FruitLook March 2015: Making Water Efficient

Dear Mr. Doe,

In the Western Cape water is a critical resource for which there is strong competition between the urban, industrial and agricultural sectors. Farmers are subject to this increased competition for water while climate models suggest rainfall is becoming less predictable. In order to sustain irrigated agriculture or even increase agricultural output (production) efficient use of fresh water is of paramount importance. The principal goal of FruitLook is to provide relevant and timeous information to farmers that will lead to an improvement in efficient agricultural water use.

FruitLook provides a direct quantification of crop water use through the actual evapotranspiration data product; this is the actual water lost from the hydrological system to the atmosphere through soil evaporation and plant transpiration. It provides insight in actual water use: thus not what is applied on a field through irrigation but rather how much water is actually lost from the complete fresh water supply available for agriculture.

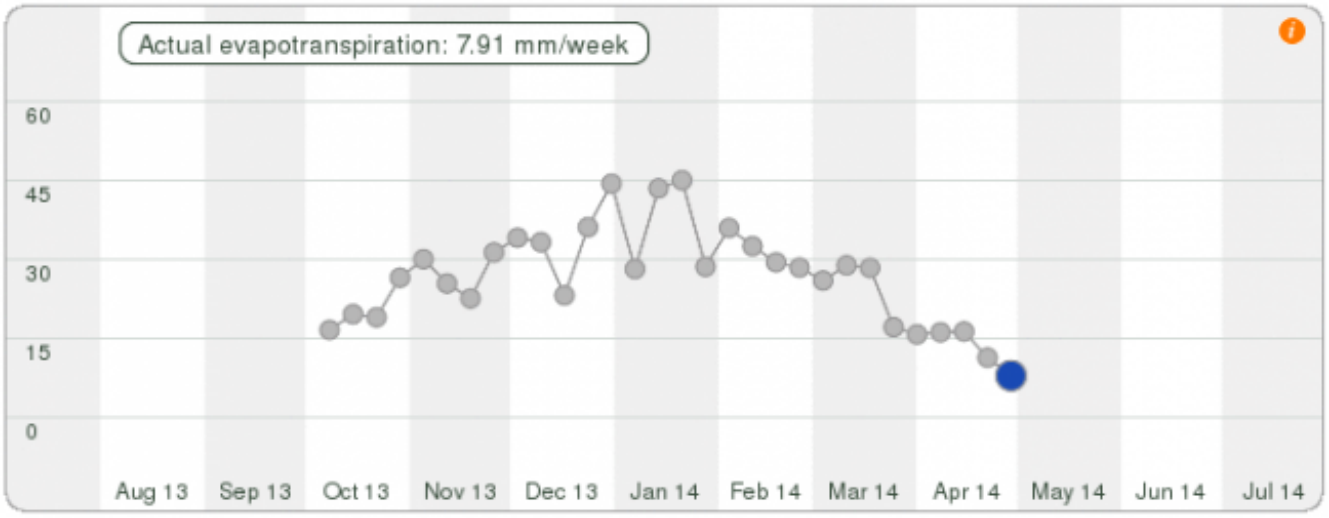
In this newsletter we focus on the use of the evapotranspiration parameters in FruitLook. We do so in our monthly newsletter topic covering the description and possible applications of a FruitLook parameter.

FruitLook Parameter Discussion: Actual Evapotranspiration and Evapotranspiration Deficit: In this newsletter topic a FruitLook parameter is scrutinized. Three questions are covered: 1) What is it?, 2) What can you expect?, 3) How can you use it? It is important to note that although we will describe the data products separately, they are related and of influence to each other. For example, a strong increase in evapotranspiration deficit will lead to a reduction in biomass production due to water stress.

The January 2015 newsletter focused on the Vegetation Index. In the February 2015 newsletter the Biomass Production was discussed. This month we focus on the **Actual Evapotranspiration** and **Evapotranspiration Deficit**:

Actual Evapotranspiration/Evapotranspiration Deficit: What is it? The Evapotranspiration (ET) is the sum of the amount of water that is evaporated from the soil (E) and the amount of water that is lost through transpiration by the crop, cover crop and/or weeds (T). Where non-consumed water can be recaptured for downstream use, or replenishes the groundwater, water consumed by evapotranspiration cannot. It represents the actual amount of water lost in the crop production process and is expressed in mm/week. Where actual evapotranspiration (ETact) is the real crop water use at a certain day, the potential evapotranspiration (ETpot) represents the amount of water that could be evaporated and transpired under actual meteorological conditions and ample water supply. The difference reflects the crops shortfall in what it can potentially achieve. This absolute evapotranspiration deficit (ETdef) is defined as the difference between ETpot and ETact in mm/week and is hence crop and site specific.

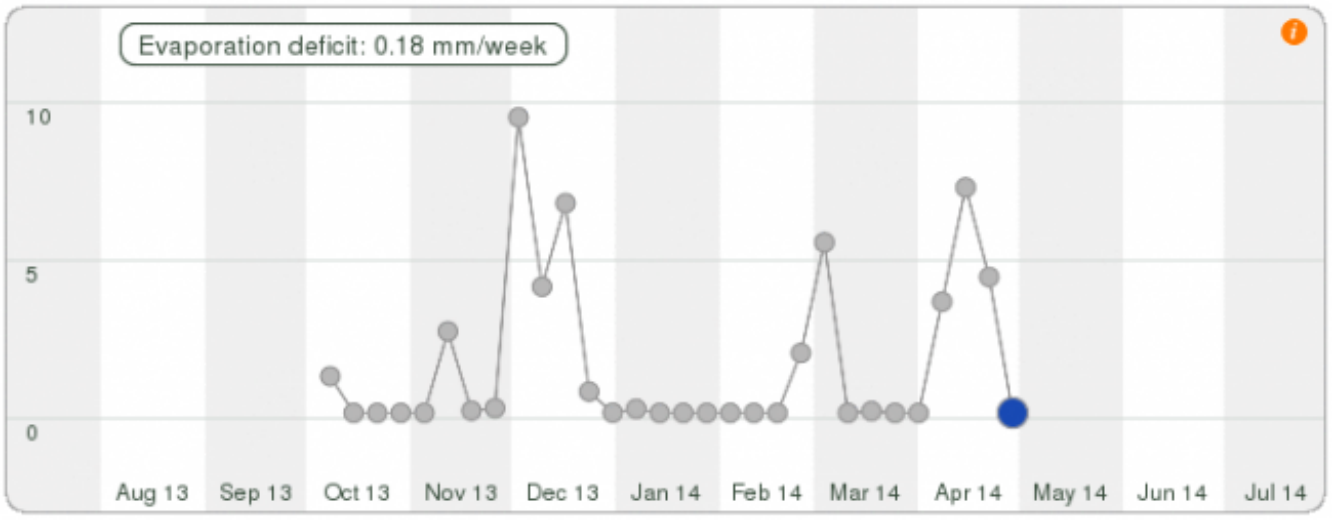
What can you expect? The Actual Evapotranspiration can vary between no or little evapotranspiration and values as high as 55 mm/week. Commonly values for deciduous fruits grown in the Western Cape were found to fluctuate between 15 and 45 mm/week. Evapotranspiration is normally lower at the beginning and at the end of the season as the crop development is respectively just initiated or over its peak. Peak values are typically reached in mid-summer, but greatly depend on the plant physiology and management. Climatic conditions are also of influence: in the midst of summer solar energy is more abundant than in spring and fall meaning more energy is available for the evapotranspiration of water. Whether or not this potential is reached is strongly dependent on water availability.



A typical ETact curve is depicted above. Small variations in evapotranspiration from week-to-week are visible. These are most likely caused by variation in meteorological conditions:

- An increase in air temperature will mean more potential for evapotranspiration.
- A decrease in relative humidity (dryer air) will increase the water potential gradient between the leaf and the surrounding air layer which also enhances evapotranspiration.
- During clear conditions more energy is coming from the sun for photosynthesis which encourages the stomata to open. Cloudy conditions reduce potential evapotranspiration amounts.
- Wind still conditions decrease transpiration as water vapor accumulates close to the leaf surface, causing the water potential gradient between leaf and surrounding air to drop.

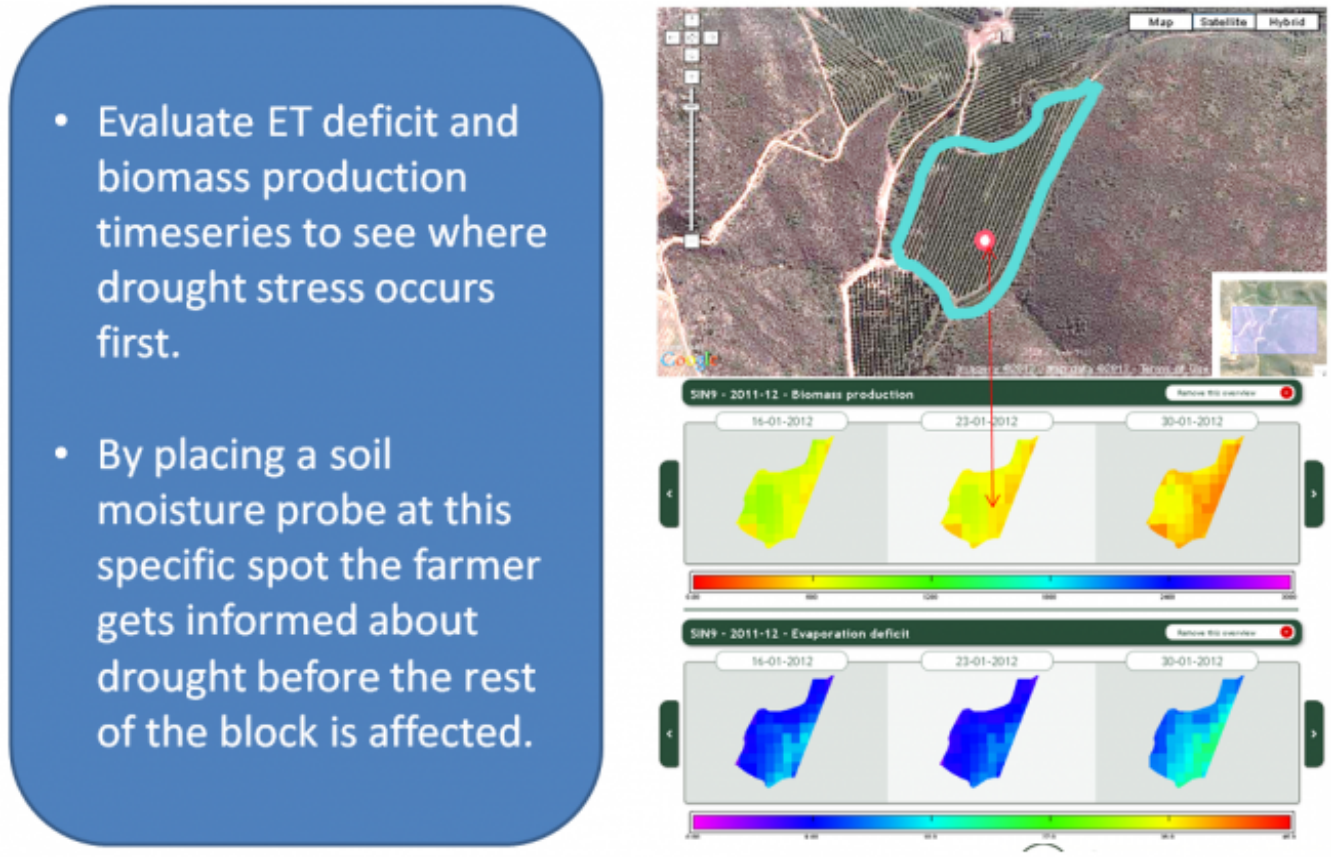
Very hot or dry air can cause ET deficits to occur. When a crop loses too much water because the moisture gradient between leaf and surrounding air becomes too steep it tends to close off its stomata causing a decrease in evapotranspiration. Apart from meteorological conditions factors as soil salinity, poor land fertility, the presence of hard or impenetrable soil horizons, pests and diseases and poor soil management may limit crop development and reduce evapotranspiration.



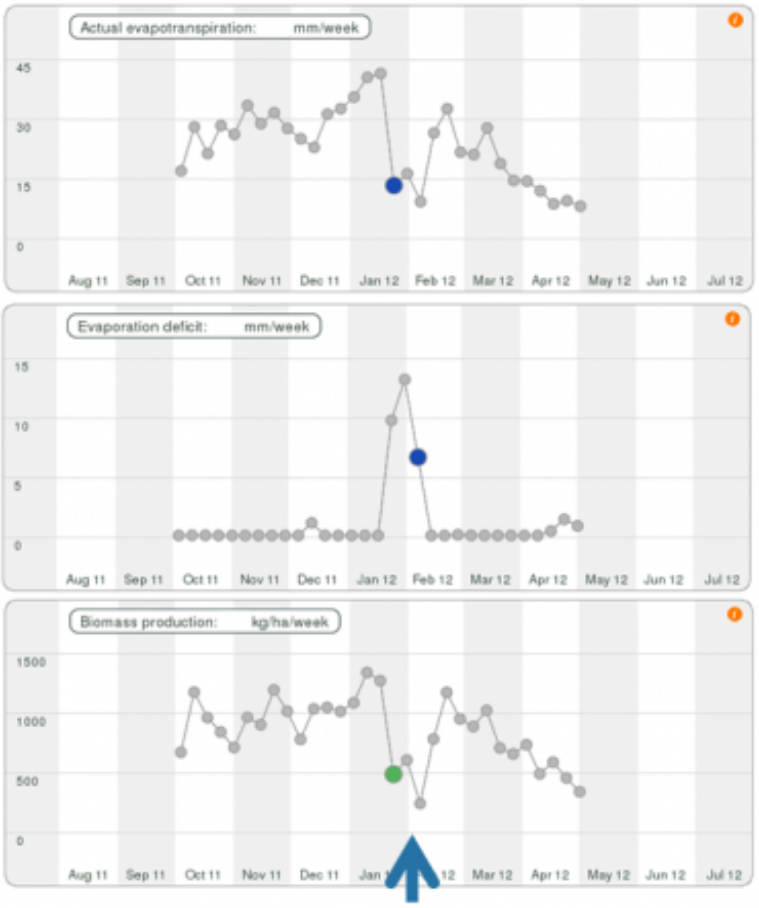
A typical ET deficit curve is depicted above. ET deficits are visible at certain periods over the growing season. No ET deficits over a season suggest wet conditions and it could possibly mean over-irrigation is taking place. This can best be investigated in combination with the biomass water use efficiency parameter. To determine whether a block is over-irrigated or not is challenging and requires knowledge of the crop and block. High ETdef values occurring over a number of consecutive weeks suggest that the soil is drying out, the plants are possibly experiencing stress and the producer is possibly lagging behind with irrigation applications.

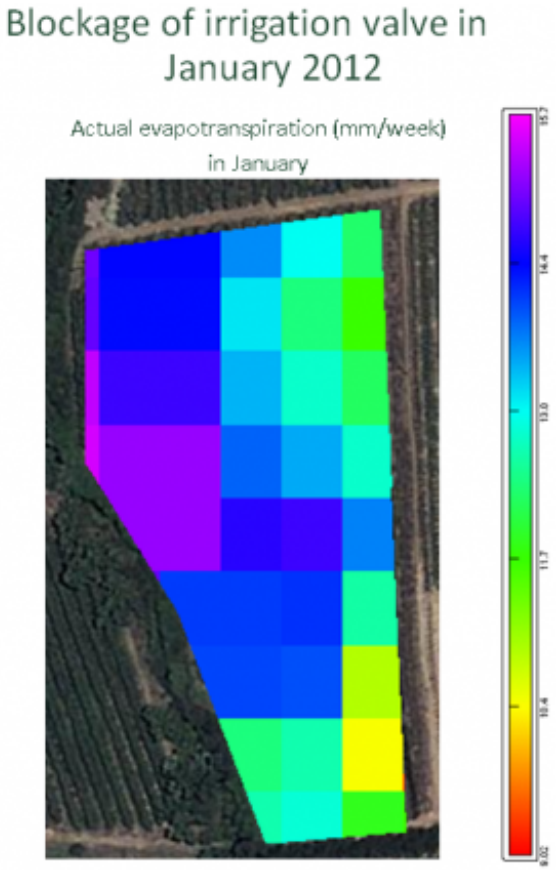
How can you use it? Spatial Overview: Monitoring ET on a regular basis gives a direct insight in crop water status. Areas of low crop water use can be identified. Furthermore differences in ET within fields might indicate points of water logging or faulty irrigation equipment and suggest the opportunity for improved water management in the block to reduce spatial variation in ETact. Spatial variation in ETact and ETdef might also be caused by variation in underlying soil structure. As an irrigation system is often developed for an entire block it might overlook these

variations in soil causing parts of the block to receive suboptimum irrigation. You can use the data to try and identify these variations in soil composition. Another application is to use the Biomass Production in combination with the Evapotranspiration Deficit for the placement of soil moisture probes. By evaluation of Biomass Production and ET Deficit time series the best spots to place soil moisture probes can be determined. An example of this is included below.



Temporal Overview: You can use the temporal profile to easily see if your blocks show continuous development throughout the growth season. The combination of ETact and ETdef can show whether or not your block is affected by drought. A drop in ETact without an increase in ETdef is most likely caused by meteorological circumstances. In example below a drop in ETact corresponded to an increase in ETdef caused by the blockage of an irrigation valve. In general if a sudden trend-break shows a drop in ETact combined with an increase in ETdef and this continues for multiple weeks in a row this could be a clear indication of irrigation issues.





The evapotranspiration parameters can be a great help in evaluating irrigation and keeping track of the moisture status of your block. Please keep in mind the climatic circumstances strongly influence this parameter: a well-performing orchard in Ceres will certainly show a different temporal pattern compared to a well-performing orchard near Grabouw. Similarly an irrigated vineyard in Vredendal will certainly show a different pattern compared to a dryland vineyard in Stellenbosch.

Interested to learn more? Search "Evapotranspiration/plant transpiration" on Google: many articles can be found covering this parameter. A number of general, open sources are Wikipedia, USGS and FAO

If you have any remarks/questions about this newsletter or FruitLook in general, feel free to contact us via info@fruitlook.co.za. See you soon on FruitLook!

Best regards,

The FruitLook Team

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