

Milestone Report No1 Sustainable Horticultural Irrigation Project (SHIP).

Summary

A management committee has been formed comprising of the irrigation project champions for avocado and macadamia industries and the SHIP project leader. This committee will provide direction and ensure mutually beneficial cooperation between the industry funded projects and the SHIP program. In consultation with the committee two on-farm sites each have been selected for the macadamia and avocado irrigation research in the Bundaberg region. Macadamia growers on the Atherton Tableland have been surveyed on their water management practices and this will be used to guide some of the work conducted in this area.

The Bundaberg avocado trial site was visited in early June by 320 delegates attending the Australia /New Zealand Avocado Conference. During the visit a summary of the proposed research program was outlined to producers . A poster was also presented at the conference. At the conference links were established with Dr David Turner, University of Western Australia, who has recently supervised a PhD student examining water use efficiency in avocado.

SHIP Management Committee

A management committee has been formed comprising of the project champions for the industry funded macadamia irrigation project and the avocado nutrition and irrigation project and the SHIP project leader. The industry project champions are producers from the research and development committees of the macadamia and avocado producers associations who have responsibility for particular industry funded project areas in this case water management issues. This committee will provide direction and ensure mutually beneficial cooperation between the industry funded projects and the SHIP program. The inclusion of industry will also ensure that project outcomes are directly relevant to producers and assist in uptake of project outcomes.

The committee will also ensure that where there is no duplication of industry and SHIP research areas and that research is complementary. For example, in the avocado nutrition and irrigation project it was intended to compare whole of orchard floor watering with conventional watering at a single site due to the cost. Due to the cooperation between the industry and SHIP projects this work will be conducted at three sites, two in the Bundaberg area and one on the Atherton Tablelands.

In consultation with and assistance from the industry members of the committee two on-farm sites have been selected for both the macadamia and avocado irrigation research in the Bundaberg region.

Macadamia trial sites

One of the major problems with macadamia is that the harvest is conducted over a 4-5 month period as the nuts fall naturally from the trees. In order to maximise quality and minimise costs nuts are usually picked up mechanically from under the trees every two-three weeks. Growers

usually estimate yield from blocks by the number of harvester bins that they recover over the season this can lead to considerable error. In contrast, harvesting traditional trials with small tree plots requires considerable labour with the nuts first having to be raked out, picked-up, and then dehusked before weighing, drying and sorting. This high labour requirement has in the past limited the amount and type of research that could be conducted.

At both Bundaberg sites the growers have in the last year equipped either their mechanical harvester or their receival bin with load cells that can accurately weigh large quantities of nuts. Using this equipment will enable a greater range of treatments to be applied, as the labour component will be considerably reduced, while still maintaining accuracy. The sites also contain a range of soil types from deep sandy loams to shallow podzolics which present different water management issues. Conducting on farm trials under commercial conditions will enhance the credence of project outcomes among producers and improve the adoption of water management options identified by the project.

Avocado research sites

Avocado is a rainforest tree that has evolved in the cool, wet, 'cloud forest belt' of Central America where it is found growing in deep freely drained volcanic soils. As a consequence avocado has a high water requirement and is susceptible to water stress. Avocado however, is also susceptible to root rot caused by the fungus *Phytophthora cinamomi* which proliferates in poorly drained soils which if left unchecked rapidly kills the tree. This presents considerable water management problems for the producer who must supply adequate water for production and growth while avoiding conditions that favour the growth of the root rot fungus.

The two sites chosen for the avocado work in the Bundaberg region represent two contrasting soil types, a deep freely draining volcanic red clay (krasnozem) and a shallow sandy soil on a relatively impervious clay layer. The growers at each site have also taken contrasting approaches to water management of the crop. At the Krasnozem site the grower uses a 'whole of orchard floor' approach where under tree 'rotators' provide an even coverage of water both under the tree and across the inter-row. Using this system the grower applies water at a rate close to pan evaporation in the summer. Water use for the whole season is usually between 9-12 MgL/ha. On the shallow sandy soil the grower uses one conventional micro sprinkler per tree and waters under the tree only. This system uses approximately 6-8 MgL/ha over the season. In addition, the growers have both taken innovative approaches to orchard floor management in order to improve water infiltration and retention of rainfall. At the sandy soil site the grower has developed an orchard floor aerator which he uses to reduce compaction in the inter-row and potentially capture more of the rainfall for crop growth and reduce run off. At the sandy soil site there is a computerised packing line that will enable fruit from project tree to accurately sized and graded. This is important as fruit size is one of the major determinants of orchard profitability in avocado.

Research Program

Survey of grower water management practices

The survey has been developed in conjunction with the Bundaberg based 'Water for Profit' officer and is part of the cooperation between the adoption and research components of the RUWE initiative. This survey will be used to both guide the adoption and research programs and to 'benchmark' the impact of both projects on water management practices. The survey has already been used and refined by the 'Water for Profit' officer for a range of tree crops in the Bundaberg district.

As part of the SHIP project a survey of grower water management practices for Atherton Tableland macadamia producers has been completed and is being analysed. The Bundaberg survey is presently under way and is expected to be completed by mid August. The avocado survey will commence in September after some additional modifications to the survey have been made.

Macadamia

The project will initially concentrate on five main areas and it is expected that at least 3 of the areas will be covered at each experimental site. As these trials are being conducted under commercial conditions it may not be possible to replicate trials in a conventional manner. For example, in order to produce the microclimate modification using pulse irrigation it will be necessary to irrigate a block of several hundred trees to minimise edge effects. In this case a block of several hundred trees under pulse irrigation will be compared with an adjacent block under a conventional irrigation regime. Care will be taken to select blocks on the same soil type. While this does not provide replication the number of trees involved will provide a reasonably robust answer. Similarly when using the *Fullstop* a whole block will need to be irrigated using this as the monitoring mechanism attached to the pump control unit for the farm. Water use for the '*Fullstop*' block, expressed as water use per single tree unit, will then be compared with an adjacent block monitored by conventional means.

The five main project areas are:

1. Conversion of tree from a sprinkler to a drip based irrigation system

Within a block of macadamia an experiment has been set up to examine converting trees from a sprinkler based irrigation system to a dripper based system on a shallow soil. The project will detail any potential water savings and economic cost of conversion and will examine any potential adverse impacts on inter-row root function. If the inter-row roots are no longer irrigated are they able to survive on rainfall and will their ability to take up rainfall be compromised?

2. Partial root zone drying

A partial root zone drying trial is also being established which will utilise a sprinkler based irrigation system. In this trial a second irrigation line will be installed and every second sprinkler in the row transferred to it. This will allow alternate sprinklers to be turned off or on as required using a single tap. Sprinkler head size will also be changed from 70l per hour to 100l per hour which will result in an increase in individual sprinkler output of 43% but a reduction in overall water use of 29% with only every second sprinkler working.

3. The 'Fullstop' monitor as a method of irrigation scheduling

It is also intended to set up a block where the irrigation scheduling will be determined by using a 'Fullstop' system. Negotiations are presently under way with a grower with a Netafim irrigation controller which can be modified to accept the 'Fullstop' system.

4. Pulse irrigation

A block has been established that will examine the role pulse irrigation may play in improving yield and nut quality. Pulse irrigation involves providing small amounts of water during the morning to modify the microclimate and keep the trees photosynthesising longer. The main irrigation is applied during the early evening. This approach is used in countries such as Israel where crops such as avocado are grown in 'stressful' environments.

5. Orchard floor aeration to improve infiltration and maximise precipitation capture

An experiment is being set up to examine the impact of orchard floor aeration on water infiltration. The harvesting method used in macadamia results in the severe compaction of the soil surface under the tree, which markedly reduces the rate of water infiltration. While this has implications for the type of irrigation system used it also has an impact of the ability of the soil to absorb rainfall. Runoff in macadamia orchards can be high when the rate of precipitation exceeds the rate of water infiltration. This experiment will examine whether a recently developed orchard floor aerator can reduce the level of compaction and aid infiltration of both irrigation and rainfall and thus improve water use efficiency.

Avocado

It is expected that the partial root zone drying, the whole of orchard floor watering and the pulse irrigation will be conducted at both sites. The major concern is that neither grower has an irrigation controller capable of incorporating the 'Fullstop' irrigation monitor. Due to the large size of trees and the need to modify microclimates it may not be possible to replicate trials in a conventional manner to compensate larger numbers of trees will be used for each treatment and care will be taken to ensure soil types are consistent.

The project will concentrate on four main areas:

1. Whole of orchard floor watering

A trial is being established comparing conventional micro-sprinklers with under tree rotators that water the entire orchard floor. Whilst this will increase water consumption there is some evidence that the additional water reduces stress within the tree and results in larger fruit which is one of the major determinants of orchard profitability.

2. Partial root zone drying

A partial root zone drying experiment is also being set up similar to that outlined for macadamia. However, there is some concern after discussions with Dr David Turner, University of Western Australia, who conducted a partial root zone drying experiment in potted trees, where severe stress resulted in the formation of permanent tyloses in the xylem. These tyloses permanently blocked water movement even after rewatering and Dr Turner believes they may have the potential to reduce growth and yield for several years until sufficient new xylem vessels are formed.

3. Pulse irrigation

A trial will be established to examine the role pulse irrigation may play in improving yield and fruit quality. Pulse irrigation involves providing small amounts of water during the morning to modify the microclimate and thus keep the trees photosynthesising longer. The main irrigation is applied during the early evening. This approach is used in countries such as Israel where crops such as avocado are grown in atmospherically 'stressful' environments. Pulse irrigation under these conditions results in larger fruit which has a major impact on farm profitability. The ability to produce fruit of the size required by markets such as the US and Canada will be vital if Australia is to develop an export industry.

4. The 'Fullstop' monitor as a method of irrigation scheduling

The project is still searching for a suitable site to manage a block of trees using the *Fullstop* irrigation system. At the moment no suitable irrigation controller can be found. If a suitable controller cannot be found then a smaller experiment may be conducted that which will involve a *Fullstop* system as part of the rotator experiment. Control will be determined manually

Linkages

Links have been established with Dr David Turner, University of Western Australia, who has recently supervised a PhD student examining water use efficiency in avocado. Dr Turner has agreed to assist the project by providing input into experimental design. Dr Turner may also be a potential candidate to bring to Queensland to provide input into the project as outlined in the original project submission.

Outcomes

The Bundaberg avocado trial site was visited in early June by 320 delegates attending the Australia /New Zealand Avocado Conference. During the visit a summary of the proposed research program was outlined to producers at the field site. A poster was also presented at the conference (see attached file). Feedback from the delegates was very positive with considerable interest shown by Queensland producers. A request was made by members of the New Zealand Avocado Growers Association to present project outcomes at the next conference as they felt the information would have relevance to their situation.