Information Sheet

5. IRRIGATION

5.6 Water Quality

Introduction

The quality of river, dam or borehole water plays a significant role in determining the success or failure of irrigated sugarcane production in South Africa. If irrigation water is of good quality, the soils to which it is applied may be improved because of the calcium in the water and the beneficial effects derived from leaching any excess salts from the soil. On the other hand, irrigation with poor quality water which is saline and/or sodic can induce water stress, reduce soil permeability and lead to a marked decline in crop yield. A paired site survey conducted in 1995 (van Antwerpen and Meyer, 1996) which compared irrigated soils under commercial cane production with those from adjacent virgin bush showed that on average the cultivated soils were slightly more saline, but considerably more sodic (about 2 SAR units) than the virgin soils (see Figure 1).

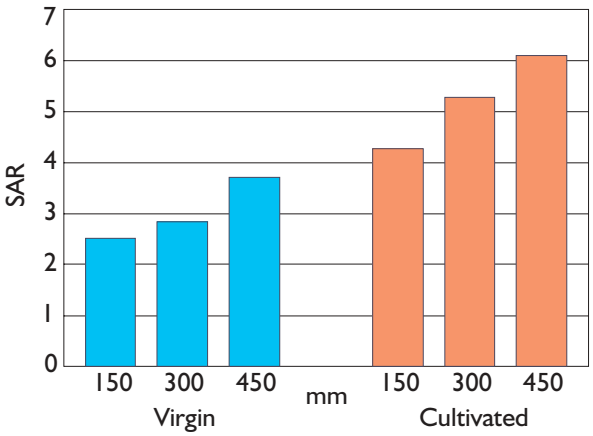

Figure 1. Build-up of sodicity in cultivated soils compared with virgin soils (irrigated areas).

Figure 2. Good quality water is essential for irrigation purposes.

A recent survey of river water quality in the South African cane belt (Meyer and van Antwerpen, 1995) showed that several rivers have moderate to high levels of salt and sodium, especially during periods of low flow (see Figure 3). **To keep soil degradation to a minimum and sustain crop yields, it is extremely important for growers to regularly monitor the quality of their irrigation water by sending samples for analysis to the Fertiliser Advisory Service (FAS) laboratories at Mount Edgecombe.**

Collection of water samples

For water quality analysis to be meaningful, great care should be exercised when taking water samples. The following precautions are recommended:

- Use a PVC container that holds at least a quarter of a litre, and does not leak when sealed.
- Make sure that a **clean** container is used.

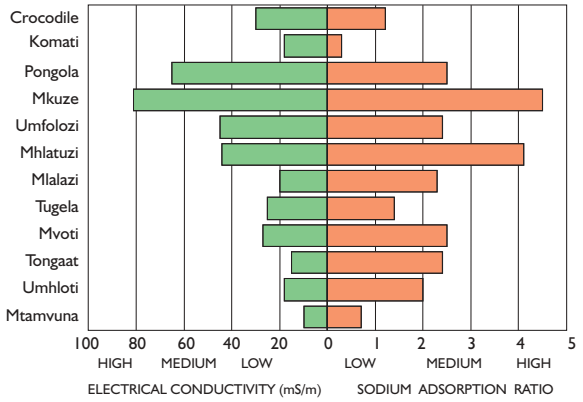

Figure 3. Salinity/sodicity hazard of selected rivers in the South African sugar belt.

- Rinse the container at least twice with the water source to be analysed.
- Select the point of collection carefully:
  - avoid sampling close to the edge of an open water source such as a river or dam
  - collect water as close as possible to the intake from where it is pumped to the field
  - let the water run for some time before it is collected from a pipe.
- Seal the container immediately.
- Attach all relevant information on the **blue water sample label** supplied by FAS, including source of water, mean annual rainfall and the purpose for which the water is to be used.

Water analysis

Four major chacteristics determine quality of water for irrigation:

- **Total concentration of soluble salts** as measured by **electrical conductivity (EC)**. This is expressed as **milli-siemens per metre (mS/m)**, and the higher the EC value the higher the concentration of salts.
- **The concentration of sodium (Na)** and the **proportion of sodium to calcium (Ca) plus magnesium (Mg)**, known as the **sodium adsorption ratio (SAR)**. The higher this ratio the higher the sodium concentration of the water.
- **pH and the concentration of bicarbonates**. A water pH of more than 8,4 is not only an indication of a high sodium concentration, but also the presence of bicarbonates. Bicarbonates in the soil solution will precipitate out as insoluble Ca and Mg carbonates and result in a reduced Ca + Mg content relative to sodium. This effectively increases the SAR of the soil solution, leading to soil physical problems.
- **The occurrence of minor elements** such as **boron** in amounts that are toxic.

Water quality assessment

Factors influencing EC and SAR values

- **Rainfall** – due to the diluting effect of rain, EC values have to be corrected according to local mean annual rainfall to obtain an effective EC value (EEC).
- **Bicarbonate** – the SAR value has to be adjusted to accommodate the increased sodium hazard caused by bicarbonate in the water (ASAR).

The EC and SAR values of all water samples analysed by FAS are adjusted accordingly.

The relationship between ASAR and EEC is used to determine the quality class of irrigation water (see Figure 4).

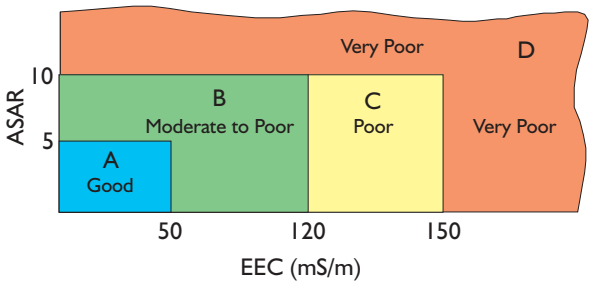

Figure 4. SASEX diagram for classification of water quality.

Explanation of water classes

Class A

Suitable for use on all irrigated soils. Soils that do not qualify are those with extremely low permeability, or excessive salinity/sodicity levels.

Class B

Suitable for irrigation of well drained soils only. Salinity and/or sodicity hazards make it unsuitable for safe irrigation of poorly drained soils, eg Bonheim, Estcourt, Katspruit, Kroonstad, Rensburg, Swartland and Valsrivier form soils.

Class C

Poor quality water which can only be used on well drained soils if water of better quality is not available. Excessive salinity may reduce the normal growth response expected under irrigation. Particular care should be taken to avoid waterlogging. For sprinkler irrigation the maximum tolerable EEC value is 220 mS/m.

Class D

Unsuitable for irrigation of sugarcane under normal irrigation practice.

An alternative system of water classification is that used by the United States Department of Agriculture (see Figure 5).

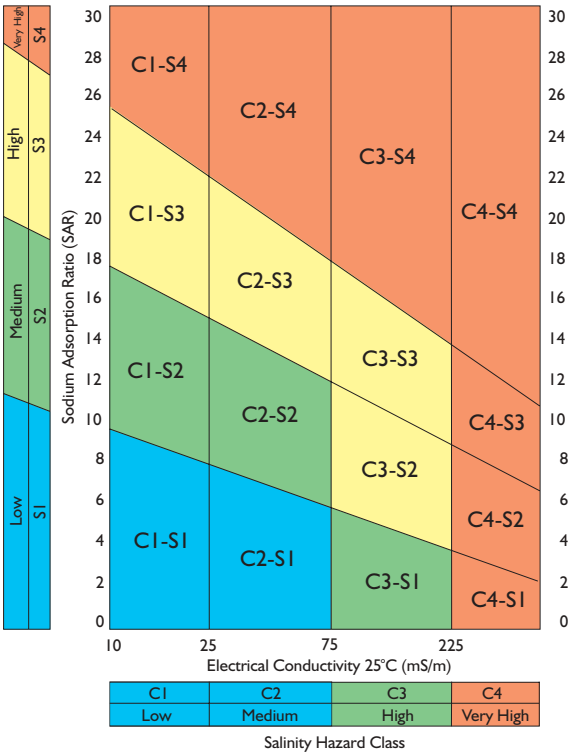

Figure 5. United States Department of Agriculture diagram for classification of irrigation water (this uses the FAS, EC and SAR values directly).

Salinity classification

C1 *Low salinity water*; can be used for irrigation on most soils.

C2 *Medium salinity water*; can be used if a moderate amount of leaching occurs.

C3 *High salinity water*; cannot be used on soils with restricted drainage. Special management practices for salinity control are advised when used on soils with adequate drainage.

C4 *Very high salinity water*; is not suitable for irrigation under ordinary conditions but may be used occasionally under very special circumstances. The soil must be permeable, drainage must be adequate and irrigation water must be applied in excess to provide considerable leaching.

Sodium classification

S1 *Low sodium water*; can be used for irrigation on almost all soils, with little danger of the development of a sodium problem.

S2 *Medium sodium water*; may present a moderate sodium problem in clay soils unless gypsum is applied. This water can be used on well drained sandy soils and soils high in organic matter content.

S3 *High sodium water*; may produce troublesome sodium problems in most soils and will require special management such as good drainage, high leaching and the additions of organic matter.

S4 *Very high sodium water*; is generally not suitable for irrigation except at low or medium salinity levels where it may be used in conjunction with gypsum or some other amendment.

References:

Meyer JH and van Antwerpen R (1995). Trends in water quality of selected rivers in the South African sugar industry. Paper presented at the 69th Congress of the South African Sugar Technologists' Association.

van Antwerpen R and Meyer JH (1996). Soil degradation under sugarcane cultivation in northern KwaZulu-Natal. Paper presented at the 70th Congress of the South African Sugar Technologists' Association.

November 1997