SUITABILITY OF VARIOUS INDICES FOR ASSESSING RIPENESS IN MANGO

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Abstract

Pulp penetration pressure (Pp), degree of shoulder development, degree of skin colouration, degree of pulp colouration and total soluble solids content were quantified from the time fruit became mature until two weeks after the general harvest date. Pp was considered to be superior as an index for assessing ripeness for the reasons that it showed a strictly decreasing trend and is an objective measure. Correlations between Pp and each of the remaining indices were visibly poor. On the basis of these correlations, none of the remaining indices were considered to be adequate substitutes for Pp, assuming that Pp accurately reflects ripeness in terms of the time required for fruit to become eat-ripe. In directly comparing Pp with degree of pulp colouration, the currently adopted index, on the strength of their relationship with the time required for the stage of eat-ripeness to be reached, the relationship for Pp was strongest. Since the relationship with Pp was strong in absolute terms, it was concluded that Pp is a good index, per se, for assessing ripeness in mango.

INTRODUCTION

Maturation refers to the stage when a fruit becomes a fully grown organ about to enter the ripening phase of its existence (Leopold and Kriedemann, 1975). In South Africa, mangoes are harvested after maturation and once processes associated with ripening have been initiated. Ripeness for sea export is currently based on the degree of transition in pulp colouration from white to yellow or yellow/orange. Fruit are deemed suitable for export by sea when this transition is one-third complete or "at 33%." The extent of the transition is rated visually after cutting the fruit through transversely.

Bezuidenhout (1988) reported that incorrect maturity was the most significant factor for fruit rejections during the 1986/87 export season. Rejections were due to fruit being either under-ripe or over-ripe. Kirsten (1991) reported that one of the major problems associated with South African mangoes exported to Europe during the 1990/91 export season, was that of "immaturity" coupled with the incapacity of fruit to ripen. Du Preez (pers comm) concluded from observations made of mangoes arriving at Rungis market, Paris, in March, 1991, that South African fruit arriving by sea were often "immature," requiring up to 14 days to ripen at the temperatures prevailing in Paris at the time. Furthermore, flavour was unsatisfactory on ripening, the fruit having an abnormally low total soluble solids content (TSS). Poor eating quality has previously been associated with picking too early in the season (Medlicott *et.al.*, 1987; Medlicott *et.al.*, 1990a).

It would appear that the suitability of the present method of assessing ripeness of mangoes for sea export is questionable. The following reasons might be recognized for the presently adopted index being inadequate:

* The correlation between degree of pulp colouration (Pc) and the time required for the stage of eat-ripeness to be reached (Tr) is poor.
* Differences exist between cultivars with respect to Tr from the time fruit show 33% pulp colouration.
* The method of assessing Pc gives rise to a high degree of error due to it being largely subjective.

An "ideal" index for assessing ripeness of mango for picking and storage might be recognized as being one that satisfies the following:

* Change of the index, in terms of a reduction or increase with time, commences prior to the optimum time of picking.
* The change during the period prior to the optimum time of picking is large enough to be detected by the method of measurement.
* The method of measurement is accurate and simple to perform.
* The correlation between the degree of change and Tr is good irrespective of the conditions of storage and ripening to which a consignment of fruit is exposed.
* Cultivar differences with regard to the foregoing correlation do not exist or are small enough to be disregarded.
* Measurement does not result in destruction of the fruit.
* The change of the index with time is either strictly increasing or decreasing without there being high rates of change at any stage.

Research results indicate that prestorage ripeness has a strong bearing on the suitability of the storage temperature (Medlicott et al, 1987, 1990a, 1990b). Furthermore, differences in this relationship with respect to cultivar are also apparent (Oosthuyse, 1990). The optimum stage of ripeness to commence cold-transit storage for the temperature regimes locally under consideration for sea export, have still to be determined for the mango cultivars exported from South Africa. For such determinations to be meaningful, the identification of an index that reliably indicates stage of ripeness is essential.

Since the optimum stage of ripeness to pick and commence cold-storage has still to be ascertained for the various cultivars exported locally, it might be added, in reconsidering the requirements of an ideal index, that measurable change of the index commence from the time of maturation.

For the purpose of appraising Pp, degree of skin colouration (Sc), Pc, degree of shoulder development (Sh) and TSS individually as indicators of the stage of ripeness in mango, and presenting a case for the use of Pp as an index, the following were ascertained in the present study:

1) The changes with time of Pp, Pc, TSS, Sh, and Sc from the time of maturation.
2) Correlations between Pp and each of the remaining indices mentioned above.
3) The relationship between Pp and Tr, and between Pc and Tr, for picked fruit.

MATERIALS AND METHODS

Two experiments were performed, the first to ascertain "1" and "2" above (Experiment I), and the second to ascertain "3" above (Experiment II).

Experiment I

During the first week of July, 1990, 10 healthy Sensation mango trees having

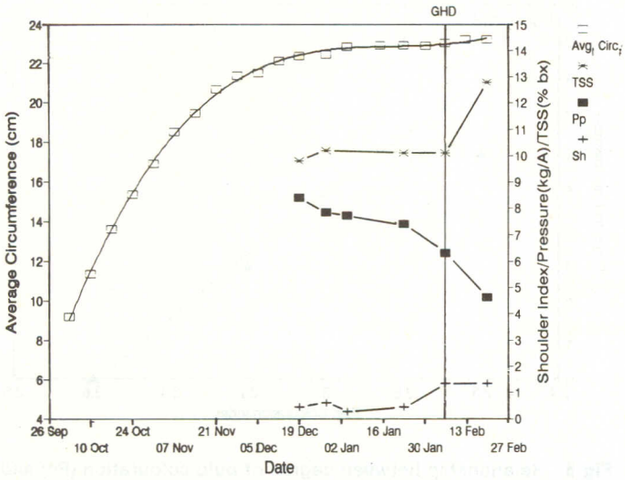

Fig 1 Fruit growth and the concurrent changes in total soluble solids content (TSS), pulp penetration pressure (Pp) and degree of shoulder development (Sh) from 6 weeks before the general harvest date (GDH) until two weeks after this date (cv Sensation).

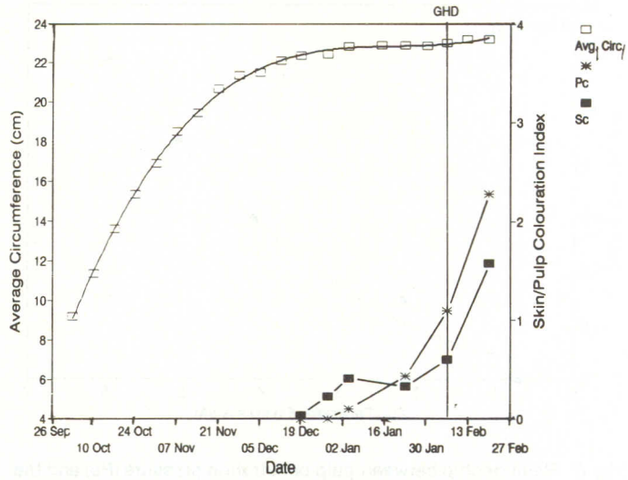

Fig 2 Fruit growth and the concurrent changes in degree of pulp colouration (Pc) and skin colouration (Sc) from 6 weeks before the general harvest date (GDH) until two weeks after this date (cv Sensation).

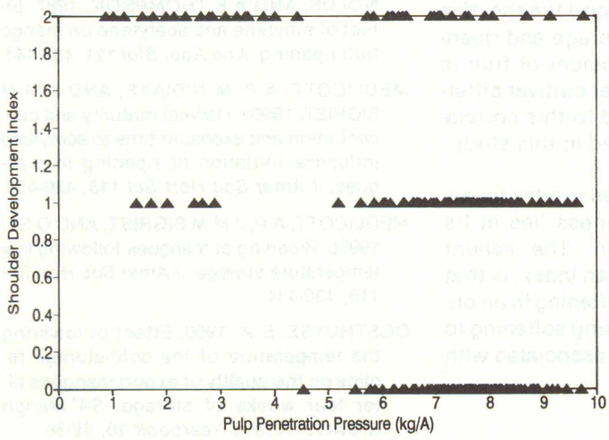

Fig 3 Scatter plot of degree of shoulder development (Sh) versus pulp penetration pressure (Pp) (cv Sensation).

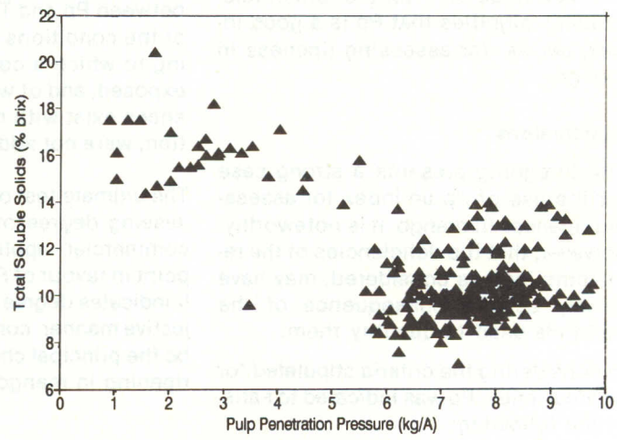

Fig 4 Scatter plot of total soluble solids content (TSS) versus pulp penetration pressure (Pp) (cv Sensation).

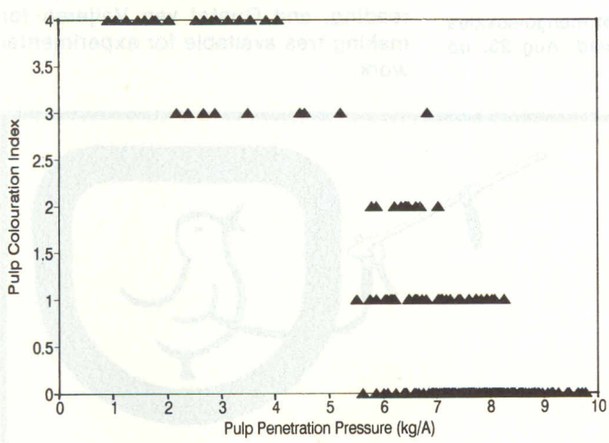

Fig 5 Scatter plot of degree of pulp colouration (Pc) versus pulp penetration pressure (Pp) (cv Sensation).

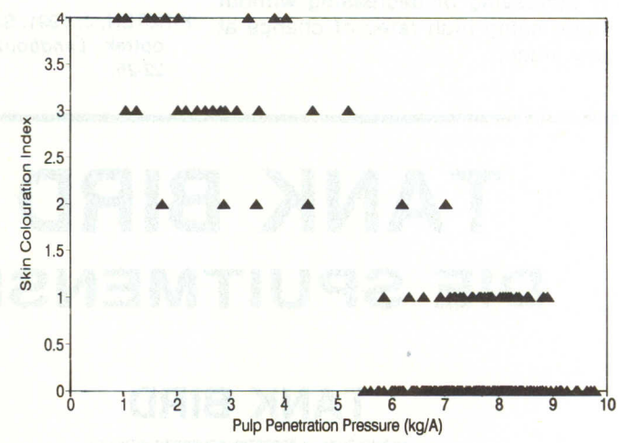

Fig 6 Scatter plot of degree of skin colouration (Sc) versus pulp penetration pressure (Pp) (cv Sensation).

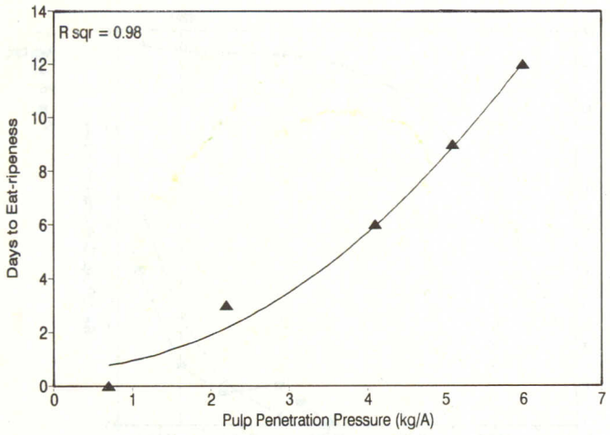

Fig 7 Relationship between pulp penetration pressure (Pp) and the time required for the fruit to become eat-ripe (Tr) (cv Kent).

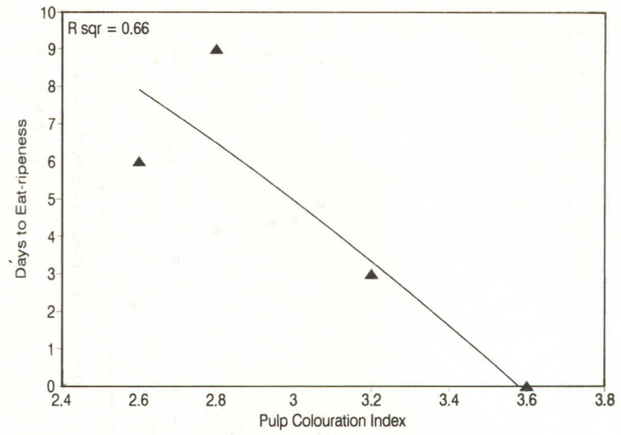

Fig 8 Relationship between degree of pulp colouration (Pc) and the time required for the fruit to become eat-ripe (Tr) (cv Kent).

tionship was stronger than the latter, as indicated by these percentages, suggests that Pp is a better index for assessing ripeness than Pc. Furthermore, the high value of R^2 for the former relationship signifies that Pp is a good index, *per se*, for assessing ripeness in mango.

Conclusions

The foregoing presents a strong case for the use of Pp an index for assessing ripeness in mango. It is noteworthy, however, that the deficiencies of the remaining indices considered, may have largely been a consequence of the methods used to quantify them.

In considering the criteria stipulated for an ideal index, Pp was indicated to satisfy the following:

* Measurable change commences from the time fruit reach maturity.
* The method of quantification is accurate and simple to perform.
* The change with time is either strictly increasing or decreasing without there being high rates of change at any stage.

The criterion that the method of quantification be non-destructive was not met.

The question of whether the correlation between Pp and Tr is good irrespective of the conditions of storage and ripening to which a consignment of fruit is exposed, and of whether cultivar differences exist with regard to this correlation, were not addressed in this study.

The ultimate test of Pp as a index for assessing degree of ripeness lies in its commercial application. The salient point in favour of Pp as an index, is that it indicates degree of softening in an objective manner, considering softening to be the principal change associated with ripening in mango.

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