MARQUIS
MACADAMIAS

09/06/2022

Growers Guide to Kernel Quality Testing

Important Definitions

All kernel descriptions are from the Australian Macadamia Society Kernel Assessment Manual, 2016.

Premium Kernel (PK)

Fully mature kernel that is plump (not shrivelled), round and firm with even white or cream colouring, with no 'off-odour' or rancidity.

Commercial Kernel (CK)

Has minor defects on kernel, i.e. light discolouration, light discoloured crest, and light shrivelled. These are still acceptable for human consumption. Marquis pay the same price for commercial and premium kernel.

Reject Kernel (RK)

Has major defects on kernel that are not fit for human consumption. Reject categories are heavy discolouration, heavy discoloured crest, heavy shrivelled, insect damage, internal discolouration and mould. Descriptions and images of the reject kernl catgories are in Figure 2.

Total Kernel Recovery (TKR)

Refers to the total percentage of kernel and includes premium, commercial and reject kernel.

Saleable Kernel Recovery (SKR)

Refers to the sum of premium and commercial kernel recovery. Growers are paid on SKR not TKR.

Nut in Shell (NIS)

The macadamia kernel encased in the shell. The total NIS weight is made up of these two components.

Consignment sampling

One sample is taken for every 2 t NIS or part thereof. Loads greater than 10 t NIS may be reduced to one sample for every 4 t NIS. For example, 8 t NIS would have 4 samples.

Each sample consists of two parts – a lab sample and a retention sample. The lab sample is assessed to determine the consignment value, when more than one sample is taken all as assessed and then averaged. The retention sample is stored.

Moisture content (MC)

Refers to the moisture content of nut-in shell (NIS) when it arrives at the factory, this is determined by a lab test on a wet basis. A 250 g sub-sample is taken from each consignment sample, then dried for 24 hrs at 105° C and then re-weighed for calculation of moisture content.

Payments are made based on a moisture content of 10%, the industry standard formula is:

$$\text{Weight @ 10\% MC (kg)} = \text{Consignment NIS weight (kg)} \times \left(\frac{100\% - \text{MC\% @ delivery}}{90\%}\right)$$

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The Quality Assessment Process

Marquis is certified by the Australian Macadamia Society Kernel Laboratory Accreditation Scheme (KLAS). All methods used by Marquis and the staff completing the assessments are accredited and audited under this scheme. Figure 1 describes the process of kernel assessment.

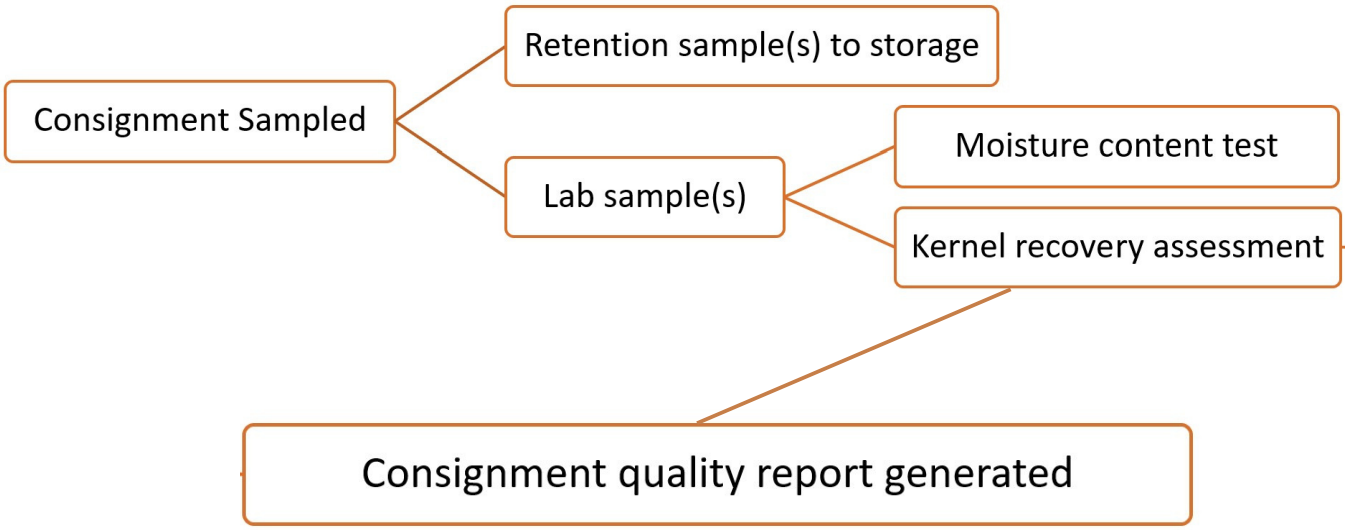

Figure 1: Kernel quality testing process flow.

Kernel recovery assessment

Before kernel recovery assessment, NIS samples are dried at 30°C until under 10% moisture and then at 38°C until under 1.5% kernel moisture. The NIS is then cracked and categorised into shell, premium kernel, commercial kernel and reject kernel. Sample separation is checked, then weighed and entered into the system that generates the Consignment Quality Report (CQR). The different kernel grades for each sample are placed into separate zip lock bags, then sealed in a foil pouch for storage in the warehouse.

Factors that contribute to Reject Kernel

If you have high reject levels, your consignment report can help refine growing or harvest practices to try and reduce levels. This is a guide only, as it does not replace on farm monitoring over the entiregrowing season e.g. pest scouting and timely implementation of pest management. For example, poor insect and disease management can result in premature nut drop that will be mulched orcleared prior to harvest so this damage won't be reflected in your consignment report but could still be causing significant yield losses.

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Reject description	Contributing factors	Example
Heavy Discoloured crest (Germination) Top of kernel has a ridge that is green-grey/brown	• Nuts left in wet and warm conditions • Long intervals between harvest rounds • Leaving nuts under leaf litter or buried in coarse mulch or soil • Nut on ground during extended wet weather periods • Poor NIS storage conditions • Storage of wet nut in husk under poor conditions (e.g. large volumes with inadequate air flow, high moisture) for longer than 12-24 hrs	
Heavy Shrivelled (Immaturity) Kernel shrunken, shrivelled or deformed. Heavily immature nuts are very hard when dried.	• Water stress during the oil accumulation/nut maturation stage • Insect and disease damage that causes the nut to drop prematurely e.g. husk spot, fruit spotting bug • Normally most immature nut should drop in December-January and be removed in pre-season clean-up.	
Heavy Discolouration Kernel is stained brown-black, this comes from a water-soluble phenolic compound in the shell.	• Long intervals between harvest rounds • Nut on ground during extended wet weather periods • Long storage times in silos • Older kernel, past maturity • Storage of wet nut in husk under poor conditions (e.g. large volumes with inadequate air flow and/or high moisture) for longer than 24 hrs	
Mould Fungal organisms cause fuzzy, colourful growth on kernel Mould proliferates at >12.5% moisture content and above 25°C (Freshly harvested nuts are above 12.5% moisture)	• Requires an entry point into the nut in shell e.g. cracks, holes or open micropiles. • Holding nuts on farm in poorly designed silos • Long harvest intervals • Can also occur on insect damaged kernel • Storage of wet nut in husk under poor conditions (e.g. large volumes with inadequate air flow and/or high moisture) for longer than 24 hrs	
Insect Damage	• Most insect damage will come through in the first few harvest rounds. If you continue to have high insect rejects, you should review your: - pest monitoring schedule, sampling technique and identification - product selection and if suitable for target pests - spray coverage and application timings. • Main insect damage seen in the lab is fruit spotting bug, green vegetable bug and macadamia nut borer	
Internal discolouration Also called brown centres. Pink-brown colouring inside, may taste rancid.	• Is a complex issue and research is still underway into contributing factors. However, the primary cause is inadequate storage conditions of nut in shell e.g. high moisture, inadequate airflow etc.	

Figure 2. Descriptions and images of reject kernel

Insect damaged kernel identified in the factory may be attributed to a specific pest by examining the kernel. Fruit spotting bug damage may also identify the most likely period damage occurred. If you have high insect damage that you are concerned about the Marquis Macadamias Grower Services Team can offer this identification service.

The table in the previous page provides some examples of the different reject kernel grades and some factors that contribute to these. If you are concerned about your kernel quality or orchard performance the grower services staff are available to assist you in determining the significance and possible solution to the issues.

Further reading

1- Du Preez, A., 2015. Studies on macadamia nut quality. Master of Science Thesis, University of Stellenbosch.

2- Quinlan, K., Treverrow, N., Slaughter, G., Mason, R., Wallace, H., & Walton, D. (2008). Adoption of quality management systems in macadamia (Project No. MC03008). Horticulture Australia.

3- Stephenson, R. A., Gallagher, E. C., & Doogan, V. J. (2003). Macadamia responses to mild water stress at different phenological stages. Australian Journal of Agricultural Research, 54(1), 67. https://doi.org/10.1071/AR02108. Linked to reduction of photosynthesis of water stressed trees

Disclaimer

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