



The salinity risks with irrigation



Australian Government

What are the hazards?

There are three obvious salinity risks associated with irrigation:

1. The irrigation water may contain high levels of salt that may either directly affect plant growth or add salt to the soil so that plant growth is eventually affected by the increasing level of soil salinity.
2. Applying more irrigation water than is actually required by plants may raise the water table under the area. If the water table is saline, and shallow enough to be in the root zone, plant growth could be affected. Deeper saline water tables may also be a problem; if within 2 metres of the surface dissolved salt can be moved into the root zone by capillary movement in profiles with a high clay content.
3. Irrigated cropping changes the water balance in a number of ways compared to perennial pasture. A key factor is cultivation, and fallowing before sowing. During this period, evapo-transpiration is reduced and more water will infiltrate to the groundwater, with the potential to raise the level of a saline water table.

In summary, the main irrigation hazards are applying salts to the plants and the soil if the water is saline, and raising the height of a saline water table.

Salt in the irrigation water

The most common salt in irrigation water is sodium chloride. There will be other types of salts, particularly in bore water, but for the most part we need to concentrate only on common salt.

Salt in the water has three effects on plants:

1. Direct ion toxicity. Both sodium and chloride cause leaf burning, particularly in woody crops (e.g., tree fruits).
2. Nutrient interactions. High levels of sodium and chloride in the soil can increase the availability and uptake of other ions in the soil, to the extent that they become toxic, for example cadmium and boron. High salt levels can also reduce the availability of some elements, for example calcium, to the extent that they become deficient.

3. Osmotic effects. High salt concentrations in the soil water make it more difficult for plant roots to extract water from the soil. This increases water stress to the extent that plants may wilt while sitting in water.

Measuring and classifying water salinity

Water salinity is easily measured with a conductivity meter; electrical conductivity (EC_w) of water is directly related to the salt level, the type of salt, and temperature. Most conductivity meters have in-built temperature compensation and the main salt is usually sodium chloride, so EC meters can quickly and cheaply measure the salinity of a water sample.

Conductivity meters read EC in various units, but the standard unit is deci-Siemens/metre (dS/m).

You can convert “conductivity” reported as dS/m to “parts per million of salt” (ppm) by multiplying by 640. Also 1dS/m is equivalent to 1000 microS/cm or 1000 EC Units.

Table 1. Water salinity classes for irrigation

Class	Level	EC _w , dS/m	Comments
1	Low	0–0.28	Generally suitable
2	Medium	0.28–0.8	Sensitive crops affected
3	High	0.8–2.3	Need good drainage; only for tolerant crops
4	Very High	2.3–5.5	Only plants with high tolerance
5	Extreme	>5.5	No use for irrigation

Class 1. Suitable for most crops on most soils, with little chance of developing a salinity problem.

Class 2. May cause leaf scorch on sensitive crops, especially under high temperatures.

Class 3. Should not be used on soils with restricted drainage. With adequate drainage, management for salinity control will still be needed.

Crop tolerance to irrigation water salinity

Table 2 shows examples of crop tolerance to water salinity, with EC_w levels at which crop yields are reduced by 10 and 25%. A detailed list is in Saltpak¹.

Table 2. Crop tolerances to water salinity

Crop/pasture	Irrigation water salinity, EC _w (dS/m)		Crop tolerance rating
	Up to 10% yield loss	25% yield loss	
Barley	5.3	8.7	Very High
Pea	1.7	2.4	Medium
Potato	1.1	2.5	Low
Onion	0.8	1.8	Low
Bean	0.7	12.5	Low
Tall Wheat Grass	5.0	9.0	High
Perennial Rye Grass	3.7	5.9	High
Lucerne	1.3	3.6	Medium
Strawberry Clover	1.1	2.6	Low
White Clover	1.0	2.4	Low

The risk of accumulating salt in the soil

If salt added through saline irrigation water is not leached by rainfall or irrigation water in excess of crop water requirements, there is a risk of salt accumulating in the soil profile and eventually affecting plant growth.

For example, water of 1 dS/m salinity contains about 640 parts per million of salt. That is equivalent to 640 kilograms of salt per million litres (megalitres) of water applied to the land (a megalitre is equivalent to 100 mm of water over 1 hectare).

Leaching will occur naturally in most areas of Tasmania in wet winters, but in heavy clay subsoils leaching is restricted and may not occur quickly enough to avoid an increase in salinity levels. In these circumstances, monitoring subsoil salinity is important.

Risk of excess irrigation water raising the water table

In some of the lower rainfall areas of the State, high salinity groundwater is present under good cropping land. Cropping and irrigation management systems generally result in more water leaking through the soil profile to the water table. This can result from irrigation directly, from heavy rain to an area where the soil is already wet due to irrigation, or from rainfall to an area that is fallowed before a crop is sown.

In some situations, the presence of a saline water table may not be apparent at the surface. The change to irrigated cropping is most likely to increase the leakage of water to the groundwater and raise the level. If the level of a saline water table rises to within about 2 metres of the surface, salt may be moved into the root zone by capillary movement of water through the soil, adversely affecting plant growth.

What can you do?

Measure the salinity of the water that you are using for irrigation. Salinity can vary throughout the year, so check it regularly. An EC meter can be purchased for around \$150.

Find out whether there is a saline water table under the area that is being irrigated. This is particularly important in the areas of the State where salinity risks are higher (for example, lower rainfall, flat areas and drainage lines near areas with surface expressions of salinity). In these areas drill test holes to 5 metres and check for saline groundwater; install piezometers and monitor the groundwater depth and salinity. Sometimes a freshly drilled hole will not reveal groundwater immediately after drilling, so allow a week for groundwater to seep into the bore.

If irrigating with Medium or High salinity water, monitor soil salinity levels by measuring at the soil surface and in the subsoil.

If the irrigation water is saline, make sure that surface drainage is good. Preferably, do not apply Medium or High salinity water to poorly drained soils because there will be less leaching than where the soil profile is well-drained.

Irrigating at night will reduce the direct effects of salt on the leaves of plants.

Keep soil moisture levels high by irrigating with smaller amounts less often. This reduces the opportunity for salt in the soil water to concentrate between irrigations.

Growing crops on mounds or raised beds will provide a volume of soil that is better drained, and irrigation will provide some leaching of salts from the root zone.

Use an irrigation scheduling system to ensure that irrigation water applications do not exceed the water holding capacity of the soil.

Consider mixing High salinity water with better quality water if another source is available – “shandyng” water is a good strategy.

¹ Saltpak Tasmania. Tasmanian Department of Primary Industry and Fisheries.

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