
Technical Case Study – Ref 5.1.12

A comprehensive independent report on the response of wheat after installation of Agriwater's Water Treatment Technology



Agriwater Independent Agricultural Case Study, Greefslaagte, Lichtenburg District, 2011 Compiled

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To determine the effect of Agriwater treatment of irrigation water on the growth and yield of irrigated wheat

The use of Agriwater Water Treatment Technology for irrigation systems and pivots was widely known. Several positive results had been measured and reported. Given the benefits seen on other farms, a system was installed during 2011 at an 80 hectare pivot near Greefslaagte at the beginning of the wheat season. However, the question each farmer asks when purchasing new technology is the following: “Have I made the right decision for my soils, crops and budget and is the decision economically justifiable?”

With this in mind, it was decided to measure the effect of the treated irrigation water on all the components of the wheat crop where possible and thus to determine the result of Agriwater Water Treatment Technology in the crops and soils.

During a pre-season farmers’ day held at Greefslaagte the system’s operation and benefits were discussed and various measurements of the dissolved oxygen in the irrigation water from the borehole to the field, were done. The tests taken before and after the RainBox showed higher levels of dissolved oxygen, as was expected given use of this technology.

The SST 843 wheat cultivar was planted during the first half of July. For the purpose of comparison a large pivot (80 ha) was treated with Agriwater treated water and a small pivot (20 ha) with standard irrigation water. The adjacent pivots has been managed on a similar agronomical basis over several seasons and the soils were homogenous. The total fertiliser applications were 180 kg N/ha, 30 kg P/ha and 30 kg K/ha.

During the wheat growing season:

- Various plant and root samples were taken to monitor the differences in growth and development between the two systems.
- Furthermore, in collaboration with Omnia’s Omni-Bio program, soil and root samples were also taken and analysed to show any influence of the two systems on nematode counts, as well as to determine the effect on fungal and bacterial populations.
- Plant samples were taken during the physiological maturity of the wheat to determine yield components, yield and water use efficiency.
- Profile holes were dug to observe the root distribution of the two different systems.

Remarks made by the hands-on farmer, Abel Rootman, who monitored his wheat crops on a daily basis:

“The fields that received the treated water sprouted quicker and plant development was better. In the beginning of the wheat growing season, blockage of the pivot’s sprinklers occurred almost daily. During the cleaning process, deposits were found ranging in colour from brown to black. As the season progressed, less blockages occurred, but at the same time it became evident that the volume of water being applied per cycle (at the same pivot speed) had increased. This improved flow of the system was attributed to the reduction of deposits in the irrigation lines and sprinklers that had been building up in the system over time.”

Growth and plant development of the wheat

As observed by the farmer, the initial growth and development with the treated water was noticeably better. Plant samples were taken at physiological ripening, the number of stalks and ears per plant counted, ear sizes measured and the average number of grains per ear calculated. Yield and root development were determined at the same time. Yield of the Agriwater treated pivot was 10% higher than the standard treatment and water use efficiency 31% better. The results are summarized in Table 1.

Table 1. Results of the yield components measured on the Agriwater treated and standard irrigation water systems

Plant component	Agriwater treated water	Standard water	% Improvement
Average number of tillers/plant	4.64	3.71	25.1
Average number of ears/plant	4.18	3.29	27.1
Ear length (cm)	10.5–11.0	9.5–10.0	10.0
Tiller diameter (mm)	4	3.6	14.3
Plant height (cm)	86	84	2.4
Maximum kernels/ear	48	44	9.1
Maximum spikelets/ear	18	16	12.5
Yield (ton/ha)	7.125	6.459	10.3
Water use efficiency (kg yield/mm water applied)	13.76	10.54	30.6

Picture 1. Wheat plant samples taken during the grain fill stage: Agriwater treated water left and standard water right



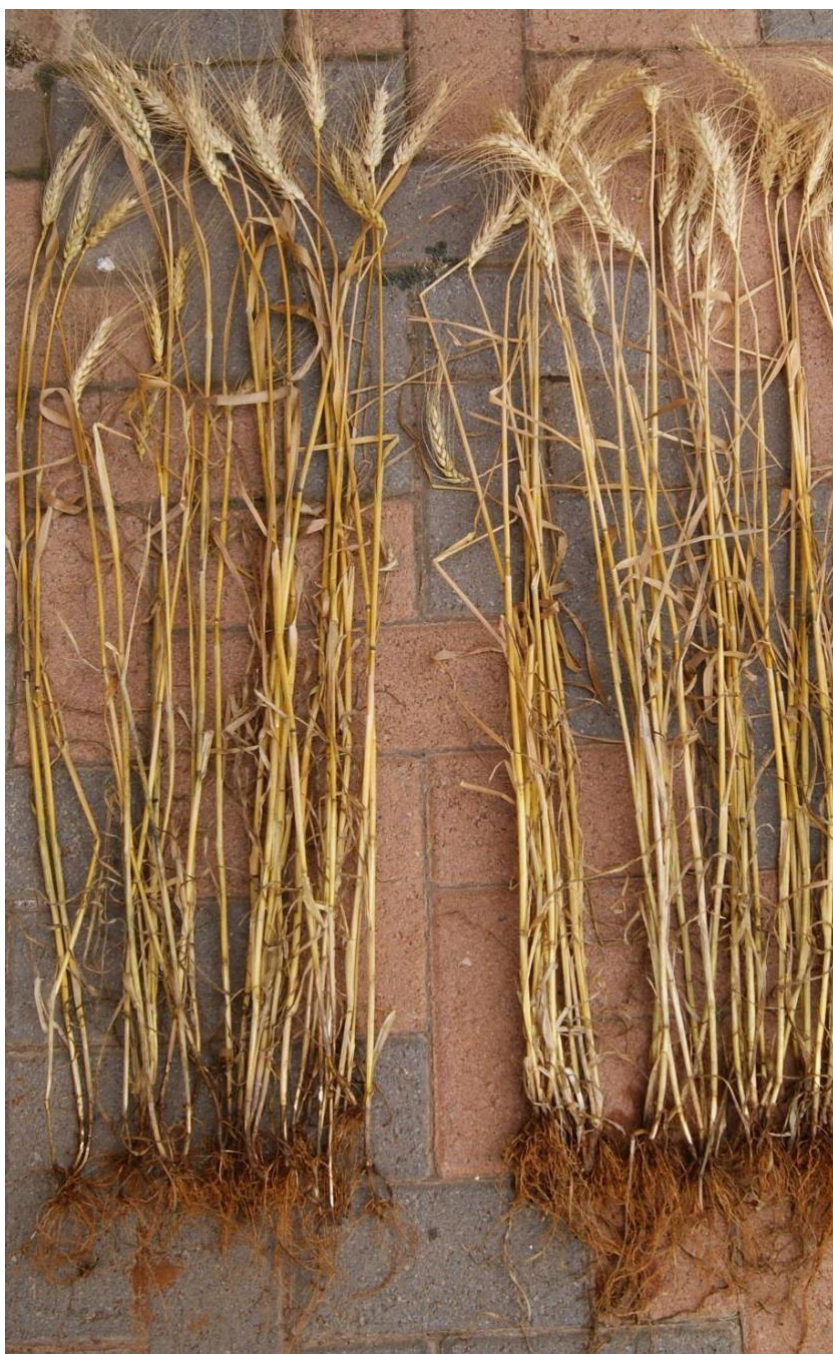
Picture 2. Wheat plant samples: Agriwater treated water left and standard water right



Picture 3. Wheat plant samples taken during ripening: Agriwater treated right and standard water left



Picture 4. Wheat plant samples taken during ripening: Agriwater treated water right and standard water left



Root development

Profile holes of the soils were dug over the rows during physiological maturity to monitor root distribution. Drastic differences occurred in the distribution of the roots through the profiles of the two systems as observed in the pictures.

Picture 5. Root distribution with Agriwater treated water



A higher concentration of finer roots was observed in the upper portions of the soil profile.

Picture 6. Root distribution with standard water



Less fine roots were observed in the upper portions of the soil profile.

The yield, as well as the total volume of water applied on the two systems were taken into account to determine the water use efficiency. The Agriwater treated water system produced a higher yield with less irrigation water provided in total – thus leading to a higher efficiency of water use. The excellent root development, especially in the topsoil of the profile, indicated that water absorption by the plants was more efficient. The available groundwater in the treated system was totally extracted, whereas in the standard system, groundwater was still available deeper in the profile until late in the growing season. See Table 1 & 3 for water use efficiency.

Number of nematodes, fungal and bacterial populations

These measurements were repeated twice during the growing season. The first was done during the early tillering stage and the second measurement at physiological maturity. The results are summarised in Table 2.

Table 2. Results of the nematode counts, fungal and bacterial populations during early tillering and physiological ripening

Growth Stadium: Early tillering			Nematode Count**	
Treatment	Bacterial count*	Fungal count	Beneficial	Parasitic
Control	9.55%	100%	6958	1559
Physiologically ripe				
Control	10.5%	100%	6072	1403
Agriwater treated water	10.7%	100%	5359	479

*Bacterial and fungal scores expressed as a percentage of the optimal value for wheat.
**Nematode count is the amount of nematodes in a 200 ml soil sample.

Discussion and Summary

The establishment of plant growth and developmental differences in wheat plantings irrigated with Agriwater treated water versus standard water irrigation led to interesting differences. Keep in mind that point measurements were done with care being taken to eliminate obvious soil differences and other variations between the two systems.

Irrigation water used in the pivots came from underground water sources (bore holes). The water was pumped into an irrigation dam from where it was pumped to the respective pivots. A good level of dissolved oxygen was naturally present in the water supply when pumped into the dam – as measured during the farmers’ day. This was to be expected. Also as anticipated, the Agriwater treatment increased the dissolved oxygen and higher oxygen levels were measured at the last nozzle of the pivot, as compared to standard water. However, any increase in oxygen levels played a minor role in the measured soil and crop improvements. The Agriwater Advanced Oxidation Process (P-AOP) first optimised the water quality and cleaned the irrigation system and thereafter passed on the benefits of improved water quality to the soils and crops.

Growth and development of both the respective wheat fields were consistently good. Due to the season’s low rainfall, the irrigation scheduling was under pressure – but the prevalence of diseases, particularly leaf diseases and ear diseases, were low. Nevertheless, Table 1 clearly showed yield improvements of 10% with Agriwater water treatment and improved water use efficiency of 31%.

This trial emphasized the positive effect of the treated water on the root development of wheat. The mass of fine roots that developed in the upper 30 cm of the soil profile was clearly visible in the pictures and measured. These roots contributed to the efficient use of available groundwater, as well as irrigation water and applied nutrients. The differences in plant development, growth and yield could largely be credited to this. The effect of the treated water on soil bacterial and fungal counts was not dramatically different from that of the standard water. Another

data set showed that bacterial seed-treatments were enhanced by the Agriwater water treatment and activity was more evident than in the standard water system. The nematode counts showed that parasitic nematodes were especially reduced by the Agriwater treated water.

The economic considerations of the irrigation water use and efficiency were also done. The production estimate showed that the cost of irrigation water constituted 19% of the total irrigation costs/ha for the R 2374/ha for 600 mm water applied. Maintenance costs and electricity bills respectively were 18% and 63% of the total costs per hectare. It was further calculated that the cost of irrigation was R 3.96 /mm water applied.

The savings in irrigation costs at different levels of water usage can be seen in Table 3. Linking these to the 31% improvement in water use efficiency in Table 1 – the cost savings in water, maintenance and electricity costs were substantial.

Table 3. Total savings in irrigation costs and electricity at different levels of water usage

mm Water irrigated	Water use efficiency (kg yield/mm water)	Irrigation costs (R/ha)	Savings in total costs (R/ha)	Electricity savings (R/ha)
600	12.08	2374.00	-	-
570	12.72	2257.20	116.80	75.30
540	13.43	2138.40	235.60	150.60
510	14.22	2019.60	354.40	225.90

When targeting a yield of 7.250 ton/ha, less irrigation water was used by administering Agriwater treated irrigation water, which also resulted in reduced costs per hectare. These savings were due to the increased root development of the plants, which leads to better utilisation of available water and nutrients in the soil. Plants functioned more efficiently, resulting in improved water usage.

The increased use and availability of nutrients in the soil profile could lead to a lower input of fertilisers over a couple of seasons. The positive growth response and better yields in this trial were also achieved at a lower cost, thus enabling a better economic return.

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