BENCHMARKING BEST IRRIGATION MANAGEMENT PRACTICES IN AVOCADO

Mohammed Aleemullah, David Clark, Mark Panitz and Rohan Geddes,
Queensland Fruit & Vegetable Growers Ltd

Introduction

Avocadoes are commercially produced in Far North Queensland in the Mareeba-Dimbulah Irrigated Area and the Atherton regions. It is also the second largest production centre in Queensland (Adamson, 1998). It is irrigated throughout the year, hence, an important crop for the Queensland Rural Water Use Efficiency Initiative (RWUEI) program to investigate and benchmark its irrigation practices. The main objective of the "Best Irrigation Management Practice" in avocado industry is to establish and develop guidelines for growers to adopt better irrigation practices, resulting in more profitable and sustainable production system. It also aims at promoting efficient and sustainable management of water, as a resource. It gives a measure of crop water use, yield and product quality.

Methodology

A three-year study in benchmarking best irrigation management practices in avocadoes is being conducted by Queensland Fruit and Vegetable Growers limited, under the RWUEI program. However, results reported in this paper are from the investigation that were undertaken for two consecutive years, during the 1999-2000 and 2000-2001 season, on commercial growers properties to determine and benchmark best irrigation practice. All sites were irrigated by under tree mini sprinkler. Soil moisture levels were monitored on these sites using capacitance probe systems namely C- Probe, Gopher and Buddy. This method of determination of soil moisture content is based on the change in the frequency of a RF pulse due to changes in the dielectric constant of a material. As water content of the soil increases, the measured dielectric constant increases.

In order to determine the variation in irrigation practices, growers were asked to information on their pattern of watering. This information included frequency of irrigation and the number of hours of each watering.

Results and discussions

The trials are still continuing, therefore, results reported in this paper may vary at the end of the trial period. However, results to date are presented in table. 1. These results indicate that there are differences between years and among properties. Site one, recorded highest water use efficiency, with 532 and 445 trays/ML of water used (Table.1.). Whereas, site two was the least efficient producing only 50 and 100 trays/ML. Whereas, site three, stood second in terms of water use efficiency, producing 372 trays/ML of water used and site four, ranked third giving 150 trays/ML of water used.

Banks (1992) divides a year into four seasons, namely, spring, summer, autumn and winter. He then reports that a full bearing avocado tree at age 7 and onwards are irrigated at 850 L/tree/week during spring, with 1-2 watering /week; 1000 L/tree/week during summer, with 2-3 watering / week; 450 L/tree / week during autumn, with 1-2 watering/ week and 300 L/tree/week during winter, 1 watering every 10 – 14 days. However, in the Mareeba-Dimbulah Irrigated Area and the Atherton regions growers do not recognise these four seasons for the avocado crop (personal communication). Therefore, the avocado growers of this region cannot follow Banks recommendations. Arguably, it is therefore essential to outline the climatic conditions and timing of the phenological stages of avocadoes that occur in this region.

In the Mareeba-Dimbulah Irrigated Area and the Atherton regions for the purpose of irrigating avocadoes, the seasons in a year are classified into two categories, first category – cool months / winter and summer months; second category being dry and wet season. Cooler months or winter starts from June and ends in August, while summer months are from September to May. The dry season starts in April and ends in August, while, the wet season starts with storms in September, October and November, with December, January, February and March as rainy months. Therefore, most of the winter is dry.

With respect to crop phenology, in avocadoes the usual time of flowering extends from end of June to end of July. The fruit set occurs during flowering and they are of noticeable size four weeks from flowering. Soon after fruit set, fruit development starts and fruits continue to develop until the end of December/January. Then after, harvesting of mature fruits continues until April/May.

Table 1: Water use efficiency on commercial avocado production sites that were monitored for soil moisture.

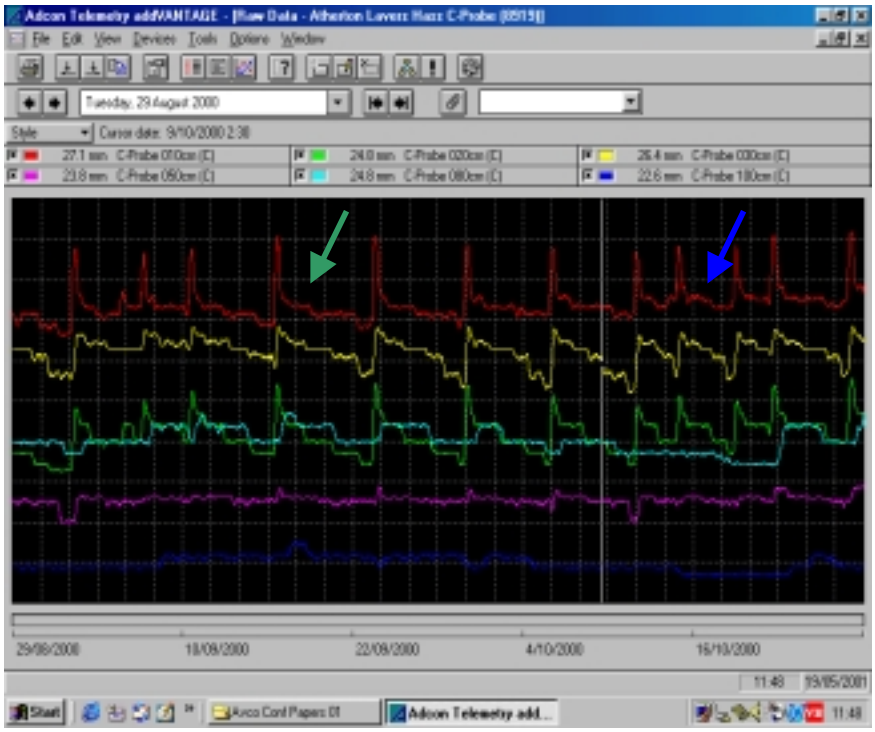
Site Number	Year	Total water used (ML/ha)	Yield (trays/ha)	Rejects (trays/ha)	Water Use Efficiency (trays/ML)
1	2000	4.67	2227	260	532
1	2001	4.46	1872	114	445
2	2000	6.07	557	48	100
2	2001	7.5	300	71	50
3	2001	4.84	1656	132	372
4	2001	4.34	627	19	150

An avocado grower has to match his or her irrigation practice to crop water demand that occur at different phenological stages and weather conditions in order to become an efficient irrigator. The best tool to improve and increase water use efficiency is to adopt soil moisture monitoring to schedule irrigation. Soil-based methods of irrigation scheduling are farmer friendly. They are specific to site and crop, and responds directly to the depletion of soil moisture as the crop uses the water during its growth. Soil moisture monitoring on a continuous basis accurately gives the relative change or trend in soil moisture, during,

before and after an irrigation event. This information can be further used in making decisions on irrigation management and scheduling of subsequent irrigations. Hence, the results in irrigation practice were monitored through soil moisture, as given in figures 1, 2 and 3.

The results in figure 1, shows that the grower with the “best” irrigation scheduling maintained soil moisture reserve between 25 and 28 mm in the active root zone depth. This way the best irrigator is having sufficient soil moisture and the trees are never stressed. Thereby, at various stages of fruit development, from the early stage of fruit set, which corresponds to embryo development and multiplication in cell numbers to the later stages of cell filling and cell elongation, there is adequate moisture to support high yields of large size fruits (Table. 1. Site. 1). The scheduling practice was such that rewatering occurred when the 30 cm depth soil moisture dropped to 25 mm. This grower also exhibited that his practice has reduced soil moisture below the 60 cm depth zone, indicating no under or over watering. This irrigator therefore had a better control over the way he does irrigate. Not adding any to the ground water past 80cm is producing the crop on a sustainable system.

Figure 1: Irrigation frequency and soil moisture status at peak crop water demand in avocado under best irrigation management practice.



The best irrigator had a scheduling practice of watering in such a way that that the frequency of irrigation shifted from 7 days (Fig. 1. Green Arrow) to every 3 days (Fig. 1. Blue Arrow) as crop water use increased to maintain the same soil moisture reserve that would be available to support active fruit growth and development. This irrigator used only 4.64 ML/ha to produce 2227 trays for the market and 259 trays as

rejects, giving about 532 trays/ML, in 1999 - 2000 season (Table. 1). Similarly, this irrigator had a good performance in 2000 – 2001 season (Table. 1).

Results in figure 2 and 3, shows that the grower with the "bad" irrigation scheduling does not maintained a uniform soil moisture reserve to support fruit set, growth and development. Consequently, the trees are stressed between irrigations throughout the cropping cycle resulting in poor yields (Table. 1, site 2). Basically the crop remained under irrigated. The scheduling practice was such that it failed to maintain a uniform and constant supply of soil moisture through out the cropping cycle. The practice also had drier and wetter cycles, with trees at times not having enough soil moisture to times when it was adding water to the ground level past 80 cm depth.

Figure 2: Trends in soil moisture status under a bad irrigation practice in avocado during 1999 – 2000 season.

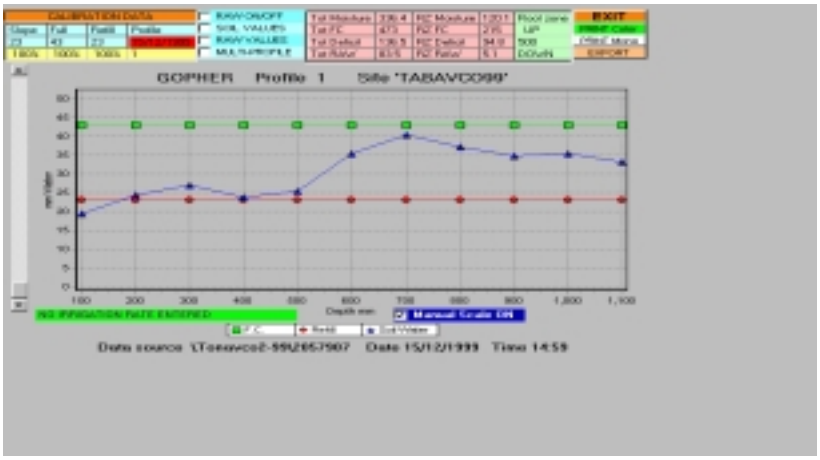
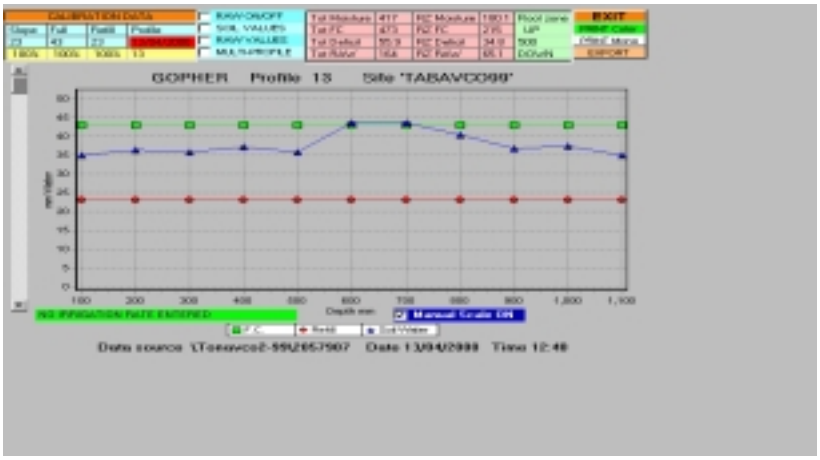


Figure 3: Trends in soil moisture status under a bad irrigation practice in avocado during 1999 – 2000 season.



The "bad irrigator" had a scheduling practice of watering in such a way that the frequency of irrigation did not shifted to lesser days between two irrigations to match crop water demand, as was evident with a good

irrigation practice. This irrigator used 6.07 ML/ha to produce only 557 trays for the market and 48 trays as rejects, giving about 100 trays/ML, in 1999-2000 season (Table. 1). Similarly, this irrigator had a bad performance in 2000 – 2001 season (Table. 1).

Conclusion

There are large variations in irrigation practices among the avocado growers. Some irrigate at a constant freequency of once a week irrespect of the crop water demand as evident during different phenological stages and weather conditions. While, others have a cyclic pattern of watering once a week during off season and twice a week during the season. While, others have a cycle of irrigating once a week for 8 months and twice a week for 4 months. The discgarge rate of under tree sprinklers vary from 90 L/h to 300 L/h. These variations has to be quantified through an extensive survey to determine the process that has to be put in place to improve and increase water use efficiency in the adocado industry.

It is evident from this study that using soil moisture to scheduled each irrigation throught the year, both during flowering and fruit load and also in the off season gives an outstanding crop preformance year after year.

References:

Adamson, D. (1998). Queensland horticultural production – small area analysis. University of Queensland. 126 - 128

Banks, A. (1992). Growing avocados in Queensland. Department of Primary Industries, Queensland Government. 11p.