Agrisoft Systems
NEWSLETTER
Fiftieth edition, Oct.— Des. 2024

Message from the Management

Monitoring climate data

Dear Customers and Friends,

As the world confronts the impacts of climate change, it is becoming increasingly evident that industries across the board must adapt. This is especially true for agriculture, where weather variability directly influences crop performance. Among the most affected sectors, oil palm plantations face unique challenges, as unpredictable rainfall patterns, extended dry spells, and temperature fluctuations threaten both yield stability and sustainable operations.

At Agrisoft Systems, our mission has always been to equip our clients with the tools to navigate these uncertainties. We understand that now, more than ever, the ability to record, monitor, and analyze climate data—particularly water deficits—is essential for strategic decision-making and long-term resilience.

Water availability is a key determinant of oil palm productivity. Insufficient water supply and extended dry periods lead to increased plant stress, reduced growth, and lower oil yields. In periods of water deficit, where precipitation fails to meet the evapotranspiration demand of the crop, the effects on yield can be profound. Such conditions can also trigger secondary issues like increased susceptibility to pests and diseases.

Capturing and maintaining reliable records of climate parameters, in particular relating to rainfall quantities and timing, allows plantations to get a good idea of the typical monthly weather

Agrisoft Systems
NEWSLETTER
Oct.— Dec. 2024

Message from the Management

and rainfall patterns specific to their location. This is very helpful for general planning of various plantation activities, e.g. to identify the best months for N fertilizer application or for planting new palms. Having accurate weather data is also an important prerequisite for any meaningful yield gap analysis, in order to answer the question of whether a certain change in yield can be attributed to a weather effect or not.

Of course, analyzing the past correlations between climate parameters and yield or other outputs is not just about getting a clearer understanding of what happened in the past. Having a good idea of how e.g. a past drought or a period of flooding affected different areas in your plantation is essential in order to be able to consider possible interventions such as improving drainage, building dams, or even implementing irrigation. Even if you're not going to be able to really mitigate the effects of the weather, being able to identify periods of weather-induced plant stress can help improve the accuracy of crop forecasts and budgets. This in turn can help to plan for many things such as labor requirements, infrastructure improvements and so on.

The main feature article in this newsletter edition takes this point further and discusses in more detail how water deficits are calculated in OMP and how tensiometer readings can provide a further corroboration of periods of water stress. As usual, the "What's new" section at the end of this newsletter provides an overview of some of the topics we are working on.

Warm regards,
Max Kerstan

Agrisoft Systems
NEWSLETTER
Oct.— Dec. 2024

Feature

Water deficits and tensiometers in OMP

All over the world, the accelerating effects of climate change are gradually shifting typical weather patterns as well as increasing the frequency and intensity of extreme outlier events such as severe droughts or excessive rainfall. All crops are dependent on a certain water supply in order to provide high yields. While oil palms are perhaps relatively drought-tolerant compared to other common crops, they are no exception. In fact, water deficits and droughts are the biggest limiting factor for a site's yield potential. Due to the long time lag between floral initiation and harvest in oil palm, water deficits can have a very delayed effect on yields up to two years later. All this underlines that accurate estimation and recording of water deficits is highly important for oil palm agronomy, both for analyzing past plantation performance and as a key input parameter for longer-term crop forecasting and budgeting.

The amount of water in the soil, and thus available for update by the oil palm's roots, is determined by a water balance equation. Essentially, rainfall or irrigation increase the amount of water in the soil while it is reduced by evapotranspiration (evaporation of water either directly from the soil surface or from plant leaves after uptake into the plants). Soils cannot store unlimited amounts of water. Once the maximum level is reached, any additional water supplied by rainfall or irrigation will be lost to surface runoff or percolation into deeper layers of the soil. If W_n is the amount of water in the soil at the end of month n (in mm) and R_n, I_n and ET_n the amounts of rainfall, irrigation and evapotranspiration respectively, the development can be described as follows.

If $W_{n-1} + R_n + I_n - ET_n < 0$ then $W_n = 0$ mm
If $W_{n-1} + R_n + I_n - ET_n > W_{max}$ then $W_n = W_{max}$
Otherwise, $W_n = W_{n-1} + R_n + I_n - ET_n$

Here, W_{max} is the maximum soil water reserve or the maximum level of water that the soil can contain. Whenever the soil water reserve drops to zero, the palms experience water stress and we say that there is a water deficit given by the excess evapotranspiration. If WD_n is the water deficit in month n, then

If $W_n > 0$ then $WD_n = 0$ mm
Otherwise, $WD_n = W_{n-1} + R_n + I_n - ET_n$.

Strictly speaking of course the question of whether a palm is suffering water stress or not is not as binary as the above calculation equations suggest. In reality, there is of course a difference for the palms between a month with very high rainfall compared to a relatively dry month where perhaps a formal water deficit was only avoided by a few mm due to reserves of water from the previous month. Nevertheless, water deficits calculated using the above definitions have proven themselves over many years as highly useful estimates of the existence and severity of water stress.

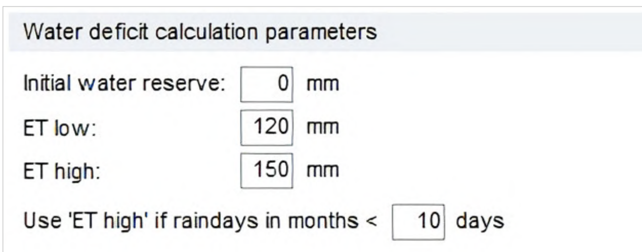

Figure 1: Setting calculation parameters for water deficit.

Feature

Of the terms in the equations above, the rainfall and irrigation amounts are quite straightforward to measure, at least in principle. More complicated is the maximum soil water reserve W_{max}. This quantity is clearly different for different soil textures and thus will be different from site to site. Within OMP, the value of the maximum water reserve can be specified in the system settings

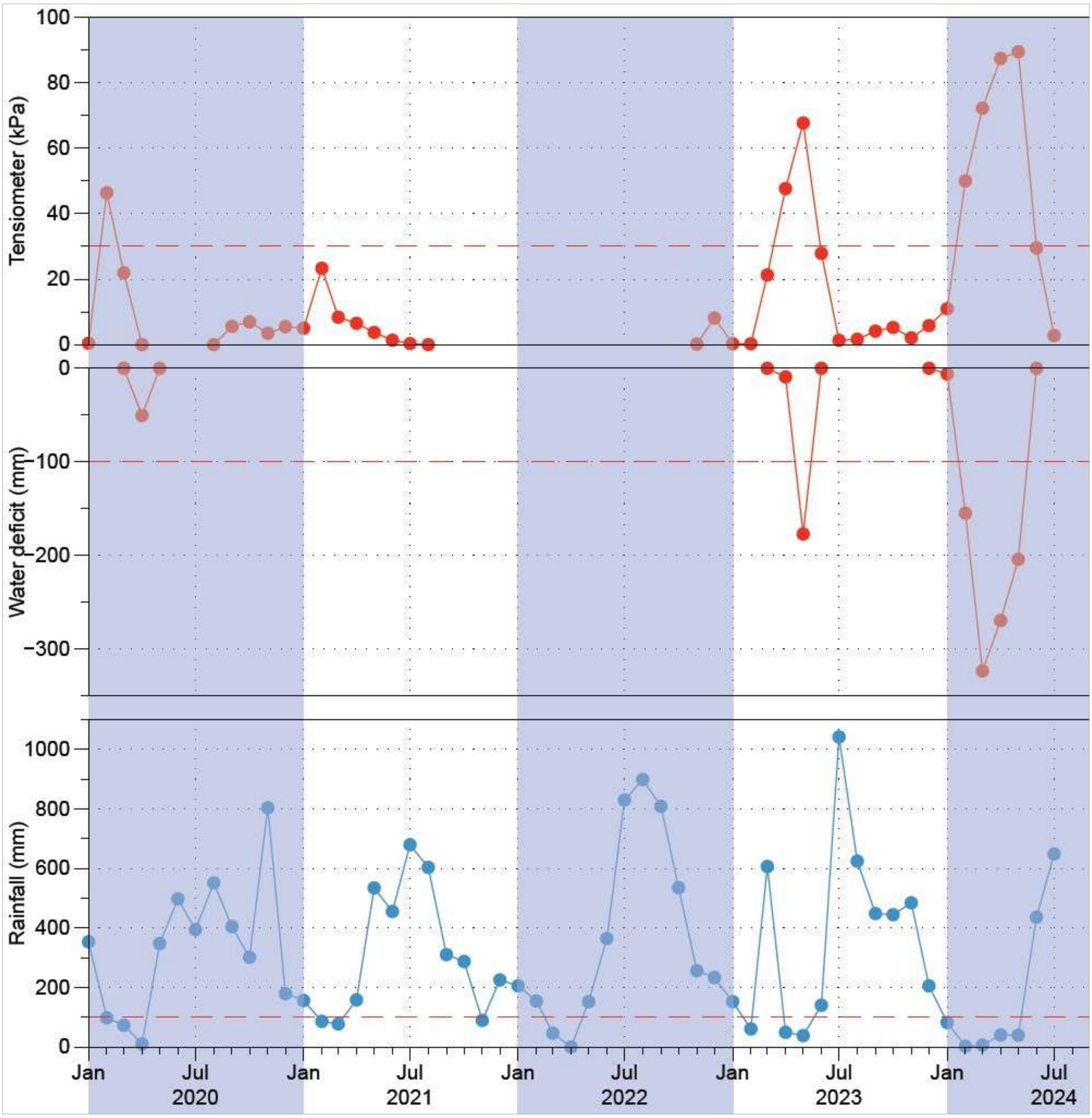

Figure 2: Correlating rainfall, water deficit and tensiometer readings.

Feature

area. While W_{max} may be difficult to estimate accurately especially for a plantation with varying soil textures, a typical value is in the region of 50mm and the value does not really change over time. Therefore, even if we were to use an "incorrect" value of W_{max} in the calculations that is off by a few tens of mm this would not prevent us from using these formulae to identify times with relatively more or less water stress.

The most difficult factor is the actual evapotranspiration because this is relatively difficult to measure or calculate and can vary significantly from month to month. A well established method to estimate the evapotranspiration is the IRHO/CIRAD method described by Surre (1968). In the original approach, the monthly evapotranspiration was taken to be 150mm if the number of raindays in that month was less than 10, and 120mm if the number of raindays was 10 or greater. The IRHO method is implemented in OMP and you can adjust the key relevant constants for each individual weather station in the OMP picker definitions (see Figure 1).

The IRHO method has been successfully used for many years, in particular when used to evaluate a prospective site's suitability for oil palm cultivation by calculating an averaged monthly water deficit over a number of years. Nevertheless, it is clear that it is only a relatively crude approximation if you're really trying to get the water deficit of a specific individual month. However, more recently weather stations have become available

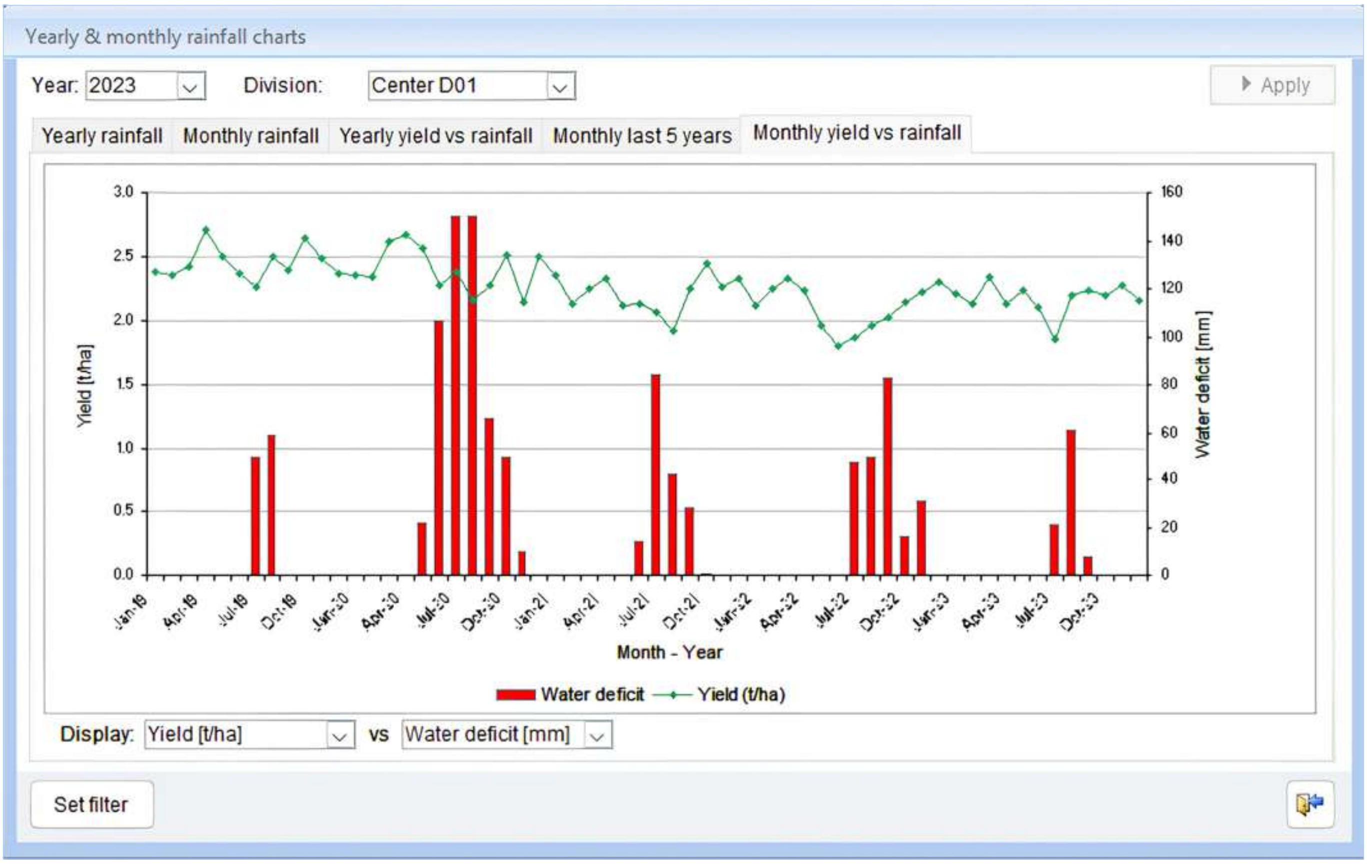

Figure 3: OMP chart on long term yields vs monthly water deficits.

Feature

which automatically calculate and output the actual evapotranspiration from the measured primary data such as solar radiation, humidity etc. If you have such a weather station, you can enter these explicitly measured values into OMP instead of the IRHO method, significantly improving the water deficit calculations in OMP.

A completely different approach to estimating water stress on your palms is to directly measure the available water in the soil using tensiometers. Tensiometers are very simple instruments which roughly speaking measure the pressure with which the soil "sucks up" any additional water. This effectively is a measure of how difficult it is for plant roots to extract water from the soil. High tensiometer readings correspond to dry soil whereas low tensiometer readings mean that there is more water available. Note that the interpretation of tensiometer readings depends strongly on the soil texture. For example, a value of 30 kPa could mean high water stress on a sandy soil but plenty of available water on a clay soil.

The charts shown in figure 2 were created from data stored in the OMP database of one of our customers, extracted using suitable queries in the OMP Query Writer add-in. In this case, the evapotranspiration that was entered into OMP (and therefore used for the water deficit calculation) was measured by the weather station and not estimated using the IRHO method. As you can see, the periods of high water deficit are very well correlated with periods of high tensiometer readings. This illustrates the usefulness of installing and using tensiometers in your plantation to complement the data from automatic weather stations, especially if your weather stations do not provide a direct evapotranspiration measurement.

Having solid water deficit data in your OMP database is very useful when looking to understand and analyse past yield patterns. When identifying a drop in plantation yields, it is useful to look at the long-term water deficit data to see whether there was significant water stress at the critical times in the fruit development, e.g. leading to a bad sex ration or high floral abortion rates. A useful chart showing the long-term development of monthly yield against monthly water deficits is shown in figure 3. This kind of chart is particularly useful for visualizing time-lagged effects. Analysing how past water deficits have affected yields can also help us to make better crop budgets and forecasts for how current water deficits are going to depress yields in the future.

Agrisoft Systems
NEWSLETTER
Oct.— Dec. 2024

From the developers desk

A selection of the on-going developments and plans which are part of our constant efforts to continue to improve Agrisoft products.

Palm census using AI image analysis

- Automatic identification and counting of palm trees from aerial images
- Classification of palms into categories such as mature, immature, abnormal etc.
- Identify the outline of the palm canopy, nut just center point
- Calculate leaf area indices and identify areas with canopy damage
- Use multi-spectral imagery to identify areas with bad palm health
- Table to record location, ID and status of every individual palm

Integration of daily and monthly production

- Automatic updating of aggregated monthly data when any daily production data is entered
- Implementation via back-end triggers requires no manual action by the operator
- Support for primary data entry either at monthly or daily level
- Handling and special data migration as part of the version update.
- Addition of a new system setting to choose whether the monthly harvest round length should be based on average or maximum of daily harvest rounds.

General improvements

- Report for the number of blocks and area where a certain pesticide was applied per month
- Implement a setting to exclude HCV areas when entering pesticide recommendations in rates
- Add option of grouping by plantation on additional forms and reports
- Add chart report combining multiple charts on leaf nutrients and critical levels
- Add chart report combining multiple charts on climate parameters
- New “production crosstab” form to see how combinations of different parameters affect yield
- Portuguese language version of OMP
- Option to avoid restricting the monthly yield vs rainfall chart to a single division.
- New fields for relative humidity in OMP climate data
- New point type “Row” in OMP Field Survey
- Support for using “number of points surveyed” in OMP Field Survey expressions