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CERES/KOUE BOKKEVELD-KULTIVARPROEF ONDER BESPROEIING: DONKERBOS 2020/2021

EMPANGENI INFORMATION DAY A SPUD-TACULAR LEARNING EXPERIENCE

Die GeoFarmer-platform maak monitering maklik

Stuit Alfalfa-mosaïekvirus in sy spore

Potato product exports: A twelve-month snapshot

In August this year, PSA hosted a follow-up practical irrigation course for enterprise development farmers in Limpopo.

Practical irrigation course: Water smarter

By Chantel du Raan, Potatoes SA, Prof Martin Steyn, University of Pretoria, and Chris Barnard, Fertigation Academy

Water is a critical input for agricultural production and plays an important role in food security. Proper irrigation is therefore vital to our country's food security, and measures are needed to protect our limited water resources. It is thus important that producers make use of the best available irrigation practices and tools to supply optimal amounts of water to their crops, while minimising the impact on the environment.

The Research and Development as well as the Transformation departments of Potatoes SA (PSA), recently joined forces and arranged a follow-up practical irrigation course for PSA's enterprise development farmers in Limpopo. Twenty-seven delegates gathered at Chinaka Game Lodge near Vivo, Limpopo, in August this year. Chris Barnard from the Fertigation Academy and Prof Martin Steyn from the University of Pretoria acted as expert facilitators, with the aim to address irrigation-related issues faced by these producers.

This practical irrigation course not only highlighted that water is a scarce and precious resource, but also exposed the producers to tools that will help minimise wasteful nutrient losses. In addition, the aim to maximise transpiration was underscored, along with the beneficial loss of water due to its direct link with photosynthesis, and thus final yield and quality affecting profitability.

Potatoes are shallow-rooted plants with a network of finely branched roots and a fairly large leaf canopy. This makes the crop very sensitive to even small deficiencies in irrigation water, which can negatively affect growth rate, quality and yields.

The effect of water stress on crop performance depends on the crop's growth stage. It is therefore important to understand the water requirements during each stage, and how a shortage or excess of water can affect the crop.

The practical irrigation course provided producers with tools to help minimise wasteful losses of water and nutrients.

Farming roots, not potatoes

Roots are out of sight and therefore usually out of mind, but they remain the lifeline of a plant. Barnard compared the roots of a plant to

an engine. They take up water and nutrients from the soil, and move these up into the leaves, which can be referred to as the factory of the plant. There they interact with sunlight to produce sugars and energy, which in turn affect the yield.

Stronger, healthier roots will ensure better absorption of water and nutrients, enhancing crop development throughout all stages and under all environmental conditions, and producing stronger stems and foliage. When a crop has a good root system, critical resources are easily absorbed, leading to a healthy plant that can better withstand environmental stress conditions, especially in a challenging climate. A healthy root system therefore ultimately helps to ensure good yields.

To illustrate the importance of farming roots, Barnard used an example of a tobacco production practice used in the past. Farmers would plant a tobacco seedling, add 20 litres of water to it, and not irrigate it again. This would force the plant to develop deep roots in search of water, which ensured a well-developed root system.

Oxygen – the forgotten element

Oxygen is a forgotten, yet essential element that affects the uptake of nutrients as well as the occurrence of soilborne diseases. Barnard explained this by asking the audience whether a person could eat a hamburger under water. No, you cannot, and plants work the same way. They cannot take up nutrients if there is no oxygen in the soil (*Table 1*).

Table 1: The effect of oxygen in the soil on the uptake of nutrients.

% O_2	K uptake (%)	P uptake (%)
20	100	100
5	75	50
0.5	37	30

A balance should therefore be established between oxygen and soil moisture, since saturated soil contains little to no oxygen.

Soil as a retainer of water

Prof Steyn stated that soil acts as a sponge that can take up and retain water. Just like soil, a sponge consists of solid parts, air, and water. The movement of water into the soil is referred to as infiltration, and the downward movement of water out of the crop's root zone is called percolation. Pores in the soil form the conduit that allows water to infiltrate and percolate. It also serves as a storage compartment for water. In the following discussion, soil will be compared to and referred to as a sponge.

Frost and irrigation management

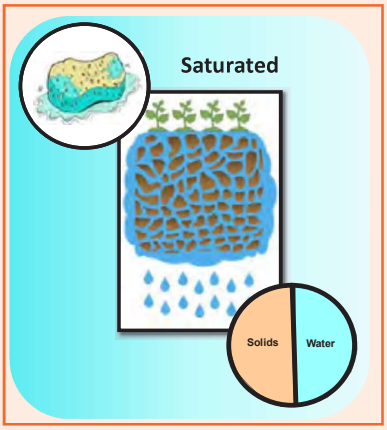
Following the recent frost experienced in Limpopo, one participant asked whether it is recommended to irrigate when a cold period is expected. When soils are dry, more soil pores are filled with air, which will reduce heat transfer and storage within the soil. Therefore, in dry years, frost protection is improved by wetting dry soils.

Saturation

When water (rain or irrigated water) is poured slowly over the sponge (representing the soil), it will soak into the sponge. When the sponge has been saturated, water will start dripping from the bottom – this represents the process of percolation, whereby gravity pulls excess water out of the soil (*Figure 1*). All pores are thus filled with water, with no air present, and water is lost by percolation.

This typically occurs with over-irrigation, which can have multiple negative effects on yield and quality. Potato yields are sensitive to water stress during all growth stages from tuber initiation onwards. Prof Steyn advised producers to avoid very wet soils, especially late in the season (the last month before harvest), as tuber quality will especially be hampered.

Figure 1: An illustration of the saturation of soil, using the sponge as reference.

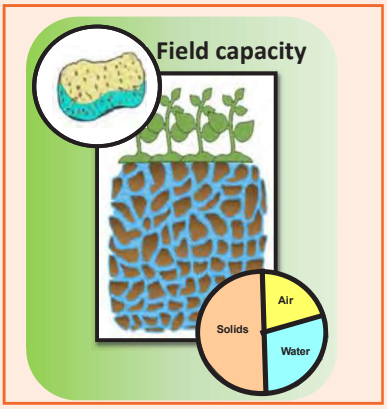


Field capacity

When discontinuing the pouring of water onto the sponge and allowing the excess gravitational water to drain out, the soil will reach field capacity (*Figure 2*). The soil (sponge) retains some water that is available for plants to take up for growth, as well as for soil microbes to live in. The pores are now balanced with air and water, two crucial elements for plant growth.

To obtain optimal growing conditions for the crop, it is important to establish uniformity. This is done by avoiding large soil deficits and water stress periods, while maintaining optimal soil water content in the root zone. Water should therefore be distributed evenly throughout the growing season.

Figure 2: An illustration of the field capacity of soil, using the sponge as reference.

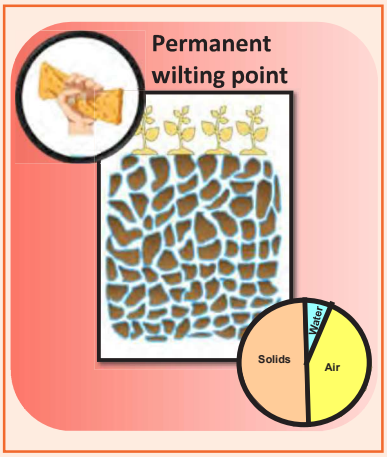


Permanent wilting point

When the sponge is squeezed, it reaches a point where it stops dripping. Although most of the water has been squeezed out of the sponge, it still feels slightly wet, which means a very small amount of water remains in the soil but is held so tightly, that it is not available to plants (*Figure 3*). This is referred to as the wilting point.

The pores are mainly filled with air and a very small amount of water. Depleting the soil to this point should be avoided, since potatoes are very drought sensitive and will experience stress, which may negatively impact the yield and quality.

Figure 3: An illustration of permanent wilting of soil, using the sponge as reference.



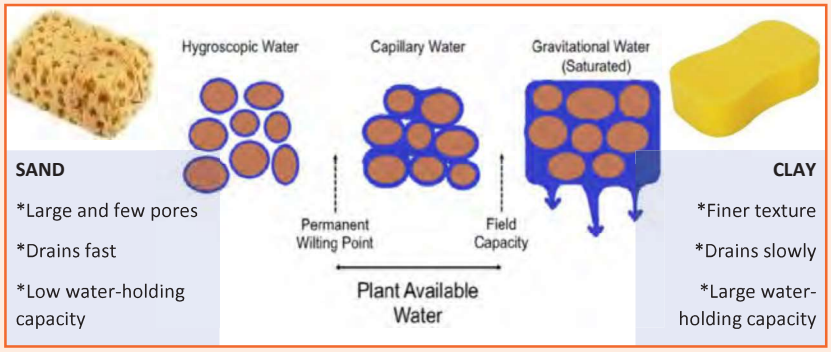
Soil type and soil reservoir

The amount of water soil can hold depends on the soil texture. Soil texture is the ratio of sand, silt and clay particles in soil. Soil type determines how many and how big the pores in the 'sponge' are, which in turn regulate how much water the sponge can hold. Generally, the finer the texture, the greater the water-holding capacity.

This means that clay-like soils can hold more water but drain slower than silty and sandy soils (with fewer and larger pores). Soil type therefore determines the field capacity, permanent wilting point and plant available water (PAW) of a soil *(Figure 4)*.

This means that sands need more frequent irrigation, but with smaller amounts. Loamy and clay soils can be irrigated less frequently with larger amounts of water.

Figure 4: Plant available water, field capacity and permanent wilting point of various soil types.



The goal is to maintain the soil water content near field capacity. It is not necessary to wet the soil deeply because most of the daily heat transfer and storage occur within the top 30 cm. It is best to wet dry soils well in advance of a frost event, so that the sun can warm up the soil. It is also very important not to irrigate the night before the cold is expected. Ample time needs to be allowed for the plants to dry off before the cold arrives.

In the next issue of *CHIPS*, we will be summarising the negative effects of both over- and under-irrigation on yield and quality.
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