

Annexure R: Maluma Hass avocado cultivar: Cultivation, ripening and post-harvest protocols

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Background

The 'Maluma Hass' avocado cultivar is a 'Hass' type selection from the Limpopo province in South Africa. It is predominantly of Guatemalan origin with some Mexican genes and was discovered in the early 1990s by Mr. Dries Joubert on his farm Maluma, South Africa, as a chance seedling of unknown parentage.

Plant Breeder's Rights (ZA 20043215) were granted to Allesbeste Nursery on 7 November 2004. After years of semi-commercial research, Maluma Hass was released commercially at the VI World Avocado Congress held in Vina del Mar, Chile, during November 2007.

Characteristics

'Maluma Hass' is notable for being precocious and having good yields. Its fruit are larger and slightly more pear-shaped than 'Hass' fruit. It is an early bearing, triangular shaped, upright, growing tree with a natural central leader and lateral branching.

Chemical growth retardants are not required to support production. These characteristics make it possible for Maluma Hass to be considered for high-density plantings.

Cultivation

The main cultivation features of Maluma Hass include the following:

- High density plantings are possible.
- Planting densities lower than 408 trees per hectare (7 m X 3.5 m) are not recommended.
- Pruning by machine or by hand is recommended.
- No growth retardants (e.g., paclobutrazol and uniconazole) are needed.
- 1 Copper spray per year for Anthracnose control in dry to regular rainfall-years. More sprays might be needed in stressed orchards to contain pepper spot. Two to three sprays are required in wet years.
- Picking should preferably be managed carefully to ensure top quality.

Irrigation management

In the successful cultivation of any crop, proper irrigation management is of the utmost importance. Irrigation in avocado orchards plays a major role in the post-harvest behaviour of avocados. Important times are during flowering and fruit set, as this will aid in the uptake of calcium and boron through the transpiration stream.

Optimum soil-moisture near harvest will also reduce the risk of external chilling injury on fruit, which may be aggravated by water stress. The rule will be to keep the trees within the irrigation norms by maintaining shallow Tensiometer readings of -10 to -30 kPa and deep Tensiometer readings of -20 to -40 kPa.

Pruning

A central leader pruning is most commonly used in both high and low density 'Maluma Hass' orchards. The principle behind this pruning is to select the main central leader, remove competing vertical branches and manage horizontal branches to open up the tree. Trees should be trained to a central leader system from year one.

Tree stress

Maluma Hass trees exposed to heat and water stress are included to produce fruit with aborted seed coats ("dead seed"). Such fruit is more susceptible to post harvest disorders such as grey pulp and has reduced storage life. Additionally, insect pests (e.g., mealybug, leafroller, mites) are usually attracted to stressed trees. The presence of these pests is often a symptom of tree stress.

Fruit nutrient and mineral status

The mineral nutrients, nitrogen, calcium and iron play an important role in the quality of avocado fruit. Maluma Hass fruit should be sampled to determine the level of these nutrients as a predictor of fruit quality. The correct sampling procedure is crucial for accurate information regarding an orchard's fruit mineral and dry matter status that will influence the harvesting time for optimal fruit quality of that specific orchard. Sampled orchards should not be under any stress and should preferably be irrigated 1-2 days before sampling. When fruit is picked for dry matter testing, tensiometer readings should not exceed - 45 kPa.

A sample of +/- 20 fruit should be taken from each orchard (not bigger than 3 ha). Fruit should be of a representative size for the specific orchard, and of approximately the same count size. No more than 2 fruit from the same tree should be picked for sampling. Fruit should be picked at shoulder height, and from four sides of the tree (North, East, South and West). Fruit should be picked from the inside and outside of the tree canopy. Orchard numbers should be used as sample numbers.

The sample should be used to determine:

- Average fruit weight (indicates average fruit size and aids with interpretation of Nutrient analysis)
- Fruit moisture content (indicates fruit maturity level and gives an early indication of the possible time the season will commence).
- Mineral analysis (Nitrogen, Calcium and Iron content).

January fruit mineral analysis

The optimal mineral levels for the January fruit analyses are:

Mineral	%	ppm
N	< 1.0%	< 10 000ppm
Ca	> 0.05%	> 500 ppm
Fe	> 0.006%	> 60 ppm

These January mineral norms are for fruit sampled +/- 8 weeks before the fruit is expected to reach minimum harvesting maturity. Nitrogen (N)-levels in January should ideally test below

1.0% at this period. Fruit from high-risk orchards (high N-levels, low Ca, few fruit) should be harvested less mature rather than more mature. This fruit should therefore be harvested from 20% to 22% DM. High N promotes susceptibility to senescence-related disorders such as grey pulp. The greater the fruit maturity, the greater the risk of such disorders developing.

Tree age

Fruit from young trees with high leaf nitrogen are at a greater risk to post-harvest problems. High N levels are common in young orchards where the fertiliser programme is often high in N to encourage rapid tree growth. These young trees typically have vigorous vegetative growth with few fruits, making their fruit to shoot ratio low (few fruit, lots of shoots).

The shoots are a stronger sink for essential nutrients such as Ca. Fruit deficient in such essential nutrients are more susceptible to post-harvest disorders. Nitrogen and Calcium levels must be perfectly managed.

Fruit Maturity and Harvesting

Dry matter content

The minimum dry matter content for Maluma Hass is currently set at 22% in the local market and export standards. The South African Department of Agriculture, Land Reform and Rural Development (DALRRD) has granted an industry-wide dispensation for the export of Maluma Hass with a dry matter content of 20%. The owner of Plant Breeder's Rights to Maluma Hass, Allesbeste Nursery, however, still recommends that, for optimal eating quality, the fruit should be harvested between 23% and 26% dry matter content (77-74% moisture content) under high-risk situations such as sub-optimal N and Ca nutrient levels or tree stress due to pests, diseases, or adverse climatic conditions.

Maturity testing should commence 6 weeks prior to harvesting. Harvesting should be delayed after heavy rains. The fruit are more susceptible to developing vascular browning after protracted periods of rain which may also be associated with decay. Furthermore, during and directly after wet periods, the fruit is more sensitive to mechanical damage which manifests as lenticel damage and/or bruising.

An increase of 0.5% dry matter content is expected per week in fruit in a well-managed orchard.

Anthraxnose

More than two sprays are required in a wet season, as copper fungicides are washed off the fruit when it rains. Three to four sprays may be necessary for old trees with lots of dead branches (which are a source of inoculum) in wet seasons. A calcium nitrate spray (100 – 300 kg/ha) should be applied 6-8 weeks after fruit set, to boost fruit calcium content making it more resistant to fungal diseases.

Dead seed associated grey pulp

Grey pulp in Maluma Hass is often associated with dead seeds, usually in the count 20-24 range and smaller. Larger fruit generally have a lower incidence of dead seed. The number of dead seeds should be determined at the time of harvest. If the number of dead seeds exceeds 10%, then the use of 1MCP/SmartFresh™ should be considered.

Industry-wide norms have not yet been established for dead seed incidence per count size category, and the variability between orchards, regions and seasons is unknown. Packhouses are advised to sample 30 fruit for each count range, per orchard/consignment, to determine the dead seed incidence rate. Larger samples (60+ fruit) may be required where the incidence rate is highly variable. It is further recommended to market the smaller counts locally or to treat them with 1-MCP/SmartFresh™, at 300 ppb, before exporting them under controlled atmosphere conditions.



Figure 1: Dead seed (indicated on picture) of smaller count Maluma Hass fruit.

Vascular staining

The pigment anthocyanin is responsible for vascular staining. The incidence and intensity of vascular staining decreases as the fruit matures and is not a major concern for exporting.



Figure 2: Vascular staining on Maluma Hass fruit.

Vascular browning

Failure to cool fruit soon after harvest is one of the primary post-harvest causes of vascular browning. In some situations, it may develop pre-harvest due to water stress. Fruit displaying vascular browning are not suitable for export.



Figure 3: Vascular browning on avocado fruit



Figure 4: Vascular browning in ripe, Maluma Hass fruit. Severe cases as shown in the fruit at bottom left are often associated with stem end rot.

Respiration rate

Maluma Hass fruit respire at a much higher rate than 'Hass' fruit and need to be placed into cold storage as soon as possible after harvest. The rate at which Maluma Hass loses firmness during storage is lower than that of 'Hass', especially at lower storage temperatures. During storage at a relatively high temperature (7 – 8°C), it takes nearly two weeks to bring Maluma Hass to a respiration that is comparable to that of 'Hass'. In research carried out by Kruger and Lemmer (2012), when stored at 8°C, the firmness of Hass reduced by 0.80 iq units per day while that of Maluma Hass dropped by 0.68 iq units per day. At 4°C the firmness of Hass decreased by 0.51 iq units per day while that of Maluma Hass reduced by 0.36 iq units per day.

Door-to-door consignments in controlled atmosphere (CA) containers are ideal to keep the cold chain unbroken. CA containers carrying Maluma Hass fruit must be set at 3% - 10% CO₂ and 2% - 5% O₂. Fruit respiration rate will drop at the natural build-up of 8% CO₂. O₂ is not required to manipulate the fruit respiration rate.

Cooling requirements and Shipping temperatures

It is beneficial, and in the case of younger trees with a high nitrogen status, essential, to shorten the harvest-to-cooling period. The fruit should reach the packhouse within 4 hours of harvesting and then should be packed and placed in the cold room as soon as possible. Small trucks and trailers should be used to shorten the window from picking to cooling.

Cooling packed fruit to the required shipping temperature is vital. It is suggested that fruit temperatures should be within +2°C to +3°C of the cold room's air delivery temperature within 24 hours after packing. Fruit should be transferred from regular cooling to controlled atmosphere storage in 4 days.

Palletizing in cold rooms is desirable so that slow filling pallets are not left unrefrigerated for any great length of time.

The temperature requirements for Maluma Hass with a fruit dry-matter content of 23 – 26 % are:

- Cold room/Packhouse: +7.0°C
- Cold Truck: +6.5°C
- Holding Store: +6.5°C
- Vessels: +6.5°C
- Last week: +6.0°C

The temperature regime that should be used is **AV2** (PPECB standards): Carry at + 7.0°C, 2 days after departure lower the temperature to + 6.5°C, after 6 days at + 6.5°C (i.e. 8 days after departure) lower to + 6.0°C and keep until discharge.

Ripening

Maluma Hass is a fast-ripening cultivar making it vulnerable to soft landings at distant markets. After harvest, the fruit are generally less firm than 'Hass'.

'Hass' and Maluma Hass soften at a similar rate, when stored at 20°C (representing the ideal ripening temperature).

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