

Technical Case Study – Ref 5.1.1c

Comparison of actual irrigation water used by HN Pieterse Farming on lemons, versus standard practice and the Netafim™ uSchedule® software program - 2013 to 2016

The objectives of this case study were to compare the actual volumes of irrigation water used by HN Pieterse Farming in Groblersdal on citrus after installation of RainBox (also referred to as Agriwater's Water Treatment Technology) with standard irrigation practice of other citrus growers in the area and with recommendations of a standard irrigation scheduling program. Three-year-old lemons under drip irrigation on orchards 8 - 12 were the study crop in this instance.

Given that all the data for the uSchedule® program had been in use at HN Pieterse Farming for some years and was up to date – the uSchedule® program was used as a standard. The Netafim™ uSchedule® program is a unique and effective irrigation scheduling program and takes into account many different aspects of soil, crop, irrigation and evaporation parameters etc..

After the installation of a RainBox in 2013, HN Pieterse Farming recorded conservative water savings of some 30%. These estimated water savings were based on comparisons with other top citrus producers in the area, with similar aged orchards and varieties, on similar soil types, with similar yields and quality. Prior irrigation records, records of actual usage versus standard irrigation practice and that recommended by the Netafim™ uSchedule® program showed even greater water savings.

What was very notable was that actual water usage in these orchards and others, were far below that theoretically recommended by uSchedule®. See uSchedule® (Fig. 1 below) for lemon orchards 8 - 12, planted in 2013 and measured on 25 May 2016. For moderate evaporation, the recommendation was 2 pulses of 1.7 hours = 3.4 hours per tree per day.

Figure 1. Netafim™ uSchedule® recommendations

Netafim South Africa
uSchedule
Version: 2.07



Name: 8 tot 12 25-May-16 Date printed Orchards Crop Type
Crop: Suurlemoene 2013 Date planted 60 % Crop coverage
Age of orchard (printed year) 3 Years - 2.1 Hours Irrigation time (theoretical)
Application rate (ℓ/h/tree) 7.6 Efficiency reduction 8.0 ℓ/h/tree (Total) 95% Total Efficiency

ETo - Evaporation		Litres		Tree Requirement per Day		Irrigation Schedule at: 100% of tree potential. K _v = 0.29					
mm/day	Description	- 100%	Time			Days	Pulses	Time		Actual	mm/day
1.5	Early Spring	6.5	51.2 Minutes			2	1	1.7	Hours	40%	0.36
2.5	Cool	12.9	1.7 Hours			1	1	1.7	Hours	40%	0.72
5.0	Moderate	25.9	3.4 Hours			1	2	1.7	Hours	40%	1.44
7.5	Warm	38.8	5.1 Hours			1	2	2.6	Hours	61% H	2.16
10.0	Heat Wave	51.8	6.8 Hours			1	3	2.3	Hours	54%	2.88
>10	Extreme Heat	71.2	9.4 Hours			1	4	2.3	Hours	56%	3.96

Note: In dry regions also irrigate evergreen trees during winter months.

Type of system	Drip	Method	Strip	A.W.C. 'Per depth'	90	mm/m		
System flow rate (water meter)	4.4	m ³ /h/ha	Lat./crop row	1.0	#	Allowable depletion	50	%
Emitter flow rate: Total	1.60	ℓ/h	Wetted strip	0.60	m	Less Rock (stones)	67	%
Only applicable for Micro + Strip	n/a	-	Wetted area	10.0	%	Effective root depth	0.60	m
Only applicable for Micro + Strip	n/a	-	Leaching	0	%	P.A.W. (root depth)	8.91	mm
System Efficiency	95	%	Emitters/tree	5.0	#	Actual rate 'WET'	4.2	mm/h

Emitter spacing	0.60	m	by Rows	6.00	m	=	Number of Emitters	2,778	#/ha
Plant spacing	3.00	m	by Rows	6.00	m	=	Number of Trees	556	#/ha

However - in comparison and based on years of experience, use of uSchedule® as a base template, monitoring of DFM probe water withdrawals at various root depths up to 80 cm, use of profile pits to evaluate water infiltration and root development - ***HN Pieterse Farming only irrigated 2 hours every three days. This was the standard practice on these lemon orchards for this time of the year.***

Thus, uSchedule® recommended a theoretical 23.8 hours of irrigation per week versus the actual 4.7 hours per week applied. That represented an 80% saving on the recommendation. This had been happening since the installation of the RainBox units.

If one looks at the theoretical volume of water recommended by uSchedule®, 25.9 ℓ was recommended per tree per day which is equivalent to 181 ℓ/tree/week for 95% efficiency. This is a bit more than standard industry norms for these three-year-old lemon orchards at $18.3 \times 7 = 128 \text{ ℓ/tree/week}$ ($18\text{-}25 \text{ ℓ/tree/day} \times 0.85$ irrigation factor for Groblersdal in May). However, in some areas three-year-old lemon orchards received 200-230 ℓ/tree/week, so these figures are for comparative purposes only. Note that these standard figures exclude the effects of blocked drippers and uneven irrigation delivery. ***In comparison to the 181 ℓ recommended per tree per week - HN Pieterse Farming used only 36 ℓ per tree per week at this time of the year. They now also had uniform irrigation delivery with no more blocked drippers.***

The same trend was observed for each season and evaporation potential – far lower water usage as compared to theoretical uSchedule® recommendations, standard irrigation norms in the Groblersdal area and other local top producers on similar soils and orchard age.

Note that these types of water savings are not isolated to HN Pieterse Farming, but have been recorded on many orchards and pivots in South Africa. ***See the Agriwater Case Study Ref 5.1.5 - Patensie Citrus (Ripple Hill Farm),*** over the 2013/2014/2015 citrus seasons. Various varieties were monitored by an independent consultant. Water usage on 8 - 15 year old citrus orchards decreased from an average of 300 ℓ/tree/week to <140 ℓ/tree/week between July 2014 and November 2014, and even less over the summer of 2015.

When presented with these types of verified facts, one must ask the question - Why and how does HN Pieterse Farming apply so little water?

As reported in the Landbouweekblad of 23 October 2015 (Limpopo Young Farmer of the Year article Ref 5.2.4), Christoff Smit of HN Pieterse Farming realised that many traditional methods were no longer working on the farm - they were farming in soil, and the soil was the factory in which they produced crops. Therefore they wanted to restore soil life and condition, and optimum soil productivity. They started with various soil amendments as well as Dagut Science® products. One of their objectives was to have deeper feeder roots and good water withdrawals at 20, 40, 60 and 80 cm. The new soil management approach and products used showed improvements in soil health and productivity, but they still battled to get water withdrawals deeper than 10-20 cm. All types of irrigation scheduling and soil amelioration were used to get water withdrawals deeper down the soil profile, but nothing really seemed to make a notable difference. After installation of the RainBox, they started to observe water withdrawals at 30, 40 and then 60 cm.

To illustrate this standard trend, see Fig. 2 clearly showing the water withdrawals at each measured depth, for the 2014/2015 season on these same lemon orchards. Soils were being aerated, compaction reduced, infiltration improved and water holding capacity improved. Given these observations, the frequency and duration of irrigations were reduced far below that recommended by uSchedule®, or other standard irrigation recommendations.

Previously water withdrawals or “steps” were only visible at 10 and sometimes 20 cm. This meant roots were only really active and drawing water in the day, down to 10-20 cm. Deeper levels had little root activity and the graph level lines >20 cm were straight with no evidence of daily water withdrawals. The soil moisture content only showed the irrigation event as a peak on the graph, which gradually subsided with no steps. When viewed on a daily basis – this was not good at all and indicated poor infiltration, compaction etc.. This was confirmed by

constant monitoring of many profile pits. Shortly after installation of the RainBox, water withdrawals were observed at 20, then 40, then 60 cm as can be clearly seen in Fig. 2 below.

Figure 2. DFM probe utilities measurements showing water withdrawals at 20, 40 & 60 cm – Block 11 Lemons



These DFM probe readings for lemons in Block 11 clearly demonstrated the positive effects in soil aeration and water infiltration after installation of the RainBox. Similar readings for all blocks of citrus and grapes on HN Pieterse Farming show exactly the same trend and every pumphouse of HN Pieterse Farming now has RainBox's installed.

These water savings have implications on pump hours and electricity savings, and the question regarding reduced pump hours and electricity usage must also be asked. Given a conservative estimate of 30% water saving (never mind the 80% savings versus uSchedule®), this would also equate to at least a 30% decrease in pump hours and electricity costs. Likewise it would be much quicker to irrigate all the lands and handle any water emergencies, therefore reducing risk. On top of this the irrigation system was now clean, so pressure at key points was reduced and flow rates increased, and uniform water and fertiliser distribution were achieved.

Other cost savings of cleaner irrigations systems included reduced labour and maintenance costs, and a lower frequency of filter cleaning and backwashing. These facts are reported in Agriwater Case Study Ref 5.1.1a.

Lastly, the reality of being able to farm and utilize an extra 40 cm of soil depth with the correlated deeper root growth, meant that HN Pieterse Farming was effectively farming in an extra 4000 m³/ha of soil in this example. In simple terms, HN Pieterse Farming was now farming in three times the volume of soil as before, and this had a very positive impact on crop resilience and potential, and reduced production risk could be speculated.

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