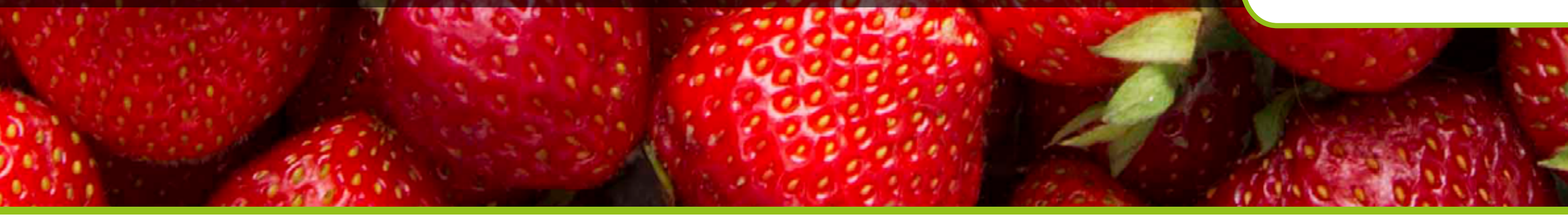
Irrigation water quality for strawberries



Overview

When irrigating strawberries, the use of poor water quality can affect both the crop and soil in which the plants are growing.

Water analysis is a valuable tool for determining potential or existing salinity problems, developing irrigation strategies, and verifying toxicities or mineral imbalances.

The standard irrigation water test for irrigating strawberries measures the following:

PROPERTY	COMPONENT
Salinity	Electrical Conductivity (EC)
	Sodium Adsorption Ratio (SAR)
	Total Soluble Salts (TSS)
Alkalinity	pH
	Alkalinity
	Calcium Carbonate
Macro-nutrients	Nitrate Nitrogen
	Total Nitrogen
	Total Phosphorus
	Potassium
	Magnesium
	Calcium
Micro-nutrients	Boron
	Chloride
	Copper
	Iron
	Manganese
	Molybdenum
	Sodium
	Zinc

The poor quality of irrigation water must be analysed by a competent laboratory, preferably NATA accredited.

All irrigation water contains variable quantities of ions, salts and nutrients, which in an extreme situation can cause production losses, soil degradation and affect irrigation equipment.

Use of poor quality irrigation water in strawberry production can cause:

ISSUE	RESULT
Salinity/ sodicity	Excessive sodium and total dissolved salts can affect the permeability or the drainage of the soil
Toxicities	Excess chloride, aluminum and boron can bring about phytotoxicity to growth or roots
Deficiencies	High pH water or the addition of certain elements can cause an imbalance or decrease the availability of essential nutrients
Damage	Irrigation equipment may corrode or become encrusted with salts

This project has been funded by Hort Innovation, using the strawberry research and development levy and contributions from the Australian Government. Hort Innovation is the grower owned, not-for-profit research and development corporation for Australian horticulture.

Water quality parameters you should know about

Salinity

Salinity is commonly measured by electrical conductivity (EC), with the higher the salt load, the higher the conductivity. The ability of the crop to tolerate salty water depends on many things, including the crop type, management of the soil type, the irrigation system and climatic conditions which prevail when irrigating.

Strawberries are very sensitive to salt. The presence of chloride will impact on yield, even at very low levels. The type of irrigation system, such as drip versus sprinkler; and the weather conditions, like high evapotranspiration, contribute to the effects of salinity on the crop.

ANALYTE	SATISFACTORY	PROBLEM	INTERPRETATION COMMENT
Chloride mg/L (using drip irrigation)	< 4	> 10	If levels exceed 4 mg/L leaf or tip burn may occur, especially if there are high evapotranspiration conditions
Electrical Conductivity dS/m	< 0.7	> 3	If > 0.7 avoid wetting leaves on hot dry days
Total Dissolved Solids (TDS) mg/L	< 450	> 2000	If > 450 avoid wetting leaves on hot dry days
Sodium mg/L (using drip irrigation)	< 3	> 9	If levels exceed 3 mg/L leaf or tip burn may occur, especially if there are high evapotranspiration conditions

Source: Haifa

1mg/L = 1 ppm
1 EC unit =0.64 ppm
EC unit = 1mS/cm =1dS/m

Managing water high in chloride and salinity can include:

- Finding an alternative water source
- Diluting with better quality water (shandy)
- Avoiding leaf wetting
- Irrigating at night
- Improving soil drainage
- Establishing crops using good quality water
- Installing desalination units for domestic use.

Soil permeability/sodicity

The sodium adsorption ratio (SAR) is a measure of the sodium hazard or imbalance of sodium ions relative to calcium and magnesium. When irrigation water has a high SAR level the permeability of the soil can be reduced and result in poor structure, infiltration, aeration and drainage. The SAR ratio for irrigation water used on strawberries should be under 3, otherwise specific management strategies need to be put in place such as the application of gypsum.

ANALYTE	SATISFACTORY	PROBLEM	INTERPRETATION COMMENT
Sodium Adsorption Ratio (SAR)	< 3	> 9	When SAR is high apply gypsum or provide better drainage

Source: Haifa

Alkalinity

pH is a measure of acidity or alkalinity. Alkaline water with high carbonate and bicarbonate levels can affect the plants ability to uptake calcium, magnesium and some trace elements. The use of high alkaline irrigation water will in time increase the soil pH and create deficiencies of zinc, iron and boron.

ANALYTE	SATISFACTORY	PROBLEM	INTERPRETATION COMMENT
pH (b)	5.5 - 8.5	< 5.5 or > 8.5	Low pH water tends to be corrosive. A pH > 8.5 may lead to increased scale formation. This is due to the high levels of calcium, carbonate and/or bicarbonate normally present in alkaline water
Carbonate meq/L (a)	0.1		High levels of carbonate can affect uptake of magnesium and some trace elements
Bicarbonate meq/L (a)	< 2		High levels of bicarbonate can affect uptake of magnesium and some trace elements

Source: (a) IncitecPivot "Water Manual Notes"
(b) NSW Department of Agriculture Advisory Bulletin 1

Calcium Carbonate

The Calcium Carbonate index is determined from the relationships between pH, salinity, alkalinity and hardness of the water. It gives an indication of whether the water is going to cause corrosion to metal parts of the irrigation system, such as pumps, or is likely to cause blockages from encrusted salts breaking loose from within the irrigation system, blocking filters or drippers.

ANALYTE	SATISFACTORY	PROBLEM	INTERPRETATION COMMENT
Calcium Carbonate Saturation Index	-0.5 to + 0.5	< -1.5	Water within satisfactory levels is suitable for most situations. Little likelihood of corrosion or scale formation.
Water Hardness $CaCO_3$ mg/L	< 50	> 150	Soft water is suitable for irrigation purposes. In hard water, precipitate may form when phosphorus fertilisers and sulfate are injected into the irrigation water. Calcium phosphate, calcium sulfate and calcium borate may be deposited.

Source: Drip irrigation "A grape growers guide" NSW Agriculture

Macronutrients

In most cases macronutrients are very low in irrigation water sources, other than bores where calcium and magnesium can be found in high levels in hard water. In most cases nitrogen, phosphorus, potassium and sulphur would provide some minor benefit in the form of added nutrient for the growing crop.

ANALYTE	SATIS-FACTORY	PROBLEM	INTERPRETATION COMMENT
Nitrate Nitrogen mg/L (a & b)	< 5	> 30	Sensitive crops may be affected with increasing concentration up to 30 mg/L, above which severe problems may arise. Should be considered as a nutrient when applying nitrogen fertilisers.
Sulphur mg/L (a)	5	-	Metal corrosion may be increased by high sulphur levels. Application of large quantities of high sulphur water to the soil may be a factor in contributing to soil acidity.
Phosphorus mg/L (a)	0.2	> 0.25	Concentrations > 0.25 mg/L may encourage algal growth. Should be considered as a nutrient when applying phosphorus fertilisers.
Potassium mg/L (a)	15	-	Should be considered as a nutrient when applying potassium fertilisers.
Calcium mg/L (a)	< 100	> 200	High calcium concentrations in the water may compensate for high soil sodium levels and may reduce a potential soil sodicity hazard.
Magnesium mg/L (a)	< 100	-	High magnesium levels have a significant impact on the soil. Magnesium saturated clays tend to disperse on wetting and set hard on drying. Continual use of irrigation water high in magnesium may lead to a deterioration of soil structure, especially on poorly drained, heavy textured soils.
Aluminum mg/L (b)	< 1	> 5.1	High levels can affect sensitive foliage and continuous application to soils can fix soil phosphorus.

Source: (a) IncitecPivot "Water Manual Notes"
(b) NSW Department of Agriculture Advisory Bulletin 1

Micronutrients

Concentration of micronutrients such as zinc, copper and manganese are commonly very low in water samples. Iron and boron status can be high especially in irrigation water sourced from bores.

ANALYTE	SATISFACTORY	PROBLEM	INTERPRETATION COMMENT
Copper mg/L (a)	< 0.2	> 0.21	For irrigation purposes, problems are unlikely unless the concentration of the element in the water is high. Problems are more likely in situations where the soil concentration is already high for that element. The effect depends on soil and crop type.
Zinc mg/L (a)	2	> 2.1	As above.
Manganese mg/L (a)	0.2	> 0.21	As above.
Iron mg/L (b)	0.1 - 1	> 1	Where iron concentrations exceed 5 mg/L in irrigation, deposits of iron may discolor or shade foliage reducing photosynthesis.
Boron mg/L (b)	< 0.3	0.5 - 3	Sensitive crops may be affected with increasing concentration >3 mg/L, above which severe problems may arise. Damage to the crop can occur from both root absorption and foliar absorption of the boron and may occur even if the total salinity of the water is low.

Source: (a) IncitecPivot "Water Manual Notes"
(b) NSW Department of Agriculture Advisory Bulletin 1

Other water quality parameters to consider

Tests for algae, bacteria and turbity can be undertaken by specific laboratories who provide the service.

Algae

Algal growth will occur at quite low concentrations of phosphorus; above 0.01 mg/L P, provided other conditions are favorable (such as water that is warm, still and relatively clear). Such conditions occur usually over summer during periods of low stream flow. The N:P ratio of the water will determine the type of algal growth.

Bacteria

Bacteria are usually associated with surface water supplies, including dams which are subject to contamination from inflows by sewage, decaying organic matter, manures or transmitted diseases. As a result, bacterial problems such as Paratyphoid (salmonellosis) may result from contaminated water. Certain bacteria may cause precipitation of iron or sulphur, or form slime in the system. This can result in blockages and inconvenience.

Turbity

Turbid or murky water is due to the presence of suspended material such as organic matter, clay or silt particles, or even iron compounds. These tiny particles remain in a suspended state as they are negatively charged and have a large surface area compared to their weight. Turbid water is unsightly, can stain and affect irrigation equipment, block irrigation drippers or spray nozzles and reduce the efficiency of water softening units. Only rarely is the degree of turbidity so severe as to make the water unsuitable for irrigation. High levels of turbid irrigation water can leave a film of suspended particles, protecting micro-organisms from the effects of disinfection and can stimulate bacterial growth.

Further information on water analysis and its application may be obtained from your local water authorities. They will be able to direct you to a NATA accredited commercial water analysis laboratory.

Other helpful resources

- Environmental Assurance Guidelines – Horticulture for Tomorrow – Chapter 2: Water management
  http://hoho3216.staging-cloud.netregistry.net/environmental-assurance-guidelines/chapters/water-management/
- State government department websites such as:
  http://agriculture.vic.gov.au/agriculture/horticulture/vegetables/vegetable-growing-and-management/irrigating-vegetable-crops-with-water-high-in-soluble-salts
  https://www.daf.qld.gov.au/plants/fruit-and-vegetables/farm-management/effects-of-water-quality
- Managing water for yield and profit – A training guide for Irrigators in the Australian Vegetable Industry – AHR
  http://ahr.com.au/wp-content/uploads/2015/03/Managing-water-for-yield-and-profit_Training-guide.pdf
- Irrigation Essentials - updated 2012 – Research and innovation for Australian irrigators
  http://npsi.gov.au/products/npsi06121
- Using Recycled Water in Horticulture – A Growers Guide
  http://www.recycledwater.com.au/uploads/File/documents/Growers%20Guide%20web.pdf

References

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- Advisory Bulletin 1 “Water Quality Assessment for Irrigation” A.S Ward, NSW Department of Agriculture, Rydalmere 1984
- Drip irrigation “A grape growers guide” NSW Agriculture 2nd edition 1995 ISBN 073105623 X
- Haifa, 2014, “Strawberry crop guide: special sensitivities of strawberries”

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