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Water Quality for Irrigation

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Water Quality for Irrigation

Question:

As landscape architects we often come across situations where it is possible to irrigate with recycled or non-mains water. Can you explain what water quality we should be looking for when considering such water for irrigation?

Answer:

Before considering a water for irrigation purpose information on the total dissolved salts, and the composition of those salts must be known.

The **total salt level** in an irrigation water is usually assessed by measuring the **electrical conductance (or EC)** of the water. The common units used are the mS/cm (same as dS/m) or uS/cm. Thus a salinity or EC measurement of 1 mS/cm is the same as 1000 uS/cm. These are units of electrical conductance, the principal being that salty water conducts electricity (low resistance) and pure water does not (high electrical resistance).

The other unit often used is milligrams of salt per litre (mg/l or ppm). Electrical conductance can be converted to total dissolved salt by using a factor of 640. Thus 1 mS/cm approximately equals 640 mg/l of dissolved salt.

The scale is interpreted for use as irrigation using Table 1.0

Table 1.0 Interpretation of EC values.

| EC | Class | Interpretation |
|-------------|-------|--|
| 0 - 0.28 | 1 | Low salinity water suitable for use on most crops with few restrictions except on soils with very low permeability |
| 0.28 - 0.80 | 2 | Medium salinity water posing few restrictions if some leaching occurs on reasonably drained soils. Under high evaporation and poor drainage some precautions needed. |
| 0.80 - 2.3 | 3 | High salinity water cannot be used on soils with poor drainage. Even with good drainage efforts must be made to encourage leaching and salt tolerant crops must usually be used. |
| 2.3 - 5.5 | 4 | Very high salinity water must be used only on well drained soils with salt tolerant crops and constant salinity monitoring and leaching. |
| > 5.5 | 5 | Extremely high salinity water almost totally unusable even with strict precautions. Occasional emergency use in mild weather only. |

The total salinity present in the water is one, and probably the most important, determinant.

The other important factors are the sodium content, and the alkalinity.

Sodium is not a plant nutrient and can be harmful to soils, causing clay dispersion and salinisation, and to plants where it can cause tissue damage. EC or total dissolved salts tells us nothing about what salts are present. Thus a salinity of say 1.0 dS/m due largely to calcium is less harmful than if that salinity were due to sodium. This factor is expressed as the SAR or sodium absorption ratio. This expresses the ratio of sodium to calcium and magnesium. The

units are complex but suffice it to say that SAR should be considered again as a sliding scale illustrated by Table 2.

Table 2.0 Interpretation of SAR values.

| SAR | Interpretation |
|------|--|
| < 5 | few problems except under continued use with inadequate replacement of calcium as lime or gypsum. |
| 5-15 | Increasing problems. Soil salinity, and exchangeable sodium levels be monitored regularly and calcium supplements made or the water modified by the addition of soluble calcium. |
| 15 | Almost unusable unless the water is modified by the addition of calcium with low salinity water this is easily done. |

Alkalinity is a further problem usually associated with sodium. Alkaline water can push up the pH of the soil to unacceptable levels causing continued iron deficiency. This is made worse by poor drainage and salt accumulation. Soil must be regularly acidified (usually with Ag S or iron sulphate) or the water treated with acid agents. The effect of alkalinity can be predicted only by knowing the alkalinity of the water, the amount of water added, and the buffer capacity of the soil. The usual unit of alkalinity is mg of lime equivalent per litre.

From these few measurements we can make a good estimate of how the water will behave and what management practices are needed to control salinity build up. The perfect water quality for few management restraints would be-

| | |
|----------------------------|--|
| Total dissolved salt (TDS) | < 175 mg/l |
| EC | < 0.28 dS/m |
| SAR | < 5mmol ^{1/2} l ^{1/2} |
| Total alkalinity | < 150 mg/l (depends on soil buffer capacity) |

Notice that constant reference is made, during the interpretation to soil drainage, plant tolerance, and the need for leaching as water quality deteriorates. It is implicit that while it is possible to use a wide variety of water quality for irrigation of soils and plants, with declining water quality management procedures become more demanding and the requirements of the soils and plants become more restrictive. Failure to match the soil with the water and the management type can result in damage to soils and plants.

The **management procedures** used to prevent salt build up are-

Soil Drainage. To control salts soil must be permeable. Thus a sand is much more forgiving of poor water quality than a heavy clay. This is largely because a permeable soil can be leached to wash out salts.

Leaching. Leaching is the usual tool we use to control salt build up and to reduce salt levels once they have got out of hand. By regular monitoring of soil salt levels the need for or effectiveness of leaching programs can be measured. Generally, the higher the salt level in the water, and the more arid the climate, the greater will be the requirement for leaching. Leaching requirements can be calculated (See Handreck and Black) or the manager can profile the soil regularly using a salt meter after attempted leachings (the monitoring approach).

Irrigation frequency and duration. Irrigation scheduling can seriously affect salt accumulation. Light, daily watering is bound to cause salt build up in the surface soil due to evaporation whereas deep, slow, and long irrigation will mitigate against such build up. I would rather see a fortnightly to monthly deep irrigation of the whole soil profile than frequent light

irrigations. Sprinkler systems are more effective at leaching than point source systems such as drippers, unless the drippers are at high densities.

Soil and water amelioration. Water can be modified with agents such as calcium sulphate (gypsum) to improve SAR, iron sulphate to decrease alkalinity, or even lime if the water is too acidifying. Remember, however, that anything you add to water increases its salinity further so that these options are usually only available if the existing salinity is moderate or low.

Soils can be modified by applying gypsum, acidifying agents and other chemicals. Often the major soil modification required is drainage so that leaching can be achieved.

Plant Selection. With other management options such as good drainage being unavailable it is often necessary to select plant lists to tolerate the salinity that you know will occur from time to time. Thus Azaleas might be ruled out where soil drainage is poor and water quality is low, and alternative shrubs such as Melaleuca chosen for their salt tolerance. "Grow What Where" is a useful text for such selection of plants.

References and further reading.

Handreck, K. H., and Black, N. D. (1994) *Growing Media for Ornamental Plants and Turf*. UNSW Press. Randwick NSW.

Australian Plant Study Group (1984). *Grow What Where*. Thomas Nelson. Melbourne Australia.