AUSTRALIA'S NATIONAL CADMIUM MINIMISATION STRATEGY

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Abstract

Cadmium has been recognised in Australia as an insidious problem facing clean agricultural production systems, threatening free trade in international food commodities. Cadmium is added inadvertently to soils in phosphatic fertilizers, livestock manures, sewage biosolids and recycled organic materials. Atmospheric inputs of Cd to soils appear to be minimal in Australia. The propensity of some Australian soils to allow crops to accumulate Cd to levels above or close to maximum permitted concentrations has required that a strategic approach to Cd management be undertaken. The federal Standing Committee on Agriculture and Resource Management established in July 2000 a National Cadmium Minimisation Strategy, with the aim to minimise additions of Cd to agricultural soils, and to reduce accumulation of Cd by food crops. The strategy is currently: harmonising State regulations and standards controlling Cd in manufactured fertilizers; developing best management practices for growers to minimise Cd accumulation in crops; establishing national quality assurance programs for analysis of Cd in crops and foods; and providing input to international standards for Cd concentrations in traded food commodities through Codex.

Background

Food quality is often a "luxury" concern of well-fed nations. In the spectrum ranging from food shortage and famine to food surplus and plenty, societies place increasing emphasis on food quality rather than quantity as they move toward a well-fed condition. "Quality" means different things to different people, with desirable attributes sometimes being unquantifiable and mysterious.

Whether used or abused, the label "clean" food is an important marketing tool being used by many suppliers, including Australia, in export markets for rural commodities. Domestically, the public requires constant reassurance that foods are not being contaminated due to agricultural or manufacturing practices.

At present a real issue of concern with regard to fertilizer use in agriculture is food purity, specifically the introduction of unwanted elements such as cadmium (Cd) into foodstuffs through atmospheric deposition, the use of phosphatic fertilizers, and the recycling of organic and urban/industrial wastes to land.

Why cadmium?

Cadmium is a widespread naturally occurring element, present in all soils, rocks, waters, plants and animals. Phosphate rocks (depending on the source), and hence phosphatic fertilizers, generally contain slightly higher concentrations of Cd than other rocks or minerals. Of the non-essential trace elements (arsenic, lead, cadmium, and mercury), Cd is the element of most concern in agriculture, due to the presence of Cd in all phosphatic fertilizers. Levels of the other contaminants in fertilizers generally appear to be low, or if present, the elements are not taken up to any great extent by plants.

Cadmium is absorbed by animals and humans through ingestion and/or inhalation. A large proportion of the Cd ingested is excreted by the body. However, a small proportion is retained, mostly in the kidneys and liver, so that it may accumulate in these organs. It is thought that above a level of 200 µg Cd per g (wet) of kidney, pathological symptoms may appear. Cadmium can cause health problems in humans after long-term exposure. It may lead to gradual renal dysfunction if exposure is high over a long period. While cadmium can induce effects on organs other than the kidneys, the effects generally occur at doses higher than those associated with renal effects. Population-based studies in Japan and Belgium have shown a clear relationship between indicators of renal dysfunction and environmental and occupational exposure to cadmium.

The World Health Organisation/Food and Agriculture Organisation Joint Expert Committee on Food Additives (JECFA) proposed in 1972 a provisional tolerable weekly level for intake (PTWI) by humans of 6.7-8.3 µg Cd per kg body weight. This was revised in 1980 to 7 µg Cd per kg body weight per week. JECFA reassessed Cd exposure data in 2000 and reaffirmed this level.

Trade issues

Cadmium is recognised as a human health risk in many countries, so that regulations controlling Cd concentrations in water, air and foods have been promulgated in many jurisdictions. There are several instances of international trade in food commodities being disrupted due to violations of food Cd standards. Due to the risk of Cd standards being used as international barriers to free trade, the Codex Committee on Food Additives and Contaminants is developing internationally recognised "guideline levels" for Cd in major traded commodities.

The National Cadmium Minimisation Strategy

The National Cadmium Minimisation Strategy (NCMS) was developed as a result of a task force report on cadmium set up by the Standing Committee on Agriculture and Resource Management (SCARM) in 1998. The brief of the task force was to provide SCARM with:

a) information and recommendations on sustainability issues in regard to cadmium in soil;

b) recommendations for a uniform national policy on cadmium standards in fertilizers, other soil ameliorants, and animal mineral supplements, which is achievable by the fertilizer and other industries;

c) recommendations on best management practices for farming and horticultural production systems to minimise cadmium in agricultural and horticultural produce;

d) recommended strategies for encouraging the adoption of these best management practices by farmers and horticulturists in situations where cadmium has, or can become, a problem in harvested produce; and

e) recommendations of other appropriate actions to progress cadmium minimisation in Australian agriculture.

Several key recommendations resulted from the task force report and these were to form the core of the NCMS. These were that:

1) all State departments harmonise regulations for maximum permitted concentrations in phosphatic fertilizers at a level of 300 mg Cd/kg P;

2) the issue of Cd in organic wastes (sewage biosolids and animal manures) should be examined to minimise Cd inputs to agricultural soils;

3) all States consider having fertilizers labeled with their Cd content and warning statements attached;

4) best management practices be adopted by industries in high risk situations;

5) FIFA develop a code of practice for fertilizer use that minimises cadmium concentrations in products; and

6) a National Cadmium Coordinator be appointed (part time) to oversee the strategy, provide a focus for government and industry action, and ensure implementation of appropriate actions to minimise Cd accumulation in Australian agriculture.

The NCMS is managed by a Committee comprising State departmental representatives from Queensland, New South Wales, Victoria, Tasmania and Western Australia. The horticultural and fertilizer industries are also represented, as is the National Farmer's Federation. The NCMS is funded by industry (FIFA, HRDC and GRDC) with in-kind support from CSIRO.

NCMS actions to date

Since the NCMS was launched in July 2000, a number of tasks have been undertaken, and are planned, by the Committee. These are

1) A national review of relevant fertilizer legislation relating to Cd for both manufactured fertilizers and organic wastes;
2) A media campaign to publicise the strategy both in Australia and overseas;
3) A national database of Cd concentrations in crops to assist and focus management action for Cd minimisation;
4) A national quality assurance program for Cd analysis of crops and foods;
5) Respond to international developments affecting Australia's position with regard to health and trade issues affected by Cd (e.g. Codex);
6) Develop codes of practice or best management practices (BMPs) for industries to minimise Cd contamination of soils or crops; and
7) Coordinate research data on Cd in soils and plants to assist BMPs for Cd minimisation

Current issues for the national strategy

A number of developments in the national and international arena have relevance to Australia's NCMS.

New food regulations have recently (March 2001) been promulgated in the European Union, with some guideline values being below those of the Australia New Zealand Food Authority (ANZFA) (see Table 1). In particular, the limits for animal offal and some vegetables (non-leafy, non-root/tuber) could pose problems for some produce currently produced in Australia.

The development of guideline levels for traded food commodities through Codex will also require close monitoring to ensure that Australia is not disadvantaged by any new quality system.

An issue closer to home is the current push to re-use urban and animal wastes on agricultural soils. Sewage biosolids, the solid waste generated as part of treatment of sewage waters, are increasingly being re-used on agricultural soils in many States.

It is vital that appropriate controls are in place to ensure agricultural production is not compromised by excessive additions of Cd to soil, and in this regard there appears to be a need to examine the scientific basis for the current soil Cd guideline values for biosolid re-use. Permissible additions of Cd to agricultural soils in biosolids far exceeds typical application rates in phosphatic fertilizers given current fertilizer regulations. Imminent changes to EU regulations governing permissible Cd loadings to agricultural land from biosolids will also throw the spotlight on Australia's standards in this area (Table 2).

Table 1. A comparison of some ANZFA and EU food Cd regulations.

Food	Australia/NZ	EU
	mg/kg fresh wt	
Chocolate	0.50	-
Kidney	2.50	1.00
Liver	1.25	0.50
Leafy vegetables	0.10	0.20
Meat	0.05	0.05
		0.20 (horse)
Peanuts	0.10	-
Rice	0.10	0.20
Root and tuber vegetables	0.10	0.10 (root/tuber)
		0.20 (leafy veg.)
		0.05 (other veg.)
Soybean	-	0.20
Wheat	0.10	0.20
Other cereals	-	0.10

Table 2. A comparison of Australian and EU Cd regulations with regard to re-use of sewage biosolids on land.

Jurisdiction	Guideline value mg/kg dry wt.
Ceiling soil concentrations	
NSW	1.0
Victoria (proposed)	1.0
	3.0 (pH ≥6)
SA	1.0
Tasmania	0.7
EU latest proposals	0.5 (5≤pH<6)
	1.0 (6≤pH<7)
	1.5 (pH≥7)

It is interesting to note that the EU has proposed regulating sewage biosolid Cd on the basis of P concentrations, as for inorganic fertilizers. The proposed limit value is 250 mg Cd/kg P.

Another issue requiring effort is the regular screening of new crop cultivars for Cd uptake characteristics. Some countries, e.g. Canada, have made major investments in plant breeding as a means to minimise Cd accumulation in cereal grains. It is imperative that selection by breeders to improve crop disease resistance and nutrient efficiency does not inadvertently select for Cd accumulation.

The future

New research on the epidemiology of Cd in human populations is underway in several countries which will improve the understanding of the role Cd plays in human health at low levels of ingestion in food. How this will affect the WHO PTWI cannot be predicted, but the recent affirmation that the current PTWI should remain suggests that any changes will not happen in the next 3-5 years. Furthermore, even if the PTWI were to be raised, there would be political sensitivities in many countries regarding any weakening of food Cd regulations.

In the short term there are many ways to minimise soil-plant transfer of Cd, and growers are already using these to ensure produce is low Cd. It is for the long term that concern and management action now needs to focus.

Accumulation of Cd in fertilized agricultural systems in Australia has certainly slowed in the last 10 years, but we do not have enough information to calculate accurate Cd balances for all systems. It is likely many systems are still slowly accumulating Cd, but there are unanswered questions regarding the magnitude of Cd leaching from topsoils, and the degree to which Cd becomes bound into non-plant available forms over time in various soils. Research is needed to address these issues.

Plant breeding also offers a way to minimise food chain transfer of Cd, and perhaps some more effort needs to be directed to at least screening new Australian and imported germplasm for Cd accumulation characteristics.

Summary

Australia has reacted proactively to the issue of Cd accumulation in agricultural soils and produce. The national strategy to minimise Cd accumulation in Australian agriculture is a unique combination of use of regulation, industry codes of practice, research, quality assurance programs, and partnerships with growers in managing Cd additions and soil-to-plant transfer of this potentially toxic element. Such approaches are essential if we are to maintain and enhance our reputation as a clean and green supplier of food commodities.