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Technical Case Study – Ref 5.1.1d

Improvements in water infiltration and rooting depth of Bloempoort Delta Valencias at HN Pieterse Farming - 2013 to 2016

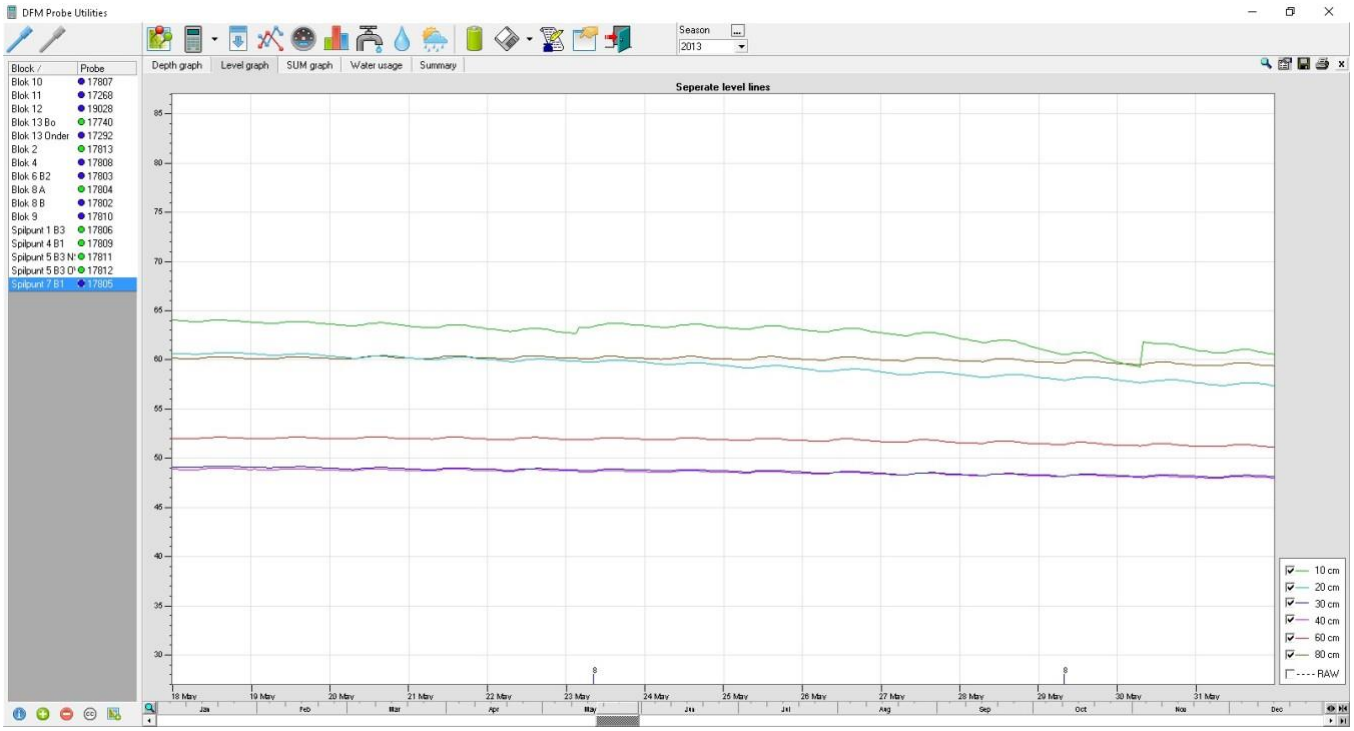
Land S7 was a block of Delta Valencias on the Bloempoort farm of HN Pieterse Farming in Groblersdal, irrigated by centre pivot at 8mm/rotation. One of the challenges on these Glenrosa type heavier clay soils, was getting water infiltration and active roots past 10 cm in depth. In spite of the use of gypsum and calcitic lime, normal liquid fertilisers, fulvic and humic acids, and various biological products, numerous advisors on soil chemistry and water scheduling – the situation did not improve much. Soil profile pits showed limited root growth, water penetration below 10 cm was slow and the soils remained saturated down the profile. The soils were high clays and there appeared to be a compaction layer below 10 cm.

Therefore one of the HN Pieterse Farming objectives was to have deeper feeder roots, better infiltration and good water withdrawals at 20, 40, 60 and 80 cm. Therefore a probe was installed on this land on 10 May 2013, to monitor effects. All types of irrigation scheduling and soil amelioration had previously been used to get water withdrawals deeper down the soil profile. Nothing really seemed to make a notable difference.

The focus of this case study was to show how water infiltration, daily transpiration cycles and effective rooting depth improved after installation of the RainBox on Block S7. All information was supplied by Christoff Smit, as per HN Pieterse Farming records, practices and procedures.

Fig. 1 from 18 – 31 May 2013 showed the typical trend for this land – hardly any water withdrawals at 10 cm, little evidence of transpiration cycles (steps) and limited root activity at 10 cm depth. No evidence of water withdrawals were seen below 10 cm. All the other level lines deeper down the profile stayed fairly constant despite irrigations, which meant that S7 at 20–80 cm remained at the same water contents, and somewhat saturated. Furthermore, limited leaching if any, occurred. This was typical of these and other lands on this farm. The green and blue lines (10 and 20 cm) remained at 57-65% moisture content, while 80 cm also remained constant at around 60 % moisture. Note that soil moisture content as measured by the probes at each depth varied depending on various soil factors at each level - texture, aggregate structure etc.. Over time one would aim to achieve uniform transpiration cycles as evidenced by uniform steps at each level. These would hopefully correlate with lower moisture contents per level, as one went deeper down the soil profile, although this depends very much on the soil factors.

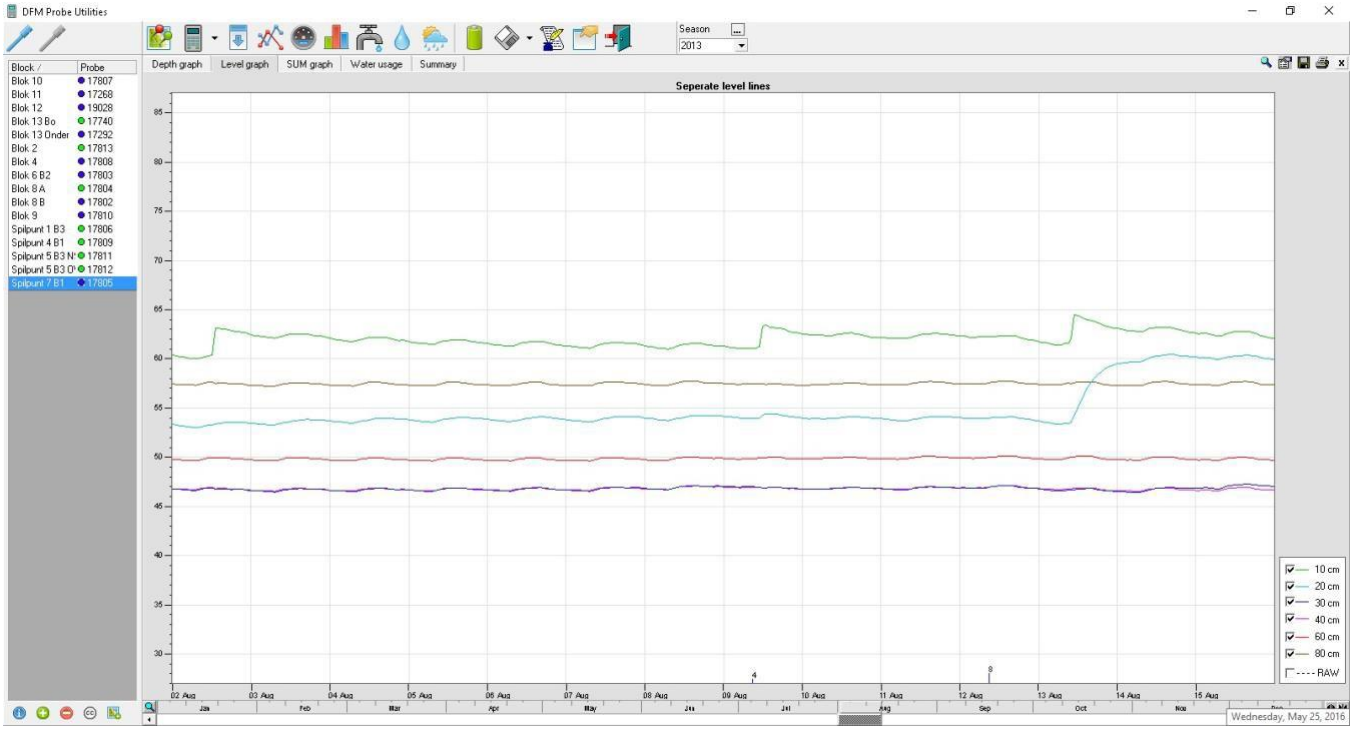
Figure 1. DFM level graph on S7 from 18 – 31 May 2013 before Agriwater installation



10 cm	20 cm	30 cm	40 cm	60 cm	80 cm

At the end of July 2013, the first RainBox was installed on S7. Almost immediately slight improvements in transpiration cycles, water withdrawals and root activity could be seen at 10 and 20 cm. This was due to better aeration and feeder roots extracting water and nutrients more efficiently at 20 cm. See the green and blue lines in Fig. 2 below.

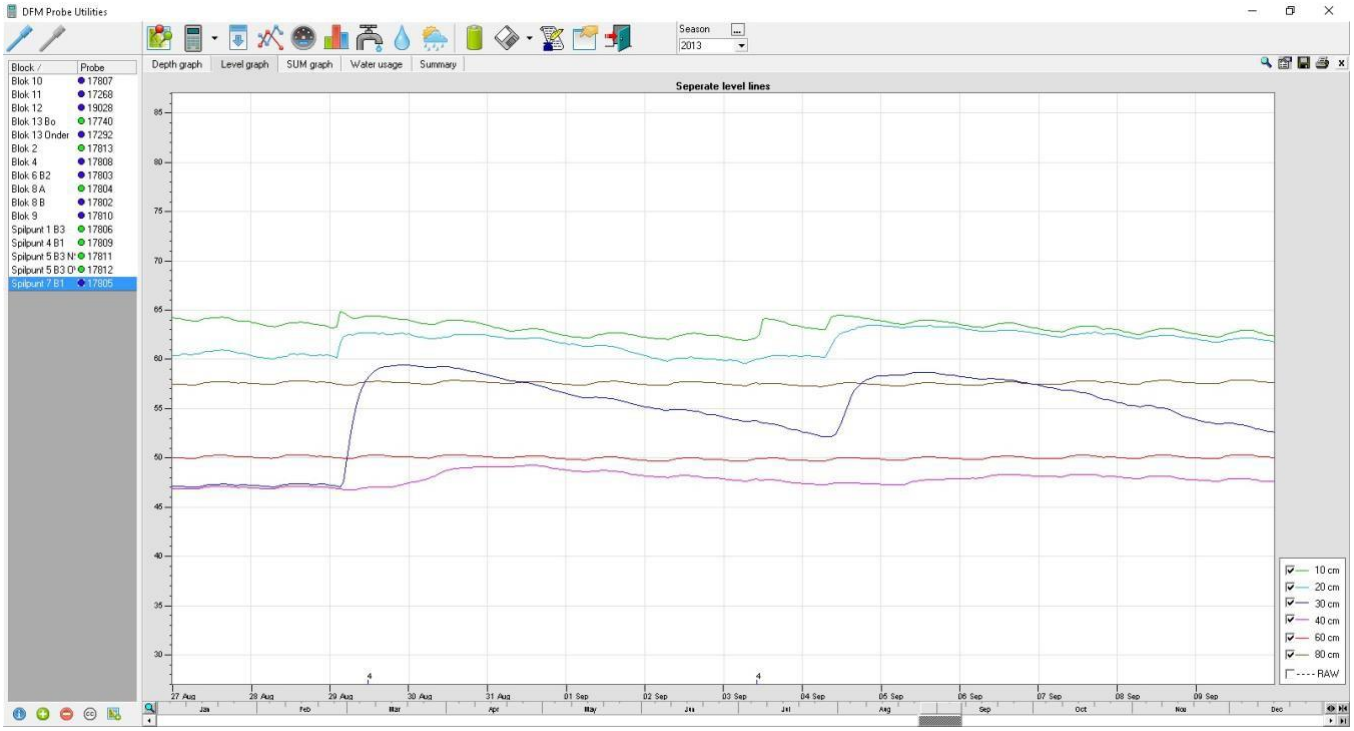
Figure 2. DFM level graph on S7 from 2 – 15 August 2013 after Agriwater installation



10 cm	20 cm	30 cm	40 cm	60 cm	80 cm

The same trend was even more notable by September (Fig. 3) with steps more pronounced at 10 and 20 cm, and the previous flat lines (dark blue) at 30 cm clearly showing the irrigation cycle. The irrigation cycle was also evident at 40 cm (purple) for the first time ever. Note that this was not a function of increased heat units in August and September – it had previously not been possible to get water withdrawals deeper down the profile, regardless of season. The infiltration on these Glenrosa soils was previously very slow and level lines at all depths remained flat (See Fig.1), thus evidence of these irrigation events at 30 & 40 cm one month after Agriwater installation was very significant.

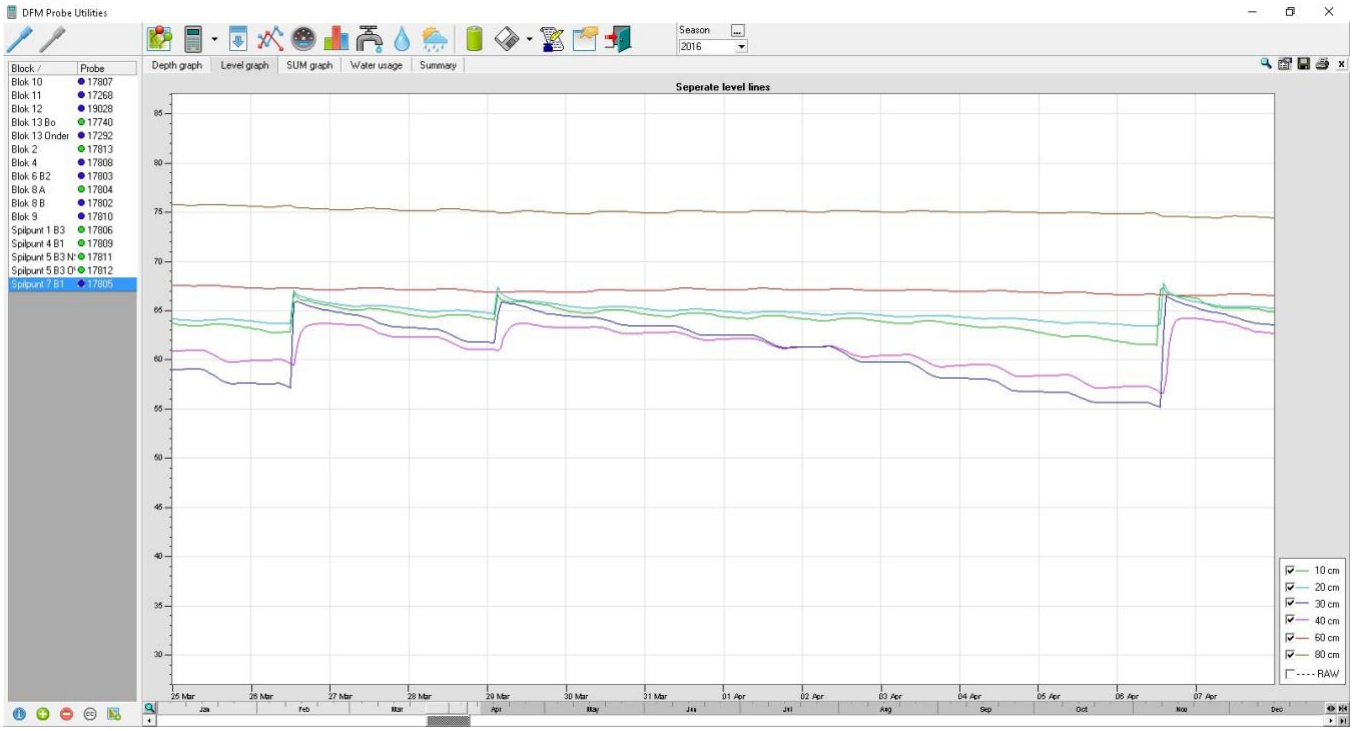
Figure 3. DFM level graph on S7 from 27 August – 9 September 2013 after Agriwater installation



10 cm	20 cm	30 cm	40 cm	60 cm	80 cm

In comparing Fig. 1, 2 & 3 the improvements in both daily transpiration cycles and active rooting depth were clearly evident. The same trend continued over time, with transpiration cycles being more evident down the soil profile. By 2014 daily cycles and movement at 40 cm (purple) were clearly visible and this was still the same in 2016 (Fig. 4). Probes in other orchards with similar soil problems recorded daily transpiration cycles that moved progressively down from 10 cm to >60 cm over time, while others moved from 10 cm to 80 cm.

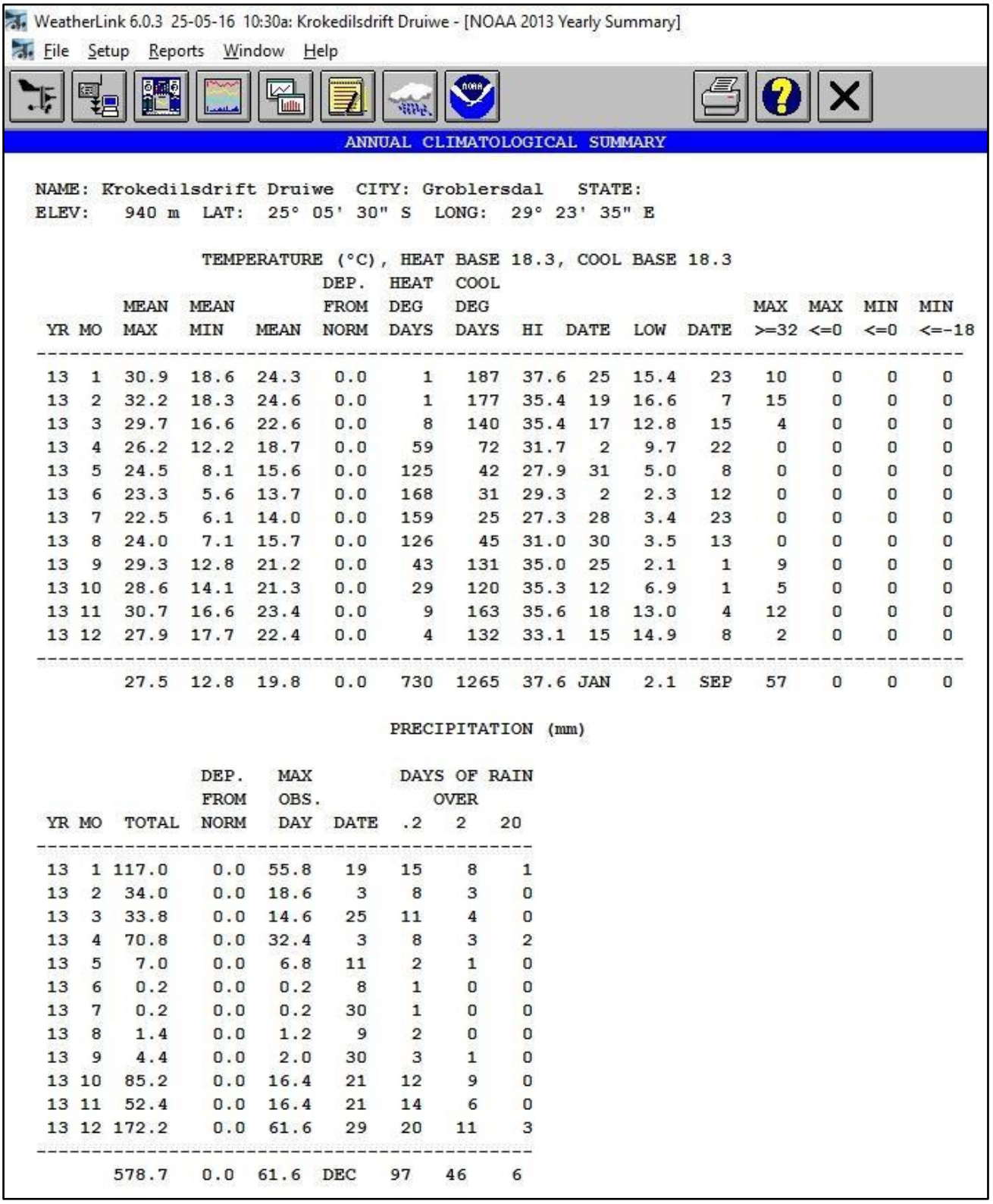
Figure 4. DFM level graph on S7 from 25 March – 7 April 2016 after Agriwater installation



10 cm	20 cm	30 cm	40 cm	60 cm	80 cm

Fig. 5 below shows weather data from Krokodilsdrift in Groblersdal, which gives an indicator of weather parameters over the 2013 period. Although May to August are the colder periods in Groblersdal with average temperatures of 13.7 to 15.7°C, the maximum temperatures were 27.3 to 31°C, and there should have still been clear daily transpiration cycles evident at this time. There was also limited rainfall over this period.

Figure 5. Groblersdal weather data for 2013



WeatherLink 6.0.3 25-05-16 10:30a: Krokedilsdrift Druiwe - [NOAA 2013 Yearly Summary]

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ANNUAL CLIMATOLOGICAL SUMMARY

NAME: Krokedilsdrift Druiwe CITY: Groblersdal STATE:
ELEV: 940 m LAT: 25° 05' 30" S LONG: 29° 23' 35" E

TEMPERATURE (°C), HEAT BASE 18.3, COOL BASE 18.3

YR	MO	MEAN MAX	MEAN MIN	MEAN	DEP. FROM NORM	HEAT DEG DAYS	COOL DEG DAYS	HI	DATE	LOW	DATE	MAX >=32	MAX <=0	MIN <=0	MIN <=-18
13	1	30.9	18.6	24.3	0.0	1	187	37.6	25	15.4	23	10	0	0	0
13	2	32.2	18.3	24.6	0.0	1	177	35.4	19	16.6	7	15	0	0	0
13	3	29.7	16.6	22.6	0.0	8	140	35.4	17	12.8	15	4	0	0	0
13	4	26.2	12.2	18.7	0.0	59	72	31.7	2	9.7	22	0	0	0	0
13	5	24.5	8.1	15.6	0.0	125	42	27.9	31	5.0	8	0	0	0	0
13	6	23.3	5.6	13.7	0.0	168	31	29.3	2	2.3	12	0	0	0	0
13	7	22.5	6.1	14.0	0.0	159	25	27.3	28	3.4	23	0	0	0	0
13	8	24.0	7.1	15.7	0.0	126	45	31.0	30	3.5	13	0	0	0	0
13	9	29.3	12.8	21.2	0.0	43	131	35.0	25	2.1	1	9	0	0	0
13	10	28.6	14.1	21.3	0.0	29	120	35.3	12	6.9	1	5	0	0	0
13	11	30.7	16.6	23.4	0.0	9	163	35.6	18	13.0	4	12	0	0	0
13	12	27.9	17.7	22.4	0.0	4	132	33.1	15	14.9	8	2	0	0	0
		27.5	12.8	19.8	0.0	730	1265	37.6	JAN	2.1	SEP	57	0	0	0

PRECIPITATION (mm)

YR	MO	TOTAL	DEP. FROM NORM	MAX OBS. DAY	DATE	DAYS OF RAIN OVER .2	OVER 2	OVER 20
13	1	117.0	0.0	55.8	19	15	8	1
13	2	34.0	0.0	18.6	3	8	3	0
13	3	33.8	0.0	14.6	25	11	4	0
13	4	70.8	0.0	32.4	3	8	3	2
13	5	7.0	0.0	6.8	11	2	1	0
13	6	0.2	0.0	0.2	8	1	0	0
13	7	0.2	0.0	0.2	30	1	0	0
13	8	1.4	0.0	1.2	9	2	0	0
13	9	4.4	0.0	2.0	30	3	1	0
13	10	85.2	0.0	16.4	21	12	9	0
13	11	52.4	0.0	16.4	21	14	6	0
13	12	172.2	0.0	61.6	29	20	11	3
		578.7	0.0	61.6	DEC	97	46	6

It could be argued that the 1st probe readings on S7 were done in May/June when transpiration levels were lower and thus explains the minimal transpiration activity or steps. This is simply not true, as well aerated soils with good rooting depth and activity will still show clear evidence of transpiration cycles (steps) at this time of year in this milder winter area. To illustrate this point, see the observations after more RainBoxes were installed and Fig. 6 below from Lemons in Block 11 in May 2015. This was once again a classic portrayal of how Agriwater Water Treatment Technology improved soil and aeration and subsequently water infiltration and rooting depths, with clear steps evident in May 2015, during the colder period.

Figure 6. DFM level graph on Lemons in Block 11 from 7 – 28 May 2015 after Agriwater installation

10 cm	20 cm	30 cm	40 cm	60 cm	80 cm

Given the evidence provided by S7, and also seen with every subsequent installation of a RainBox – improvements in water infiltration, daily transpiration cycles and effective rooting depth were clearly demonstrated.

Given these results plus reduced water usage, cleaning of irrigation systems, labour and cost savings (all documented in Agriwater Case Study Ref 5.1.1a & c), every land owned by HN Pieterse Farming now has RainBoxes installed.

Some other notable benefits were:

- Given roots down to 60 cm, they were now effectively farming in another 40-50 cm of soil or an extra 4000-5000 m^3 of soil per ha. Thus the vertical volume farmed was literally trebled.
- Given this extra volume of soil in which to farm and deeper root development – crop resilience was improved and production risk reduced.
- Clean drippers and irrigation system resulted in uniform water distribution and water savings. See Agriwater Case Study Ref 5.1.1a & c.
- More efficient fertiliser use, better balanced soils and improved availability of various minerals which could be attributed to observed improvements in soil structure, biology and earthworm activity. See Agriwater Case Study Ref 5.1.1b.

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