High density cultivation: a case study of central leader pruning with Maluma

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Abstract

With high density plantings becoming increasingly popular, a need has developed for pruning techniques and cultivars supporting this cultivation method. Central leader pruning is well suited for high density planting as it enables greater space utilisation. After studying a Maluma orchard on Allesbeste, Limpopo, South Africa, Maluma has been identified as a cultivar that is well suited for central leader pruning methods. Maluma, a less vigorous, precocious and productive early bearing Hass-like cultivar, is characterised by a visible natural central leader, with prominent lateral branching (≥ 90º angle). The pruning of trees planted in the field should commence during the first year from planting. The pruning method implies the selection of the strongest vertical shoot as your central leader, then removing all other vertical growth, which leaves you with pyramid-shaped trees. The sylleptic growth habit of Maluma supports this pruning technique which results in highly productive lateral branches. This pruning method increases light penetration and supports the moving of the volumetric production capacity of the tree closer to the ground, utilising space better as well as enabling picking to be done faster and more efficiently. The production capabilities of high density planting is tremendous as the surface area planted is being utilised better. Most farmers are cautious to commit to high density plantings as pruning is seen as a mammoth task. However in this study it is illustrated that with the supportive characteristics of Maluma, high density plantings are a viable option lowering input costs without sacrificing productivity.

Key words: High Density, Maluma, Central leader, Volumetric Production Capacity

Cultivo de alta densidad: estudio de caso de poda del líder central con Maluma

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Resumen

Al volverse cada vez más populares las plantaciones de alta densidad, se desarrolló la necesidad de técnicas de poda y cultivares que apoyen este método de cultivo. La poda del líder central es ideal para plantaciones de alta densidad ya que permite una utilización mayor del espacio. Después de estudiar un huerto de Maluma en Allesbeste, Limpopo, Sudáfrica, Maluma se identificó como cultivar ideal para métodos de poda del líder central. Maluma, un cultivar precoz, productivo, fructífero, tipo Hass, menos vigoroso, se caracteriza por un visible líder central natural, con ramas laterales prominentes (ángulo ≥ 90º). La poda de árboles plantados en el campo deberá comenzar durante el primer año de la plantación. El método de poda implica seleccionar el brote vertical más fuerte como líder central, luego extraer todo crecimiento vertical que lo deje con árboles en forma de pirámide. El hábito de crecimiento siléptico de Maluma apoya esta técnica de poda que da como resultado las ramas laterales altamente productivas. Este método de poda aumenta la penetración de la luz y apoya el movimiento de la capacidad de producción volumétrica del árbol más cerca del suelo, usando mejor el espacio y permitiendo una recolección más rápida y eficiente. Las capacidades de producción de la plantación de alta densidad son enormes ya que el área de superficie plantada se usa mejor. La mayoría de los granjeros tiene la precaución de dedicarse a las plantaciones de alta densidad ya que la poda se considera una tarea descomunal. No obstante, en este estudio se muestra que con las características de apoyo de Maluma, las plantaciones de alta densidad son una opción viable que baja los costos de entrada sin sacrificar la productividad.

Palabras clave: De alta densidad, Maluma, Del Líder Central, Capacidad de Producción Volumétrica

1. Introduction

Modern avocado farming is characterised by a search for more effective and efficient methods that creates more profitable businesses as rising input costs in farming is placing pressure on overall business success. By character avocado trees are vigorous, and the larger size of commercial orchards cause excessive expenses for orchard management and managing overcrowded trees (Ben-Ya'acov and Michelson,1995). Hofshi (1996) suggests that to be competitive requires an overhaul of farming practices and varieties grown. Hofshi (n.d.) also suggests that high density plantings should be considered as a solution to the modern competitive situation.

Stassen (in Hofshi, n.d.) and Snijder (2001:148-153) both suggest central leader pruning as a canopy management technique to obtain, and sustain high density plantings. Hofshi (n.d) further suggests a cylindrical shaped tree. The main advantage of this type of pruning is to obtain better light penetration. Light penetration is a key factor in high density plantings especially as trees are so closely grouped (Hofshi, 1996). A cylindrical or pyramid-shaped tree allows light penetration from multiple sides of the tree, up to 4 or 5 sides, due to the cylindrical shape, where hedgerows mainly allow sunlight from 2 sides, or 3 at most (Hofshi, 2004).

In order for high density plantings to be successful, and to obtain superior central leader trees it's preferential that trees should already be produced within the nursery with a central leader. It is further suggested that if trees from nurseries arrive without central leaders, these trees need to be pruned directly after planting (Snijder, 2001:148). Thorp (1999:66) also suggests this notion, and adds that good root development is crucial. It is also stated that trees with less dominant lateral shoots are crucial. However it has to be noted that this statement is most likely related to cultivars like Hass with lateral growth that is upright in nature, unlike cultivars like Maluma, with dominant lateral shoots but that grow rectangular to the main shoot and does not threaten the survival of the main shoot.

Hofshi (n.d.) suggests that high density plantings have the following premises:

- Low avocado prices due to competition require more efficient farming and a significant increase in productivity.
- Young trees are vigorous, produce large fruit early, have better canopy to root ratio and reach full production by 7 or even 8 years.
- Smaller trees are easier and less expensive to harvest.
- Spraying is also more effective and more practical on smaller trees.

One key aspect that might be missing from the above list is the fact high density can improve the spatial utilisation of farming. It is well known that overgrown avocado trees only produce on the canopy boundary, and probably only in the first meter or two from the edge of the canopy. All the volumetric capacity inside the abovementioned boundary remains unused as only unproductive branches grow here. The theory therefore with high density plantings would be that, by keeping the tree smaller, the volumetric production capacity of the orchard is increased in relation to the total volume of the trees and therefore space utilisation is more efficient, with the whole volume of the tree being productively active. With trees being closely grouped or spaced, the farmer does not compromise on surface utilisation when decreasing tree size. The volumetric production capacity is not only increased for the orchard, but also lowered to a more manageable height.

Worker safety is also an issue commonly associated with high overgrown trees that will be avoided in high density cultivation methods, smaller trees will reduce the risk of labour falling from trees. In the case where cherry pickers are used, smaller trees will decrease the cost and time of picking tremendously, as cherry pickers will not be needed.

Snijder (2001:148) also suggests the following advantages of canopy management:

- Increased light penetration within the tree to keep shoots active
- Tree size and shape maintenance for effective light utilisation
- Maintaining tree size and shape for effective tree management
- Encouragement of regular branch renewal ensuring that new wood becomes available for fruiting
- To obtain tree complexity for maximum bearing units for maximum production.

For high density plantings to be successful the following prerequisites are suggested (Hofshi, n.d.):

- Cultivars are an important consideration. Hass trees on high density plantings may become problematical after a few years as they expand equally on all sides as they grow. Upright growers such as Gwen, Reed and Lamb Hass are better suited.
- Availability of reasonably priced clonal trees
- A plan for tree manipulation to extend the sustainability of high density.
- Tree removal rather than rejuvenation when productivity begins to decline.

What can also be added is the use of dwarfing trees (Thorp, 1999:67). Hofshi (n.d.) might be suggesting this with the choice of cultivars above, however Ben-Ya'acov and Michelson (1995) suggest that dwarfing rootstocks would be the best way for size control. The Nachlat group of rootstocks are mentioned for their dwarfing characteristics, with the setback that they are only useful in well aerated soils. In the largest part of South Africa this is of no use as soils rather tend to be heavy clay-type soils.

High density plantings have not yet been adopted commercially on a large scale worldwide. Currently high density plantings have been adopted by young industries and areas with cooler climates and marginal conditions such as Chile. Other traditional avocado producing countries such as Mexico, Spain, California, New Zealand, Australia and South Africa have largely lagged behind.

The latter countries need to put careful consideration into choices surrounding cultivar and cultivation methods to obtain success.

The aim of the study is to document the central leader pruning techniques followed by Allesbeste Boerdery, on the farm Allesbeste, Tzaneen, South Africa (23°48'27''S, 30°07'19"E). Two Maluma orchards were used during the trial, as Maluma poses itself as a new generation cultivar that meets many of the criteria of cultivars fit for high density programs. Maluma is undoubtedly one of the highest producing cultivars, with average yields under South African conditions of between 20 and 30 tons per hectare.

2. Materials and methods

Two Maluma orchards were chosen as follows:

Block: D5
Cultivar: Maluma
Size: 12.9 Ha
Date planted: April 2009
Irrigation: Micro Sprinklers
Spacing: 7 x 3, 5 (tramline, Figure 1)
Trees: 10709 (830 trees/ ha)

Block: E4
Cultivar: Maluma
Size: 2 Ha
Date planted: November 2006
Irrigation: Micro Sprinklers

Spacing: 7 x 3, 5 (tramline, Figure 1)
Trees: 1632 (816 trees/ ha)

Two blocks were used, as high density pruning and training needs to start early to ensure the correct shape and to prevent rectifying measures. These blocks were both planted in a “tramline” method (Figure1). The reasoning behind this was to allow for tree removal to a 7 x 3,5 m spacing if needed in future.

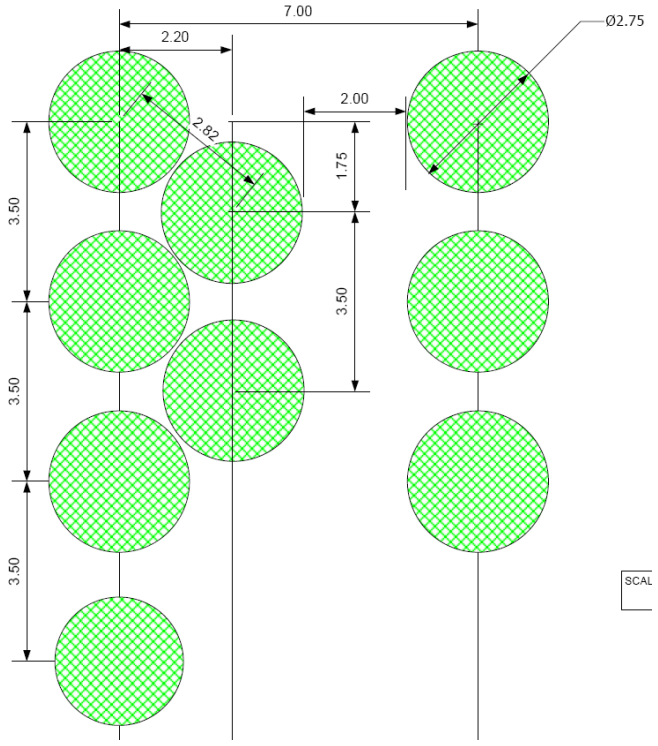

Figure 1. Tramline planting diagram

Trees are planted on a regular 7 x 3.5 m spacing, except a second line of trees is planted on the diagonal of every row, two meters from the original row.

For the canopy management pneumatic loppers were used, that are connected to a compressor on a small tractor, together with a height guide of four meters.

The main method that was followed when pruning young trees is as follows (see figure 2):

1. Identify the central leader, or in other words the strongest, most vertical branch of the tree.
2. Remove all vertical growth that attempt to influence the growth or performance of the central leader.
3. All other growth with an angle smaller than 45° to the central leader is removed.
4. Any lateral branches that grow inward, into the tree, towards the central leader, as well as those that cross other branches need to be removed as they clutter the tree and hamper light penetration.

Figure 2: Pruning process

This method remains the same for the second round of pruning as well as at least for the third round of pruning, and even further possibly, depending on conditions (on a bi-annual pruning program).

The pruning of older trees was done on much the same basis, except that by now step 1 (above) has been achieved except for some cases. All the other steps remain the same.

Maluma, a less vigorous, precocious and productive early bearing Hass-like cultivar, is characterised by a visible natural central leader, with prominent lateral branching (≥ 90º angle). The pruning of trees planted in the field should commence during the first year from planting. The pruning method implies the selection of the strongest vertical shoot as your central leader, then removing all other vertical growth, which leaves you with pyramid-shaped trees. The sylleptic growth habit of Maluma supports this pruning technique which results in highly productive lateral branches.

3. Results and discussion

A key characteristic of Maluma is its central leader tendency (see Figure 3 & 4), as opposed to Hass with its multiple leaders, as well as the fact that Maluma tends to produce more suitable “willowy” like lateral growing branches. By “willowy” branches (see figure 4) it is suggested that instead of Hass branches that tend to connect to main branches on angles smaller than 45°, Maluma has branches that connect rectangular to the main branch (see figure 4) and tend to be slack. These branches are characterised by shorter internodes, growth is not as powerful and the angle of growth by itself already allow superior light penetration.

Figure 3: 4 Year old high density Maluma with central leaders

Figure 4: 1.5 year old Maluma tree after second round pruning

The tendency described above makes Maluma a tremendous fit for central leader pruning and the task is therefore simplified.

The key to the early (young tree) pruning is not to remove any weak vertical growth as this does not threaten the performance of the central leader in the short term, and are often fruiting branches which will be dragged down as they perform their task. If these weak branches do in fact pose a threat as time passes they can very well be removed at the next pruning time without any detrimental effect.

Thereafter, when the tree has grown substantially by year 3 or later (depending on conditions) the process remains relatively the same, however by now the central leader should have been firmly established and therefore step 1 (material and methods) is eliminated. The other steps (step 2 to 4; material and methods) remain the same. Pruning by now is a simple task where the main focus is on watershoots (“bullshoots”). The only step that needs to be added now is preventing the trees from growing into each other. Here a 30cm gap is maintained by nipping the branch back to the next lateral branch, keeping to the horizontal growth but preventing the overcrowding of the trees.

One important factor to suggest in high density plantings is the use of plant growth regulators. Although plant growth regulators are very successful in controlling growth vigor, none were used on these Maluma trees, which make the result of this method on Maluma even more exciting as this saves even more on input costs.

This pruning method results in a central leader tree that is cylindrical in shape and allows superior light penetration. This light penetration improves productivity, and through this method trees are kept small enough to achieve high density cultivation. To date the oldest orchard is 5 years old and the high density situation is foreseen to be maintained comfortably as the trees had already grown to full expected size in year 4.

4. Conclusion

High density farming is undoubtedly inevitable in modern avocado farming. High density cultivation methods are few and limitations to these methods are high, especially in warmer climates where cultivars like Hass tend to grow rapidly and produce few fruit. New generation cultivars are needed that embrace this change in cultivation techniques.

Central leader pruning that achieves a cylindrical tree shape has been proven to work, as it allows superior light penetration and optimises space utilisation. Although this method might be possible with all cultivars, its success is rather determined by the correct selection of cultivars and possibly dwarfing rootstocks.

Maluma is one such cultivar that, through its characteristics, have been proven to positively react to this cultivation method on a commercial basis. Maluma trees are much more compact and prone / supportive to higher or even superior yields. Its success lies in its growth pattern and ease of pruning.

Thorp (1999:67) calls for farmers to be involved and gain experience on the guidelines set by researchers regarding canopy management in high density situations. This study provides guidelines on how this can be achieved with very promising and sustainable results.

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