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Balancing Act: Managing vigour and yield in Macadamia orchards

Centuries of selective breeding with apples has led to an increase from 100 trees per ha to up to 10 000 trees per ha in the last 70 years. Macadamia's natural vigour may restrict options for high-density plantings in certain contexts, and comparing the evergreen macadamia with an inclination to grow vigorously by nature with deciduous apples, is not that simple. Nevertheless, differences aside, basic plant physiology still applies to both of these horticultural crops, and much can be learned by "borrowing" information and principles on which cultivation and tree manipulation in other tree crops are based. Dense, vigorous macadamia trees may limit tree productivity due to source-sink competition and a deficient photosynthetic capacity. So if one wants to increase tree productivity, does that mean strong vigour needs to be curbed? The answer is somewhat contradictory.

Strong vegetative growth at the juvenile stage is crucial for orchard establishment and uniformity. Initial vigour with good upper ground growth (a large effective leaf surface) provides sufficient photosynthates to be transported to the roots, to promote the development of a well-buffered root system, able to withstand environmental stressors such as drought spells. New flushes are very important for future bearing branches and the production of leaves. The leaves can be seen as the "factory" of the plant, photosynthesising to produce carbohydrates. There is also a positive correlation between early vigour and precocity.

But on the contrary, strong vigour in mature trees is not necessarily desirable. The goal should be to obtain initial high vigour, with low (or rather controlled) vigour at maturity.

The aim of all pre-planting and post-planting practices should always be on achieving a balance between vegetative and reproductive growth. If done correctly and timeously, these practices will create good tree architecture with an adequate supply of carbohydrate reserves stored in the permanent parts of the tree in autumn and summer. Such parts include the trunk, branching structure and root system. The better these organs are developed, the higher the storage capacity for carbohydrate reserves. These carbohydrates are utilised during the stages of nut growth and oil development since carbohydrate production through photosynthesis alone is not sufficient to provide in the very high demand of such sinks during these stages.

A prerequisite for opting for a high density planting scenario in macadamia, is moderate, controlled growth. In high-density plantings with dwarfing rootstocks, tree volume will be restricted and precocity promoted. Research in apples has proven that dwarfing rootstocks allocate a higher amount of dry weight to reproductive growth, accompanied by a decrease in vigorous vegetative growth. Unfortunately, there are currently no vigour controlling rootstocks, commercially available in the macadamia industry.

In early years training can be done so that vegetative growth and thus nut distribution is improved. With almonds, apples and pears, branches are trained horizontally which eliminates apical dominance, produces a shorter branch with shorter internodes, fewer nodes and more and longer racemes. Flowering and fruitfulness are increased with this practice. Such relationships in macadamia are unclear at this stage. It is interesting that the natural branching angle on dwarfing rootstocks also tends to be wider, which then naturally have the same result as achieved with the manipulation of limb bending.

Deciduous horticultural species have been researched much more comprehensively when compared to the relatively few research results available on evergreen, naturally vigorous forest trees such as macadamia. Macadamia has only been domesticated for about 150 years, and most commercially cultivated varieties are only two to five generations removed from their wild ancestors. Compare that to the apple industry (between 4 000 and 10 000 years old) and the viticultural industry (11 000 years old), and it becomes clear that best practices in macadamia still need to be refined to the same extent.

To take the young macadamia industry to the next level, much research is needed on advanced tree training, pruning systems and dwarfing rootstocks, all of which are widely applied and well-researched principles in the cultivation of apples and grapes. These practices allow for a reduction in tree spacing and increased flowering points per hectare, resulting in high yield efficiency, and reduced and controlled growth. The current focus of research in macadamia is on increased yield and quality of nuts of scion cultivars, with very little research on dwarfing varieties in macadamia and understanding of canopy architecture specific to macadamia. The fact that the gene pool of macadamia is largely untouched is a big positive, and opens up tremendous

scope for future breeding. Principles already thoroughly researched in other industries may be explored which may lay a solid foundation for future research in macadamia.

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