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FRUIT SET AND GROWTH PROBLEMS OF 'PINKERTON' AVOCADO IN SOUTH AFRICA

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Abstract

Although 'Pinkerton' is known for its consistent heavy yields, the main drawback in South Africa is that it flowers over a very long period (June to December). This results in differences in fruit maturity during picking time, ultimately causing post- harvest quality problems. Fruit size, growth rate and fruit fall of the 'Pinkerton' avocado was monitored for two seasons in different climatic areas.

Results indicate that the main fruit set period occurred over at least a three month period, i.e. August, September and October. Data showed that a higher fruit fall can be expected from the sets that occur during the second half of the flowering season. Fruit set date had a marked effect on final fruit size. Fruit which set late (mid- September to mid-October) has a much faster growth rate than early set fruit (July - August), and on average has the potential to be 40 mm longer (and thus larger), at the end of the season. Fruit size and growth rate for the various fruit set periods and for the different tree quadrants are presented, and coupled to on-site meteorological data.

At both mid-season and harvesting stages, three trees were harvested in order to determine total fruit size distribution. Correlations between fruit length, width, mass and volume are presented. 'Me best correlation was found to be between fruit mass and volume. These non-destructive measurements can be used to calculate on-tree fruit sizes and thus predict final fruit size.

Additional keywords: *Persea americana*, flowering, fruit, growth.

1. Introduction

Fruit of the avocado are sometimes used as an evaluation tool for research purposes, as well as for determining picking dates. However, it is not always certain what the history of the fruit are, i.e. date of fruit set, fruit growth period, fruit growth rate, maturity stage and climatic conditions?

These factors are important parameters that could have an effect on the reproducibility of any research work undertaken. It has been found in literature that fruit are mostly selected randomly

for research purposes, for instance such as measuring fruit in an irrigation or fertilization trial. These same factors are also important to the producer who must decide which fruit are ready for harvesting. Post-harvest quality problems experienced with 'Pinkerton' fruit motivated this research project. A study was therefore carried out to investigate indices of fruit growth.

2. Materials and methods

The trial was conducted in three different climatic areas, namely Kiepersol (25º05'S; 31º01'E; 800 m; 939 mm), Heidelberg (25º18'S; 30º56'E; 774 m; 755 mm) and Schagen (25º19'S; 30º45'E; 800 mm; 952 mm). Uniform-sized four to five year old 'Pinkerton' trees grafted on Duke 7 rootstock were selected for data collection. These trees received standard horticultural practices.

2.1 Fruit set aspects

The tagging dates for the different sites and different years ranged from early August to end October. During the 1990/91 season, 100 fruit were selected and measured at four different tagging dates, which were August 21, September 4, September 19 and October 3. During the 1991/92 season the number of fruit were increased to over 500 fruit per tagging date. During each monitoring date all tagged fruit were counted and measured. Data were accumulated on fruit fall, fruit size and fruit growth rates. These were all related to climatic data.

2.2 Spatial shape determinations

For this purpose three trees were fully stripped of all fruit during two sampling periods, i.e. mid-November and at harvesting (May). Data were accumulated on fruit mass, fruit length, fruit width, fruit volume (every 5th fruit), seed volume (every 5th fruit - mid-November) and seed mass (every 5th fruit).

3. Results

3.1 Fruit set and fruit fall

Climate has a definite influence on flowering and fruit set. At Heidelberg these events occurred very late, allowing tagging to only commence in early October (latter part of the flowering season), whereas flowering and fruit set commenced during mid- August at Kiepersol. During the 1991/92 season, unfavourable climatic conditions had the effect that very little fruit formed at the Schagen site.

Although fruit between 20 and 30 mm in length were tagged, thus limiting pollination and fertilisation problems, a large fruit fall was still encountered. , At both Schagen and Kiepersol during 1990/91, greater fruit fall was experienced from fruit setting late, (up to 93%). 717he same trend was observed during the 1991/92 season for both Heidelberg and Kiepersol.

3.2 Fruit size

Figure 1 illustrates fruit size differences before harvesting of four different fruit set periods for Kiepersol during 1990/91. Fruit from the late set periods became larger than fruit from early set periods, even though the former had shorter development time. The same observation was made during the 1991/92 season. Even though there was a 50 day difference between first and last set, the latest set fruit still attained a larger size.

Fruit sizes from the different set periods were also compared on different quadrants of the trees. On average the western side of the tree produced the largest fruit. Fruit size distribution on the tree during both mid-November and May Oust before harvesting) was also determined. At mid-November 68.7% of the fruit were between 60 and 90 mm in length, with the median being 73.2 mm. During harvesting (May) 74% of the fruit were between 100 and 130 mm, with the median at 119.1 mm. This indicates a small improvement in size distribution difference towards the end of the season.

3.3 Fruit growth rates

The average fruit growth rate (FGR) for fruit from the late set (1.34 cm^3day^{-1}) during the 1990/1 season is greater than that of the early set (1.00 cm^3day^{-1}). 'Me highest FGR was recorded from fruit on the western side of the tree.

Table 1 summarizes average maximum air temperatures (Max T), average minimum air temperature (Min T), period applicable, and fruit growth rate (FGR) between first and last set periods at two sites as well as the relevant fruit growth phases. On average the maximum air temperature was approximately 1.4ºC greater at Heidelberg while the minimum was 0. VC higher at Kiepersol. Fruit from Kiepersol showed a higher FGR than fruit from Heidelberg for both phase I and phase II fruit growth stages. Even a 2.0ºC higher temperature at Heidelberg during phase I did not induce a higher FGR.

3.4 Spatial shape determinations

Zilkah & Klein (1987) found that the spatial shape of the avocado fruit could be evaluated by a factor (M), which has been calculated from the ratio of the fruit volume to circumferential cylinder volume. These authors proposed a formula ($Vf = M \times Pi/4 \times LD^{2)}$ to determine volume by measuring length and diameter. For the purpose of determining the M-value, fruit from the mid-November and May sampling periods were used.

The average M-value for 'Pinkerton' under South African conditions differs from small fruit (0.47) to large fruit (0.62), with an average of 0.545. We also correlated different fruit parameters of the two sampling periods (Table 2). From these data an excellent correlation was found between fruit volume and fruit mass, for both the mid- November ($r = 0.975$) and the May ($r = 0.994$) sampling periods.

4. Discussion

4.1 Fruit fall and fruit size

The trend where fruit from later set periods were more prone to fall than fruit from early set periods indicates the contribution of set period to final fruit number. Even so, the size and maturity difference of fruit between early and late fruit set periods are a concern for both researcher and producer/marketer.

Fruit used for research purposes shouldn't be picked on a random sample method. The researcher should tag fruit of similar size at the beginning of the season in order to avoid the problem of fruit being of differing maturities at harvest due to different fruit set periods. The producer who uses fruit to determine picking dates should also take cognisance of this problem. This trial has shown that larger fruit can be produced from a later set period and that such fruit

can still be immature. If the smaller fruit, from early sets, are left to increase in size, they can actually become over-mature, with the accompanying post harvest quality problems.

4.2 Fruit growth rate and climatic aspects

It was found that higher temperatures at one site does not necessarily result in a faster fruit growth rate of fruit from that site. It was also found that the average fruit growth rate of late set fruit is greater than that of early set fruit. The exact influence of climate on fruit growth, with regard to the different set periods and the phases of fruit growth, is still not clear. This aspect needs to be further investigated.

4.3 Spatial shape determinations

The availability of a formula with which the producer can determine final fruit mass and possible picking date, will greatly assist management planning. The advantage of this is that it is a non-destructive technique.

5. Acknowledgement

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References

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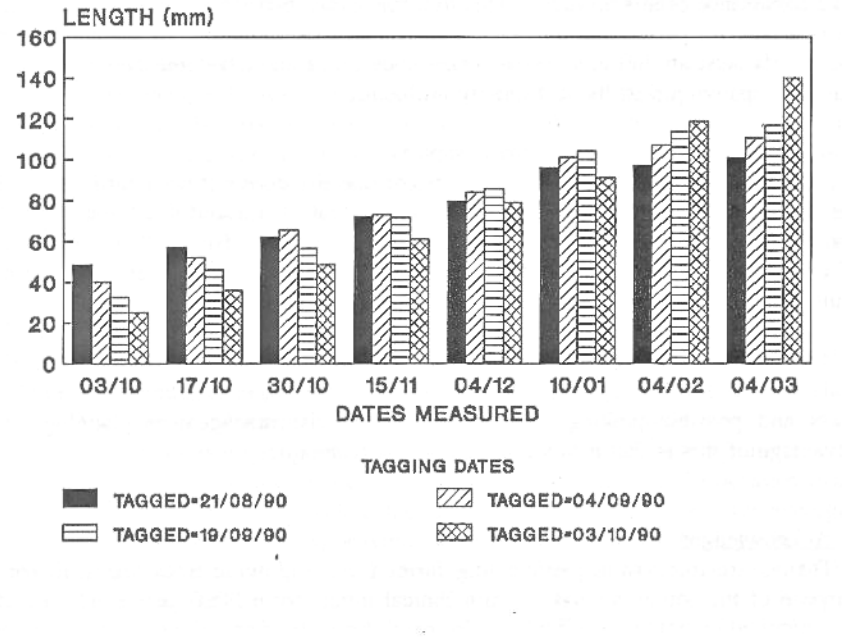

Figure 1. Growth of 'Pinkerton' avocado fruit at Kiepersol set at different periods (1990/91)

Table 1. Summary of maximum temperature (Max T), minimum temperature (Min T) and fruit growth rate (FGR) between Kiepersol and Heidelberg for the different fruit growth phases of the 'Pinkerton' avocado.

		August set		October set	
		Kiepersol	Heidelberg	Kiepersol	Heidelberg
Phase I	Max T (°C)	23.6	25.6	26.0	27.7
	Min T (°C)	13.2	12.4	15.6	14.2
	Period	11/9 - 17/10	20/9 - 17/10	18/10 - 2/12	18/10 - 2/12
	FGR (cm^3day^{-1})	1.08	0.77	0.90	0.76
Phase II	Max T (°C)	25.8	26.6	27.6	28.8
	Min T (°C)	15.8	14.7	17.4	16.3
	Period	18/10 - 14/1	18/10 - 14/1	3/12 - 11/3	3/12 - 11/3
	FGR (cm^3day^{-1})	2.05	1.82	2.03	1.88
Phase III	Max T (°C)	29.6	30.8		
	Min T (°C)	18.6	17.3		
	Period	15/1 - 11/3	15/1 - 11/3		
	FGR (cm^3day^{-1})	0.48	0.54		

Table 2. A Pearson correlation analysis of fruit parameters sampled at mid-November and at harvest (Prob > 0001)

		May '92						
		Mass	Length	Width 1	Width 2	Fruit volume	Seed volume	Seed mass
November '91	Mass	-	0.843	0.946	0.941	0.994	-	0.842
	Length	0.954	-	0.734	0.710	0.828	-	0.655
	Width 1	0.940	0.930	-	0.967	0.945	-	0.794
	Width 2	0.950	0.937	0.978	-	0.942	-	0.806
	Fruit volume	0.975	0.916	0.898	0.912	-	-	0.835
	Seed volume	0.742	0.683	0.704	0.711	0.723	-	-
	Seed mass	0.765	0.711	0.712	0.721	0.749	0.941	-