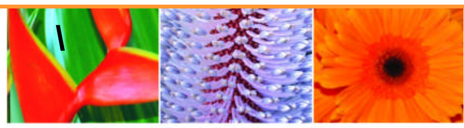
Fact Sheet



FAQI

Flower Association of Queensland Inc.
www.flowersqueensland.asn.au

Effects of water quality on plants and soil

Soil

Using a salt tolerant plant is not a silver bullet when it comes to using salt laden water for irrigation. It is important to be aware that salts in the water can build up through evaporative concentration and can damage both plants and soil.

Sodicity

This is the effect the irrigation water will have on the physical properties of the soil due to an accumulation of sodium.
Sodium can affect plants and soil in three ways:

1. By destroying soil structure causing clay particles to disperse rather than cling together as small peds (coarse blocky texture, crust formation after rain or irrigation) and reducing water movement (permeability) and aeration in the soil.
2. By poisoning sodium sensitive plants when absorbed by either their roots or leaves.
3. Calcium and/or potassium deficiencies may occur if the soil or irrigation water is high in sodium.

Sodium adsorption ratio (SAR)

The sodium adsorption ratio is an indicator of the relative proportion of sodium ions in a water sample to those of calcium and magnesium. SAR is used to predict the sodium hazard of water.
The sodium adsorption ratio is used to predict the potential for sodium to accumulate in the soil, which would result from continued use of a sodic water. A water sample with a high SAR and a low residual alkalinity usually has high sodium content due to the predominance of sodium chloride.
In order to calculate the SAR from water analysis data it is essential to convert the units from parts per million or milligrams per litre to milliequivalents per litre:

$$meq / L = \frac{ppmor(mg / L)}{Equivalent\ Weight}$$

SOUTH EAST QUEENSLAND IRRIGATION FUTURES SEQ-IF
Rural Water Use Efficiency for South East Queensland

RURAL WATER USE EFFICIENCY INITIATIVE
Improving irrigation management for a profitable and sustainable future

Queensland Government
Natural Resources and Water

Queensland Government
Department of Primary Industries and Fisheries

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Where equivalent weights are:

Calcium = 20
Magnesium = 12.2
Sodium = 23

Bicarbonate = 61
Carbonate = 30

$$SAR = \frac{Na}{\sqrt{\frac{(Ca+Mg)}{2}}}$$

This parameter quantifies the ratio of sodium to calcium and magnesium in terms of the ability of sodium to dominate the exchange complex of the soil. The lower the SAR the less likely the water is to cause structural degradation of susceptible soils. Table 1 outlines the levels at which SAR indicates a hazard to soil structure. The susceptibility of differing soil types to degradation is then further quantified in Table 2.

Table 1 Hazard levels for SAR

SAR	Hazard
<10	Safe to irrigate with no structural deterioration but may affect salt sensitive plants depending on EC/TDS
10-18	Hazard on fine textured soils with a high cation exchange capacity. OK on coarse textured soils with good drainage
18-26	Hazard on most soils. Need to manage with amendments and drainage i.e. leaching.
26	Not suitable for irrigation.

Table 2 SAR limits based on soil

Soil	No Hazard	Slight – Moderate hazard	Severe hazard
2:1 clays	<6	6-9	>9
1:1 clays	<16	16-24	>24
Sand, ECw>1.5 dS/m	<16	16-24	>24
Sand, ECw<1.5 dS/m	<6	6-9	>9

2:1 clays such as montmorillonite, illite and smectite are the common clay minerals found in black earths and yellow solodic soils. 1:1 clays such as kaolinite are commonly found in self mulching red-brown earths (krasnozems). The SAR at which a 2:1 clay is at risk is lower than for a 1:1 clay, as the bonds holding the 2:1 clay platelets together are more unstable in water than those of a 1:1 clay mineral.

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Effective SAR

The SAR can be corrected to allow for calcium carbonate precipitation. It usually raises the reading for SAR because the presence of calcium can result in the SAR understating the importance of sodium in a water sample.

Residual alkalinity (RA)

Residual alkalinity represents the amount of sodium carbonate and sodium bicarbonate in the water and is said to be present in a water sample if the concentration of carbonate and bicarbonate ions exceed the concentrations of calcium and magnesium ions. Residual alkalinity is usually expressed as milliequivalents per litre (meq/L) of sodium carbonate, or on some analysis reports as calcium carbonate.

When irrigation water containing residual alkalinity is used on clay soils containing exchangeable calcium and magnesium, sodium from the residual alkalinity in the water will replace calcium and magnesium in the soil. An increase of sodium content in clay soils may cause structural damage.

RA predicts the accumulation of sodium in the soil based on the potential precipitation of calcium/magnesium carbonate.

$$RA = (CO_3 + HCO_3) - (Ca + Mg)$$

A negative RA indicates water is unlikely to cause structural degradation. An RA greater than 1.25 indicates a potential hazard to soil structure. Additions of calcium source (eg Gypsum) or acidification of the water prior to use may be required.

SI

The saturation index (SI) of water is a relationship between pH, salinity, alkalinity and hardness. It assesses the potential of the water to cause scaling and precipitation (positive number) or corrosion (negative number).

If SI is between –0.5 and + 0.5, there is little likelihood of scaling or corrosion.
If SI is between + 0.5 and + 1.5, there is moderate risk of scaling.
If SI is > + 1.5, there is strong risk of scaling.
If SI is between –0.5 and –1.5, there is moderate risk of corrosion.

Leaching requirement

It is possible to ensure that salt levels in the soil do not exceed that of the irrigation water by leaching the salt beyond the rootzone. Adequate drainage should ensure that this salt laden water does not cause further environmental damage.
The fraction of irrigation water that must pass through the rootzone to control salts at an acceptable level is described as the leaching requirement or leaching fraction, derived from the following equation.

$$LR = \frac{EC_w}{5EC_{ec} - EC_w}$$

Where:
EC_w = irrigation water salinity (dS/m)
EC_{ec} = Crop Electrical Conductivity Threshold if known (dS/m)
Salinity Threshold = chosen value based on knowledge of plant tolerances and soil type