RMIT Workshop
Biosolids Research
Inorganic Characteristics

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Introduction

- This is an attempt to steer you towards people and research priorities
- I have adopted a loose interpretation of the inorganic constituents of biosolids
- Given the sensitive nature of the subject much of the information is in CIC reports which cannot be cited
- Difficult to get comparative data
- Don’t underestimate clay, silt and sand

Time Team 1982-2012

Dr. Peter May -manures as growth media

Mrs Cathy Botta - manures, biosolids and plants

Scott Birchall - dairy effluent database

Dr. Graham Brodie - modelling and microwaves

Dr. Robyn Taylor - biosolids blending

Dr. Zahida Muyen - biosolids and sodicity

Dr. Graham Moore - engineering of biosolids

Mrs Lakshika Goonewardena -geotechnical media

Dr. Kithsiri Bandara Dassanayake - agronomic and hydraulic modelling

1. Manures and Sludge

1. Feedlot manure-’’Maxi Crap’’- pen scraping
2. Turning poultry manure into gold-’’Dynamic Lifter’-
   focus on plant response rather than fate of constituents
3. Pig, rabbit, zoo, fish farm and dairy manure
   bedding and scraping

Focus is on macronutrients and organic matter .

All contain heavy metals and clay and all contain salt and particularly potassium and sodium

Sand and silt can also be present-this impacts physico chemical properties and composting potential

2. Biosolids

Harvest, transport and stockpiling leads to consolidation and compaction.

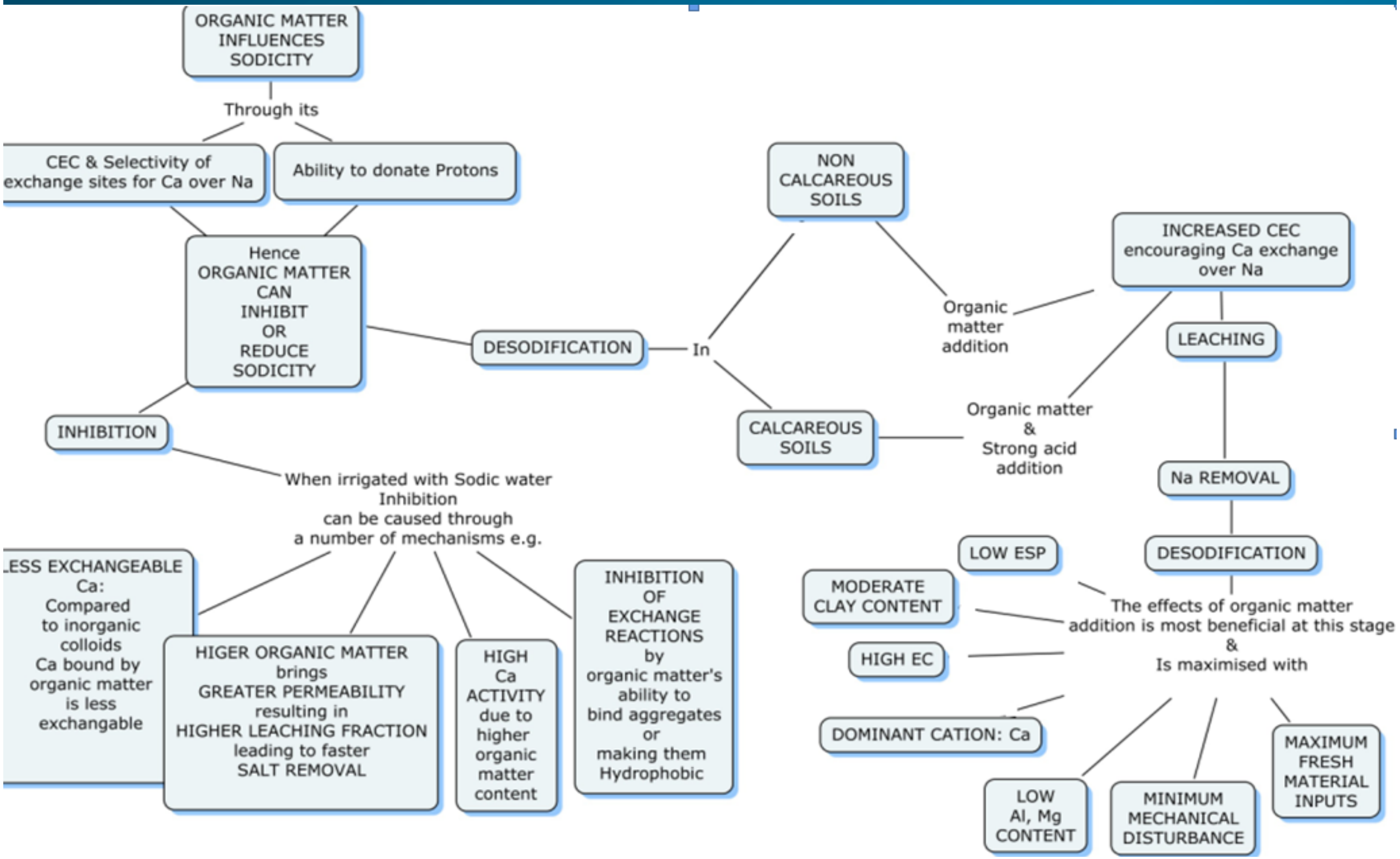
The presence of clay increases cohesion and limits infiltration and permeability

2(a) Sodic Soil, Biosolids and Recycled Water – Zahida Muyen

Can biosolids buffer soil dispersion associated with rainfall on a recycled water site?

Profile position	Topsoil (T)		Subsoil (S)		
Water Quality	Potable Tap (D)	Tertiary Treated Sewage (R)			Raw Sewage (W)
Biosolids mass (g/kg)-ratio dry to wet	150-100:0	150-80:20	150-60:40	50-100:0	0

2(a)Soil Dispersion



2(a) Results

- Biosolids can be used to ameliorate recycled water irrigation sites but the impact of salinity and sodicity of the biosolids cannot be discounted
- Biosolids can buffer the dispersion of a sodic soil as well as serving as a shroud to protect the soil surface from the impact of rainfall
- The mechanism of stabilisation is complex and it is not just a matter of the beneficial value of increasing soil organic matter

2(b) Biosolids Blending- RobynTaylor

Biosolids from the Melbourne Water Eastern Treatment Plant (Grade C2)

2(b)Biosolid large blocks or consolidated material

Biosolid was broken down into friable texture before blending

2(b)Biosolids composition (mg/kg)

P	10006	Cd	6.59
K	2745	Pb	100.1
Mg	4746	Ni	67.95
Ca	8262	Cu	306.7
Na	1618	Zn	580.7
S	3535	Al	42099

2(b)Process

- Four treatment blends were used in the experiment. The blends were mixed according to commercial practice by varying the proportion of biosolid into a 'standard' compost (7 parts sand: 3 parts organic matter) blend.
- The ratios of biosolid incorporation were 1:9; 1:6; 1:3 (v/v) and a control of 'standard' compost only.
- Concentrations of PTMs were determined and agronomic assessment of the media treatment blends was performed pre and post trial.

2(b)Treatment Blends

Pre-trial analysis of Cadmium (mg/kg) of media treatment blends

Blends	Cd	
B-C	1.25	
B-9	1.52	
B-6	1.76	
B-3	2.27	
s.e.d Signif.	0.177 <0.001	

2(b)The plant species chosen represented a broad range of plants used in amenity horticulture

Calendula

Tomato

Wallaby grass

2(b)Plant Establishment

Plug plants (5 replicates per treatment) were established in the glasshouse prior to transplanting into 2.8 litre pots at advanced seedling stage (approximately 15 cm in height).

Design and Management

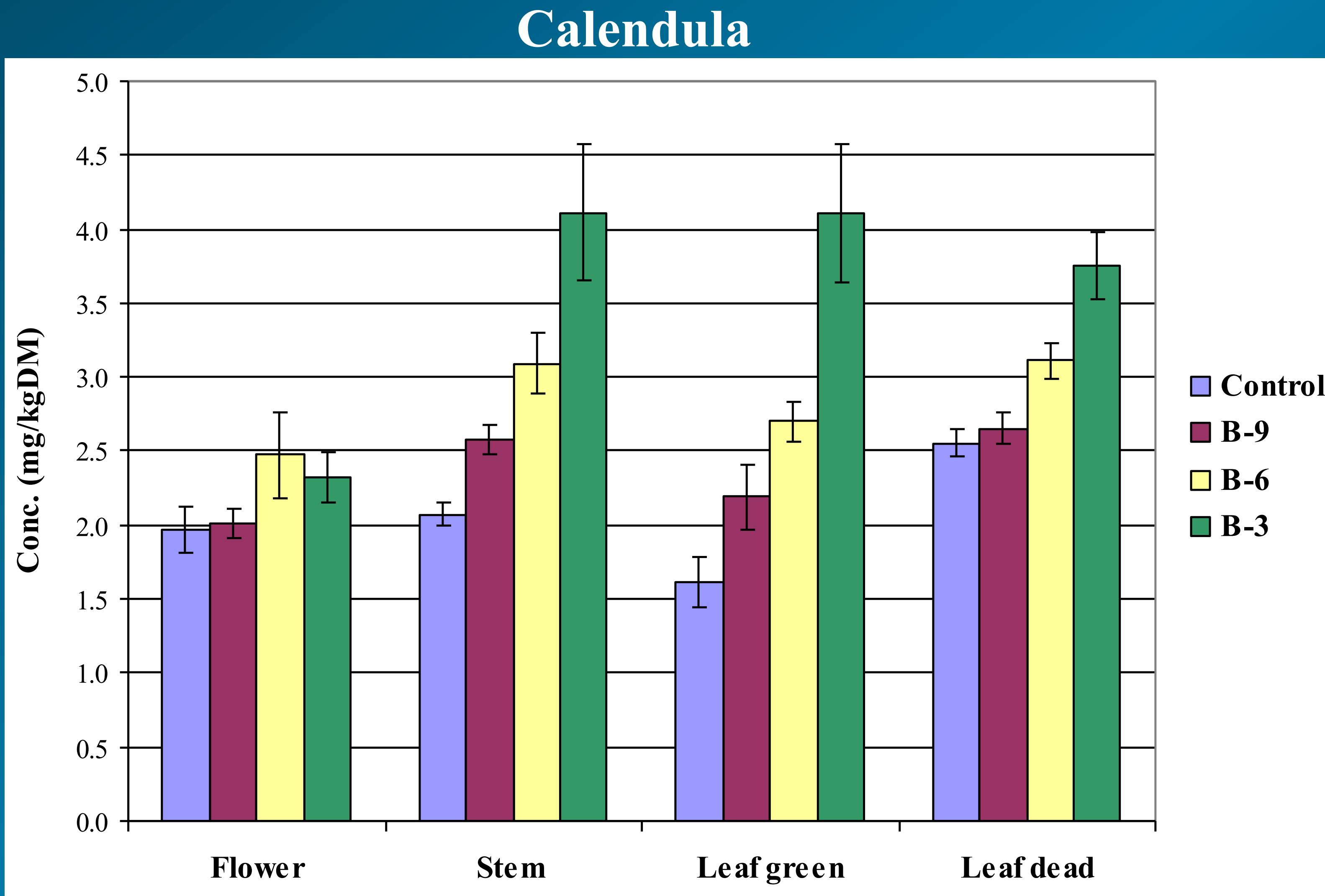
- The pots were arranged in the glasshouse in a completely randomized design blocked by species on benches.
- All plants were watered to field capacity by irrigation with a known volume of water. All pots were placed on saucers for the collection of any leachate.

Analysis

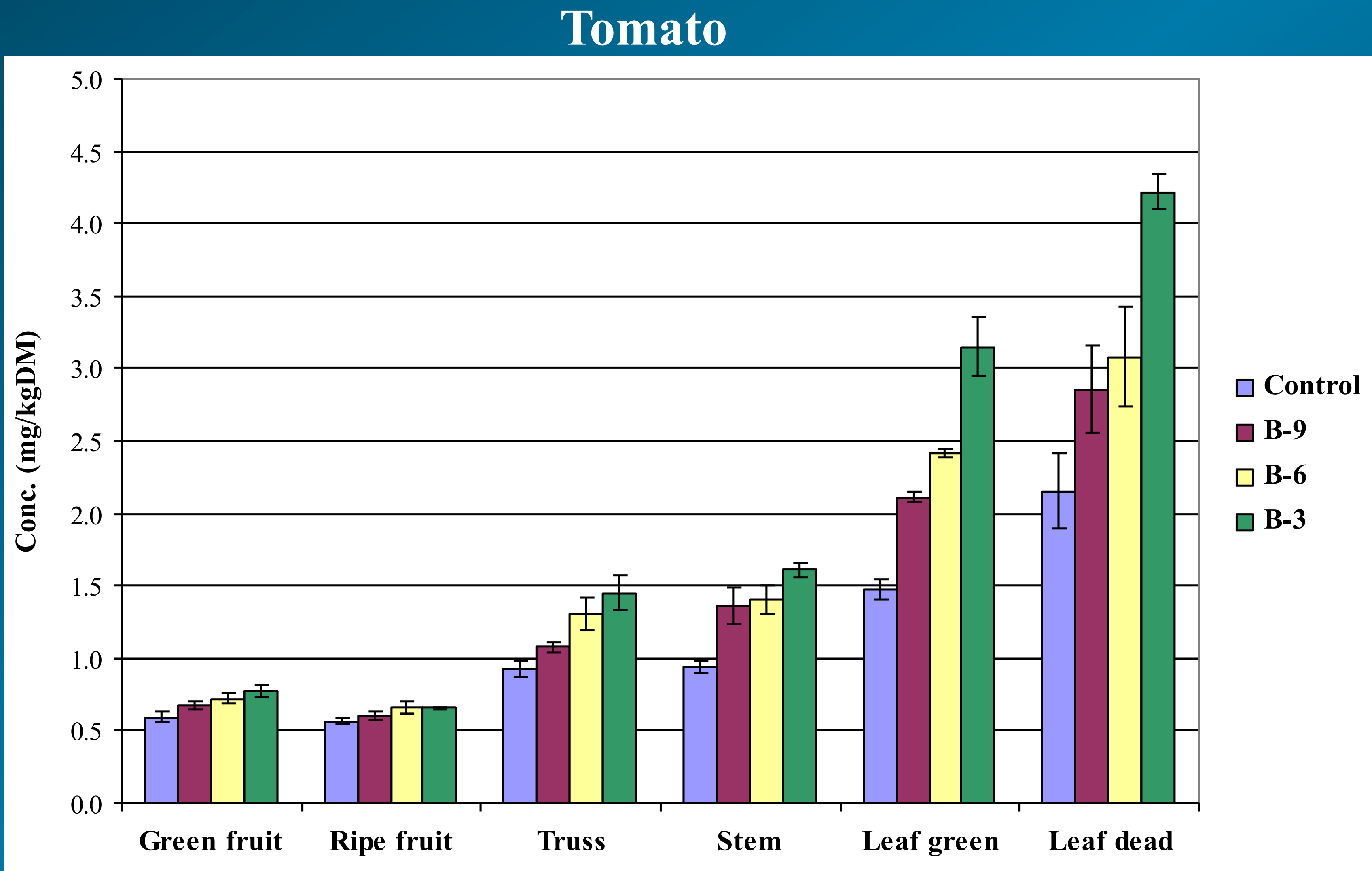
- Samples of growing media, plant fractions and leachate were assessed for PTM's, agronomic characteristics, pH and EC.

- All data were subjected to analysis of variance (ANOVA) with the main effects of treatment (3 d.f.) and plant species (2 d.f.).

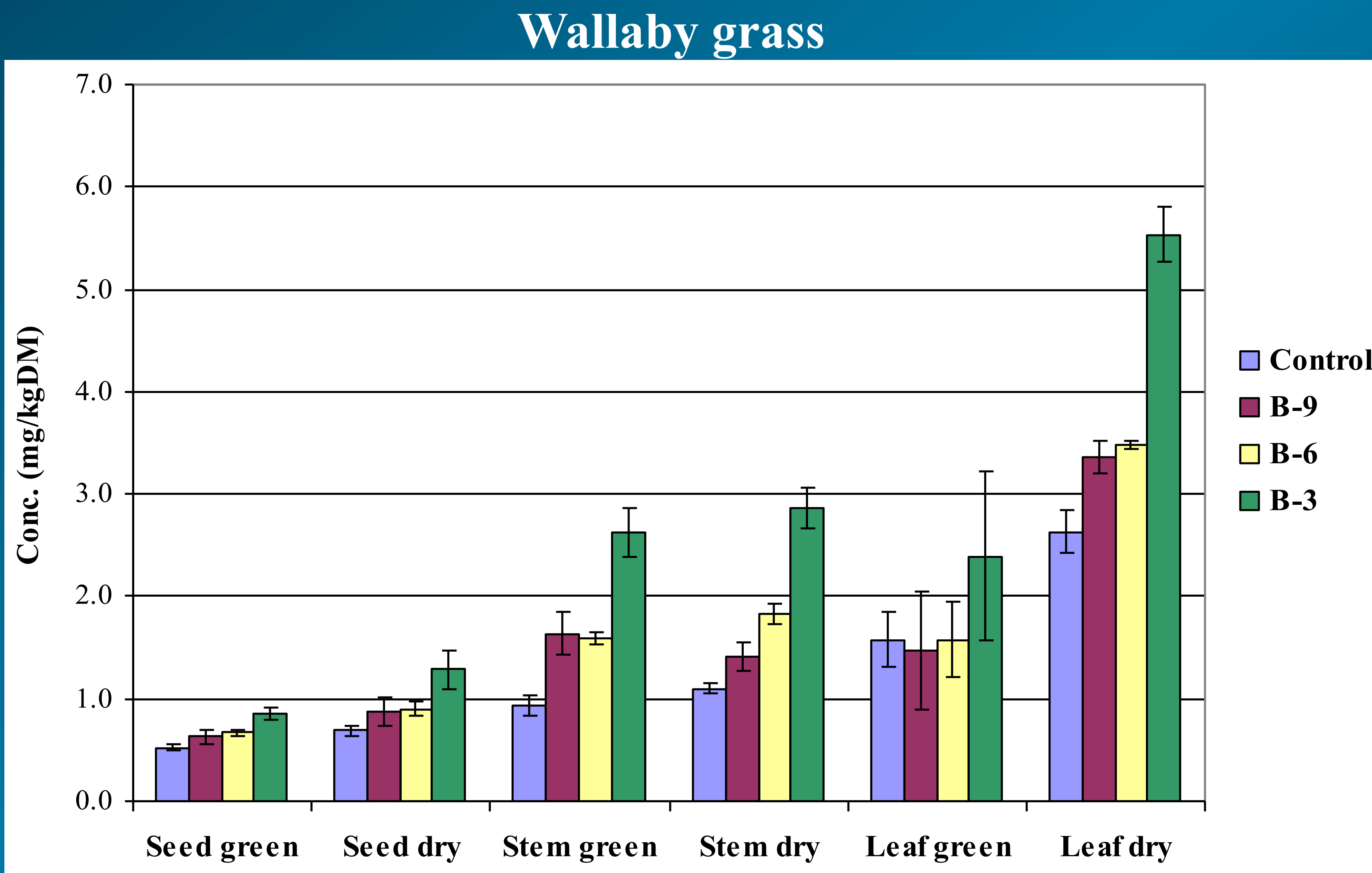
2(b)Sample Results - Cadmium



2(b)Results - Cadmium

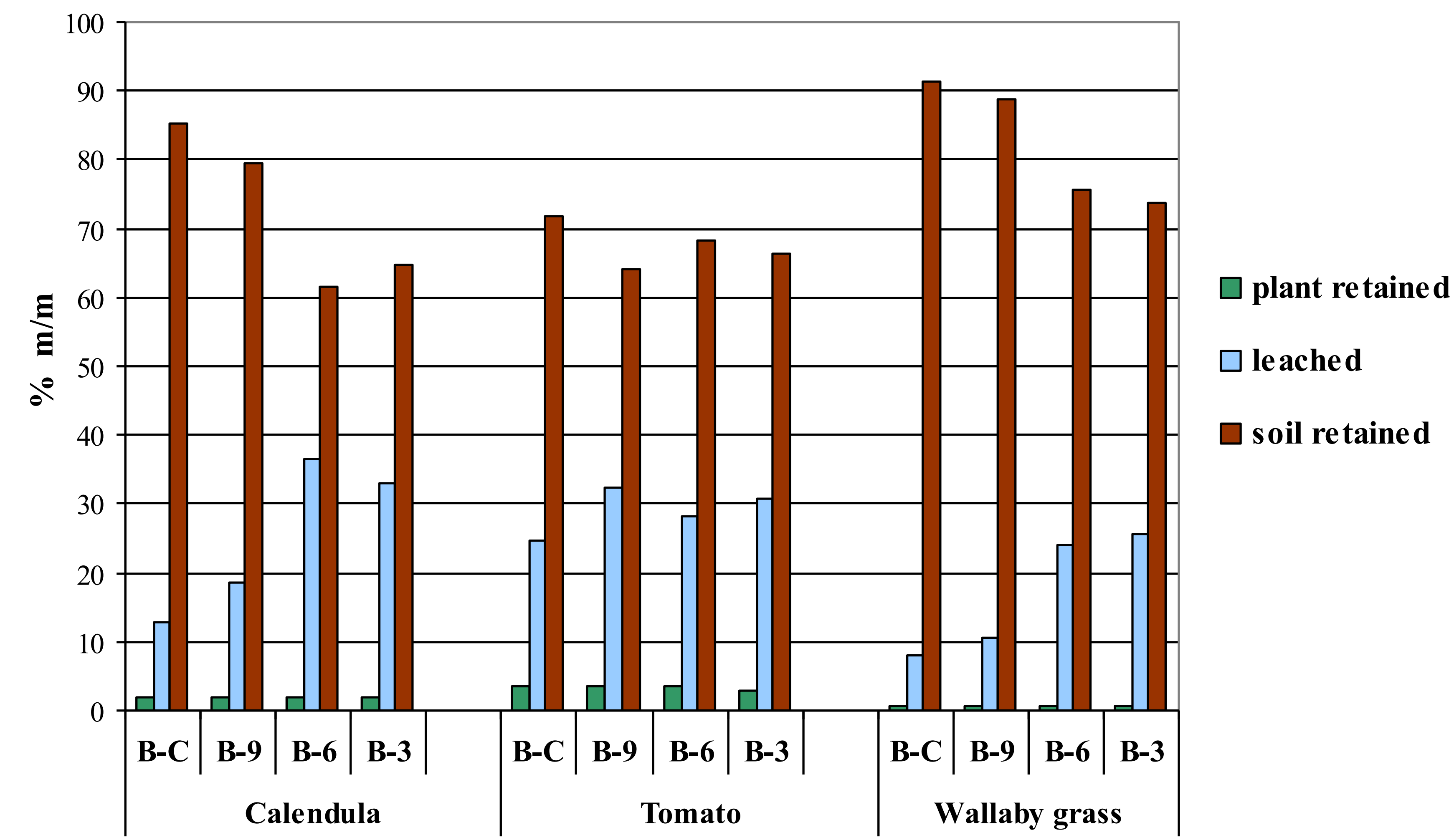


2(b)Sample Results - Cadmium



2(b)Sample Results - Cadmium

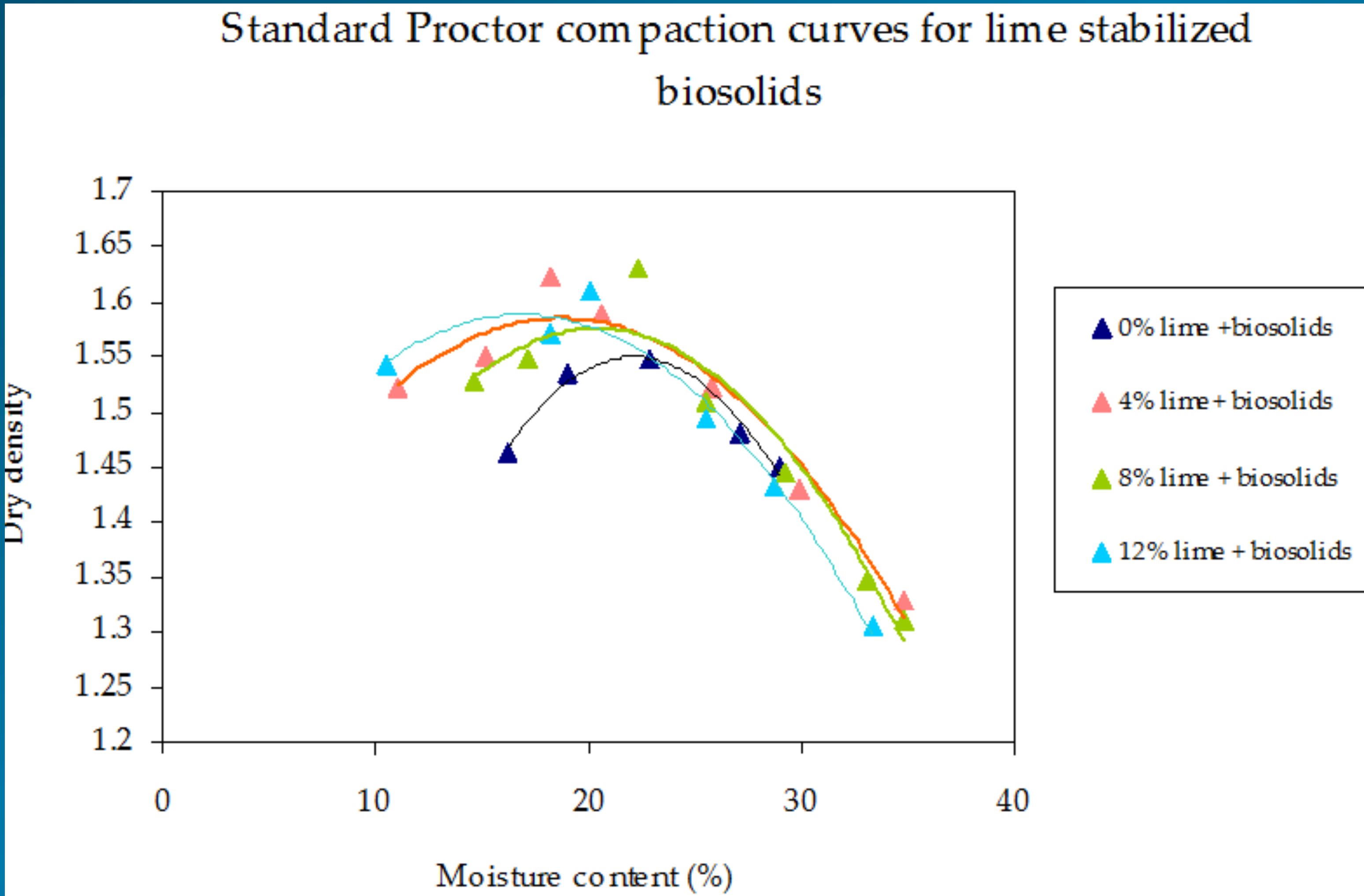
Mass balance – all species



2(b) findings

- no evidence of poor plant growth or development.
- uptake of toxic metals in all plant species was limited. The increases in concentrations in the food crop (tomato) are unlikely to have any health implications for consumers.
- limited release (via leachate) of various toxic and potentially toxic metals
- Wallaby grass was of particular interest. Limited research is available on indigenous grass species in relation to biosolid application and PTM's

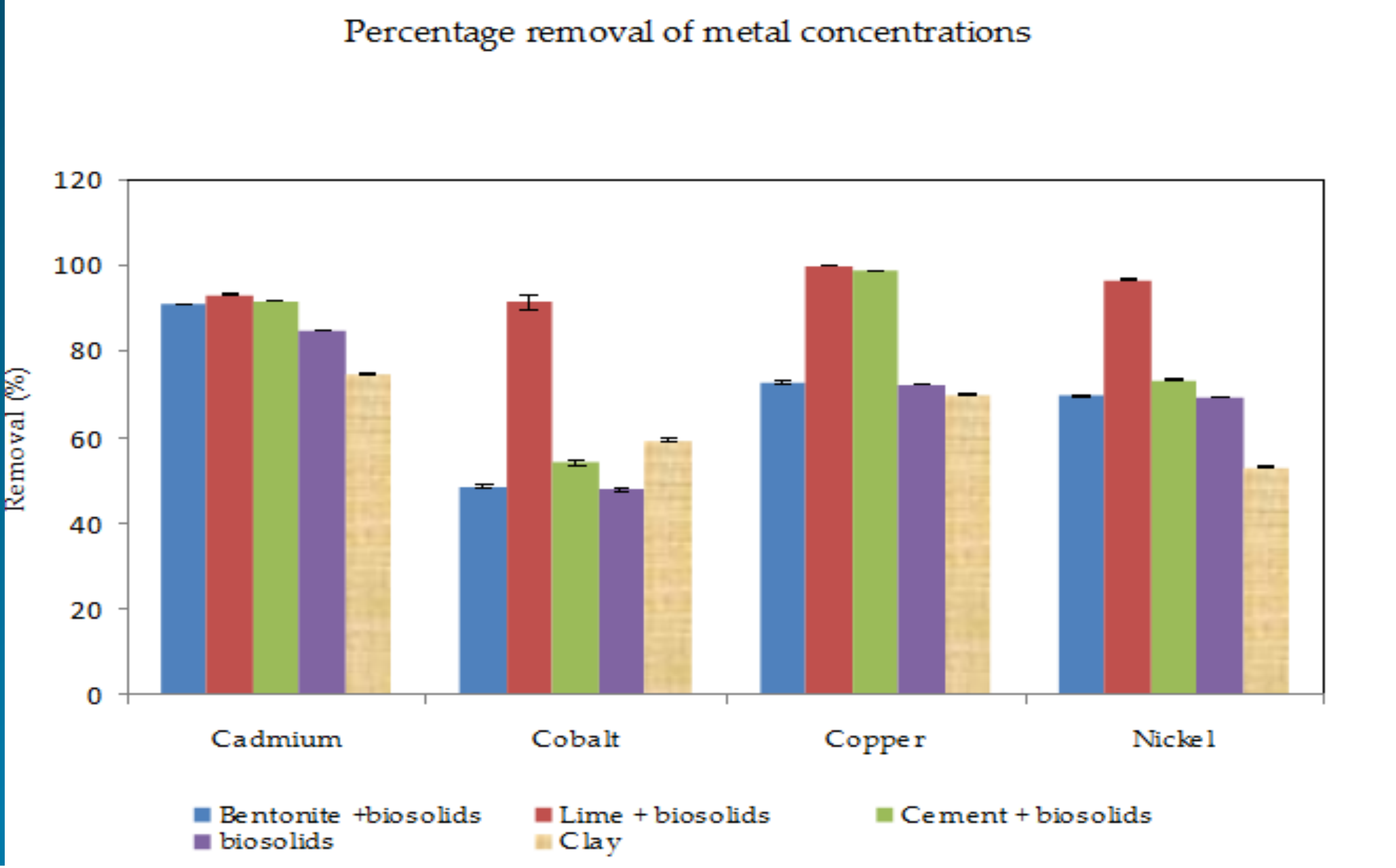
2(c) Stabilisation of Biosolids to Improve Geotechnical Properties- Lakshika Goonewardena



Maximum percolation rates

Biosolid Admix	Liquid Flux ($m^3/m^2/d$)	EPA, Victoria (2001) Requirement ($m^3/m^2/d$)
Biosolid	0.0002	0.0001
Biosolid + 4% cement	0.0001	0.0001
Biosolid + 12% lime	0.0001	0.0001
Biosolid + 4% bentonite	0.0001	0.0001

2(c)Fate of Metals



3. Future

- land application of WTP biosolids
- agronomic properties of biosolids
- source of clay, silt and sand in biosolids
- role of clays in the inorganic fraction of biosolids
- use of uncompacted but chemically stabilised biosolids as media for plant growth over a capped landfill
- agronomic performance of biosolids compared with manure and commercial fertiliser