

Integrated orchard management (IOM) in macadamia

May 2022, Primefact 22/357, second edition

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Since the *NSW DPI Integrated orchard management practice guide* (2016), *Integrated orchard management case study guide* (2016) and the *Integrated orchard management drainage guide* (2017) were released, changes in how canopies, orchard floors and drainage are managed has created more sustainable orchards (stage 2). The benefits in yield and productivity from having our orchards at stage 2 are clear, but what are the benefits for pest and disease control?

5 years later – how can it assist in pest and disease control?

Canopy

General effect on pest and disease management

Adequate spray coverage is more easily achieved when the canopy is at stage 2 (Figure 1). Canopy height will be equal to or less than row width, i.e. it should be easily covered by annually-calibrated air-blast sprayers. Having good coverage is essential for adequate pest and disease control.

Having 13+ m high trees will extend the capabilities of most sprayers and full spray coverage might not be achieved. Most (60%) yield will be produced where most light penetrates the canopy. Within the middle of a 13 m high orchard block, that 60% will be in the top 1/3 of the canopy, i.e. from 9–13 m high. Unless the typical air-blast sprayer has incorporated cannons and increased output delivery height, it is unlikely to provide full coverage.

Examples for effect on pest management

Pests such as macadamia lace bug (MLB) and fruit spotting bug (FSB) prefer tall dark, closed-in canopies. FSB will be at the tops of these trees in the light, preying on the nuts, where the sprayer cannot reach. Similarly, MLB will be at the tops, preying on the new flowers. Dense canopies allow them to travel along adjoining tree branches, encouraging their spread throughout the orchard. Dense canopies also provide higher humidity, which is preferred by FSB, as well as making it easy for FSB to hide from predators such as birds. An integrated orchard management approach will limit the negative effects from these and other pests.

Examples for effect on disease management

Canopies that allow light to the orchard floor will generally have good ventilation and be less prone to diseases promoted by prolonged moisture at certain temperatures and relative humidity. Botrytis blight, flower blight and green mould are all less likely to occur in an open well-ventilated canopy.



Figure 1. Stage 2 canopy.

Orchard floor

Stage 2 orchard floor should have adequate ground cover (Figure 2). This will usually be the semi-shade tolerant grass species, sweet smother grass (*Dactyloctenium australe*). Many within the industry are anxious that this grass species will lead to an orchard floor monoculture and therefore limit the biodiversity within the orchard. Less biodiversity could reduce the ability of beneficial insects to control pest insects.

NSW DPI's integrated pest and disease management (IPDM) program is investigating ground covers with a mix of flowering plants in a small unsprayed block. These plants include Rhodes grass (*Chloris gayana*), white clover (*Trifolium repens*), red clover (*Trifolium pratense*), mustard (*Brassica*), chicory (*Cichorium intybus*) and lucerne (*Medicago sativa*). Perennial flowering plants including *Grevillia* spp., *Banksia* spp., *Leptospermum* spp., *Westringia* spp. and *Lomandra* spp. were established adjacent to the block.

This type of ground cover should harbour many thousands of beneficials. We will be determining the population densities and the diversity of these. Specifically, we will investigate the effect of these beneficials on productivity; for instance, does having more beneficials within this mixed ground cover result in higher productivity as more pests are predated on by the increased population of beneficial insects?

Having a sound, grassy orchard floor can reduce erosion by 99% (Alt et al. 2009) and this allows us to build the soil around the tree roots. This creates a desirable system for tree health, which leads to strong sap flow. Healthy trees with strong sap flow are more likely to withstand attack from pests such as bark beetle that rely on low sap flow to enter the tree.

A healthy soil with high organic matter in the root zone provides the trees with more resistance and resilience to *Phytophthora* spp., and ultimately builds orchard resilience for extended dry periods. A simple test to determine the strength of soil and tree root

structure is the 'snap test'. This involves pushing a shovel into the soil and if the soil does not 'snap' as the shovel enters (the 'snap' being the sound of breaking roots), it could indicate insufficient root structure in the soil. This means those roots might not be delivering sufficient moisture and nutrients to the tree. An integrated orchard management approach for the orchard floor, stage 2 would promote ideal root growth.



Figure 2. Stage 2 orchard floor.

Drainage

Having stage 2 drainage means that excess water will be diverted to designated grassed water courses (Figure 3) and will exit the farm with minimal nutrients and sediment, instead of running randomly through the farm, taking with it valuable soil and nutrients. Good drainage also means that inputs should stay where they are placed, improving soil health and therefore tree health. If the organic matter placed around the tree is not washed away, the organic carbon within the soil will start increasing, as will the cation exchange capacity. Having higher organic carbon in the soil means there will be greater water holding capacity, which is critical, especially when water resources are limited. Increased water holding capacity also allows trees to function more effectively and maintain sap flow, which will strengthen their capacity to withstand attack from pests such as bark beetle. Good sap flow will also be less favourable for diseases such as *Botryosphaeria* dieback.

Conclusions

Over the past 5 years we have seen enormous efforts from growers to continue their IOM programs. These efforts are clearly worthwhile, with growers achieving a harvest through the worst drought in memory. Integrated orchard management, like IPDM, is a continual journey throughout the life of the orchard. As trees age and develop, the

interactions between the orchard floor, canopy and drainage subtly change each year. Growers need to be aware of this and understand these changes as well as how to work with them to maintain good productivity. New initiatives are also being developed in the IOM system such as limb removal with excavators, making it possible to remove large limbs in a much more cost-effective way.



Figure 3. Stage 2 drainage.

Reference

Alt S, Jenkins A and Lines-Kelly R. 2009. [Saving soil: a landholder's guide to preventing and repairing soil erosion](#). Northern Rivers Catchment Management Authority.

Reference number: PUB22/357.

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