FACT SHEET

Ballance agri-nutrients

CADMIUM AND FARMING

Cadmium is a naturally occurring element, a metal that is present at trace levels in the earth's crust, in water, in the air and in soils. In order to secure the long-term use of agricultural soils, cadmium accumulation should be kept to a minimum, through a common-sense approach to fertiliser use and farm management.

Cadmium is not an essential element for animal or plant life and, like many other elements, at elevated levels it can be toxic to both humans and livestock. People can be exposed to cadmium through industrial activities, smoking, food intake and the environment.

The World Health Organisation has set a provisional tolerable monthly intake for cadmium of 25 µg/kg body weight. The typical New Zealand diet has been shown to be well below this level (2009 New Zealand Total Diet Study).

Cadmium in soil

Cadmium can enter agricultural soils by a number of different processes, through air, water and direct deposition. Volcanic activity and forest fires release cadmium which can be deposited on the soil either directly from the air or in rainfall. In New Zealand, however, the most significant sources of cadmium today are fossil fuels and phosphate fertilisers, as cadmium is a natural contaminant of the raw materials used to make these products.

Once in soil, cadmium tends to bind on to soil particles, and thus is not very mobile. The make-up of the soil helps to determine how much immobilisation occurs. Cadmium binds to clay particles and organic matter, so sandy soils are generally less effective at immobilising cadmium than other soil types. In highly weathered soils, silt may bind cadmium too.

Cadmium and plants

Whether grown as crops or present as weeds, plants can and do take up cadmium from the soil, although it is not an essential plant nutrient. The factors that determine cadmium uptake are complex and not fully understood. To date, it appears that concentration of cadmium in the soil is not the sole determinant of cadmium uptake. Crop species (or cultivar), soil characteristics (e.g. pH and organic matter content) and agricultural practices have a significant impact on cadmium uptake.

Plants take up cadmium through their roots and store it primarily in leafy components, as opposed to tubers or stems. As a result, crops such as spinach have naturally higher levels of cadmium than, for example, pumpkins. Researchers have demonstrated that some crops show natural variability in their ability to take up cadmium; for example, different varieties of potato have low, medium and high affinity for cadmium.

There is evidence that some pasture weeds are more effective at taking up cadmium than grasses. Ryegrass and clover-based pastures have relatively low cadmium levels, while plantain and Capeweed have higher levels.

Cadmium in animals

Cadmium is taken up naturally by grasses, weeds and forage crops. When these are eaten by grazing livestock, some of the cadmium is absorbed by the animal. Cadmium can also enter livestock as a result of animals eating soil or fertiliser that has not washed off foliage and into soil. Soil ingestion has been shown to account for 3-6% of the total dietary cadmium intake of ewes. Most of the cadmium (95%) that is ingested by stock is excreted by the animal.

Any cadmium that is retained within the animal's body tends to be stored in the kidneys and to a lesser extent the liver, with the rate of accumulation being greatest in young stock. A 1988-1992 survey showed around 20% of sheep and cattle liver and kidneys exceeded the at that time (limit of 1 mg Cd/kg fresh weight). As animals age, the amount of cadmium stored in these organs increases, and this is the reason why offal from animals older than 30 months is not permitted for human consumption. These organs are removed at meat works, and should also be discarded from any home-kill animals older than 30 months.

Cadmium is present in carcass meat at extremely low levels.

Cadmium levels in milk are also extremely low. Analysis of milk powder and milk protein products showed that cadmium was generally below detectable limits. Similarly, raw milk samples analysed under the Dairy National Chemical Contaminants Programme in 2011-12 were all below detectable limits for cadmium.

Reducing soil accumulation of cadmium

Although the level of cadmium in the soil is only one factor that determines how much enters the food chain, it nonetheless is good practice to reduce the accumulation of this element where possible. The Tiered Fertiliser Management Scheme, officially launched in 2013, is a voluntary system that helps farmers manage the accumulation of cadmium in soil. Under this scheme, a structured programme of soil testing is used to identify where farms sit on a 'cadmium continuum', and this in turn informs the best phosphate fertiliser strategy for the farm.

Where testing indicates lower cadmium inputs to the soil are necessary, specific low-cadmium fertilisers (e.g. DAP, YaraMila Complex, triple superphosphate) should be used in preference to single superphosphate or RPR. Withholding applications of phosphate fertiliser would be advisable only in cases where the soil Olsen P was above the agronomic optimum for the desired production level of the property.

When crops are being planted, phosphate fertilisers could be banded, rather than broadcast. This results in a higher concentration of fertiliser close to the plant roots; it also means that less is applied on a per-hectare basis, so reducing the rate of accumulation of cadmium in soil.

Reducing plant uptake of cadmium

Many factors influence the uptake of cadmium by plants, so there are a number of intervention strategies that can be employed to reduce uptake:

- If crops, cultivars or species that have a high affinity for cadmium are being grown, consider changing to varieties that have a lower affinity, if available
- Soil pH has also been shown to influence cadmium availability, with cadmium becoming more available as soils become increasingly acidic. To minimise the impact of this, soils should be maintained at the upper end of the optimum pH for the crop being grown
- Similarly, it may be helpful to minimise the use of fertilisers that have a strong localised acidifying effect , e.g. elemental sulphur
- The zinc status of plants has been shown to influence plant uptake of cadmium. Zinc-deficient plants tend to take up more cadmium, so soils should be tested for zinc deficiency and corrected if needed
- High levels of chloride have also been shown to increase the availability of cadmium in the soil, leading to increased levels in plants. If cadmium levels are a concern, reduce the use of fertilisers containing high levels of chloride and ensure that any irrigation water used is not high in chloride
- As cadmium binds to organic matter in soil, practices that promote the accumulation of organic matter will also reduce cadmium uptake by plants.

For more information on cadmium and health, see the website of the Centres for Disease Control, www.cdc.gov

For more information on cadmium in a New Zealand farming context, see the website of the Ministry for Primary Industries, www.mpi.govt.nz