

# Salinity tolerance in irrigated crops

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Agriculture NSW Water Unit

Different crops can tolerate different levels of salinity in irrigation water. The tolerance of plants to salinity is mainly influenced by:

- climate, particularly the abundance or lack of rainfall to leach salts from soils
- soil types and drainage characteristics within the root zone which influence the ease of leaching and salt accumulation

Other factors include rootstock or variety, irrigation method (surface or flood, overhead sprinkler, drip), stage of plant growth and irrigation management.

Salinity tolerances of some commonly irrigated crops and forage plants in NSW are grouped into the following categories:

- vegetable crops (Table 1)
- fruit and nut crops (Table 2)
- field crops (Table 3)
- forage crops, pasture grasses and clovers (Table 4)

The salinity tolerance levels shown below are indicative only, and refer to crops growing in moderate to slow draining soils (the drainage characteristic occurring most frequently in soils used for irrigation) in an inland climate in NSW. Crop salinity tolerances can be up to 50 per cent higher than shown below in well-drained soils such as deep sandy loams where percolation and leaching are rapid. In very slow draining soils, such as the medium to heavy clays of the rice growing regions, tolerances can be down to about half the levels shown.

If irrigation water is saline, a leaching requirement (additional water applied to drain past the root zone) is desirable to avoid excess accumulation of salt in the plant root zone.

## Measuring salinity in water

Salinity in irrigation water is measured by electrical conductivity EC<sub>w</sub> (see *Agfact: How salinity is measured*). Salinity levels in the tables below are expressed as decisiemens per metre (dS/m) at 25°C.

Some publications express salinity as EC units (the same as microsiemens per centimetre, µS/cm) or mg/kg (the same as parts per million). The conversion factor is:

1 dS/m = 1000 EC (or µS/cm) = approximately 640 mg/kg (or ppm)

Note that one megalitre at EC<sub>w</sub> 1 dS/m contains about 640 kg of salts.

## References for these values

Salinity tolerances mostly adapted from *Primefact 1337 Farm water quality and treatment*, and ANZECC *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. In some cases, research findings (published and unpublished/personal communication) by Australian scientists were adopted.

**Table 1. Vegetable crops water salinity tolerance (EC<sub>w</sub>)**

This table indicates the yield reductions which could be expected when various vegetable crops are irrigated with saline water.

Vegetable crop	No reduction (dS/m)	10% reduction (dS/m)
Zucchini	3.1	3.8
Garden beet	2.7	3.4
Broccoli	1.9	2.6
Cucumber	1.7	2.2
Tomato	1.7	1.9
Cantaloupe/rockmelon	1.4	2.4
Watermelon	1.3	na
Spinach	1.3	2.2
Cabbage	1.2	1.9
Celery	1.2	2.2
Broad bean	1.1	1.8
Potato	1.1	1.7
Sweet potato	1.0	1.6
Capsicum	1.0	1.5
Sweet corn	1.0	1.7
Lettuce	0.9	1.4
Onion	0.8	1.2
Eggplant	0.7	1.6
Carrot	0.7	1.2
Beans	0.7	1.0
Radish	0.7	0.9
Turnip	0.6	1.3

Note: The salinity tolerance of seedlings of most vegetable plants is likely to be less than the levels shown.

**Table 2. Fruit and nut crops water salinity tolerance (EC<sub>w</sub>)**

This table indicates the yield reductions which could be expected when various fruit and nut crops are irrigated with saline water.

Fruit and nut crop	No reduction (dS/m)	10% reduction (dS/m)
Date	2.7	4.5
Fig	2.7	NA
Olive	2.6	3.0
Grapefruit	1.2	1.6
Walnut	1.1	1.6
Orange	1.1	1.6
Peach	1.1	1.4
Apricot	1.1	1.3
Grape	1.0	1.7

Fruit and nut crop	No reduction (dS/m)	10% reduction (dS/m)
Almond	1.0	1.4
Plum	1.0	1.4
Boysenberry	1.0	1.3
Avocado	0.8	1.0
Pear	0.7	na
Prune	0.7	na
Apple	0.7	1.0
Raspberry	0.7	1.0
Strawberry	0.7	0.9
Lemon	0.7	na

**Note:** Variety of rootstock may have a bearing on salinity tolerance of some fruit trees.

**Table 3. Field crops water salinity tolerance (EC<sub>w</sub>)**

This table indicates the yield reductions which could be expected when various field crops are irrigated with saline water.

Field crop	No reduction (dS/m)	10% reduction (dS/m)
Barley	5.3	6.7
Sugar beet	4.7	5.8
Canola	4.3	7.3
Safflower	4.3	NA
Wheat	4.0	4.9
Millet	4.0	4.8
Sunflower	3.6	3.9
Oats	3.3	4.2
Cotton	1.7	see note
Sesbania	1.5	2.5
Sugarcane	1.1	2.2
Faba bean	1.1	1.8
Linseed/flax	1.1	1.7
Maize	1.1	1.7
Peanut	1.1	1.4
Rice	1.0	1.3
Cowpea	10	1.7
Grain sorghum	1.0	1.4
Soybean	1.0	1.3
Beans (field)	0.7	1.0

**Notes:** During the early seedling stage of the most tolerant crops, EC<sub>w</sub> should not exceed 3.0 dS/m.

Salinity tolerances can vary between crop varieties.

**Wheat:** Durum wheat is less salt tolerant than bread wheat.

**Cotton:** Tolerance level for cotton is the average for the growing season. Yield reductions with adult cotton begin at 5.1 dS/m EC<sub>w</sub>, but as little as 1.0 dS/m can affect seedlings in moderate to slow draining soils. Experience in northern NSW indicates that yields decline rapidly after the initial threshold is reached, due mainly to the toxic effect of the chloride inducing a potassium deficiency, rather than the effect of salinity alone.

**Peanuts:** Tolerance levels shown for peanuts are those which affect pod growth, even though the plant may tolerate higher salinity.

**Soybeans:** Tolerance of soybeans is about half the level shown if they have not been grown in the field before (insufficient volume of suitable strain of Rhizobium).

**Rice:** Tolerance levels for rice are for very slow draining soils only, and during the establishment and reproductive phases. EC<sub>w</sub> threshold can increase to 2.0 dS/m during the vegetative (mid-season) stage.

#### Table 4. Forage crops, pasture grasses and clovers water salinity tolerance (EC<sub>w</sub>)

This table indicates the yield reductions which could be expected when various pasture and forage crops are irrigated with saline water.

Crop	No reduction (dS/m)	10% reduction (dS/m)
<b>Forage crops</b>		
Jap millet	4.0	6.0
Oats	3.3	4.2
Sudan grass	1.9	3.4
Corn (forage)	1.2	2.1
<b>Grasses</b>		
Puccinellia	10.0	14.5
Tall wheat grass	5.0	6.6
Couch grass	4.6	5.7
Rhodes grass	4.6	6.6
Buffel grass (Nunbank)	4.0	5.0
Perennial ryegrass	3.7	4.6
Buffel grass (Gayndah)	3.6	4.3
Phalaris	2.8	3.5
Fescue	2.6	3.8
Crested wheat grass	2.3	4.0
Paspalum	2.6	3.3
Kikuyu	2.0	4.1
Green panic	2.0	2.9
Setaria (Nandi)	1.6	2.2
Pangola grass	1.4	3.0
Lovegrass	1.3	2.1
Cocksfoot	1.0	2.1
<b>Legumes</b>		
Berseem clover	4.0	6.6

Crop	No reduction (dS/m)	10% reduction (dS/m)
Vetch	2.0	2.6
Trefoil ( <i>Lotus pedunculatus</i> )	2.0	2.5
Barrel medic (Cyprus)	2.0	2.4
Balansa clover	2.0	NA
Persian clover (Shaftal)	2.0	NA
Stylo (Townsville)	1.6	2.0
Strawberry clover	1.6	2.0
Lucerne	1.3	2.2
Red clover	1.0	1.5
Snail medic	1.0	1.6
Subterranean clover	0.8	1.4
White clover	0.8	1.3
Rose clover	0.7	1.4
Barrel medic (Jemalong)	0.7	1.3

For further information contact your Local Land Service.

### More information

ANZECC and ARMCANZ 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, vol. 1, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, paper no. 4 in the National Water Quality Management Strategy, October 2000.

<http://www.environment.gov.au/system/files/resources/53cda9ea-7ec2-49d4-af29-d1dde09e96ef/files/nwqms-guidelines-4-vol1.pdf>

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