Assessing soils for irrigation

When soils are investigated for irrigation purposes, there are a number of factors or aspects which must be taken into consideration:

**EFFECTIVE SOIL DEPTH**

Soil depth is one of the most important aspects which should be investigated. It not only influences the root development and soil water reservoir, but also the degree of drainage past the root zone. Over-irrigation usually takes place and this water must be able to drain away without any problems. Dig a profile hole, or use a soil auger to determine the depth of the soil down to the limiting layer. Basically, a limiting layer may be described as a layer with a poor water conductivity which is harder or denser than the soils above. If the soil depth is more than 900 mm, it may be classified as irrigable. Soil as shallow as 450 mm may be irrigated - provided cultivars with shallow root systems, such as planted pastures, are cultivated there. The soil may also be ridged for the planting of fruit trees, for example. However, this requires excellent irrigation management.

![Figure 1: Effect of impermeable layer on root development (tap root bent 90°) (Picture: GWK)](image)

**TEXTURE OF THE SOIL**

Soil texture influences, inter alia, infiltration rate, permeability, water holding capacity, internal drainage and the erodability of soils. The ideal texture is not too fine and not too coarse, and it must have a good distribution of particle sizes. A too-high sand content promotes wind erosion, causes low water holding and high infiltration rates. A too-low sand content results in soils which are difficult to cultivate, low infiltration rates and poor drainage properties. Soils of all texture classes are irrigable, but the following textures are undesirable within the effective root depth: clay, sandy clay, clay loam (> 35% clay), silt clay, silt clay loam (> 35% clay) and coarse sand. It must be remembered that the finer the soil particles, the greater the contact surface, the higher the volume of water held, the larger the volume of water that may be absorbed, the smaller the air pores and the greater the volume of water that is available to the crop.

<table>
<thead>
<tr>
<th>Texture</th>
<th>Clay content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>&lt;10% clay</td>
</tr>
<tr>
<td>Loamy sand</td>
<td>10 – 15% clay</td>
</tr>
<tr>
<td>Sand-loam</td>
<td>15 – 20% clay</td>
</tr>
<tr>
<td>Sand-clay-loam</td>
<td>20 – 35% clay</td>
</tr>
<tr>
<td>Clay-loam</td>
<td>27 – 40% clay</td>
</tr>
<tr>
<td>Sand-clay</td>
<td>35 – 55% clay</td>
</tr>
<tr>
<td>Clay</td>
<td>&gt;55% clay</td>
</tr>
</tbody>
</table>

![Figure 2: Soil texture chart (Irrigation Design Manual, ARC-IAE)](image)
SOIL STRUCTURE
A moderately developed granular structure is preferable. The structure must be stable in water and therefore not dispersive, or else soil crusting can develop. Soil crusting leads to aeration problems, low infiltration rates and increases the erodability of the soil. A too strongly developed structure is indicative of high clay content with its accompanying problems.

SOIL CHEMISTRY
Provided the pH of the soil lies between 7,5 and 5,5, and the soil’s electrical conductivity is less than 300 mS/m, the soil is suitable for irrigation. If these values are exceeded, the sodium (Na) adsorption ratio (SAR) and the exchangeable sodium percentage (ESP) must be determined. Under these circumstances, it is advisable to contact your local soil expert for advice. The SAR is determined by the ratio of Na to Calcium (Ca) and Magnesium (Mg) (Na:(Ca + Mg)) in soils. A high SAR-value may indicate sodium problems in the soil. The SAR of a soil is approximately equal to (1 to 2 times) the exchangeable sodium percentage (ESP) of the soil. The ESP gives a very good indication of the structural stability of a soil and the physical reaction that can be expected when the soil is irrigated. If the soil pH is lower than 5,5, the possibility of aluminium poisoning exists.
COLOUR OF THE SOIL
Although the colour of soil can give an indication as to the irrigability of the soil, the soil profile should be inspected and sampled for chemical analysis for the best recommendation. The colour of the soil alone should not be relied upon.

QUALITY OF IRRIGATION WATER
The quality of the water used for irrigation is very important. Water with an electrical conductivity (EC) in excess of 40 mS/m may lead to soil salinisation, unless some of the salts are leached and soil is well drained and permeable. In the case of sodic soils (where more than 15% of the element ions attached to the clay particles are sodium – i.e. soils with a high SAR), irrigation with water with low ECs will affect the structure of the soil and can lead to infiltration problems due to dispersion and crusting. If water quality doesn’t meet the recommended criteria, a soil expert should be consulted.

In the next article, we look at the use of crop coefficients and other factors for the determination of the crop water requirements.

REFERENCES
Irrigation Design Manual, ARC – Institute for Agricultural Engineering, Pretoria