Maluma avocado: Relationship between seed coat condition, orchard nitrogen status and grey pulp

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ABSTRACT

Feedback from overseas importers would seem to suggest that the prevalence of grey pulp is higher in 'Maluma' fruit with dead stones and dark seed coats. The present study aimed to establish whether fruit with these characteristics develop more grey pulp during storage. It further aimed to identify possible causative factors that increase the incidence of grey pulp in fruit with dead seeds and/or dark seed coats. The results indicated that although seed coat colour correlates with grey pulp, the nitrogen status of an orchard plays a superseding role. 'Maluma' orchards must not be over-fertilised and fruit from orchards with a high nitrogen status must be placed into cool storage within four hours after harvest and must not be stored for longer than 25 days before being ripened.

INTRODUCTION

The export protocol for 'Maluma' avocado fruit is continuously being upgraded (Mhlophe & Kruger, 2012; Lemmer & Kruger, 2015; Kruger *et al.,* 2016; Kruger *et al.,* 2017a; Kruger *et al*., 2017b) and the incidence and intensity of commercially important quality problems have significantly decreased during the last number of seasons.

It has been noticed by the industry that the incidence of dead stones is higher in small counts than in larger counts. It was further noted that the prevalence of grey pulp is higher in fruit with dead stones or dark seed coats (Fig. 1). The present study aimed to establish whether fruit with dead seeds and/or dark seed coats develop more grey pulp. It further aimed to identify possible causative factors that increase the incidence of grey pulp in fruit with dead seeds and/or dark seed coats. To do this, a number of experimental trials were performed at two packinghouses in the Tzaneen area. The information gathered was collated with maturity and plant nutritional data routinely recorded by the two packinghouses.

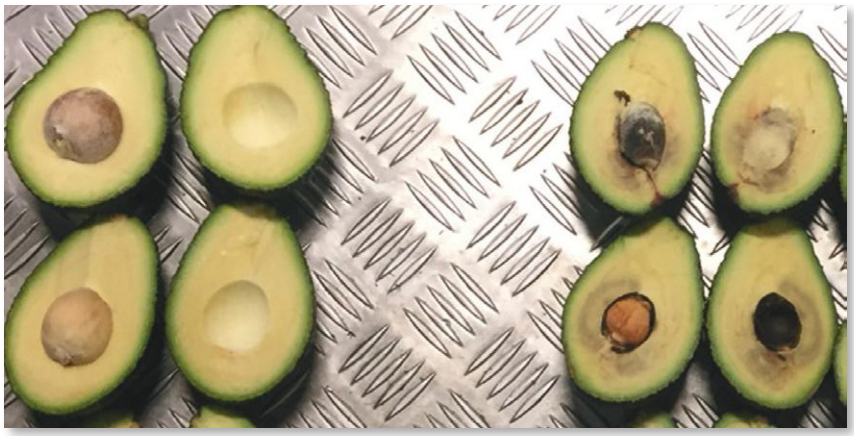

Figure 1: Evaluation of fruit by European importers/ripeners demonstrated that, in cases where grey pulp is present, it is most prevalent in smaller counts with darker seed coats.

The following aims were formulated:

- To compile a reference set of photographs for scoring purposes.
- To establish if the seed coat colour of the stones becomes darker during storage.
- To determine what relationship exists between pre-storage seed coat colour and count.
- To establish whether any association exists between post-storage seed coat colour and the development of grey pulp.
- To define the relationship between seed coat colour, fruit maturation rate and the nitrogen status of the orchard.

MATERIALS AND METHODS

Compilation of a reference set of photographs for scoring purposes

The photographs selected for reference purposes are shown in Figure 2. During scoring, intermediate values (1.5, 2.5 & 3.5) were also used.

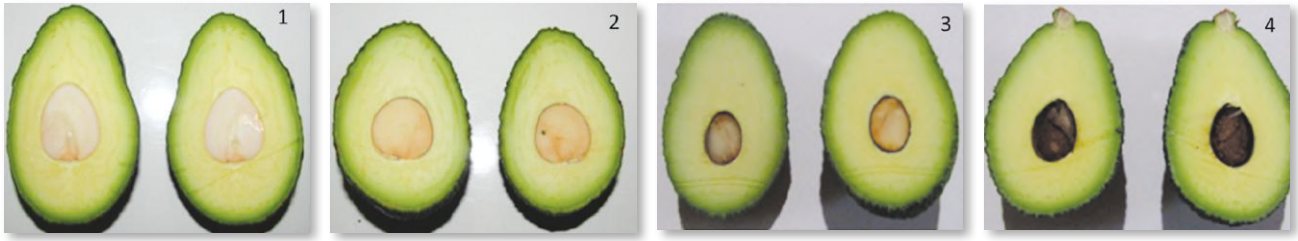

Figure 2: Seed colour chart compiled for the study. Intermediate seed coat colour scores (1.5, 2.5 and 3.5) were also used during the trial.

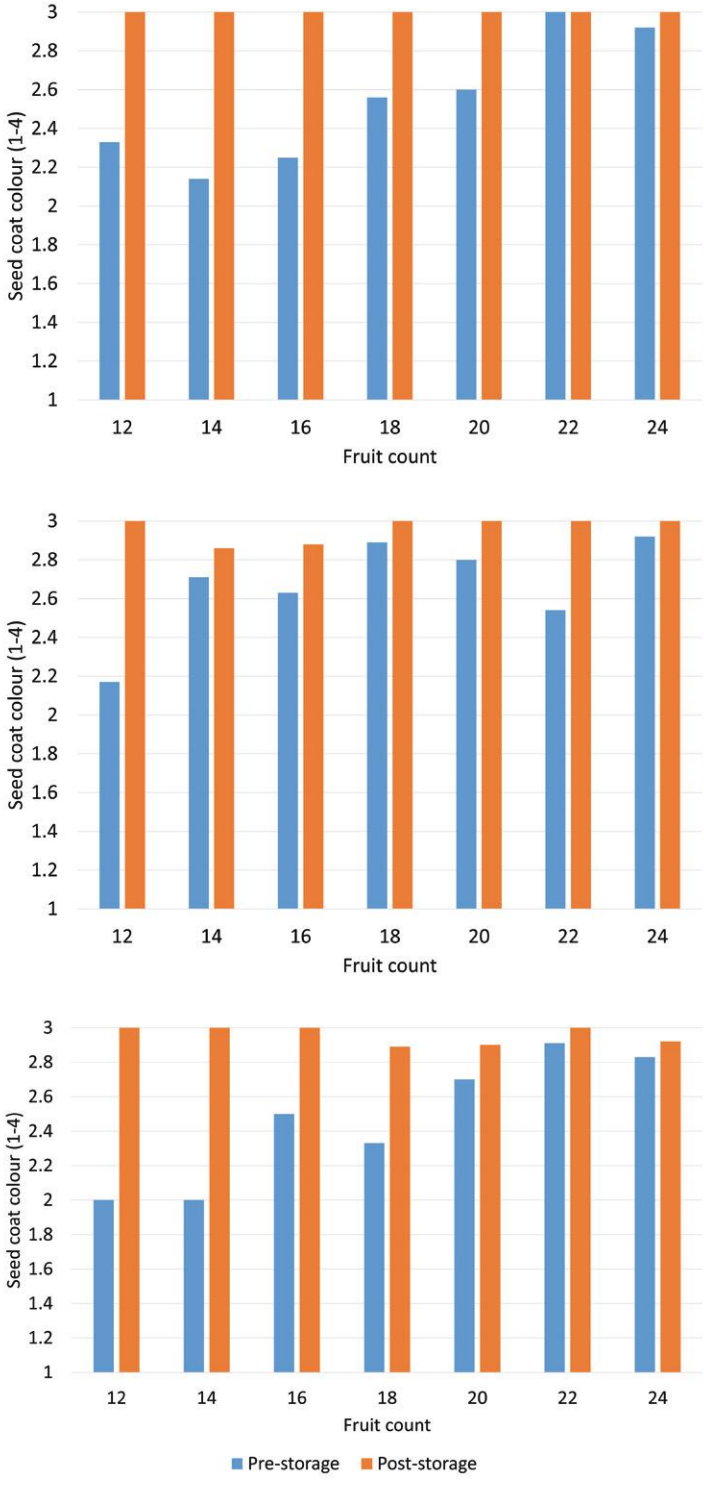

Figure 3: Seed coat colour changes that took place during storage of 'Maluma' fruit of different counts from three producers.

Establish whether the seed coat colour of the stones become darker during storage

Two cartons each of count 12 – count 24 'Maluma' avocados from three producers were sampled at a packinghouse in the Tzaneen area. The fruit in one carton were immediately dissected and scored using the above scale. The fruit in the other carton were stored for one month at 6 °C, ripened, cut and evaluated. The two scores were then compared.

Determine whether a relationship exists between pre-storage seed coat colour and count

This survey was performed during the early season with fruit from Packinghouse 2 and again during the mid-season with fruit from Packinghouse 1. In both cases, one carton of commercially packed fruit was evaluated. In the case of Packinghouse 1, counts 8-24 were analysed, while the Packinghouse 2 samples included counts 10-32.

Establish whether a relationship exists between post-storage seed coat colour and grey pulp

A total of 252 cartons of 'Maluma' fruit (counts 12-24) were sampled from a range of producers packing at Packinghouse 1 during the 2017 season. The fruit were stored for one month at 6 °C, after which the incidence of grey pulp was determined and the relationship between seed coat colour and the incidence of grey pulp plotted.

Describe the relationship between seed coat colour, fruit maturation rate and the nitrogen status of the orchard

At both packinghouses, the maturation rate of each orchard was plotted throughout the 2017 season. At Packinghouse 1, the nitrogen content of the fruit was measured during November 2016 while this was done during February 2017 at Packinghouse 2. The data was intercalated with the above seed coat colour and grey pulp information.

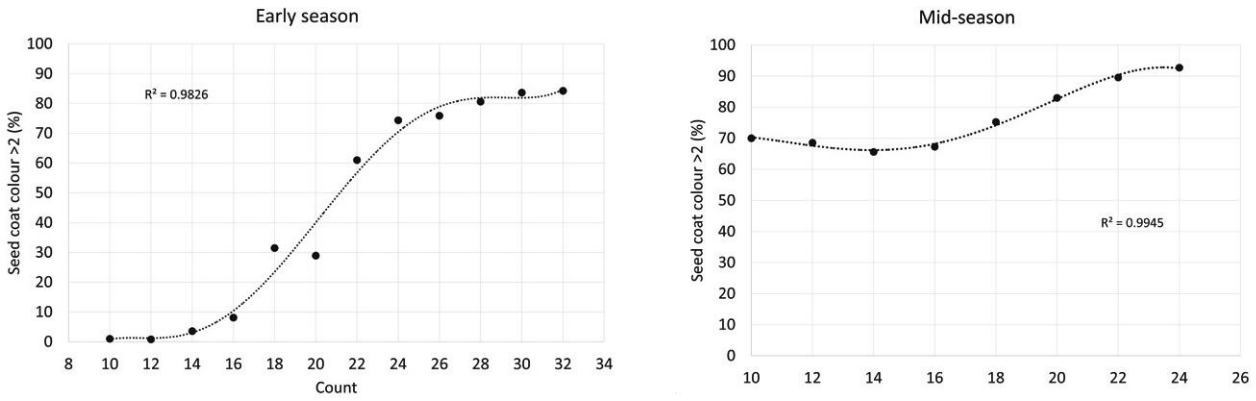

Figure 4: Pre-storage seed coat colour recorded per count during the early and mid-seasons.

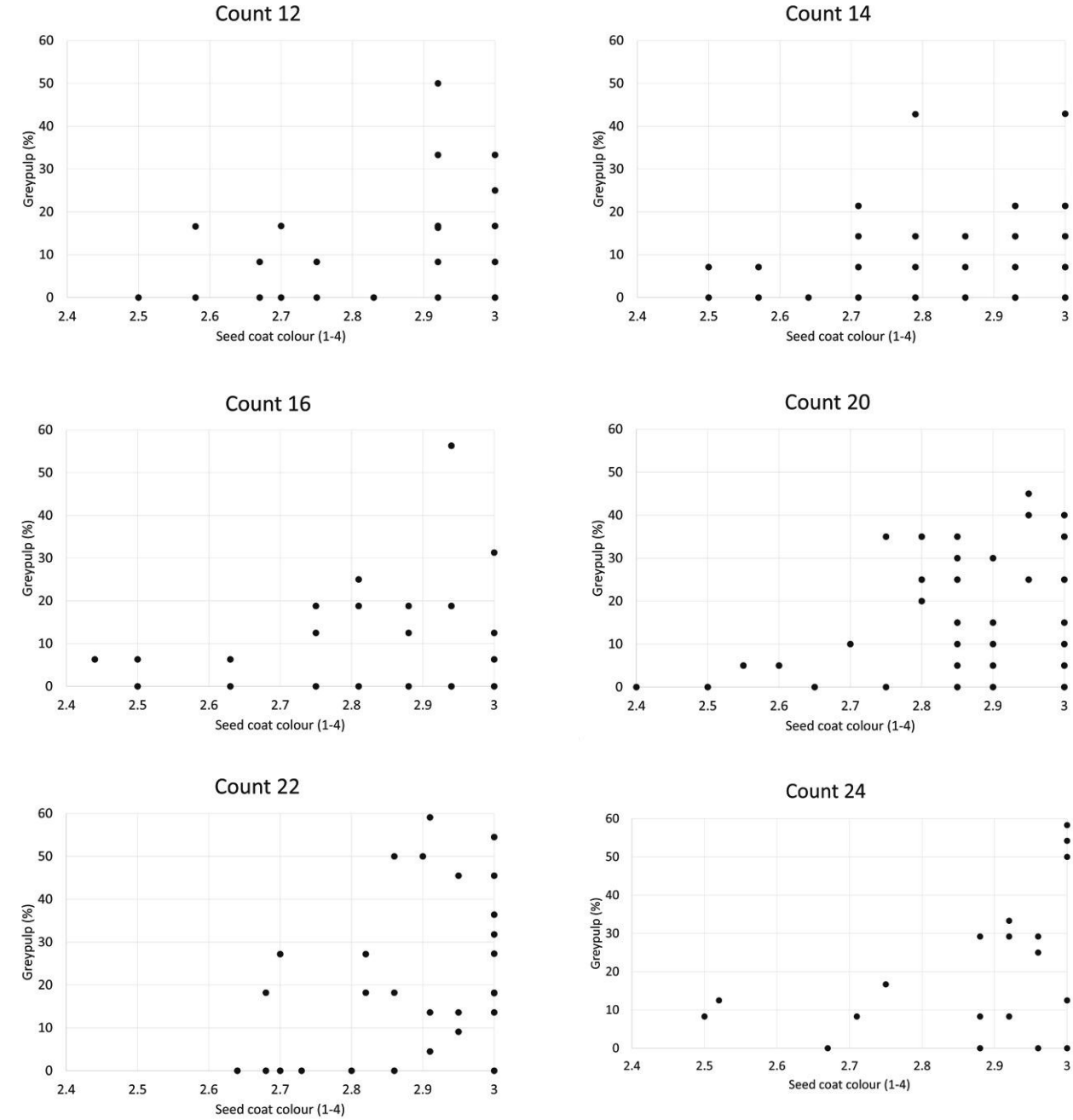

Figure 5: Incidence of grey pulp in holdback samples stored under regular atmosphere conditions for 30 days at 6 °C.

RESULTS AND DISCUSSION

The seed coat colour changes that took place during storage in different counts of fruit from three producers are shown in Figure 3. In all cases, the mean seed coat colour scores of smaller fruits were higher than those of larger fruit at the time of harvest. However, in all cases an increase in seed coat colour took place during storage and the scores of the different counts were fairly similar after storage.

The percentages of pre-storage fruit in the >2 seed coat colour bracket, as recorded during the early and mid-seasons, are shown in Figure 4. During the early season, the seed coats of the smaller fruit were much darker than those of the larger fruit. A sigmoidal curve was recorded (Fig. 4A). By mid-season, the seed coat colours of the larger fruit were only marginally lighter than those of the smaller fruit (Fig. 4B).

The relationship that existed between grey pulp and the different counts' post-storage seed coat colour is shown in Figure 5. Samples of the lower seed coat colour scores generally had lower incidences of grey pulp. However, what is important to note is that the grey pulp scores of samples with darker seed coats were anywhere between 0% to 60%. This suggests that a factor other than seed coat colour contributed towards the incidence of grey pulp. Based on our experience over the last two decades, we identified this factor to be the nitrogen status of the orchard. In Figure 6, the incidence of grey pulp is plotted against the pulp nitrogen content readings of the fruit, as recorded for each 'Maluma' orchard serviced by Packinghouse 1 during January 2017. From the graph it can be deduced that orchards with higher fruit nitrogen scores also had higher incidences of grey pulp after storage for 30 days under RA conditions.

In order to demonstrate the effect that orchard nitrogen status had on the maturation rate of the fruit, the nitrogen contents of the samples were plotted against their dry mass at the time of harvest for Packinghouse 1 (Figure 7A) and for Packinghouse 2 (Figure 7B). Quite interestingly, the two sets of data gave opposite grey pulp:nitrogen trends.

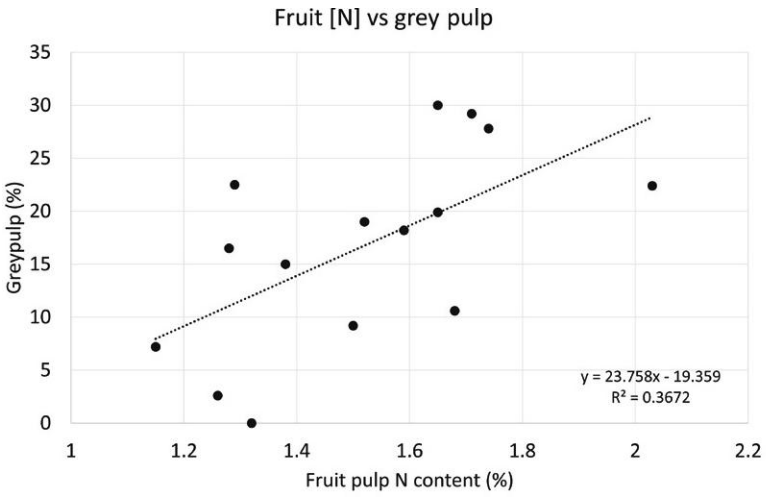

Figure 6: Relationship between the fruit pulp nitrogen content (Packinghouse 1: January 2017) and the incidence of grey pulp after storage for 30 days at 6 °C.

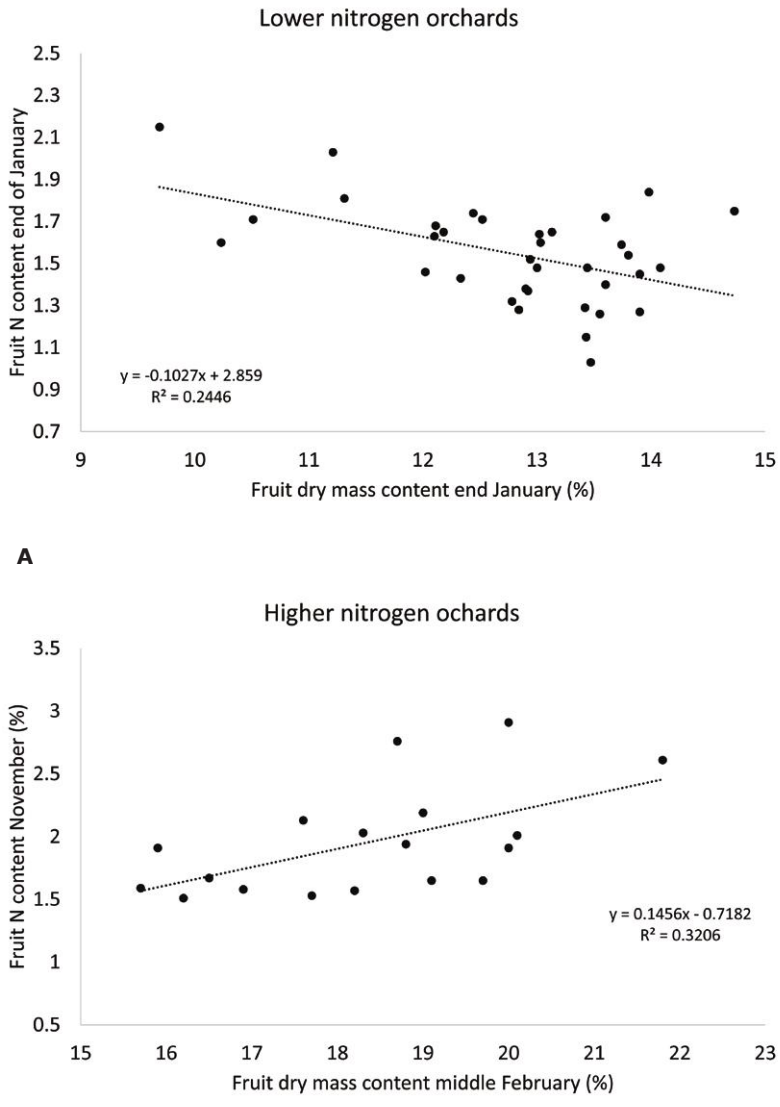

Figure 7: Relationship between fruit dry mass content and maturity in orchards with lower and higher nitrogen statuses in Packinghouse 1 (A) and Packinghouse 2 (B).

In the case of Packinghouse 2, the fruit nitrogen content decreased as the dry mass increased. This is because the nitrogen content of an avocado normally decreases as the fruit matures. This trend is most prominent in low nitrogen orchards such as those serviced by Packinghouse 1. In contrast, the nitrogen content of Packinghouse 2 increased as the dry mass content increased. The reason for this is that high nitrogen orchards such as those maintained by the single producer packing at Packinghouse 2 matures faster than those of fruit from orchards with a lower nitrogen status. Fruit from these high yielding, faster maturing orchards must receive special attention when it comes to aspects such harvest maturity, the period from harvest to cooling (maximum 4 hours), the total storage period (maximum 25 days) and the post-ripening storage period. It is further recommended to market the smaller counts locally or to treat them with SmartFresh before exporting them under controlled atmosphere conditions.

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