthora cinnamomi* in most soils (Wolstenholme, 1981).

Results of an initial study on fruit growth and maturity of three cultivars in two typical localities close to Pietermaritzburg have been reported (Me Onie & Wolstenholme, 1982). This somewhat more detailed study extends the results to a second season with one additional cultivar. The objective is to provide a firm data base for guidance of local growers.

MATERIALS AND METHODS

As for the 1981 studies, the co-operation of three growers was obtained in two different ecological areas close to Pietermaritzburg. Mr JKTrain's farm at Claridge is representative of the high rainfall moderately cool but largely frost-free escarpment of Bioclimatic Group 3 (altitude ± 930 m). Avocado orchards at Baynesfield Estates and on the adjoining Antel family farm are in a distinctly cooler and lower rainfall area in Bioclimatic Group 2(Phillips, 1973). As in 1981, severe drought conditions prevailed through autumn, winter and spring. The very heavy water-retentive Mutton form soils at all sites somewhat reduced tree stress, but, only the 'Hass' and 'Edranol' trees at Baynesfield Estates received regular irrigation.

The same procedure, developed in California by Young & Lee (1978), was used to measure fruit growth (Mc Onie & Wolstenholme, 1982). Measurements were started earlier (late February), and a single 'Ryan' tree was included at Claridge.

Moisture percentage of fruit samples was again determined at fortnightly intervals. Although this is an indirect measure of oil content (Kikuta & Erickson, 1968; Slater et a/., 1975; Swarts, 1976), results are not presented on an oil percentage basis as the relevant constants have not been determined for Natal conditions. There is also a tendency to move towards maturity standards based on percentage dry mass, as in California (Anon., 1981; Lee, 1981).

As fruit maturity is presumably correlated with seed maturity in avocado, the appearance and mass of the seed coats (testas) were recorded for the earlier samples. Testa appearance was rated from 1 (moist, thick, white) to 4 (dry, thin, brown).

Post-harvest fruit softening was monitored daily with a firmometer (Swarts, 1981), using fortnightly samples of three fruits of each cultivar. Newly harvested fruit read 12-15, and fully ripe fruit 100+ on the firmometer scale. Fruit and seed masses were determined on all ripe fruits.

RESULTS AND DISCUSSION 1

Fruit growth curves

Results are given for each cultivar and locality in Fig 1. When measurements started in late February, all fruits were growing rapidly in both length and breadth. With the onset of cooler and drier conditions, growth rate decreased, but the winter "plateau" in length growth was this year less pronounced than in 1981, except for 'Fuerte' from Baynesfield (Antel). These latter trees were more drought-stressed and this as well as colder conditions than at Claridge may have been responsible. Improved irrigation practices at Baynesfield Estate were reflected in markedly better fruit growth of 'Edranol' and 'Hass' fruit as compared with 1981. The growth pattern of 'Ryan' at Claridge was unexpected, with the fruit attaining close to maximum size by mid-April, many months before horticultural maturity.

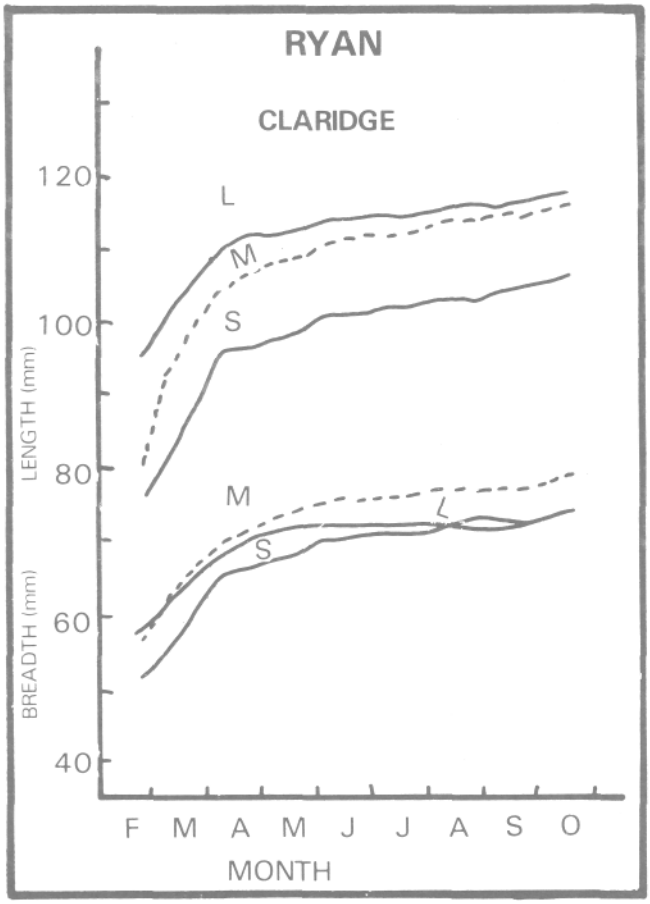
Very high correlation coefficients (usually >0,98) were found for the relationship between fruit length and breadth in large, medium and small fruit of all cultivars. The regression coefficients of fruit breadth: length were mostly around 0,7, except for

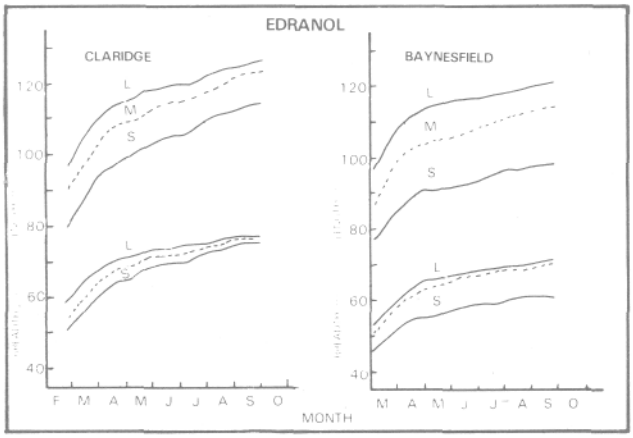
Fuerte' where breadth growth had largely ceased by April and fruits were consequently relatively thinner.

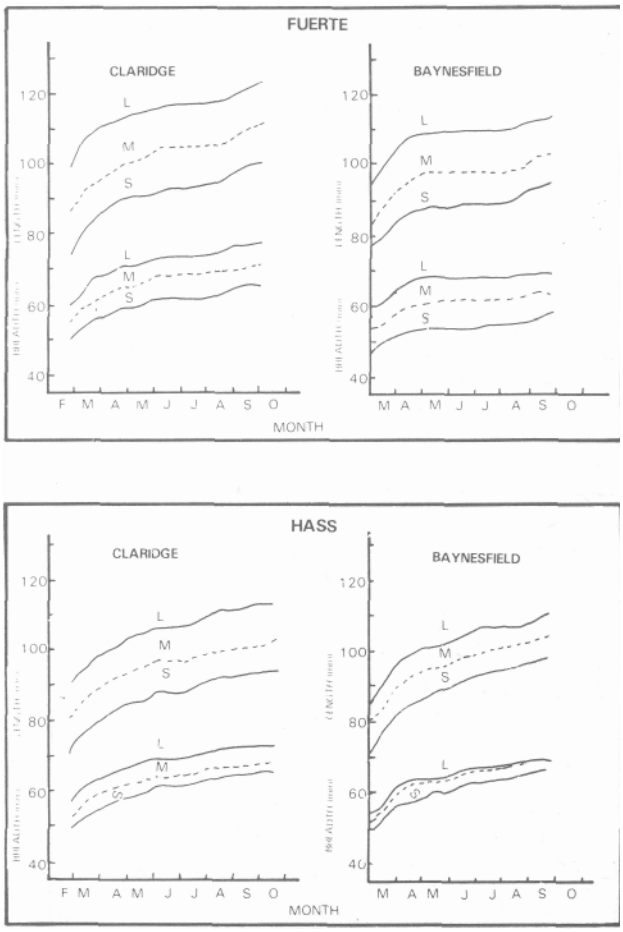
As in 1981, fruits selected in February as large, medium and small maintained these relative size differences through into October, in spite of considerable interim growth. The implication is that selective picking is desirable. Small but otherwise normal fruits will gain considerably in size and mass if retained longer on the tree.

A close relationship between fruit mass and seed mass was found for Claridge fruit picked between May and October. The regression coefficients were 0,84 for 'Fuerte', 0,87 for 'Edranol' and 0,88 for 'Hass'. Fruit mass is therefore closely correlated with seed mass, so that a large fruit is likely to have a large seed and vice versa. Factors affecting seed mass (and therefore fruit mass) appear to be determined at a very early stage of fruit development, and need to be investigated.

FIG. 1: Fruit growth curves (length and breadth) for large (L) medium (M) and small (S) fruit, by cultivar and locality





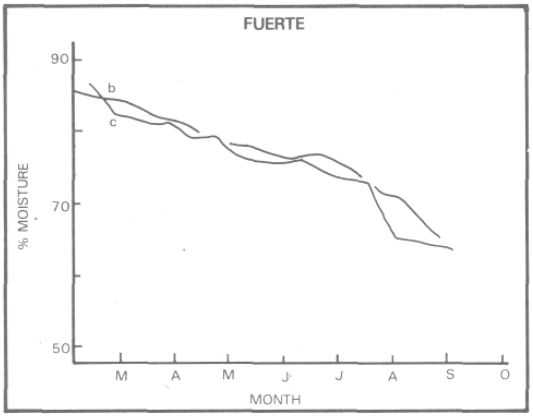


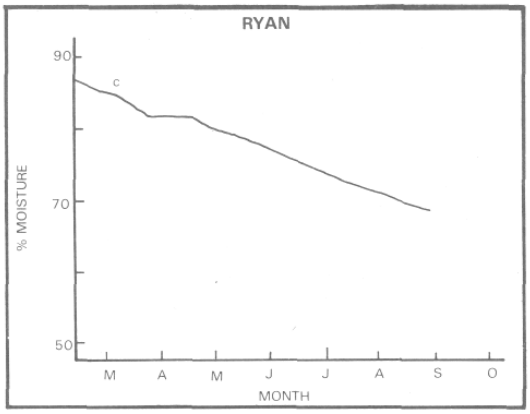
FRUIT MATURITY

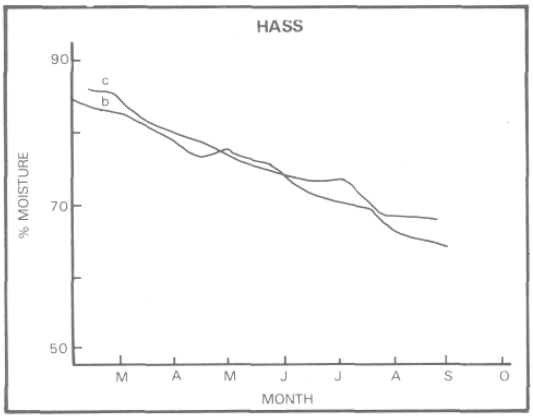
Percentage moisture Actual fortnightly fruit (flesh) moisture contents are given in Fig. 2, and derived linear regression lines in Fig. 3. Correlation coefficients Indicated high linearity of points, and regression lines were highly significant. On average, the flesh moisture percentages dropped by 1,49% per fortnight at Claridge (four cultivars) and 1,35% at Baynesfield (three cultivars).

Extrapolation from regression lines indicated that 'Fuerte' were legally mature (80% moisture) in late April at Claridge and early May at Baynesfield. For 'Edranol' the respective times early May and mid-April, and for 'Hass' early May and late April. 'Ryan' reached 80% moisture at Claridge in mid-June. There were therefore some deviations from the expected pattern of attainment of legal maturity, both for cultivar and locality.

As in 1981, 'Fuerte', 'Edranol' and 'Hass' fruit all attained legal maturity (based on the moisture standard) within a few weeks of each other. The indicated harvest dates were Judged to be far too early, even for the early-maturing 'Fuerte', and especially for the other three cultivars (up to four months for 'Hass' and 'Ryan'). The currently accepted standard therefore serves little purpose in guiding Natal growers as to harvest date.







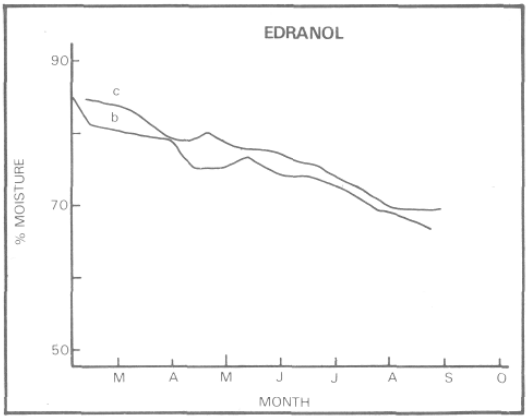


FIG. 2

FIG. 2: Cultivar trends in percentage moisture of fruit flesh for Claridge (C) and Baynesfield (B)

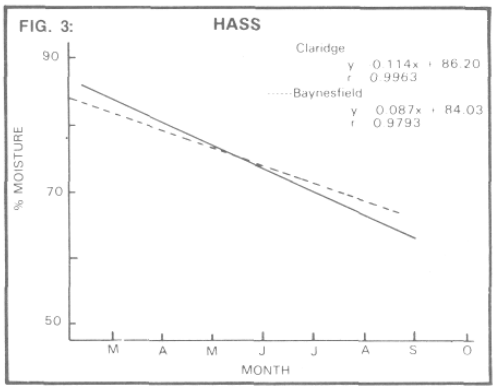
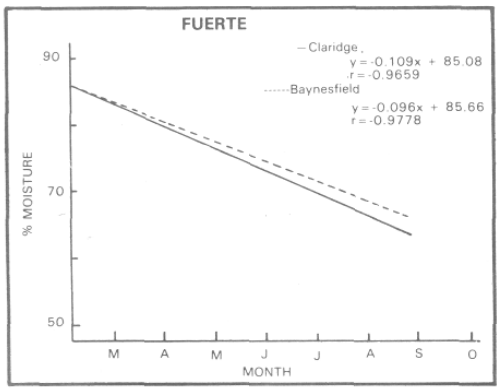
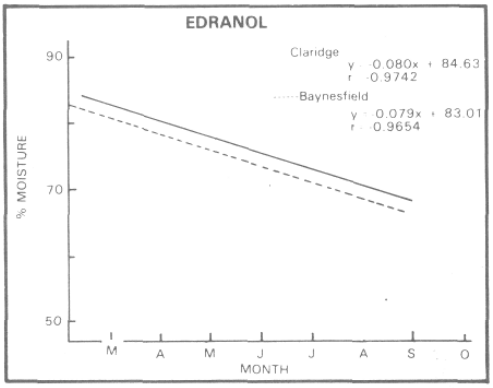


FIG 3: Linear regression lines of fruit percentage moisture during the season at two localities

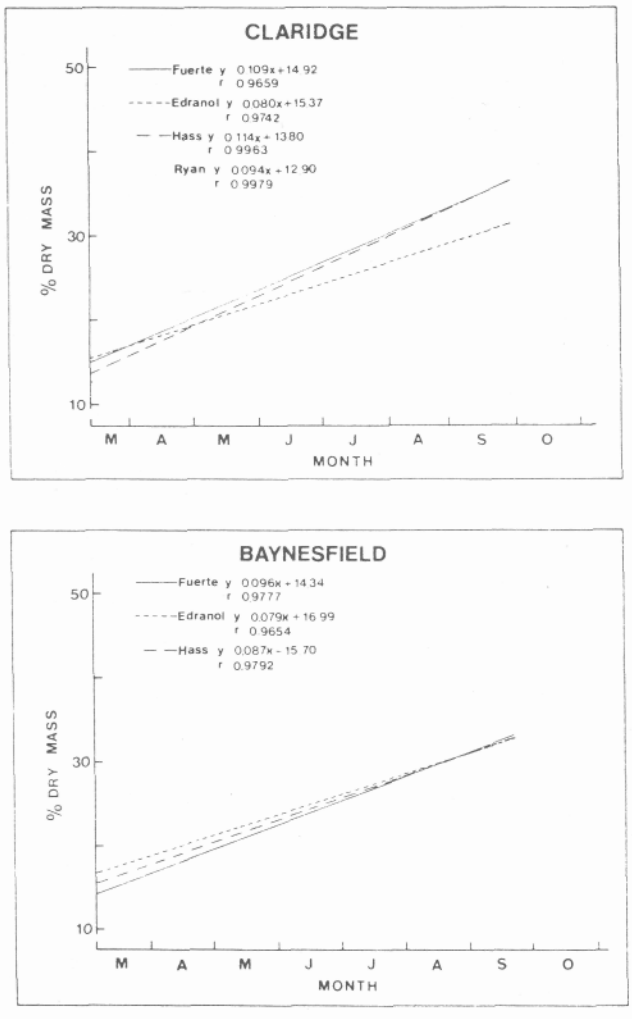




Dry mass percentage

These data are presented as regression lines in Fig. 4 in a manner which allows easy cultivar comparisons at each locality. Dry mass accumulated from around 15% in early March to 30% or more in October. The unexpectedly small differences between cultivars are again evident.

FIG 4: **Linear regression lines for percentage dry mass of fruit for various cultivars at two localities**



Testa appearance

Due to large variability between individual fruits, clear cut results were not obtained. However, in general the characteristics of the Testa indicated a later fruit maturity by at least two to three weeks than suggested by the moisture standard. Testa darkening and drying was noticeable in May in 'Fuerte'. 'Hass' testas were only scored at 1,5 on a scale of 1 (immature) to 4 (mature) in late May. After May, there was great variation in

Testa appearance, obviously reflecting differential seed maturity between fruits.

3. FRUIT RIPENING

Firmometer softening curves from May through September for fruit held at room temperature are presented in Figs 5 and 6.

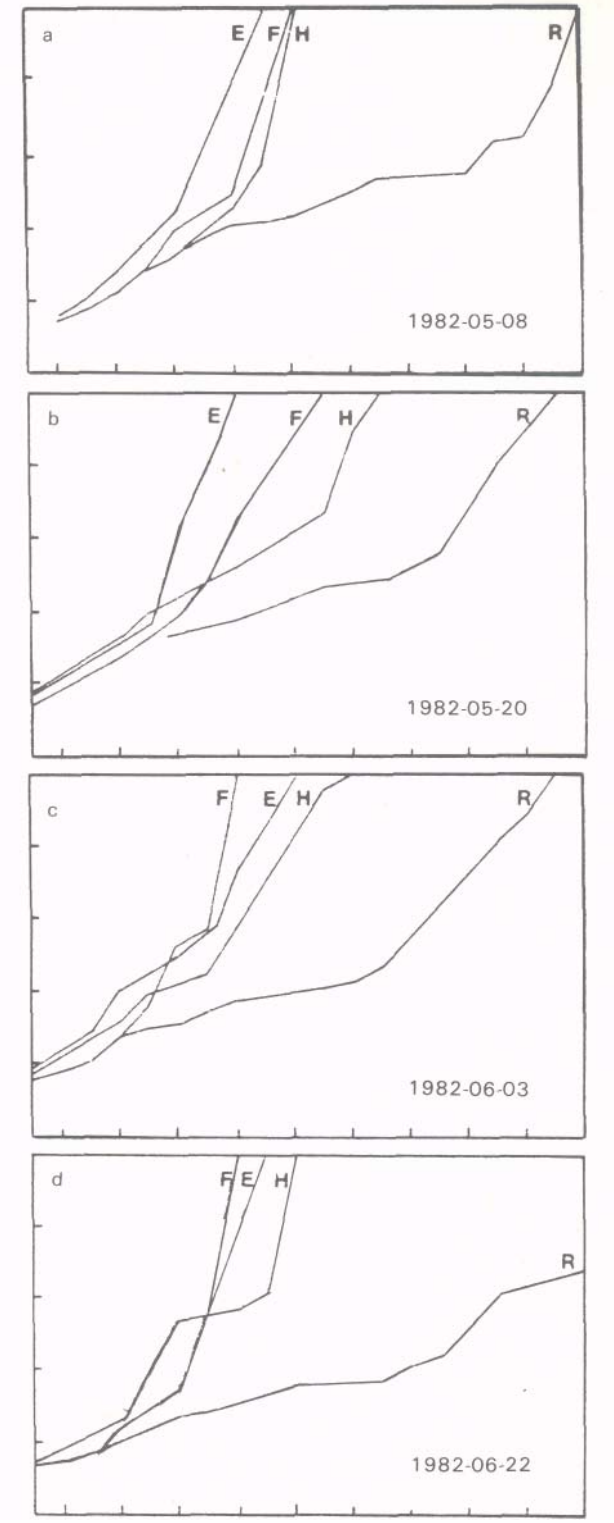
'Fuerte' and 'Edranol' fruit usually softened within six to 10 days after harvest. There was a tendency for slightly faster softening from July onwards. 'Fuerte' fruit always ripened without shriveling, but in 'Edranol' shriveling was common until about August. 'Hass' fruit typically softened in 10 to 14 days. Even at the end of September the fruit was still green when picked, and only from July did purple/black colouration develop during the softening period.

Even in mid-November in Claridge, there was little evidence of colouration on the tree except in sunburnt fruit.

'Ryan' fruit took from 13 to over 20 days to soften. Towards the end of September it softened without severe shriveling, but was only considered of acceptable eating quality in late October/early November.

The ripening curves again reflected considerable fruit to fruit variation. Ripening patterns were similar at the two localities for 'Fuerte' and 'Edranol', but 'Hass' fruit usually softened more slowly at Baynesfield. The possibility that occasional fruits which soften extremely slowly have a higher calcium content should be investigated (Tingwa & Young, 1974; Wills & Tirmazi, 1982).

5: **Firmometer softening curves for 'Fuerte' (F), 'Edranol' (E), 'Hass' (H) and 'Ryan' (R) at Claridge; harvest dates indicated**



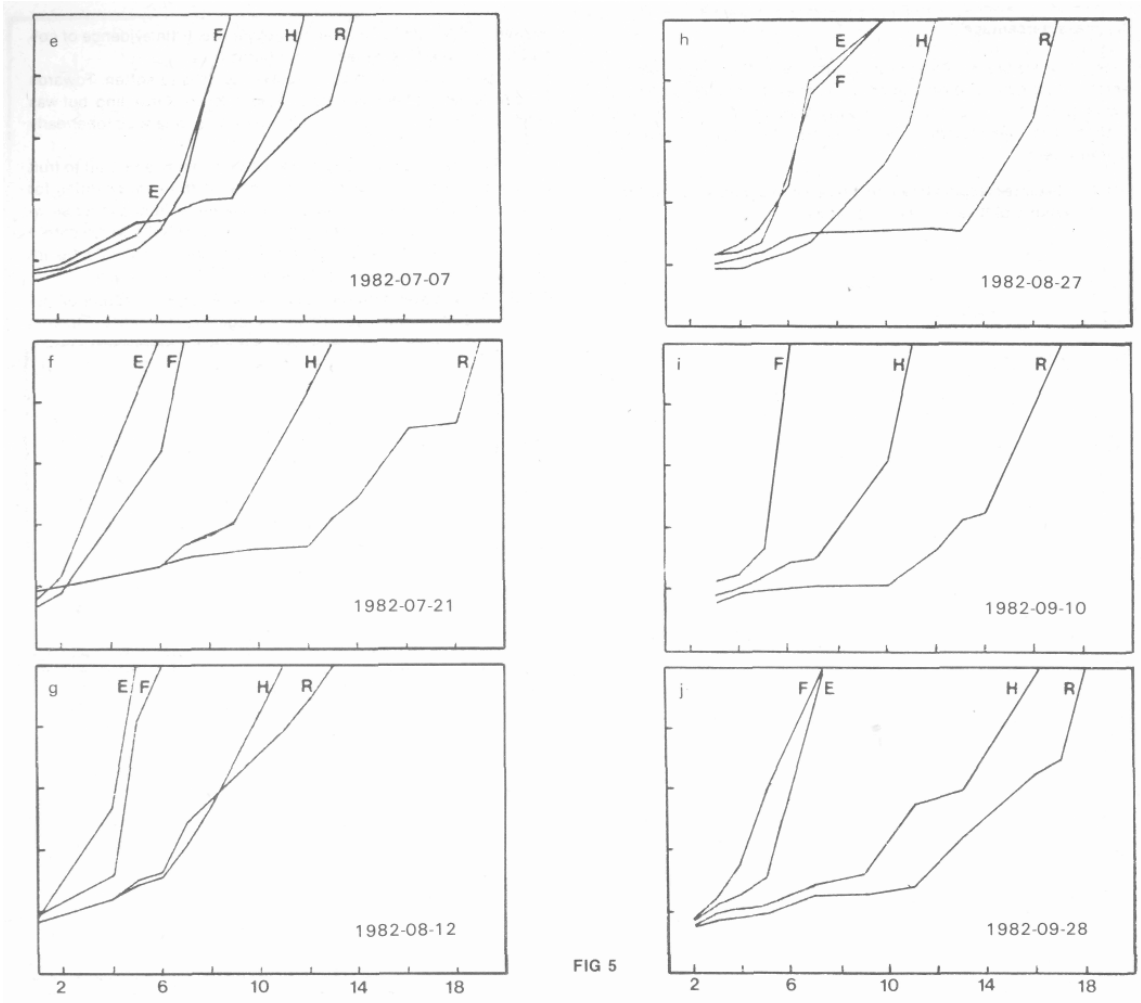
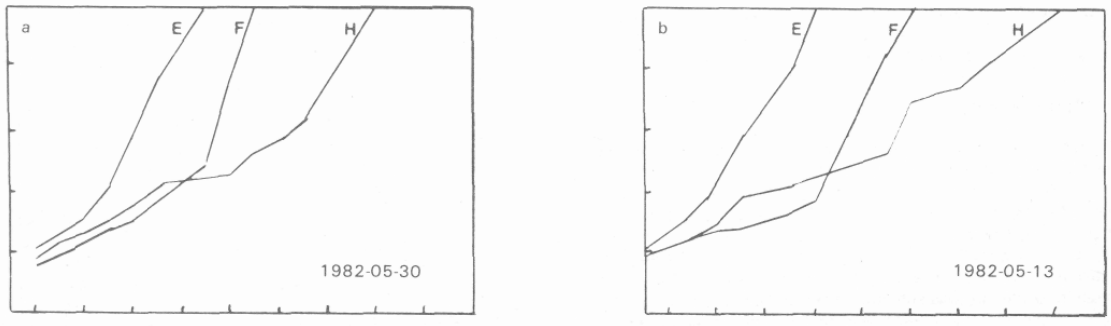


FIG 5

FIG 6: Firmometer softening curves for 'Fuerte' (F), 'Edranol' (E) and 'Hass' (H) in the Baynesfield area



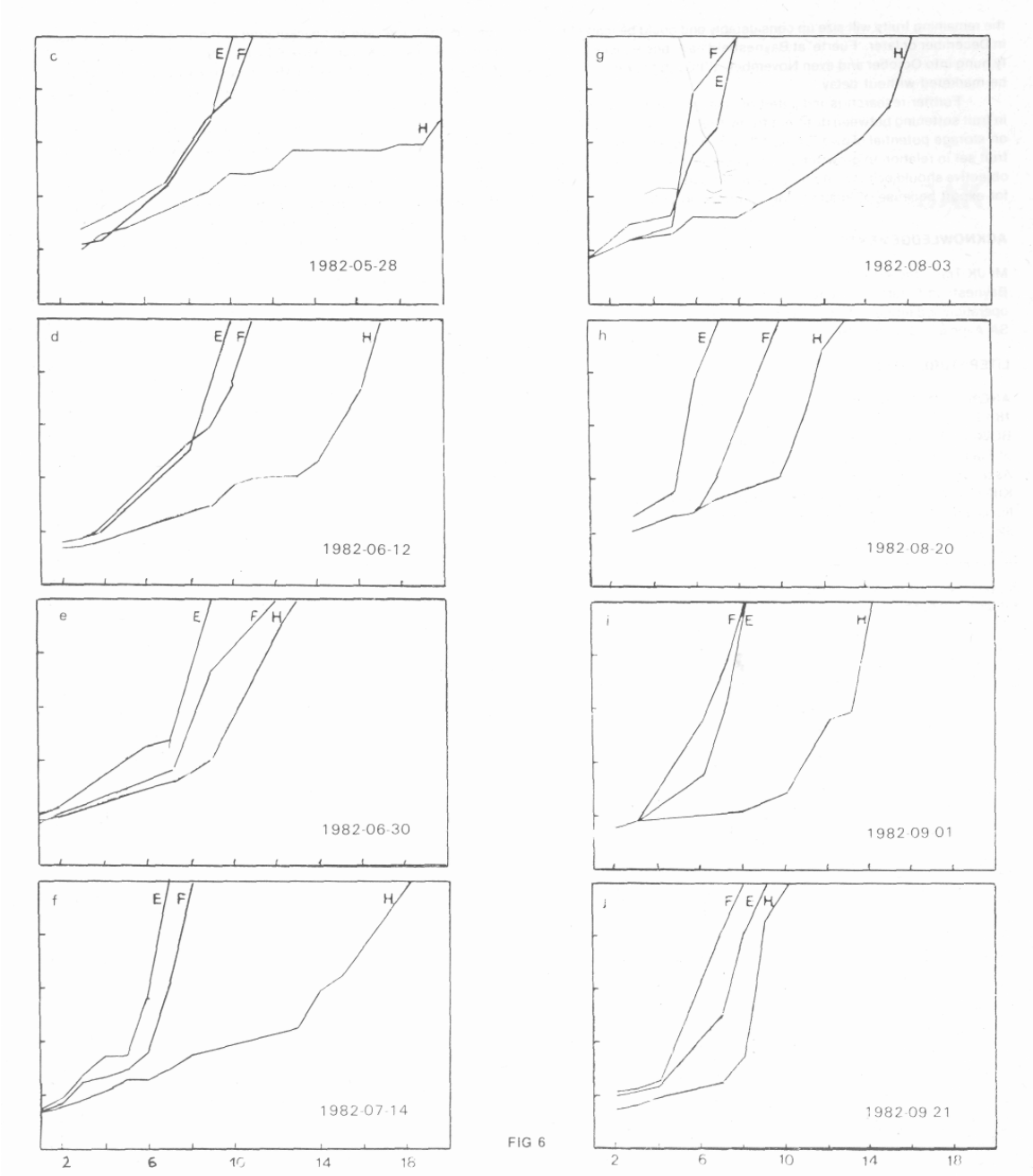


FIG 6

CONCLUSIONS

Under the conditions of below-average rainfall of the past two seasons, it is clear that the 80% moisture standard is not a meaningful maturity guide for inland Natal growers. Fruit growth curves must also be interpreted with caution because they are strongly influenced by the onset of winter, followed by a spring growth resumption.

On the basis of accumulated data from all sources, the following tentative guidelines for earliest harvesting, based on percentage fruit moisture, are suggested. The recommendations are specifically for export fruit, and particularly for air freight as Natal

growers are not yet geared for sea export.

For 'Fuerte', harvesting should not begin until fruit moisture levels have declined to at least 77%. This is about mid-June in the localities tested. A moisture content of 72 to 73% or lower is suggested for 'Edranol'. le from late July. 'Hass' harvesting can start at moisture levels of 70%. from late August. 'Ryan' should not be harvested before October, and preferably later. Even mid-November fruit ripens very slowly.

‘Hass' and 'Ryan' have excellent potential for late hanging in cool areas. If larger fruit are selectively picked and marketed earlier, the remaining fruits will size up considerably and could be marketed in December or later. 'Fuerte' at Baynesfield have been successfully hung into October and even November, although they then must be marketed without delay.

Further research is indicated on aspects such as variation in fruit softening between different fruits: the effect of water stress on storage potential (Bower *et al.,* 1982), and the effect of time of fruit set in relation to growth flushes, position on the tree etc. The objective should be to locate fruits on a tree with the best potential for export because of inherent long storage potential.

ACKNOWLEDGEMENTS

Mr JK Train, the Antel family, and Dr M Taylor and Mr D Wyllie of Baynesfield Estates are sincerely thanked for their continued cooperation and interest. This project was financially supported by the SA Avocado Growers Association.

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