Quality Evaluations of Sea-Exported South African Mangoes in Europe during the 1995/96 Season

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ABSTRACT

Sea-exported South African mangoes were sampled and evaluated in Europe from 27 December 1995 to 26 March 1996. On arrival, 86% of the fruits were hard, 11.9% were firm, and 1.2% were soft. The incidence of soft brown rot and anthracnose differed between cultivars, and increased as the fruit ripened. On ripening, 10.6% of the fruits sampled had anthracnose, and 19.1% had soft brown rot. There was a positive relationship between TSS at the soft stage and taste. The incidence of External chilling injury, internal browning, internal breakdown, and lenticel damage differed between cultivars. 'Heidi' showed the highest incidence of external chilling injury (48.5%) and internal browning (40.6%). 'Sensation' had a high incidence of internal breakdown (11.5%) and internal browning (29.6%). Lenticel damage was most severe in 'Tommy Atkins' and 'Isis'. The cultivars 'Heidi', 'Irwin', 'Isis', 'Keitt', 'Kent', 'Tommy Atkins', 'Sensation' and 'Zill' were evaluated.

UITTREKSEL

Suid-Afrikaanse mango's wat per see uitgevoer is, is in Europa gedurende die tydperk 27 Desember tot 26 Maart 1996 in Europa geëvalueer. Met aankoms, was 86% van die vrugte hard, 11.9% ferm en 1.2% sag gewees. Die insidensie van sagte bruin vrot en antraknose het van kultivar tot kultivar verskil, en het met rypwording toegeneem. 'n Positiewe verwantskap tussen TOV en smaak het ontstaan. Die persentasie vrugte met eksterne koueskade en interne verbruining, interne verval, en lentiselskade het tussen kultivars verskil. 'Heidi' het die hoogste persentasie vrugte met eksterne koueskade (48.5%) en interne verbruining (40.6%) gehad. 'Sensation' het 'n hoë insidensie interne verval (11.5%) en interne verbruining (29.6%) gehad. 'Tommy Atkins' en 'Isis' is die ergste deur lentiselskade geaffekteer. Die kultivars 'Heidi', 'Irwin', 'Isis', 'Keitt', 'Tommy Atkins', 'Sensation' en 'Zill' is geëvalueer.

INTRODUCTION

Mango exports during the 1995/96 season accounted for approximately 29% of the South African mango industry's R 70.8 million turnover. The contribution of exports to the industry's turnover is set to increase markedly in the next few years, as many of the large new plantings are aimed at the export market. In the face of increasing competition from South American and Central African countries on the European market, South African mango growers should aim to produce the quality which the market demands, viz: mangoes with good colour, good taste, minimal postharvest decay, minimal physiological disorders, and of count sizes 8, 9 &10 (400 g to 550 g). These criteria should be kept in mind whilst reading this paper. The primary aim of the evaluations carried out was to give individual growers and their export agents feedback on the quality of their fruit on arrival and on ripening. The data collected also yielded a number of interesting trends and statistics which are the subject of this paper, and should be useful in alerting the industry its problems and shortcomings.

MATERIALS AND METHODS

Sampling

During the 11 week period from 27 December 1995 to 13 March 1996, sea freighted South African mangoes were sampled on arrival in Europe. Samples were drawn from import agents mainly in and around Rotterdam, The Netherlands, and from Antwerp, Belgium. The Netherlands and Belgium were chosen as the main sampling centres because approximately 60% of South African mango exports are sold or distributed from these two countries. On two occasions during the season, samples were also drawn from import agents at the fresh produce market in Paris. For reasons of practicality, it was not possible to draw samples totally representative of the industry from every vessel arriving in Europe. The evaluations carried out, however, should give a good indication of the quality of South African mangoes exported to Europe during the 1995/96 season.

Evaluation

On arrival, the each fruit was evaluated externally

for blemishes; development of red blush colour; development of yellow background colour; firmness; degree of lenticel damage (Oosthuyse, 1993); and presence or absence of anthracnose (*Colletotrichum gloeosporoides*), soft brown rot (*Natrassia mangiferae*) and external chilling injury. The fruit was then placed in a room at ±18°C and allowed to ripen. On ripening, each fruit was evaluated externally for background colour development, cut, and evaluated for the presence of absence of internal breakdown, internal cavities, internal browning, split pip, soft brown rot and anthracnose. TSS of each fruit was determined using a refractometer. The fruit was tasted and given a subjective taste rating of either poor, average, good or excellent. TSS and taste were not determined in fruit with soft brown rot or internal breakdown. See Table 1 for the scoring system used. A fruit was rated as 'good quality' if the following criteria were met: i) at least some blush colour; ii) at least some background colour on arrival; iii) hard or firm on arrival; iv) < 25% of the fruit surface affected by lenticel damage v)taste of average rating or better; and vi) no chilling injury, decay or physiological disorders. The number of fruit evaluated per cultivar is indicated in Table 2.

Table 1 *Scoring system for mango evaluations*

Quality parameter	Rating	Score
Blush colour	% of fruit surface covered	0 to 100
Background colour	Dark green Light green Green > yellow Yellow > green All yellow	0 1 2 3 4
Firmness	Hard Firm Soft	1 2 3
Blemish	Clean Acceptable Unacceptable	0 1 2
Taste	Poor Average Good Excellent	1 2 3 4
Lenticel damage	% of fruit surface covered	0 to 100

Table 2 *Number of fruit evaluated per cultivar*

Cultivar	No. fruit evaluated
Heidi	33
Irwin	57
Isis	55
Keitt	80
Kent	326
Sensation	303
Tommy Atkins	559
Zill	141

RESULTS AND DISCUSSION

Fruit firmness on arrival

Fruit firmness on arrival was satisfactory. Of the fruit sampled on arrival, 86.8% was hard, 11.9% was firm, and 1.2% was soft.

Postharvest decay

Due to abnormally high rainfall during the period from November 1995 to March 1996, disease pressure was higher than in the past few years, resulting in higher levels of soft brown rot and anthracnose. The incidence of both soft brown rot and anthracnose increased as the fruit ripened. Of the fruit sampled throughout the season, 3.7% had anthracnose and 4.2% had soft brown rot symptoms on arrival. On ripening, the incidence of anthracnose and soft brown rot had risen to 10.6% and 19.1% respectively. The incidence of soft brown rot varied from cultivar to cultivar, with an incidence of 30.1% in 'Kent' being the highest and 3.1% in Heidi being the lowest (Table 3). It was evident also, that postharvest disease incidence was lower in fruit from the drier and earlier growing regions than in the wetter and later regions (data not published). This effect was most apparent in 'Kent' and 'Keitt', which in addition to being late cultivars, are susceptible to postharvest decay.

TSS and Taste

There was a positive relationship between TSS and taste over all cultivars (Fig. 1). Average subjective taste ratings indicate that taste of the fruit was, in general, not good, with 'Heidi' and 'Zill' having the highest average score of 2.6 (between 'average' and 'good'), and 'Irwin' and 'Sensation' having the lowest average score of 1.7(between 'poor' and 'average). This is in agreement with the findings of Oosthuyse (1991), where the taste of sea-exported South African fruit was "generally found to be poor". 'Irwin' often had a fermented taste on ripening, rendering the fruit inedible. In discussions with two different exporters, they said that they were aware that 'Irwin' was not suitable for sea export, because of the development of "off-flavours" and postharvest decay.

Internal breakdown

Internal breakdown, in the form of jelly seed (van Lelyveld and Smith, 1979) occurred mainly in 'Tommy Atkins' and 'Sensation', where the incidences were 7.0% and 11.5% respectively. In 'Heidi', jelly seed occurred in 9.4% of the fruit evaluated (Table 5). This figure for 'Heidi', however, may not be representative of the industry, as only 33 fruit were evaluated (Table 2). In the other cultivars evaluated, this disorder occurred very rarely, if at all. In 'Sensation', jelly seed seemed to be associated with over mature fruit.

Chilling injury and Internal Browning

External chilling injury, characterised by pitting and browning of the exocarp to various extents, was most prevalent in 'Heidi' and 'Isis' (Table 6). Cold stor-

Table 3 *Anthracnose and soft brown rot incidence on arrival and ripening of sea-exported South African mangoes evaluated in Europe in the 1995/96 season*

Cultivar	Anthracnose on arrival (%fruit affected)	Anthracnose on ripening (%fruit affected)	Soft brown rot on arrival (%fruit affected)	Soft brown rot on ripening (%fruit affected)
Heidi	3.0	0.0	0.0	3.1
Irwin	3.5	6.0	14.0	40.0
Isis	5.5	7.5	5.5	20.8
Keitt	2.5	17.5	3.8	23.8
Kent	2.8	11.1	5.4	30.1
Sensation	5.9	9.6	1.7	10.9
T. Atkins	1.3	6.8	3.4	10.7
Zill	19.4	26.3	5.8	7.5

Table 4 *Average TSS and taste on ripening of sea-exported South African mangoes evaluated in Europe during the 1995/96 season.*

Cultivar	Average TSS (%Brix)	SE	Average taste rating*	SE
Heidi	18.1	0.66	2.6	0.140.
Irwin	14.1	0.27	1.7	15
Isis	16.9	0.39	2.3	0.14
Keitt	15.3	0.24	2.2	0.09
Kent	16.6	0.15	2.1	0.05
Sensation	15.3	0.16	1.7	0.05
T. Atkins	14.7	0.01	2.2	0.03
Zill	17.7	0.15	2.6	0.06

*1= poor, 2= average, 3= good, 4= excellent

age procedures used were clearly not suitable for 'Heidi'. Internal browning was characterised by the mesocarp tissue adjacent to the exocarp becoming brown and spongy and/or a general browning of the mesocarp. In 'Sensation', internal browning was nearly always associated with immature fruit (as judged by pulp colour).

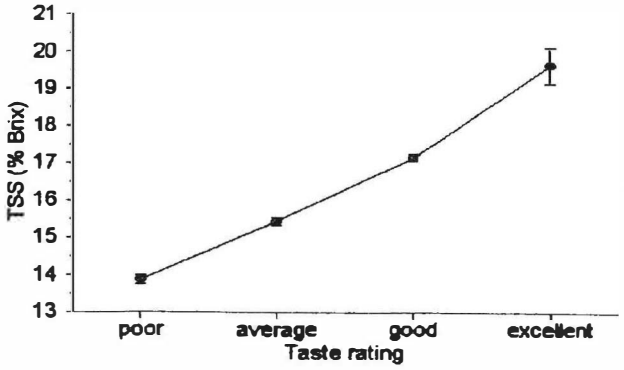

Fig. 1 *Relationship between TSS and taste rating on ripening of sea-exported South African mangoes (all cultivars) evaluated in Europe during the 1995/96 season (SE indicated by vertical bars).*

Table 5 *Incidence of jelly seed in sea-exported South African mangoes evaluated in Europe during the 1995/96 season.*

Cultivar	Jelly seed (% fruit affected)
Heidi	9.4
Irwin	0.0
Isis	2.1
Keitt	0.0
Kent	1.1
Sensation	11.5
Tommy Atkins	7.0
Zill	0.8

Table 6 *Incidence of external chilling injury and internal browning in sea-exported South African mangoes evaluated in Europe during the 1995/96 season.*

Cultivar	External chilling injury (% fruit affected)	Internal browning (% fruit affected)
Heidi	48.5	40.6
Irwin	0.0	0.0
Isis	18.2	0.0
Keitt	0.0	16.7
Kent	1.0	2.6
Sensation	0.0	29.6
T. Atkins	0.4	5.0
Zill	0.0	0.0

Lenticel damage

Lenticel damage, characterised by localised darkening of the skin tissue surrounding the lenticels (Oosthuyse 1993), was most severe in 'Tommy Atkins' and 'Isis' (Table 7). In 'Tommy Atkins', darkening around the lenticels was most severe on the red areas of the skin. Lenticel damage does not affect the eating quality of the fruit, but detracts from the cosmetic appeal. Packhouse treatments, such as detergent washes and waxing, as well as growing conditions and various cultural factors, have been implicated by growers as factors causing or contributing to this disorder. A trial in which the aforementioned parameters are monitored is necessary to determine the cause(s) of lenticel damage.

Table 7 *Lenticel damage ratings of sea-exported South African Mangoes evaluated in Europe during the 1995/96 season.*

Cultivar	Average lenticel damage (% of fruit surface)	SE
Heidi	3.8	1.58
Irwin	15.8	1.94
Isis	23.2	2.04
Keitt	10.3	1.58
Kent	3.1	0.46
Sensation	6.0	0.63
Tommy Atkins	23.2	0.83
Zill	5.9	0.90

Table 8 *Percentage of sea-exported South African mangoes rated as 'good quality' in sample evaluated in Europe during the 1995/96 season.*

Cultivar	% Good quality*	Main problem areas
Heidi	27.3	Internal browning & external chilling injury, jelly seed.
Irwin	7.0	Poor taste, soft brown rot.
Isis	21.8	External chilling injury, soft brown rot.
Keitt	13.8	Poor background colour, anthracnose, soft brown rot.
Kent	6.7	Poor background & blush colour, soft brown rot.
Sensation	19.5	Internal browning, jelly seed, poor taste.
Tommy Atkins	27.7	Lenticel damage, internal breakdown.
Zill	18.4	Poor background colour, anthracnose.

***A fruit was rated as 'Good Quality' if the following criteria were met:**
- Blush clour: at least some blush.
- Background colour on arrival: at least some yellow.
- Firmness on arrival: Hard or firm.
- Lenticel damage:ú 25 % of fruit surface.
- Taste: average or better (ie a rating of 2, 3, or 4)
- No external chilling injury or internal browning, decay, or internal breakdown.

Blemish

Of the fruit evaluated, only 3.5% was not blemished; 3.5% was unacceptably blemished, and 93.1% had blemishes rated as "acceptable". Blemishes which were generally as a result of wind damage and rough handling in the orchard and packhouse, detracted from the cosmetic appeal of the fruit. In comparison to mangoes from other countries on the European market during the same period, levels of blemish on South African mangoes were much higher. Attention needs to be paid to cultural and handling practices to reduce the levels of blemish. In hindsight, the scoring system for blemish was not adequate as only three ratings could be given, namely: "clean", "acceptable" (according to export standards) and "unacceptable". This, due to the high incidence of blemished fruit, did not allow us to identify growers, packhouses and growing regions which had more severely blemished fruit. Future evaluations should have a rating system which has a broader scale of severity.

'Good quality' rating

A good quality rating was devised to give an overall view of the quality of the fruit. The percentage "good quality" fruit was alarmingly low, with 'Tommy Atkins' being the best with only 27% of the fruits rated as 'good quality' in samples evaluated in Europe during the 1995/96 season (Table 8).

CONCLUSIONS

Soft brown rot and anthracnose were the major two postharvest problems in exported fruit during the 1995/96 season. The correct and timeous application of orchard sprays will have to be critically attended to by growers, to prevent such high levels of decay in the future. The high incidence of blemished fruit is cause for concern. Reduction of the incidence of blemished fruit will greatly improve the cosmetic appeal of the fruit. Uneven maturity of 'Sensation' resulted in high levels of both internal browning (immature fruit) and internal breakdown (over mature fruit), rendering the fruit inedible, which must harm consumer confidence in this cultivar, and in mangoes in general. 'Irwin' is not suitable for sea-export under cold storage regimes used at present. Cold storage temperature regimes used for sea-exported 'Heidi' caused unacceptably high levels of chilling injury. From the data presented in this paper, it is evident that the general quality of sea exported South

African mangoes during the 1995/96 season was far from desirable.

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APPENDIX A

Various quality parameters of different cultivars of sea-exported South African mangoes evaluated in Europe during the 1995/96 season.

Quality parameter	'Heidi'	'Irwin'	'Isis'	'Keitt'	'Kent'	'Sensation'	'Tommy Atkins'	'Zill'
Number of fruit evaluated	33	57	55	80	326	303	559	141
Average background colour on arrival (0-4)	2.4	1.5	2.0	1.0	1.9	1.9	1.9	1.4
Average background colour ripe (0-4)	3.8	2.0	3.9	1.7	1.7	2.8	3.0	2.3
Average blush colour (% of fruit surface)	50.9	47.3	21.4	28.8	19.7	52.2	57.6	20.8
Anthracnose on arrival (% fruit affected)	3.0	3.5	5.4	2.5	2.8	5.9	1.3	19.4
Anthracnose ripe (% fruit affected)	3.0	6.0	7.5	17.5	11.1	9.6	6.8	263
Soft brown rot on arrival (% fruit affected)	0.0	14.0	5.5	3.8	5.4	1.7	3.4	5.8
Soft brown rot ripe (% fruit affected)	3.1	40.0	20.8	23.8	30.1	10.9	10.7	7.5
Internal breakdown (% fruit affected)	9.4	0.0	2.1	0.0	1.1	11.5	7.0	0.8
Average lenticel damage (% of fruit surface)	3.8	15.8	23.2	10.3	3.1	6.0	23.2	5.9
External chilling injury (% fruit affected)	48.5	0.0	18.2	0.0	1.0	0.0	0.4	0.0
Internal browning injury (% fruit affected)	40.6	0.0	0.0	16.7	2.6	29.6	5.0	0.0
Average TSS (% Brix)	18.1	14.1	16.9	15.3	16.6	15.3	14.7	17.8
Average taste (1-4)	2.6	1.7	2.3	2.2	2.1	1.7	2.2	2.6
% good quality fruit*	27.3	7.0	21.8	13.8	6.7	19.5	27.7	18.4

***A fruit was rated as 'Good Quality' if the following criteria were met:**

- Blush clour: at least some blush.
- Background colour on arrival: at least some yellow.
- Firmness on arrival: Hard or firm.
- Lenticel damage: ≤ 25 % of fruit surface.
- Taste: average or better (ie a rating of 2, 3, or 4)
- No external chilling injury or internal browning, decay, or internal breakdown.