

IRRIGATION WATER QUALITY

SALINITY

The suitability of water for irrigation will be determined by two main criteria, salinity hazard and sodicity hazard. This document deals with the salinity hazard of water.

SALINITY

A salinity problem exists if the total quantity of salts in the irrigation water is high enough to cause salts to accumulate in the crop root zone to the extent that yields are affected.

Water can be placed in various salinity classes based on crop salt tolerances.

Conductivity (EC) (dS/m)	Total Dissolved Ions (mg/L)	Salinity Class (C)	Comment
<0.65	<420	1	Low salinity water, suitable for use on all crops, except the most salt sensitive, with all methods of water application, with little probability of a salinity problem developing.
0.65 – 1.3	420 - 830	2	Medium salinity, suitable for use on all but very low salt tolerance crops. Water can be used if a moderate amount of leaching occurs. Plants with medium salt tolerance can be grown, usually without special practices for salinity control. Sprinkler irrigation with the more saline waters in this group may cause leaf burn on salt-sensitive crops, especially at higher temperatures in the daytime when evaporation may be high.
1.3 – 3.0	830 – 1,920	3	High salinity - suitable for use on medium and high salt tolerant crops only. Water should not be used on soils with restricted drainage. Even with adequate drainage, special management for salinity control may be required.
3.0 – 5.0	1,920 – 3,200	4	Very high salinity - suitable for use only on high salt tolerant crops. For use soils must be permeable, free draining, and water must be applied in excess to provide considerable leaching.
5.0 – 8.0	3,200 – 5,120	5	Extremely high salinity generally unsuitable for irrigation unless soils are permeable, well drained and crops are of very high salt tolerance.
>8.0	>5,120	6	Too saline for irrigation.

Source: Interpreting water analysis for crop and pasture QDPI & F Note <http://www2.dpi.qld.gov.au/fieldcrops/3472.html>



SoilMate Fact Sheet WSAM1/2009

Total dissolved ions (TDI) = EC dS/m x 640

Total Soluble Salts (TSS) = TDI

CROP TOLERANCE TO SALINITY IN IRRIGATION WATER

FIELD CROPS

Very low tolerance Require EC < 0.7 dS/m	Low tolerance Require EC < 1.3 dS/m	Medium tolerance Require EC < 2.7 dS/cm	High tolerance Tolerate EC < 4.5 dS/cm	Very high tolerance EC < 5.5 dS/m
Bean	Broad bean Cowpea Linseed Maize Peanut Sugarcane	Lupin Oats Rice Rye Sesbania Sorghum Soybean	Canola Millet Safflower Sunflower Wheat	Barley Cotton Sugar beet

FRUIT CROPS

Very low tolerance EC < 0.7 dS/m	Low tolerance EC < 1.3 dS/m	Medium tolerance EC < 2.7 dS/cm	High tolerance EC < 4.5 dS/cm	Very high EC < 8.0 dS/m
Loquat Lychee Papaw Pecan nut Persimmon Raspberry Strawberry	Almond Apple Avocado Boysenberry Citrus fruit Grape Passionfruit Pear Stonefruit Walnut	Fig Mulberry Olive Pomegranate Rockmelon	Date palm	



Phone: 07 3220 2959 • Email: info@backpaddock.com.au • Web: www.backpaddock.com.au

SoilMate Fact Sheet WSAM1/2009

VEGETABLE CROPS

Very low EC < 0.7 dS/m	Low EC < 1.3 dS/m	Medium EC < 2.7 dS/cm	High EC < 3.5 dS/cm	Very high EC < 5.0 dS/m
Bean Carrot Eggplant Radish Turnip	Cabbage Capsicum Celery Lettuce Onion Potato Radish Sweet corn Sweet potato	Broccoli Cabbage Cauliflower Cucumber Pumpkin Rockmelon Spinach Tomato Watermelon	Zucchini	Asparagus Beetroot Kale Spinach

Pastures

Very low EC < 0.7 dS/m	Low EC < 1.3 dS/m	Medium EC < 2.7 dS/cm	High EC < 4.0 dS/cm	Very high EC < 5.5 dS/m
	Clovers – Kenya white, white, rose, sub, ladino, alsike Cocksfoot Desmodium Glycine Horse gram Lablab Lotononis Lovegrass Lucerne Setaria Stylos	Clovers – berseem, strawberry Kikuyu Medics – barrel, snail Paspalum Phalaris Sudan grass Tall fescue	Perennial ryegrass	Green couch Rhodes grass Extremely high EC < 8 dS/m Puccinellia Saltwater couch

Note: Many crops are less tolerant during germination and seedling growth.

Source: Gill J.Y. Agricultural Water Quality Assessment QDPI Information Series QI86018 ASSN 0727-6273



Phone: 07 3220 2959 • Email: info@backpaddock.com.au • Web: www.backpaddock.com.au

SoilMate Fact Sheet WSAM1/2009

Some crops are more tolerant to salinity during crop growth than at emergence while others are more tolerant to salinity at emergence than during growth.

	More tolerant at emergence	More tolerant during crop growth
Field crops		
Barley	Equal tolerance at emergence and growth	Equal tolerance at emergence and growth
Cotton		Slightly more tolerant during crop growth
Maize	More tolerant at emergence	
Rice	More tolerant at emergence	
Safflower		Slightly more tolerant during crop growth
Sorghum		Slightly more tolerant during crop growth
Wheat	Slightly more tolerant at emergence	
Vegetables		
Bean	More tolerant at emergence	
Cabbage	More tolerant at emergence	
Lettuce	More tolerant at emergence	
Onion	More tolerant at emergence	
tomato	Equal tolerance at emergence and growth	Equal tolerance at emergence and growth
Pastures		
Cowpea	More tolerant at emergence	
lucerne	Equal or more tolerance at emergence	

For a given soil type, crop yields are adversely affected by increasing water salinity as the following table shows.

Crop	Yield potential, EC dS/m (assumes a sandy loam type soil)			
	100%	90%	75%	50%
Field crops				
Barley	5.0	6.7	8.7	12.0
Bean (field)	0.7	1.0	1.5	2.4
Broad bean	1.1	1.8	2.0	4.5
Cotton	5.1	6.4	8.4	12.0
Cowpea	0.9	1.3	2.1	3.2



Phone: 07 3220 2959 • Email: info@backpaddock.com.au • Web: www.backpaddock.com.au

SoilMate Fact Sheet WSAM1/2009

Crop	Yield potential, EC dS/m (assumes a sandy loam type soil)			
	100%	90%	75%	50%
Flax	1.1	1.7	2.5	3.9
Maize	1.1	1.7	2.5	3.9
Peanut	2.1	2.4	2.7	3.3
Rice	2.0	2.6	3.4	4.8
Safflower	3.5	4.1	5.0	6.6
Sorghum	2.7	3.4	4.8	7.2
Soybean	3.3	3.7	4.2	5.0
Wheat	4.0	4.9	6.4	8.7
Fruit crops				
Almond	1.0	1.4	1.9	2.7
Apple, pear	1.0	1.6	2.2	3.2
Apricot	1.1	1.3	1.8	2.5
Avocado	0.9	1.2	1.7	2.4
Date palm	2.7	4.5	7.3	12.0
Fig, olive, pomegranate	1.8	2.6	3.7	5.6
Grape	1.0	1.7	2.7	4.5
Grapefruit	1.2	1.6	2.2	3.3
Lemon	1.1	1.6	2.2	3.2
Orange	1.1	1.6	2.2	3.2
Peach	1.1	1.4	1.9	2.7
Plum	1.0	1.4	1.9	2.8
Strawberry	0.7	0.9	1.2	1.7
Walnut	1.1	1.6	2.2	3.2
Vegetable crops				
Bean	0.7	1.0	1.5	2.4
Beet	2.7	3.4	4.5	6.4
Broccoli	1.9	2.6	3.7	5.5
Cabbage	1.2	1.9	2.9	4.6
Cantaloupe	1.5	2.4	3.8	6.1
Capsicum	1.0	1.5	2.2	3.4
Carrot	0.7	1.1	1.9	3.1
Cucumber	1.7	2.2	2.9	4.2
Lettuce	0.9	1.4	2.1	3.4
Crop	Yield potential, EC dS/m (assumes a sandy loam type soil)			



BACK PADDOCK

Phone: 07 3220 2959 • Email: info@backpaddock.com.au • Web: www.backpaddock.com.au

SoilMate Fact Sheet WSAM1/2009

	100%	90%	75%	50%
Onion	0.8	1.2	1.8	2.9
Potato	1.1	1.7	2.5	3.9
Radish	0.8	1.3	2.1	3.4
Spinach	1.3	2.2	3.5	5.7
Sweet corn	1.1	1.7	2.5	3.9
Sweet potato	1.0	1.6	2.5	4.0
Tomato	1.7	2.3	3.4	5.0
Forage crops				
Clover Berseem	1.0	2.1	3.9	6.8
Perennial rye	3.7	4.6	5.9	8.1

Source: Irrigation Water Quality Standards and Salinity Management Strategies. Texas Cooperative Extension
<http://lubbock.tamu.edu/irrigate/documents/2074410-B1667.pdf> (Adapted from Ayers and Westcot, 1976.

The other factor that affects the outcome of water salinity on crop yield is soil type. Higher salinity is tolerated by crops grown on well drained soils than poorly drained soils.

Common name	EC (dS/m) threshold for yield reduction for crops growing in		
	Sand	Loam	Clay
Field Crops			
Sorghum, crooble	11.6	6.6	3.9
Barley, grain	12.6	7.2	4.2
Cotton	12.1	6.9	4.0
Beet, sugar	11.0	6.3	3.7
Sorghum	9.4	5.3	3.1
Safflower	8.2	4.7	2.7
Wheat	9.4	5.3	3.1
Wheat, durum	9.6	5.5	3.2
Sunflower	7.5	4.3	2.5
Oats	7.0	4.0	2.3
Soybean	7.0	4.0	2.3
Peanut	4.4	2.5	1.5
Rice, paddy	4.8	2.7	1.6
Cowpea, Caloona	3.7	2.1	1.2



Phone: 07 3220 2959 • Email: info@backpaddock.com.au • Web: www.backpaddock.com.au

SoilMate Fact Sheet WSAM1/2009

Common name	EC (dS/m) threshold for yield reduction for crops growing in		
	Sand	Loam	Clay
Corn, grain, sweet	3.2	1.8	1.1
Flax/Linseed	3.2	1.8	1.1
Sugarcane	4.3	2.5	1.4
Cowpea (seed)	3.4	2.0	1.1
Phasey bean, Murray	2.7	1.5	0.9
Fruit crops			
Natal plum	7.6	4.3	2.5
Fig	5.3	3.0	1.8
Date	8.7	5.0	2.9
Olive	5.1	2.9	1.7
Pomegranate	5.1	2.9	1.7
Macadamia seedling	4.6	2.6	1.5
Peach	4.7	2.7	1.6
Rockmelon	4.6	2.6	1.5
Grapefruit	3.0	1.7	1.0
Orange	2.9	1.7	1.0
Walnut	2.2	1.2	0.7
Apricot	2.5	1.4	0.8
Almond	2.7	1.5	0.9
Blackberry	2.5	1.4	0.8
Boysenberry	2.5	1.4	0.8
Grape	3.3	1.9	1.1
Plum(Prune)	2.5	1.4	0.8
Avocado	2.3	1.3	0.8
Guava, pineapple	1.5	0.9	0.5
Apple	2.0	1.2	0.7
Lemon	1.3	0.7	0.4
Pear	1.3	0.7	0.4
Raspberry	1.3	0.7	0.4
Strawberry	1.6	0.9	0.5
Lychee	1.0	0.6	0.3



BACK PADDOCK

Phone: 07 3220 2959 • Email: info@backpaddock.com.au • Web: www.backpaddock.com.au

SoilMate Fact Sheet WSAM1/2009

Common name	EC (dS/m) threshold for yield reduction for crops growing in		
	Sand	Loam	Clay
Vegetable crops			
Kale	8.2	4.7	2.7
Zucchini	7.3	4.2	2.4
Rosemary	5.7	3.3	1.9
Asparagus	5.2	3.0	1.7
Beet, garden	6.5	3.7	2.1
Squash, scallop	4.8	2.7	1.6
Broccoli	4.9	2.8	1.6
Cauliflower	3.2	1.8	1.1
Cucumber	4.2	2.4	1.4
Pea	3.2	1.8	1.1
Squash	3.2	1.8	1.1
Tomato	3.5	2.0	1.2
Spinach	4.2	2.4	1.4
Cabbage	3.5	2.0	1.2
Potato	3.2	1.8	1.1
Celery	4.3	2.5	1.4
Sweet corn	2.2	1.2	0.7
Broadbean	3.3	1.9	1.1
Sweet potato	3.0	1.7	1.0
Pepper	2.8	1.6	0.9
Lettuce	2.7	1.5	0.9
Onion	2.3	1.3	0.8
Radish	1.5	0.9	0.5
Eggplant	3.2	1.8	1.1
Bean	1.9	1.1	0.6
Carrot	2.2	1.2	0.7
Turnip	2.5	1.4	0.8



BACK PADDOCK

Phone: 07 3220 2959 • Email: info@backpaddock.com.au • Web: www.backpaddock.com.au

SoilMate Fact Sheet WSAM1/2009

Common name	EC (dS/m) threshold for yield reduction for crops growing in		
	Sand	Loam	Clay
	Sand	Loam	Clay
Pastures			
Urochloa	11.8	6.7	3.9
Wheatgrass, fairway	11.3	6.4	3.7
Wheatgrass, tall	12.5	7.2	4.2
Rhodes grass, Pioneer	12.8	7.3	4.2
Couch grass	10.8	6.1	3.6
Barley, forage	9.4	5.3	3.1
Barley, hay	9.4	5.3	3.1
Buffel grass, Nunbank	9.5	5.4	3.2
Buffel grass, Gayndah	8.2	4.7	2.7
Trefoil, birdsfoot	7.6	4.3	2.5
Phalaris	5.3	3.0	1.8
Fescue	7.3	4.2	2.4
Wheatgrass, crested	7.6	4.3	2.5
Barrel medic, Cyprus	4.7	2.7	1.6
Green panic, Petri	5.6	3.2	1.8
Kikuya grass, Whittet	8.0	4.6	2.6
Leichhardt	4.6	2.6	1.5
Trefoil, big	4.9	2.8	1.6
Sudan grass	6.5	3.7	2.1
Setaria, Nandi	4.0	2.3	1.3
Townsville stylo	3.7	2.1	1.2
Sesbania	4.7	2.7	1.6
Desmodium, green leaf	3.5	2.0	1.2
Clover, berseem Clover	3.8	2.2	1.3
Lovegrass	4.0	2.3	1.3
Lucerne, Hunter River	4.7	2.7	1.6
Lucerne (USA)	4.3	2.5	1.4
Pangola grass	5.7	3.3	1.9
Siratro	4.2	2.4	1.4
Corn, forage	4.0	2.3	1.3
Glycine tinaroo	3.5	2.0	1.2



BACK PADDOCK

Phone: 07 3220 2959 • Email: info@backpaddock.com.au • Web: www.backpaddock.com.au

SoilMate Fact Sheet WSAM1/2009

Paspalum	3.7	2.1	1.2
Clover, strawberry (Palestine)	3.3	1.9	1.1
Clover, alsike, ladino, red	2.9	1.7	1.0
Clover, white (Safari)	2.9	1.7	1.0
Meadow foxtail	3.2	1.8	1.1
Orchard grass	3.9	2.2	1.3
Snail medic	2.9	1.7	1.0
Strand medic	3.0	1.7	1.0
Cowpea (vegetative)	2.5	1.4	0.8
Barrel medic, Jemalong	2.9	1.7	1.0
Clover, rose (Kondinin)	2.7	1.5	0.9
Clover, white (New Zealand)	2.5	1.4	0.8
Desmodium, silverleaf	1.8	1.0	0.6
Dodonea	2.9	1.7	1.0
Dolichos Rongai	2.0	1.2	0.7
Lotononis, Miles	2.3	1.3	0.8

Source: Irrigation water quality. Salinity and soil structure stability.

<http://www.nrw.qld.gov.au/factsheets/pdf/water/w55.pdf>

Another data set looking at the effect of soil type on threshold levels is given below.

Water salinity limits for flood irrigation dS/m						
Soil type	Well drained soils		Moderate to slow draining soils		Very slow draining soils	
Yield reduction	Up to 10%	25%	Up to 10%	25%	Up to 10%	25%
Field crops						
Barley	8.0	13.0	5.3	8.6	2.6	4.3
Canola	6.5	11.0	4.3	7.3	2.1	3.6
Faba beans	1.8	4.0	1.2	2.6	-	-
Maize	1.7	3.8	1.1	2.5	0.6	1.2
Millet	6.0	9.0	4.0	6.0	2.0	3.0
Oats	5.0	6.3	3.3	4.2	1.7	2.1
Wheat	6.0	9.5	4.0	6.3	2.0	3.1



Phone: 07 3220 2959 • Email: info@backpaddock.com.au • Web: www.backpaddock.com.au

SoilMate Fact Sheet WSAM1/2009

Water salinity limits for flood irrigation dS/m						
Soil type	Well drained soils		Moderate to slow draining soils		Very slow draining soils	
Yield reduction	Up to 10%	25%	Up to 10%	25%	Up to 10%	25%
Pasture grasses and others						
Paspalum	2.0	4.6	1.3	3.0	0.6	1.5
Phalaris	4.2	8.0	2.8	5.3	1.4	2.6
Per. ryegrass	5.6	8.9	3.7	5.8	1.8	2.9
Tall wheatgrass	7.5	13.3	5.0	8.8	2.5	4.4
Puccinella	16.0	22.0	10.6	15.0	5.3	7.3
Saltbush	12.0	20.0	8.0	13.0	4.0	6.6
Pasture legumes						
White clover	1.2	3.1	0.8	2.0	-	-
Sub clover	1.2	3.1	0.8	2.0	0.4	1.0
Straw. Clover	2.1	4.0	1.4	2.6	0.7	1.3
Lucerne (most varieties)	2.0	5.4	1.3	3.5	-	-
Lucerne (salt tolerant var.)	3.6	5.9	2.4	3.9	-	-
Berseem clover	6.0	18.0	4.0	12.0	2.0	6.0

Source: Target 10 Communicator January 2009

http://www.dairyextension.com.au/edit/T10_Communicator_2009/Target%2010%20Communicator%202009%2001%20Jan.pdf quoting from Southern Irrigation Soilpak, NSW Agriculture. ISBN 0 7310 9848X



Phone: 07 3220 2959 • Email: info@backpaddock.com.au • Web: www.backpaddock.com.au