BEYOND YIELD: RE-ENGINEERING THE AVOCADO

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Avocados are often planted on hillsides for various reasons: less expensive land, cold air drainage, and lower risk of root asphyxiation from standing water. Many aspects make this type of avocado farming unique and complex: increased cost of tree establishment and irrigation installation, almost no opportunity for mechanization, expensive harvesting and often poor irrigation uniformity and less than adequate light interception. Hedgerows with north-south orientation are the exception, as eroded hillsides have changing aspects and slopes.

In Chile, new avocado orchards are often planted in hedgerows on ridges up and down the hillside independent of aspect consideration. Tree spacing within the row varies but the row spacing is typically 6 meters. The ridge is built by mixing the top soil from the unplanted area with the uppermost 1-meter of soil where the trees are to be planted. The resulting ridge has relatively uniform soil structure. With the advent of pressure compensating emitters such an undertaking is successful from a hydraulic uniformity perspective. Erosion is minimized when the system is well designed and maintained. With such hedgerows, once the trees grow together, harvesting crews can only travel up and down the hillside with no opportunity for lateral movement. Successful plantings of this type are now common in Chile where the distance between trees may be as little as 2 m between trees. Exceptional early yields are reported with tree vigor tamed due to the higher tree density.

An alternative form of high density avocado planting on hillsides is the independent, stand alone slender pyramidal shaped tree planted in an equidistant pattern of 3 x 3 m. Whereas a 2 x 6 m planting has approximately 830 trees per hectare a 3 x 3m planting has 33% more trees or about 1100 trees per hectare. This type of system, if well maintained through early production and timely and aggressive canopy management solves many of the drawbacks of a hillside hedgerow system. Even with increased tree number the space covered by tree canopies is 20-25% of the land while a hedgerow covers as much as 50%. The photosynthesizing surface area remains similar in both types. With taller and wider trees a more complex structure of wood, branches and leaves that are nonproductive need to be maintained by the photosynthesizing layer of leaves. In a slender tree composed of a narrow trunk well distributed branches pulled down by the weight of the fruit and a relatively thin layer of leaves (complex leaf structure on the surface but only few leaf layers deep) has a minimum structure to support. This translates into a more efficient production system with photo-assimilates likely to be partitioned to fruit rather than unnecessary tree structure. Harvesting and other cultural activities are highly simplified as lateral access between trees is inherent to the design. Light which in a hedgerow is intercepted by basically two dimensions is intercepted by 5 dimensions, 4 sides and the top, in a stand alone tree configuration. Honey bee access is improved; air movement which can positively influence gas exchange by affecting the boundary layer around the leaf's surface and irrigation uniformity is enhanced and simplified by conforming to the hillside contour without the mandatory need for pressure compensating emitters as in the Chilean model.

It is commonly assumed that the maximum tree height in a standard hedgerow planting should be 80% of the row space. In a 6 m row spacing the maximum tree height would be 4.8 m. In a 3 x 3 m spacing design the maximum height is 2.4 m. The difference in efficiency of the workforce is evident; in the taller trees picking poles and ladders are required while in the short trees the only tools are the hands and a clipper. By simply counting the moves associated with harvesting a tree using tools versus harvesting fruit by hand only, it is clear how much more efficient this type of harvesting can be.

In California, pest control, mostly for thrips and mites has become a way of life. Applying control treatments on steep hillsides with limited accessibility and equipment makes ground spraying of tall trees very difficult or even impossible. If performed from the ground, the efficiency is reduced in relation to increased tree height and canopy density. Additionally, material use is increased with tree height. In California, due to this limitation helicopters are almost universally used. This is costly, less efficacious and because of lack of helicopter availability treatment is not always timely. Short trees are easier to spray and do not require sophisticated equipment, therefore time and materials are saved.

High density planting as described above is a holistic system looking at the whole farming operation as a production unit with all components functioning harmoniously with each other not only to produce maximum yield but also to increase production efficiency. This approach requires a trained work force that understands the system and is how to contain the trees within the design parameters to minimize future costly corrective intervention. Although the reasons for high density plantings are usually associated with high yield and early return on investment, less tangible aspects such as worker's safety, ergonomic soundness, and accuracy of size-picking and reduced dependence on highly experienced workforce are seldom mentioned in traditional cost analysis schemes.