Lawn Water Balance Observations

Executive Summary

A trial was undertaken for two adjacent lawns with one lawn installed with water saving sticks (WS) to verify water savings potential. Ambient environment for the two lawns are identical as they sit side by side. Soil moisture is measured at two soil depths to view changes in conditions.

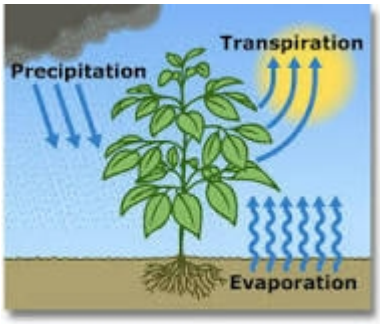
Initial stage (period 1) showed the plot with WS raised soil moisture level versus the normal plot. Starting with period 2 when irrigation water volume was reduced to both lawns, the moisture level in the normal plot rose to almost same level as WS. Observations reported normal plot lawn have signs of stress. A stressed plant takes up less water leaving more water in the soil. During a dry spell both plot soil water content went down, with normal plot losing more water than WS. At the end of the dry spell the gap in moisture level between the two widened. This period showed the ability of WS to obtain extra supplies of water from air in soil even under drier air humidity conditions.

To prevent further deterioration of the normal plot lawn, irrigation water reduction is only applied to WS after Period 3. Irrigation water to WS will be turned lower in steps until there are signs of plant stress.

Concluding the trial ……..

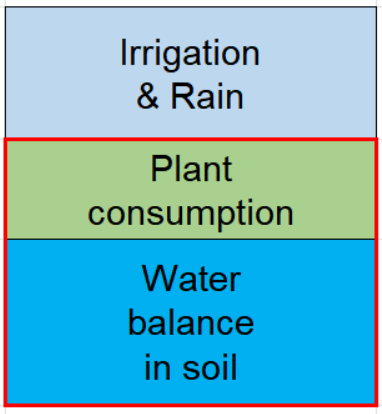
1. Basic assumptions.

1.1 Plants take up water from soil use some of it for making food and transpired water (sweating) into atmosphere. Soil water intake from rain and irrigation. Plant uptake plus soil evaporation reduces water content in soil.



1.2 The normal plot of lawn (N) and adjacent plot with Water Stick (WS) have identical environment except for the addition of WS in plot WS. Air temperature, relative humidity, rainfall and irrigation volume is the same. And that lawn plant mass is the same at the start.

1.3 It is assumed that precipitation and evaporation remains same for both N and WS. Over the trial period plant uptake changes because of internal changes in the plant.



1.4 A simple water balance is represented by this block diagram as

Water in = plant uptake + water balance in soil

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1.5 If plant consumes more, water balance in soil goes down and if plant consumes less water balance in soil goes up.

1.6 If plant consumes less, water balance goes up.

1.7 Further, if there is an effect from water saving sticks it will upset the water balance in WS soil and differ from N. This will be further explained below.

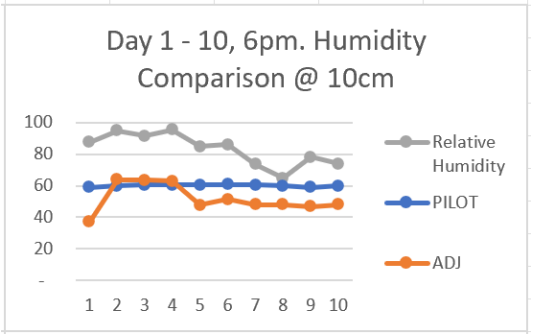
1.8 Water balance in soil is measured with a moisture meter as an index.

1.9 Irrigation water is the only variable that is managed. The aim of the trial is to seek amount of reduction in irrigation water to gauge effect of water saving sticks without detrimental effect on the plants.

2. Period 1

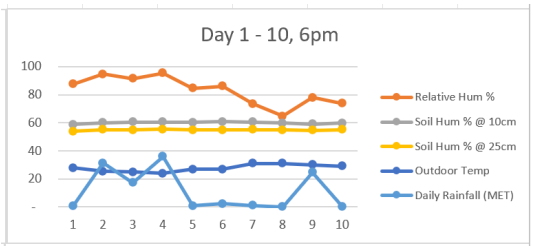
2.1 This period started on 2021-12-31 and lasted till 2022-3-27. Total 88 days. In this period the irrigation remains same as before start of trial. Plot N is at its stable state as before whereas WS incurred changes.

2.2 From day 2 onwards the soil moisture measured at 10 cm level of WS (blue line) remained steady for around 10 days.

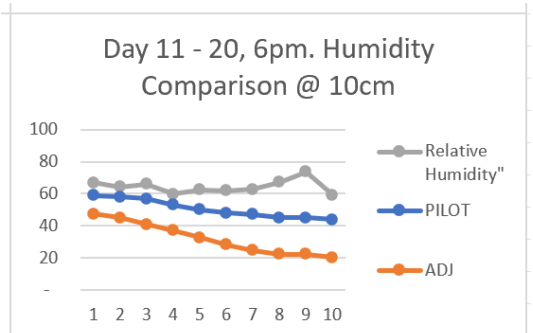


2.3 Plot N for days 5 – 10 it became steady but at a lower level than WS. The two time charts of 7 AM and 6 PM measured data is about the same but 6PM is shown here.

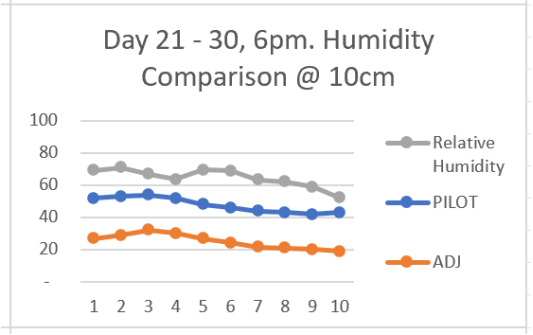
2.4 Plot N for days 1 – 4 showed similar or better soil moisture than WS. This is due to rainfall that adds more water than plants take up. Rainfall is represented by air relative humidity in upper chart on right. Environment chart will not be shown in below discussions.



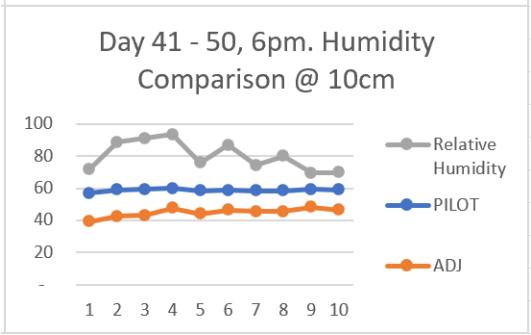
2.5 Soil moisture measured at 25 cm show no difference both plots. It is explained by the fact that grass roots do not extend that deep into the soil and takes up water in soil at around 10 cm level. However, when 10 cm water level is stressed there could be upward migration of moisture. But not enough to keep 10 cm water moisture stable.



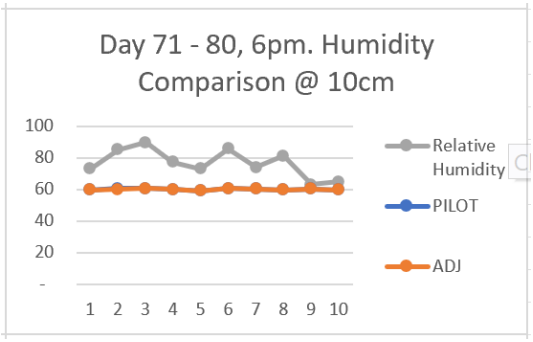
2.6 Days 11 – 30 WS (blue) and N (orange) lines keep their usual distance. Both trended down as ambient air humidity is lower (no rain for that period except day 19). Still WS kept above N and towards the end of the dry spell the gap becomes wider.



2.7 Rain returned on days 32 and 39 and days 42 – 44 and 49. Rainfall (ambient RH and less sunshine) causes water moisture levels to rise in both lawns. By day 50 the gap is back to similar as days 5 – 10.



2.8 Days 71 – 80 the two lines are almost identical. For this period plot N water moisture at 10 cm level is higher than at 25 cm. This is different from most other days.



3. Period 2

3.1 In this period irrigation water is reduced from tap opening of 8 minutes down to 6 minutes. A reduction of 25% from period 1. This lasted for 30 days from March 28.

3.2 Moisture levels at both WS and N and 10 cm and 25 cm depths are almost identical.

3.3 There was rainfall and most of this period air RH remain at 80% or above.

4. Period 3

4.1 This period irrigation water is reduced to 5 minutes of tap time. A reduction of 37% from period 1 and 17% from period 2. This period started April 27.

4.2 Similar situation about soil moisture was found as in Period 2.

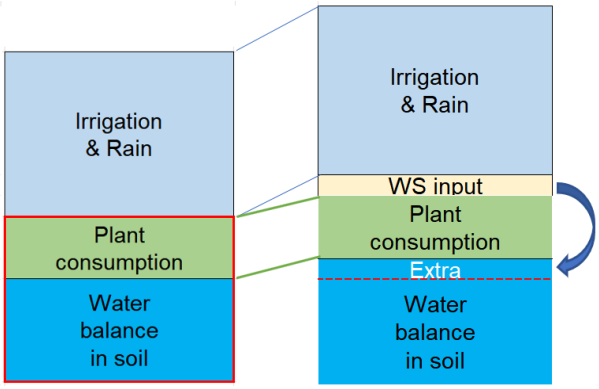
5. Attempts at Explanation

5.1 The soil moisture level comparisons for the first 60 days clearly show a difference between the N and WS. What happened here could possibly be the effect of water saving sticks.

The water balance for the two plots are represented by these two block diagrams.

Water input and plant water take up is equal for the two, assuming plant health is same.

The water level in WS (deep blue) is due to extra water input contributed by water saving sticks (WS input). An amount indicated above the red dotted line.

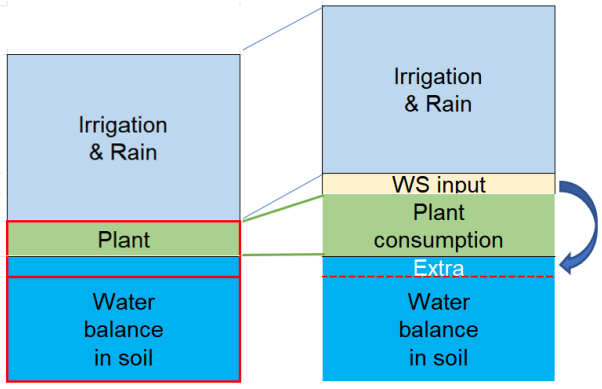


5.2 Rainfall, sunshine, and air relative humidity affect soil evaporation and plant transpiration but these are equal for both N and WS. The only changes seen is that water levels at 10 cm rises and lowers in response to weather conditions.

5.3 During dry spell from day 11 – 30 soil water content drops in both cases. However WS dropped less than N. This means there must be a supplementary supply of water, and this is most likely the effect of WS sticks th at bring in water moisture from air (not water held by soil solids) to the roots.

5.4 For Periods 2 and 3 water irrigation volume is reduced to both lawns. Moisture level in N started to rise to be close to level of WS. At first it seemed a reverse of the Period 1 trends observed. A casual observation of the lawns indicated the two to differ in plant quality. It is likely that grass in N started to be stressed when irrigation volume is reduced. It may be that previous irrigation water setting is at a just right flow level based on years of experience. Hence any reduction of water is not enough to sustain normal food growth and transpiration. Plant take up less water and water content rises in the soil.

5.5 The block diagram is redrawn to reflect observation in 5.4. Here the green belt on plot N (left bar) is reduced. That is plant water uptake is reduced so water balance in soil is increased shown as blue band above red line. Whereas the conditions in WS had not changed at all as WS sticks continue to bring in supplementary water.



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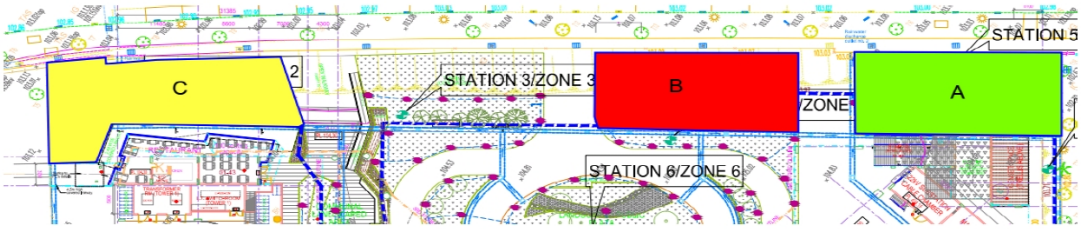
6. On June 17 a site meeting was held with Mr. Low, an irrigation specialist. Mr. Low observed these conditions for the two plots plus one slightly to the side. Zone A is the lawn with WS. Zone B is plot N with same irrigation water at reduced flow volume. Zone C is lawn with irrigation water flow not affected during the months of trial. Zone C is the yardstick for a well irrigated lawn with healthy plants. Note the comment in following picture about Zone B (N): "seem to be in a dormant state…most dry of all 3 zone." This corroborates above observations when comparing water moisture level. That is WS is working to provide supplementary water to plants.

Observation Of Turf Condition @ Aperia



Best condition @ Zone C
Turf are spiking upward.
Soil is the most moist of all 3 zone

Zone B
Turf general appears dry and seem to be in a dormant state
Soil is the most dry of all 3 zone.

Average condition @ Zone A
Some of Turf are spiking upward.
Soil is reasonability moist

7. Plot WS irrigation water volume will continue to be reduced to see how much water can be saved. Plot N will remain in a reduced stage but will not be further reduced as plants show stressed conditions. Zone C will be the yardstick in future observations as it has adequate irrigation water.

8. Flooding of N is ruled out as 25 cm shows not much movement.

9. Is the 10 cm WS level 60 i.e. 40 are lost to soil evaporation? Or transevaporation?