

MITIGATING ELEVATED TOPSOIL CADMIUM WITH TOPSOIL INVERSION TILLAGE

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A number of published soil surveys on permanent pasture soils have identified elevated cadmium (Cd) concentrations associated with intensively managed pastures in Taranaki and Waikato regions. A recent industry survey (Abraham et al. 2016- FLRC workshop) indicated that 20% of farms in these regions have reached the Tier 2 Cd management threshold topsoil concentration ($> 1 \text{ mg Cd kg}^{-1} \text{ soil}$) and will need to undertake phosphorus fertiliser management practices to decrease the rate of Cd accumulation in the soil. More detailed soil 'Cd profiling' (e.g. Loganathan and Hedley, 1997; Zanders et al., 1999 and Stafford et al., 2017) indicates a sharp stratification of Cd concentration with soil depth.

Cadmium distribution in the soil profile is strongly related to organic carbon (OC) content. In dairy pasture soils highly fertilised with superphosphate up to 90% of the added soil Cd load remains within the top 15 cm. Where top soil Cd concentrations exceed the Tier 2 trigger values ($1\text{-}1.4 \text{ mg Cd kg}^{-1} \text{ soil}$) it is likely that land use would be constrained to permanent grazed pasture or to crops that do not introduce Cd into the human food basket.

Land use change to vegetable and cereal production will require decreasing soil Cd bioavailability if edible parts of root, tuber and leafy vegetable crops are to stay below the FSANZ standard of $0.1 \text{ mg Cd kg}^{-1}$. One potential management strategy is topsoil inversion during deep mouldboard ploughing. To achieve topsoil inversion a small skimmer mouldboard is placed before the main mouldboard on a conventional plough. The small skimmer mouldboard places the topsoil (0-5 cm) Cd contaminant load at the 25-30 cm depth in the bottom of a 30 cm deep furrow. An example shows reduction of the 0-15 cm Cd concentration from an average of $1.2 \text{ mg Cd kg}^{-1} \text{ soil}$ to $0.67 \text{ mg Cd kg}^{-1} \text{ soil}$, compared to $0.82 \text{ mg Cd kg}^{-1} \text{ soil}$ with conventional mouldboard plough. In some previously uncultivated soils with a strong vertical stratification of Cd, topsoil inversion tillage can move a soil from the Tier 3 management trigger ($1.4 \text{ to } <1.8 \text{ mg Cd kg}^{-1} \text{ soil}$) to Tier 1 ($< 0.6 \text{ mg Cd kg}^{-1} \text{ soil}$).

Editor's Note: An extended manuscript has not been submitted for this presentation.