

FACT SHEET 2

DRYING MACADAMIA NIS ON-FARM

Levy funded research (MC97011) by Tim Kowitz and Richard Mason at the University of Queensland clearly identified the importance of drying conditions such as temperature, relative humidity, air speeds and ambient conditions on kernel quality, and developed important guidelines for the design and management of farm silos.

Summary

Above all else, deliver the nuts to your processor as soon as possible

- The key to successful silo management is understanding the drying process
- Adequate airflow is critical.
- Install Relative Humidity (RH) controllers
- Avoid re-wetting NIS during times of high humidity.
- High drying temperatures combined with high NIS moisture are the enemy.
- Bed depths greater than 2.5m will take too long to reach uniform moisture.

Why Farm Drying?

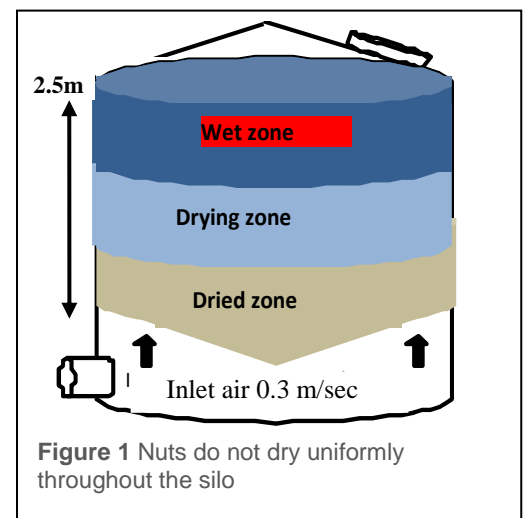
When the macadamia nut drops from the tree, its moisture content may be as high as 22-25%. High moisture contents will lead to fungal growth, reduction in shelf life, increased germination and increased brown centering, all contributing to higher reject levels, reduced product quality and lower prices to the grower.

The damaging effects of high moisture content begin as soon as the nut falls; so harvesting and drying should commence as soon after nut-fall as possible.

Even when partially dried, the deterioration of the kernel continues. Nut-in-shell (NIS) at 10% moisture can only be stored for about two weeks at 25°C before shelf life is affected.

The Objectives of Farm Drying

The growers' aim in drying NIS is to produce a batch which has uniform moisture to aid in sorting (water, air or visual sorting), and to minimise quality deterioration before consigning to the factory. Few growers have adequate facilities to dry NIS safely to a moisture content that would permit lengthy on farm storage. Ideally, NIS should be stored on farm for a maximum of 7-10 days following harvest.



Principles of Drying Nut-in-Shell

Effective drying depends on an understanding of the way nuts respond to temperature, relative humidity and airflow.

- Nuts dry in response to the relative humidity (RH) of the air, the lower the RH, the quicker will be the rate of moisture loss and the lower the moisture content that is possible. Conversely, nuts may “re-wet” if the air passing through them has a high RH. High ambient RH’s can be reduced by heating the air with gas or electric heaters, by drawing air from inside sheds and/or ceiling cavities, or by selectively avoiding moist air by using fan controllers that automatically monitor RH and switch fans off when the RH is too high. In any event, the objective is to ensure that the RH of the air that passes through the silo or bin is lower than the RH in the nuts.
- Great care is required to prevent kernel damage when using heaters. Thermostats should be set to run at 5°C above ambient with a maximum of 25°C.
- Nuts do not dry uniformly throughout the silo. Those at the bottom (nearest to the air intake) will dry first, while the nuts further up will initially increase in moisture content as the “drying front” moves up through the bed of nuts (Figure 1). This means that without an understanding of silo performance, the target of uniform nut moisture may not be achieved. NIS bed depths should not exceed 2.5m.
- Effective drying depends on adequate airflow. A velocity of 0.3 m/sec measured in the plenum or about 200ltr/sec/tonne is adequate.
- Run fans continuously for the first 24 hours after adding fresh wet nut to the silo. This will remove the heat generated by respiration. Thereafter, only run fans when drying will occur.
- During prolonged periods of high humidity run fans if the equilibrium moisture of the NIS is above the ambient RH (see Figure 2). If there is no automatic RH controller fitted to the silo, hand held humidity meters can be used. If the RH of the outlet air is higher than the inlet air some drying is occurring. Empty silo completely between batches, do not mix wet and dry nuts.

Drying for quality product can only be expected if the system is designed, operated and monitored correctly.

Silo or Bin Design

- A maximum bed depth of 2.5m. Ensure adequate air velocity.
- Make sure that backpressure is not restricting airflow. Exhaust outlets should be at least 1.5 times the area of the inlet duct. As a rule of thumb, if it is difficult to close the lid on a full silo when the fans are running there is not enough exhaust area. If backpressure exists, increase exhausts area by adding whirly birds or chinaman’s hats to the silo roof.
- Ensure there is a good seal around the silo footing. Poor seals allow air to escape and water from rain to enter the plenum cavity. Both reduce drying efficiency.
- Plenum floor angles should be between 7° and 15°. Steeper angles give an uneven bed depth resulting in increased backpressure at the deepest areas. Air will take the easiest route through the nuts (ie: through the shallow portion of the bed) leaving a wet core.
- Use RH sensing switches to turn fans on only when drying will occur, or when temperatures rise above a set limit, and off when rewetting will occur. A less satisfactory alternative is to rely on the operator’s judgment, turning fans on and off manually. Hand held humidity meters may be used. Manual operation runs the risk of rewetting NIS with the consequence of reduced quality and increased reject levels.
- If air heaters are used, set a maximum temperature of 25°C or 5°C above ambient. Drier air can be ducted from inside a nearby shed. Ducting air from the ceiling cavity utilises free solar energy.

* Check with your processor for regional specifics. Climatic conditions vary between regions and different processors may have particular preferences for handling NIS on farm.

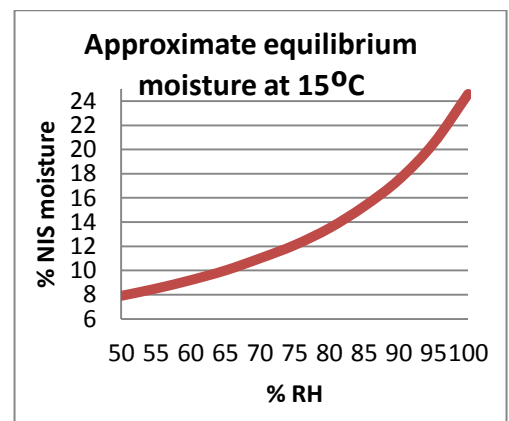


Figure 2 Approximate NIS moisture vs % RH. Use as a guide only as actual moisture may vary due to nut size, variety, kernel recovery or other factors.

Further Information

More detailed information on maintaining quality is also available in the Australian Macadamia Industry Code of Sound Orchard Practices, the Macadamia Grower's Handbook and on the AMS Website www.australian-macadamias.org

- **Kowitz T and Mason R.** 2001. *Drying macadamia nut-in-shell on farm, HAL final report MC97011.*
- **Bungay D.** *Macadamias Guide to on-farm post-harvest care. SAMAC Eskom Agrelek.*
- **Wilkie J.** 2001. *On farm Macadamia Drying using humidity meters, AMS News Bulletin May 2001.*
- **Payne S.** 2009. *Drying NIS on-farm. The Nutshell, Macadamia Processing Co Ltd, No.30 April 2009.*

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