Evaluation of deficit irrigation techniques in raspberry grown under cover

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Introduction

Climate change predictions of decreased rainfall and new water use guidelines have led to significant research into improving crop water use efficiency (WUE) without extensive losses in yield. The default technique to reduce water use is deficit irrigation (DI) which involves reduced irrigation with increased monitoring of soil moisture to prevent excessive drought. Partial rootzone drying (PRD), where irrigation is applied alternately to different parts of the root system (e.g. Dry et al. 1996), leads to reductions in water use due to drought signals from the dry portion of the roots closing stomata. PRD has been successfully applied to several crops including grape vine, but there are several reports of PRD failing to achieve benefits in some systems. Working with raspberry (cv. Glen Ample) our objectives are to:

- **evaluate potential water savings through PRD/DI**
- **to optimize application of these methods**

Figure 1. Glen Ample growing in our tunnel

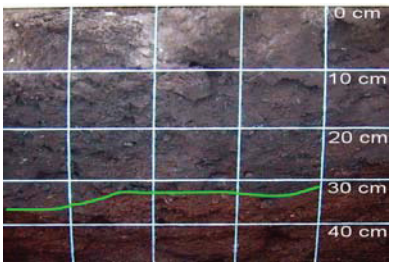

Figure 2. Soil profile of polytunnel

Methods

Experiments were carried out at SCRI in a polythene tunnel. The soil in the polytunnel is sand 71%, silt 19%, clay 10% (field capacity 27%) over a coarse sand/gravel layer that begins at 30-40 cm depth (Figure 2). In light of the results from PRD experiments in 2005 and 2006, irrigation treatments in 2007 were 100% Control, 50% DI (50% of water applied to control) and 0% DI, abbreviated as 100, 50 and 0. Water was applied to control plots based on keeping the soil at, or close to field capacity while minimizing drainage into the subsoil. Soil moisture was monitored using a PR1 Profile Probe (Delta-T, Cambridge). Irrigation was with drip emitters of different flow rates (Netafim, Tel Aviv, Israel). Stomatal conductance was measured using an AP4 porometer (Delta-T, Cambridge).

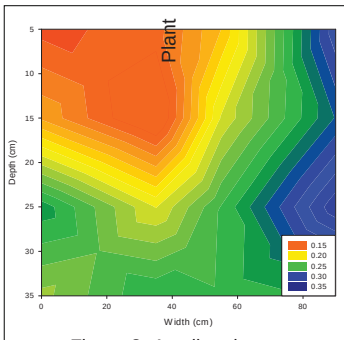

Figure 3. A soil moisture profile of a PRD plot

PRD results (2005, 2006)

- PRD has no advantage over RDI in terms of water use and yield in our soil
- plant drought response was best predicted by the moisture in the top 5cm of soil
- keeping this top layer of soil moist is important to prevent excessive stress and ensure maximum yields

Deficit irrigation treatments 2007

The irrigation treatments applied this season resulted in soil moisture levels that would be associated with negligible water stress in plants grown under the 100% treatment and significant stress in the 0% treatment (Table 1).

Table 1. Irrigation treatments, soil water content, water potential and water stress

Treatment	Soil water content (m3/m3)	Irrigation/day/ plant (L)	Soil water potential (bar)	Water stress?
100%	0.27	0.9-1.3	0.27	NO
50%	0.23	0.4-0.65	0.91	MILD
0%	0.18	0*	4.1	YES

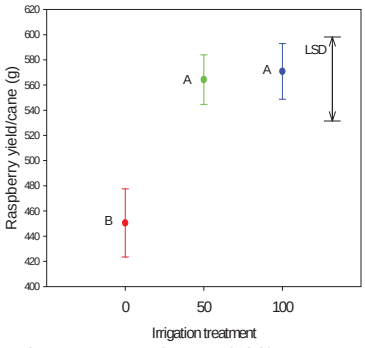

Figure 4. Raspberry yield/cane

Yield 2007

- No difference in total yield/cane between 50% and 100% treatments, but significant reduction in 0% plots (Figure 4)
- Berry size tended to be greater in 50 and 100% plots, although these differences were small (Figure 5)
- Yield reduction associated with the 0% treatment was more through reduced berry production rather than smaller berries (Figures 4,5)
- There was no difference in cane weights between treatments, although growth of new shoots was inhibited in 0% plots as one would expect

Figure 6. A bumblebee hard at work

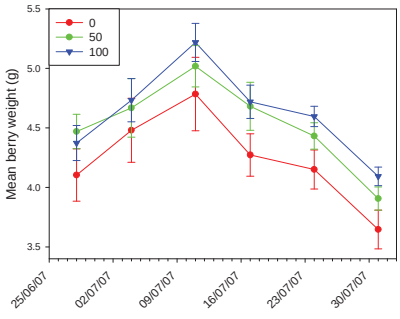

Figure 5. Mean berry weight at each harvest

Conclusions

- In all years there were no benefits to yield or yield quality in keeping the soil moisture close to field capacity throughout the rootzone
- Analysis of moisture conditions and plot soil depth revealed that berry size tended to be slightly larger in plots with slightly elevated moisture or deeper soil
- Plants in 0% treatment produced berries of similar weight to those in the other treatments, but fewer
- Although the yield loss in 0% plots was not extreme, effects on new cane growth were dire
- Introduction of pollinators prior to flowering improved berry quality in early harvests

References

Dry, P.R., Loveys B.R. Botting, D., During, H. 1996. Effects of partial root-zone drying on grapevine vigor, yield, composition of fruit and use of water. Proceedings of the 9th Australian Wine Industry Technical Conference. p 126-131

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