Cadmium in potatoes

..managing the risk from saline irrigation water

Consumer demand for quality produce is increasing.

Potato tubers exceeding the Maximum Permitted Concentration (MPC) for cadmium set by the Australia New Zealand Food Authority (ANZFA) cannot be used in the domestic market and cause problems in international trading.

Predicting the risk of producing potato crops above the MPC is an important part of managing cadmium in your cropping system.

This leaflet considers the relationship between cadmium concentration of potato tubers and quality of irrigation water.

HRDC

Australian Potato Industry Council

A joint venture

CRC Soil&Land Management

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The problem

In 1997 ANZFA revised limits for cadmium (a toxic heavy metal) in potatoes and other vegetables. The MPC is 0.1 mg cadmium/kg fresh weight, for root, tuber and leafy vegetables. The marketing of these vegetables in Australia with cadmium concentrations above this MPC is not permitted.

Elevated levels of chloride in water increases the solubility of cadmium and other elements present in soil, which increases their uptake by plants. In Australia, salinity in surface and ground-water is due mainly to chloride.

Research has confirmed increases in potato tuber cadmium levels with increasing chloride concentrations in irrigation water. The risk is higher in soils already high in cadmium, usually the result of past heavy applications of phosphate fertiliser containing high levels of cadmium as an impurity.

Cultural practices can help to reduce the risk of high cadmium concentration occuring in potato tubers. See the brochure 'Managing cadmium in potatoes for quality produce.'

Research results

The probability of cadmium exceeding the MPC of 0.1 mg/kg has been estimated from measurements of salinity of irrigation water at 130 irrigated potato sites in five states. See Figure 1.

Figure 1 shows that the probability of cadmium concentrations in tubers reaching the MPC is low when using irrigation water with a conductivity less than 2.0 dS/m. The probability then rapidly increases to above 50% as the salinity of the irrigation water increases above 3.0 dS/m.

Growers are advised to use water with a conductivity of less than 2.0 dS/m.

Research also indicated that the probability of cadmium levels of tubers reaching the MPC was increased if the soil contained more than 15 µg/kg cadmium extracted in 0.01M calcium chloride. Soil cadmium levels are likely to be high in paddocks with a history of heavy applications of phosphate fertiliser containing high levels of cadmium as an impurity.

If possible, avoid growing potatoes on these soils.

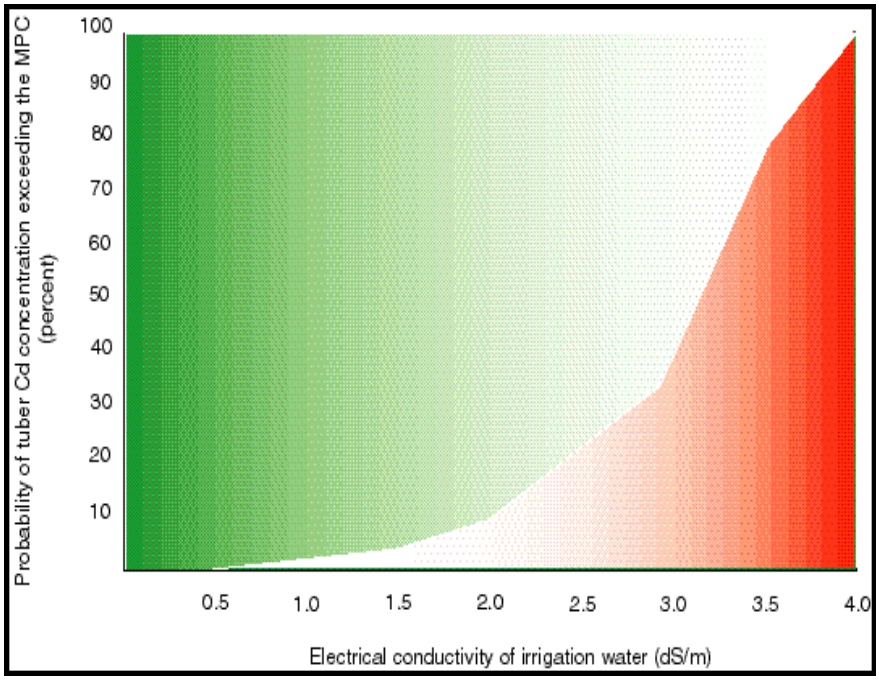


Figure 1. Probabilities of tuber cadmium levels at the MPC with varying levels of salinity of irrigation water

If irrigation water salinity is abo ve 2.0 dS/m

- Chose an alternative irrigation water source with lower salinity.
- Select varieties with low or medium susceptibility to cadmium uptake including; Wilwash, Russet Burbank, Lemhi Russet, Ranger Russet, Winlock, Tarago, Pontiac, Atlantic, Desiree and Delaware.
- Use sulphate of potash rather than muriate of potash to supply potassium.
- Confirm possible problems in high risk situations with in-crop tuber testing. Test tubers early in the season as research has shown that, when water conductivity remains constant through the season, this gives a good indication of a potential problems.

Testing of irrigation water

Preplant

To minimise the risk of producing tubers with high levels of cadmium, measure the salinity of irrigation water. Where the water is high in salinity and there are no alternative sources, potatoes should not be grown.

Post planting

Water quality can change markedly during the irrigation season, with salinity often increasing late in the season. Monitoring the salinity level of irrigation water periodically during the season should be undertaken to determine the risk of higher levels of cadmium being taken up by tubers during part of the growing season.

Testing

Water samples can be sent to a laboratory, but cheap hand-held conductivity meters are now available to test your own samples in the field (see conductivity meters).

Sampling the irrigation water

- If ground water or dam water is used, ensure that the irrigation pump is run for sufficient time to obtain a sample representative of the water in the aquifer or dam.
- Using a clean plastic or glass 500 ml container, rinse it with the water to be tested prior to taking the sample.
- Fill the container with a sample of 500 ml of irrigation water.

Testing the irrigation water with a field meter

- Calibrate the small hand-held conductivity meter according to the manufacturers instructions. Wash the electrodes with rainwater or distilled water before and after each measurement.
- Measure the electrical conductivity (EC) of the water, in deciSiemens per metre (dS/m).
  Note: 1 dS/m=100 mS/m

Conductivity meters

If you cannot access a field meter, consider purchasing one for approximately $100.

Meters are electronic and require calibration.They need to be operated and stored with care (eg not in extremes of temperature).

Seek the advice of a reputable supplier of scientific equipment who will advise which meter best suits your requirements.

Figure 2. Measuring electrical conductivity with a hand-held meter.

Suppliers of conductivity meters include;

Crown Scientific Pty Ltd

NSW :	Toll Free: 008 449 115	Tel: 02 9602 7677
Vic :	Toll Free: 008 134 175	Tel: 03 9764 4722
Qld :	Toll Free: 008 773 442	Tel: 07 3252 1066
SA :	Tel: 08 8347 3310	
WA:	Tel: 08 9352 7000	
Tas :	Tel: 03 6229 7437	

Selby Biolab

Tel: 13 2991
Free Fax: 1800 067 639
Melbourne, Sydney, Brisbane, Perth, Adelaide, Darwin, Hobart, Newcastle, Townsville.

The Cooperative Research Centre for Soil and Land Management does not warrant or recommend any particular manufacturer supplier or model of meter.

Tuber sampling

- For each soil type, potato variety or management unit, take a representative sample of at least 25 small tubers about 50-70 days after planting.
- Sample the crop in at least five locations in the field, digging up about 2 metres of row in each location.
- Take at least 5 tubers (any size) from each of the five locations and bulk the tubers together. Ensure no damaged or diseased tubers are included in the sample.
- Brush off soil and store the tubers in a clean paper bag in a cool place. Send the sample to a laboratory within 3 days for analysis of cadmium concentration. Your state contact can provide details of a reputable laboratory.

Sampling of plant tops to estimate cadmium concentrations in tubers is not recommended, as levels vary with different stages of crop growth.

Figure 3. Sampling tubers for testing.

Acknowledgments

This brochure is based on research supervised by Dr Mike McLaughlin, Cooperative Research Centre for Soil & Land Management (CRCSLM) Adelaide, in collaboration with Norbert Maier from the South Australian Research and Development Institute, and representatives from state agencies in Western Australia, Tasmania, New South Wales and Victoria.

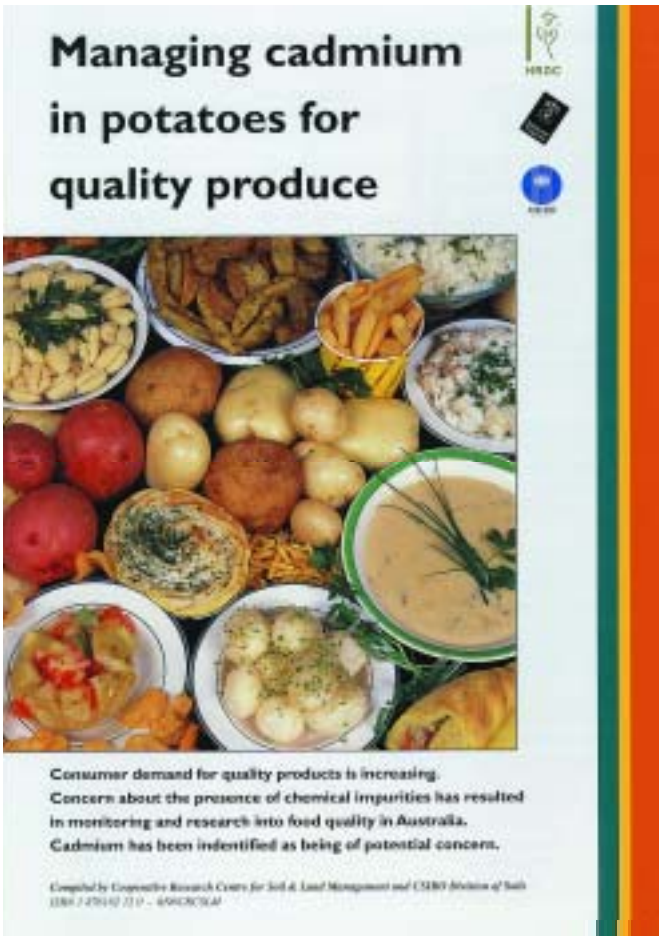
The brochure has been prepared by John Bourne and Mark Seeliger, CRCSLM, design and layout by Mary-Anne Fiebig, CRCSLM.Helpful comment was given by Leigh Walters, Manager, Australian Potato Industry, Technology Transfer Project.

Funding for printing has been provided by the Horticultural Research and Development Corporation.

ISBN: 1 876162 49 X CRCSLM/CTT01/99

Further information:

Managing cadmium in potatoes for quality produce. CRC for Soil & Land Management, Adelaide. CRCSLM/6/96, available from your state contact.



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