South African Avocado Growers' Association Yearbook 1994. 17:91-94

AVOCADO FRUIT MATURITY (CV. PINKERTON) AS AFFECTED BY FRUITSET PERIOD

A D Sippel, M A Holmes[1] and N J F Claasens[2]
Agricultural Research Council, Institute for Tropical and Subtropical Crops (ITSC), Private Bag X11208,
Nelspruit 1200, RSA
[1] Agricultural Research Council, Institute for Soil, Climate and Water, Private Bag X79, Pretoria, 0001, RSA. Stationed at the ITSC, Nelspruit
[2] South African Avocado Growers' Association, PO Box 866, Tzaneen 0850, RSA

ABSTRACT

The 'Pinkerton' avocado is well known for its long flowering period resulting in differences in fruit maturity at harvesting stage. A previous study (Sippel, Conradie & Claassens., 1992) showed that different fruitset periods have an effect on fruit growth rate (FGR). This phenomenon caused late-set fruit to grow faster than early-set fruit, giving rise to larger (but slightly less mature) fruit at harvesting stage.

This study was aimed at manipulating flowering and fruitset by limiting fruitset to a specific period through flower and fruitlet removal. This was done during 1992 using two 'Pinkerton' orchards, one at Kiepersol and another at Heidelberg (White River). Treatment 1 (August set) consisted of allowing fruit to set normally until August 26 (Southern Hemisphere), allowing no flowering after that. Treatments 2 (September set) and 3 (October set) allowed fruitset between August 26 and September 30, and between September 30 and October 28 respectively, with removal of all fruit that had developed prior to these dates and allowing no flowering after these dates. The fourth treatment (control set) allowed normal flowering and fruitset to occur.

At Kiepersol the September set had the effect of increasing fruit size whilst at Heidelberg both the September and October sets showed increased fruit size with the control fruitset showing smaller fruit sizes than the other sets. These size differences were also reflected in the spatial shape of the fruit.

The most interesting results came from the moisture percentages of the different treatments. At Kiepersol the early fruitset definitely had an advantage in being ready for marketing a month before the control fruit at Kiepersol. At the cooler climate of Heidelberg the fruit took at least a month longer than those at Kiepersol to reach the same maturity stage. Data on post-harvest cold storage are also presented.

INTRODUCTION

Flowering of avocado trees in the Southern Hemisphere normally starts around June/July with fruitset occurring during September. This was found by Robertson (1969)

for Fuerte in the Nelspruit region (latitude 25°27'S; longitude 30°58'E; altitude 660m; rainfall 755mm). This can differ for each cultivar in the different production areas. Since the beginning of local 'Pinkerton' plantings, it was noticed that this cultivar flowers profusely over a very long period, ie. from June through to December. Flowers were even noted as late as January/February with normal fruitset taking place.

The extended flowering time of 'Pinkerton' causes fruit to be developed over a long period, resulting in fruit of different maturities at harvest time, and necessitating very selective picking, a time consuming practice. It was also shown (Sippel, *et al.,* 1992) that late set fruit had a much faster growth rate and have the potential to become larger than early set fruit. These large late-set fruit, which at harvesting time can still be immature, would be prematurely picked if fruit size is taken as a maturity index.

To avoid this type of confusion and to produce uniformly mature fruit at a given time, fruit and flower manipulation was investigated as a possible means to achieve this objective. This project aimed at concentrating the fruitset period by physical removal of unwanted fruit and flower panicles. The effect of these manipulations on fruit size, fruit maturity and fruit quality, was studied in two different climatic areas.

MATERIALS AND METHODS

A trial was conducted in two different climatic areas namely Kiepersol (latitude 25°03'S; longitude 31°01'E; altitude 800m; rainfall 939mm) and Heidelberg (Nelspruit/White River) (latitude 25°18'S; longitude 30° 56'E; altitude 774m; rainfall 755mm). Five year old trees of uniform size were selected for manipulation purposes. The trees at Kiepersol were under micro-irrigation (computer controlled) and received paclobutrazol once a year at recommended rates until their fourth year. The trees at Heidelberg were irrigated with a portable sprinkler system and received no paclobutrazol treatments. Both orchards received inorganic and organic fertilizers and optimum pest and disease control. The aim of using these two orchards was to determine the effect of different climates on fruit growth rates and fruit quality.

Four different treatments were applied on randomly selected trees. Single whole tree plots were used, replicated three times. The flowering season was during 1992, with harvesting during 1993. The treatments were as follow:

First treatment (August set):

Normal early flowering and fruitset was allowed to occur until August 26. All flowers developing after that date were removed.

Second treatment (September set):

All fruit that had developed by August 26 were removed. Flowers on the tree were allowed to set fruit until September 30, after which no more flowering was allowed.

Third treatment (October set):

All fruit that had developed until September 30 were removed. Flowers were allowed to develop until October 28, after which no more flowering was allowed.

Fourth treatment (Control set):

Normal flowering and fruitset was allowed.

Flowers of all treatments were removed physically with pruning shears every two weeks during the periods concerned.

Moisture percentage and other fruit data were determined from nine fruit per treatment sampled twice before harvesting. Harvested fruit were placed under simulated export conditions. Four different cold storage temperature regimes were selected, i.e. 7.5°C, 6.5°C, 6.0°C and 5.5°C. Fruit from the different treatments were kept under these regimes for 12 days, after which the temperature was lowered to 5.5°C for 7 days. Fruit from the different treatments were also stored at the control temperature of 18°C for 10 days. A total of six trays were used for each fruitset treatment at each temperature regime. Fruit quality was examined after the required storage periods.

TABLE 1. The effect of flower and fruit manipulation on spatial shape of 'Pinkerton' avocado fruit at Kiepersol and Heidelberg during harvesting.

SPATIAL SHAPE (cm^3)		
Treatment	Kiepersol 17/05/93	Heidelberg 17/05/93
August Set	326.2	326.1
September Set	381.1	393.9
October Set	309.9	399.9
Control Set	356.0	250.0

RESULTS

FRUIT SIZE

Kiepersol

One month before harvesting the control fruit were still the largest with the early set fruit second largest. The October-set fruit had the smallest fruit at that stage. At harvesting (mid-May) (Table 1) the September-set fruit were the largest with as much as one count difference between that and the other sets (Table 2). Fruit from the other sets ended up with uniform size at harvest.

TABLE 2. Effect of flower and fruit manipulation on fruit size (count) of 'Pinkerton' avocado fruit at Kiepersol and Heidelberg during two pre-harvest sampling periods.

FRUIT COUNT				
Treatment	Kiepersol 15/04/93	Kiepersol 17/05/93	Heidelberg 15/04/93	Heidelberg 17/05/93
August Set	12	12	12	12
September Set	12	10	12	10
October Set	12	12	10	10
Control Set	12	12	12	16

Heidelberg

One month before harvesting the October-set fruit were already one count larger than

the rest, with the August set and the control fruit the smallest. This trend continued until harvesting (Table 1), but the September-set fruit actually increased so much in size that they also became one count larger in size than the August and control sets (Table 2).

The control fruit actually showed a decrease in fruit size due to the fact that the sample contained a few very late set fruit. This very late set occurred during December, and the fluctuation it caused in the data was clearly visible. The effect of this can be seen in the decreased fruit size, from count 12 in the first sample to count 16 in the second sample (Table 2).

TABLE 3. The effect of shifting fruitset period on moisture content of the 'Pinkerton' avocado fruit at Kiepersol and Heidelberg during two pre-harvest periods.

	MOISTURE PERCENTAGE			
Treatment	Kiepersol 15/04/93	Kiepersol 17/05/93	Heidelberg 15/04/93	Heidelberg 17/05/93
August Set	75.3	73.3	76.3	75.0
September Set	78.5	74.8	77.5	74.0
October Set	79.8	75.2	77.8	75.8
Control Set	80.0	75.3	79.8	78.3

FRUIT MATURITY

Kiepersol

The August-set fruit were ready for picking during mid-April (moisture content 75,3%) whilst the other sets and the control (moisture content 80%) were still outside the picking norms (Table 3). One month later all the sets were at harvestable stage with the control fruit and the October set fruit showing the largest decrease in percentage moisture, and the August-set fruit the lowest.

Heidelberg

During mid-April none of the sets were ready to be picked (Table 3). However, fruit from the August set were at the lowest moisture percentage (76,3%) and control fruit at the highest (79,8%). One month later the manipulated sets were ready for harvesting with the September-set fruit having the lowest moisture percentage at 74%. The control fruit were still outside the picking norm at 78,3% moisture, mostly due to the fluctuations in fruit set period of the control fruit.

In comparison, fruit from the August set at Kiepersol were more advanced in maturity than those at Heidelberg. However, the September-set and the October-set fruit were the reverse, with those at Heidelberg having much lower moisture content in mid April. The decrease in moisture was much greater at Kiepersol resulting in these two sets being similar by mid-May.

The control fruit at Heidelberg were not ready to be picked at the same time as those at Kiepersol, since they were still 3% in moisture content above those at Kiepersol. This can be attributed to the very late set that occurred at Heidelberg.

TABLE 4.
Cold storage data of 'Pinkerton' avocado fruit grown at Kiepersol and manipulated to set at different periods.

KIEPERSOL					
TRT and Moisture %	Temp Level (°C)	External		Internal	
		Cold Damage %	Anthracnose %	Grey Pulp %	Anthracnose %
1 (73.3%) Early	18 7.5 6.5 5.5	23.3 18.3 21.7 20	11.7 0 0 1.7	0 0 5 5	8.3 0 0 1.7
2 (74.8%) Middle	18 7.5 6.5 5.5	45 18.3 8.3 25	21.7 0 0 1.7	0 0 1.7 6.7	8.3 0 1.7 1.7
3 (75.2%) Late	18 7.5 6.5 5.5	26.7 5 5 1.7	20 0 0 0	0 0 5 0	13.3 0 1.7 0
4 (75.3%) Control	18 7.5 6.5 5.5	11.7 5 8.3 1.7	5 0 0 0	0 0 3.3 0	3.3 0 1.7 0

COLD STORAGE

Kiepersol

At the control temperature of 18°C, fruit from the control set (75,3% moisture) gave the best results, whilst fruit from the September-set (74,8% moisture) presented the worst results (Table 4). At all three temperature levels (7,5; 6,5 and 5,5°C) fruit from the October set gave the best quality. The August-set fruit tended towards inferior quality, especially at the lower temperatures. From a fruit set viewpoint the higher temperatures were better for quality from both the early and middle fruit set periods, whilst a lower temperature seemed better for the late sets and the control fruit. No definite conclusions can be made from the viewpoint of fruit moisture content.

Heidelberg

Again the fruit at the control temperature of 18°C presented the overall poorest quality (Table 5). The fruit set treatment with the poorest quality was the October set, with the August set giving the best fruit quality. At the high temperatures of 7,5°C and 6,5°C the August-set fruit performed the best, whilst at the low temperature of 5,5°C the October-set fruit had better quality, followed by the August set fruit. Overall it appears that the higher temperature of 7,5°C is the best cold storage temperature for Pinkerton fruit, especially with fruit from the cooler Heidelberg area. No definite conclusions can be given for fruit from the warmer Kiepersol area. However, fruit set period did present

different results. At Heidelberg the early set fruit had better quality than late set and control set fruit. At Kiepersol fruit from the control and late set periods had better quality, whereas fruit from the early set period had inferior quality.

High quality was obtained with fruit between 75 and 76% moisture content. At lower and higher moisture values fruit quality tended to be poor, regardless of storage temperature.

TABLE 5.
Cold storage data of 'Pinkerton' avocado fruit grown at Heidelberg and manipulated to set at different periods.

KIEPERSOL					
TRT and Moisture %	Temp Level (°C)	External		Internal	
		Cold Damage %	Anthracnose %	Grey Pulp %	Anthracnose %
1 (75.0%) Early	18 7.5 6.5 5.5	21.7 1.7 1.7 6.7	11.7 0 1.7 5	0 0 1.7 0	3.3 0 1.7 5
2 (74.0%) Middle	18 7.5 6.5 5.5	26.7 13.3 5 13.3	15 0 0 1.7	0 0 0 1.7	8.3 0 0 1.7
3 (75.8%) Late	18 7.5 6.5 5.5	31.7 10 13.3 6.7	10 1.7 3.3 1.7	0 1.7 0 0	3.3 1.7 3.3 1.7
4 (78.3%) Control	18 7.5 6.5 5.5	25 3.3 10 26.7	5 0 1.7 0	0 0 1.7 0	5 0 1.7 3.3

DISCUSSION

Manipulation of fruiting in the 'Pinkerton' avocado tree holds distinct advantages to the producer who is prepared to make the effort. With the 'Pinkerton' avocado, which has a problem of extended flowering and fruitset periods, resulting in fruit of differing maturities at harvest, this trial has shown that by limiting fruitset to a specific period, harvesting can commence as much as one month earlier.

The Kiepersol trial did not present the expected increase in fruit size with late-set fruit as was determined previously by Sippel, *et al.,* 1992. This could possibly be related to more uniform tropical temperatures during the different fruit development periods. At the cooler Heidelberg locality the expected fruit size increase with latest vs early-set fruit occurred. Both the controls gave similar data to that of the August-set fruit.

It must be stressed that at this stage data on fruit maturity and cold storage aspects investigated should be treated as preliminary. Another seasons' data is necessary to

study the effect of fruitset period on fruit maturity and fruit quality after cold storage before any conclusions can be made from the results.

Harvesting 'Pinkerton' avocado earlier could have possible advantages. However, the fact that it is a mid-season cultivar could nullify this advantage. Furthermore, the technique could have possible advantages with the 'Hass' cultivar, i.e. delaying flowering to a more suitable growth period could possibly lead to an increased fruit size. This aspect should be investigated as a means to overcome the small-fruit problem with 'Hass'.

ACKNOWLEDGEMENTS

Messrs Vos & Son (Kiepersol) and Pienaar Packers (Heidelberg), who willingly donated their orchards for the purpose of this study, is greatly appreciated. Thanks are also due to Mr & Mrs Steven and Marie Hearne for cumulating climatic data at Kiepersol and to Mrs Marie Hattingh for computerizing it. Also many thanks to Miss Mariet Christie for constant field work and computerizing all the data and to Mrs Valerie Claassens and Mr Coenie Pretorius for valuable technical assistance with the field work.

REFERENCES

ROBERTSON, B.L. 1969. The morphogenesis of the flower and fruit of the 'Fuerte' avocado *(Persea Americana* Mill x *P. drymifolia* Cham. Schlect.). *M.Sc (Agric) thesis,* Univ of Pretoria, Pretoria.

SIPPEL, A.D., CONRADIE, W. & CLAASSENS, N.J.F. 1992. Growth rates of 'Pinkerton' avocado fruit. *South African Avocado Growers' Association Yearbook* 15, 72-74.