
Technical Case Study – Ref 5.1.10

Effects of Agriwater's Water Treatment Technology on grapes at Rooiland Farm (2007–2011)

Rooiland Farm in Upington was one of the farms co-owned and managed by Flip de Bruyn. Apart from other crops such as alfalfa, wine and raisin grapes, Rooiland had 70 hectares of various varieties of seedless white, red and black table grapes. Irrigation water was supplied from the Orange River. Soils were Kimberley/Plooysburg types with a very sandy red apedal B horizon (7–12% clay) and calcium (Ca) and magnesium (Mg) concretions at a depth of about 30 cm. There were numerous production problems at Rooiland: soil base saturations of Mg were high, compaction and water infiltration poor – thus plant and root growth was adversely affected and uneven with high production costs.

This case study follows the sequence of events and improvements on a twelve-hectare block of drip-irrigated Thompson and Flame seedless table grapes from 2007 to 2011. A RainBox was installed on this block in August 2007 and all changes were measured.

History before the installation of the RainBox

Prior to 2007, the most advanced forms of crop and soil assessments had been in use to try and manage soil health and manipulate optimal root and plant growth. This included probes, irrigation scheduling technology, leaf & sap analysis, brix test, soil-profile pits, Brookside Soil Fertility tests (S007) etc.. Many biological practices such as composts, humics and fulvics, along with soil amendments (gypsum) and various nematode control methods had also been adopted. Although there was a response, it was not really notable and fertiliser costs climbed, while soil compaction remained a huge challenge. Irrigation scheduling was made especially difficult due to blocked drippers, poor water infiltration and continually wet soils. Tractors carrying out routine duties between rows on these wet soils only increased soil compaction. The standard practice to reduce compaction was ripping in alternate rows every two years. This also didn't have any lasting positive effect on root and plant development.

The other notable challenge was soil fertility. High Mg levels of 30–32% contributed to compaction, infiltration problems and the availability of other minerals. Despite many attempts, no soil treatments could be found to effectively reduce the Mg levels. As per the Brookside Soil Fertility tests (S007), available phosphate (P) levels were 25–35 ppm (Bray I) and potassium (K) 80–90 ppm. No matter how much P or K were applied through fertilisers – it remained difficult to raise these levels and the availability of minerals. Related costs and production were negatively affected.

Both the soil compaction and fertility issues also negatively impacted soil microbial life and thus soil health. There had been no earthworms present in these soils for years.

Lastly, water quality was occasionally poor and blocked & dirty irrigation systems were costly and time consuming practises on the farm. The effects of blocked or clogged drippers and micros were very evident in the unevenness of the vineyards and water run-off. Depending of the delivery of water through each dripper, the vines received varying volumes of water and fertiliser resulting in uneven growth. This further complicated viticulture management practices and timing of chemical sprays.

Rooiland had specific primary objectives:

- Reduce compaction and improve soil aeration levels.
- Improve soil fertility & health and water infiltration down the soil profile, thereby increasing rooting depth and the volume of soil in which to farm.
- Return earthworm activity in the soil.
- Clean the irrigation system in a safe, yet cost-effective manner and ensure optimal use of irrigation water.
- Yields, pack-outs and profitability would hopefully be increased as a result of the above.

Given primary benefits of the RainBox as optimised water quality, clean irrigation systems, uniform irrigation distribution and aerated soils, with secondary benefits listed as improved soil microbial activity and soil respiration, better root and crop development and more uniform, resilient and healthier crops – all appeared to fit in with the Rooiland objectives.

The RainBox was installed in August 2007 and changes were monitored. The information below was supplied by Rooiland as per farm records, practices and procedures.

Table 1. Summary of changes on Rooiland grapes after the installation of the RainBox

	Before Agriwater Treatment	After Agriwater Treatment
Labour reductions per 12 hectare block of grapes	Always used 6–8 labourers to unblock and fix drippers, flush lines and check leaks. Had continues problems with blocked drippers.	Within 3 months only 1 labourer was required. The labourer now only flushed the lines and fixed the leaks. The drippers were now clean.
Sand filters/backwash	Used to backwash every hour for two minutes per filter. An eight filter bank was used which resulted in a loss of 16 minutes every hour of irrigation.	Only backwashed every four hours for 40 seconds. This equates to 320 seconds every 4 hours or 80 seconds every hour. Backwashing time was reduced from 16 minutes to ± 1 minute 20 seconds per hour.
Electricity use	Measured in kW hours at one pump-station for periods 1 August – 31 July each year, from before 2007 until 2009, thus measurements were taken before and after.	Electricity use showed a 22% reduction in kW hours from 2007 to 31 July 2009. This was linked to the cleaning of the irrigation system, improved flow rates, uniform delivery, less backwash times and improvements in the soil.
Water usage	16 minutes of every hour was used to backwash the filters. Thus, only 44 minutes was utilised for irrigation per hour.	Only 1 minute 20 seconds of every hour was now used to backwash the filters. Therefore, ± 58 minutes were now utilised for irrigation per hour, making it easier and quicker to irrigate each block.

Irrigation lines and general condition of drippers/micros	The main and sub lines required constant flushing every two weeks, dripper/micro maintenance and effective uniform water delivery was a constant challenge.	Flushing of lines was still the same but drippers/micros and lines were now clean and subsequent damage reduced, lifespan increased as well as water delivery more uniform.
Cleaning and flushing chemicals used	The lines were flushed with 100 ppm peroxide every two months during summer.	The continuous use of only 1–2 ppm of peroxide automatically delivered through the RainBox cleaned the lines completely and was much more cost- effective.
Soil Mg levels	Previously the soil %Mg was 30–32%	Afterwards the soil %Mg was 20–24%. This occurred within three years.
Soil P levels (Bray)	Previously the soil P was 25–35 ppm.	Afterwards the soil P was 75–90 ppm. This occurred within three years.
Soil K levels	Previously the soil K was 80–90 ppm.	Afterwards the soil K was 170–190 ppm. This occurred within three years.
Fertiliser inputs	N was 120–140 kg/ha, P was 30–40kg/ha and K was 90–120 kg/ha.	N was 40 kg/ha for white varieties and 60 kg/ha for red varieties, P was 5–10 kg/ha and K was 30–45 kg/ha within three years.
Soil micro-life and structure	No earthworms were seen for years. Calcium and magnesium carbonate concretions >30 cm were obstructive. Soil aeration, structure and water holding capacity were poor.	Earthworms started to appear within 6 months of installation of the RainBox. Soil concretions broke up and the structure, aggregate stability and water holding capacity improved in the aerated soils.
Root depth	30–40 cm	>90 cm after 12 months of treatment.
Vineyard characteristics	Vineyards were susceptible to weather extremes and growth was variable.	Vineyards were more resilient with weather extremes, growth was more uniform and more vigorous with lower fertiliser inputs.
Yield	Yield variation of 15–20% was common between blocks. This was due to uneven growth and poor, shallow root development.	Variation between blocks decreased to 5–7% due to even growth across production blocks and deeper root systems.

All of these benefits resulted in reduced production risks with cost savings, improved production, more uniform vineyards, better yields and higher profitability. The cost savings are summarised in Table 2 below.

Table 2. Production cost savings with the RainBox

MEASURED FROM 2007 TO 2011 ON 70 HECTARES OF GRAPES AT ROOILAND		
	hectare/annum	hectare/month
DIRECT SAVINGS		
50% Labour savings (irrigation labourers)	R 7 740,00	R 645,00
Capital cost of dripper replacement	R 1 000,00	R 83,33
22% saving in electricity costs	R 660,00	R 55,00
Savings in water use costs	R 140,00	R 11,67
Reduced replacement & maintenance costs of system	R 250,00	R 20,83
No costs of system Cl/Peroxide clean up	R 924,00	R 77,00
TOTAL DIRECT SAVINGS	R 10 714,00	R 892,83
INDIRECT SAVINGS		
Benefits of uniform fertilisation at 5% of costs	R 600,00	R 50,00
Benefits of mineral interactions in water and soil at 10% of costs	R 1 200,00	R 100,00
Benefits of improved crop uniformity as 5% of turnover	R 5 000,00	R 416,67
TOTAL INDIRECT SAVINGS	R 6 800,00	R 566,67
TOTAL COST SAVINGS	R 17 514,00	R 1 459,50



Soil and vineyard improvements after the RainBox Installation

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