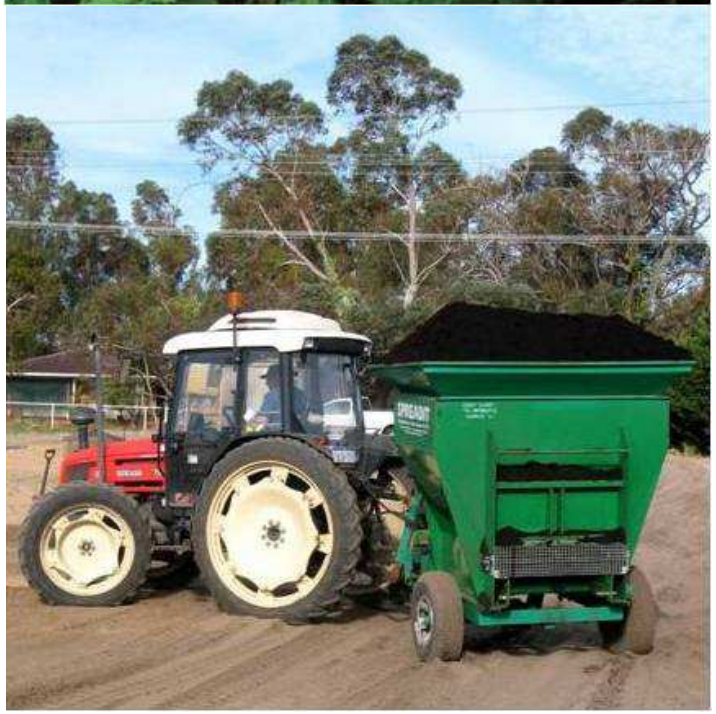
Sourcing, making and using composts on farm

Bill Grant, Blue Environment
bill.grant@blueenvironment.com.au
0407 882 070

Overview

- Background
- What is compost?
- The composting process
- What will, can, might and won't it do on your farm
- Is it a fertiliser?
- Products and standards
- Where, how and when to use compost
- On-farm composts
- Regulatory and risk management issues
- Summary



What is compost?

- Organic matter that has been through a controlled, aerobic and 'hot' process of decomposition using naturally occurring composting bacteria and fungi.

- A range of products with different attributes depending on inputs, process, particle size and level of biological 'maturity'
- It is free of weeds, weed seeds and pathogens
- It is 'Sweet' & earthy smelling
- It is dark brown in colour
- One potential tool in more sustainable land management

The compost process needs:

1. A 'balanced' mix of inputs:
   - Carbon: nitrogen = 10:1 -40:1 (preferably <30:1)
   - 1 part 'dry'/'woody': 2 part 'green'/'wet'
   - 1 part 'dry'/'woody': 1 part 'green': 1 part manure
2. Oxygen and air flow (& usually turning)
3. Optimal moisture (30-60% by weight) throughout the process
4. Bulk/volume (>1-1.5m high with initial pile heights >2-2.5 m)

The compost process needs:

4. Temperature – 50-65^{o}C for at least three days after turning & at least three turns
5. Time
6. Quality management
7. ‘Husbandry’/’artistry’ – a nose for trouble

Things are not right if:

- compost smells bad (or has strong ammonia)
- composts don’t reach and maintain high temperatures


COMPOST


724K


SUMITOMO
SH300

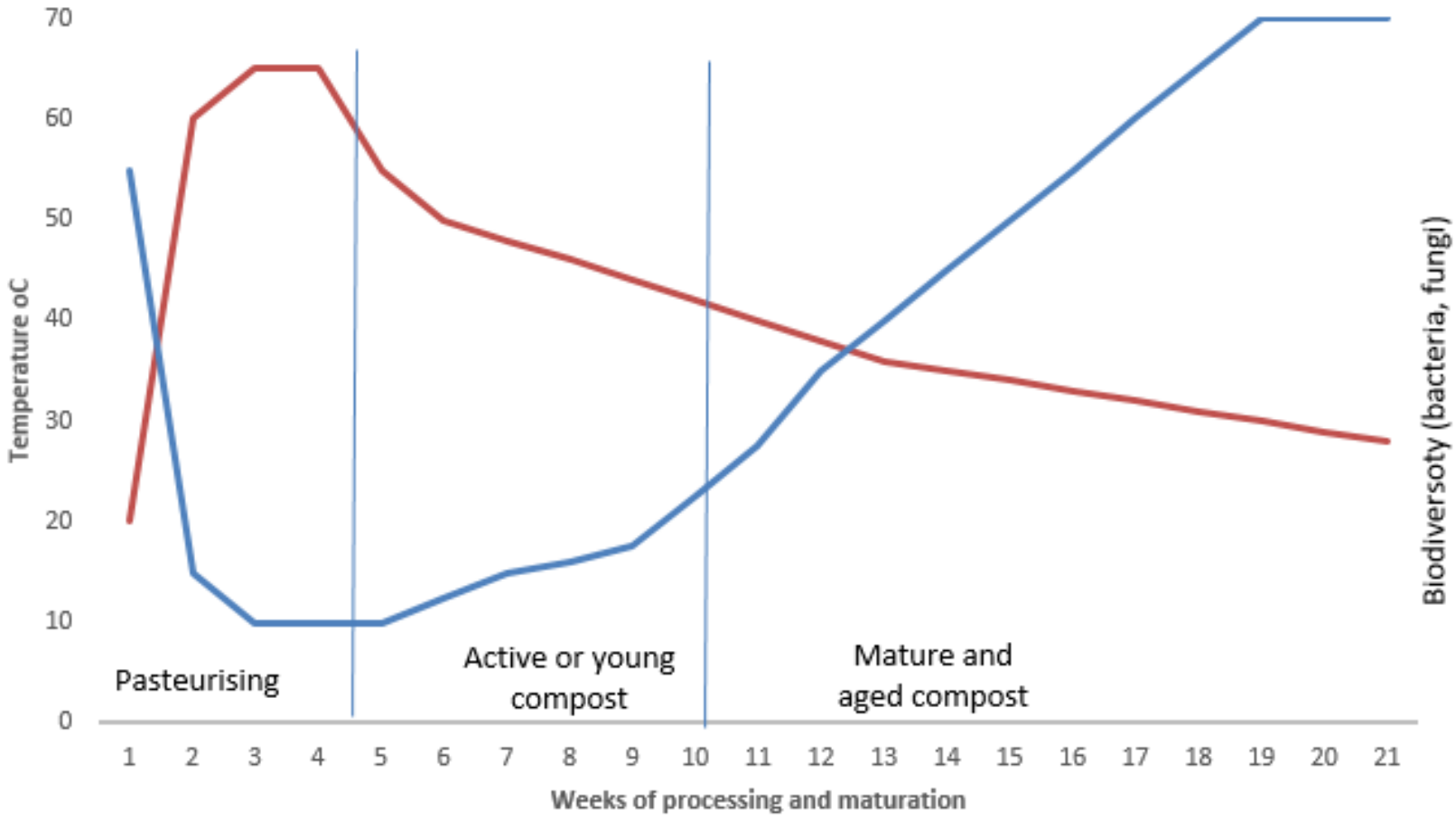

DEERE


VOLVO
Terra Select
T6


Terra Select
T6

The composting process

- Heat, biological activity and biodiversity



Know your product

- **Level of processing/maturity**
  - 'Raw' organics (NOT COMPOST)
  - Pasteurised organics
  - Young/immature organics
  - Maturing composts
  - Mature composts
- **Particle size**
  - 'Undifferentiated'/unscreened/ungraded
  - Coarse mulch (>25mm)
  - Fine mulch (16-25mm)
  - Soil conditioners/fines (<16mm)

Know your product

Product type:

- Mulch
- Source of organic matter
- Soil conditioner (organic matter, humus)
- Biological enhancer (generally beneficial biota)
- Organic fertiliser (enhanced N:P:K, trace)
- Blended compost-fertiliser, compost-lime, compost-gypsum
- ‘Pro-biotic’ compost and compost teas (cultured to contain specific beneficial micro-organisms – e.g. *Trichoderma*)

Know your product

Compost testing

- On-site
  - Moisture (squeeze test)
  - Temperature (pastuerisation, maturity, bio-diversity)
  - Solvita field test (maturity)
  - pH, EC (from water extract)
- Laboratory
  - AS 4454 testing for organic carbon level, particle size, moisture,maturity, pH, EC, phyto-toxicity, nutrients, nutrient draw down, pastuerisation, chemical and physical contamination.
  - ‘Biological’ tests (e.g. Soild Food Web)

What will compost do?

- Increase soil carbon by adding slower-degrading organic carbon /humus to the soil
- Increase cation exchange
- Add some nutrient (but can also ‘draw down’ nutrient in the short term)

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What will compost do?

Nitrogen

- Generally low in green waste composts = <1-2% by dry wt
- Only 5-10% available in the first 6-12 months, then the rest being released over 3-5 years.
- Composted manures might be higher.
- Composts can help N mineralisation and retention in the root zone.
- Compost can draw down and burn off soil N

What will compost do?

Phosphorous

- 0.5-5% by dry wt,
- 15-60% plant available in first year, and most in following year.
- Improved soil biology and root growth can mineralise some P in soil

Potassium

- 2-10% by dry wt
- 50-100% plant available in first year (more if compost is mature), and most in the following year

Other nutrients – sulphur (1-3%), zinc (<0.03%), copper (<0.02%), magnesium (<0.6%), manganese (<0.03%), boron (0.05%)

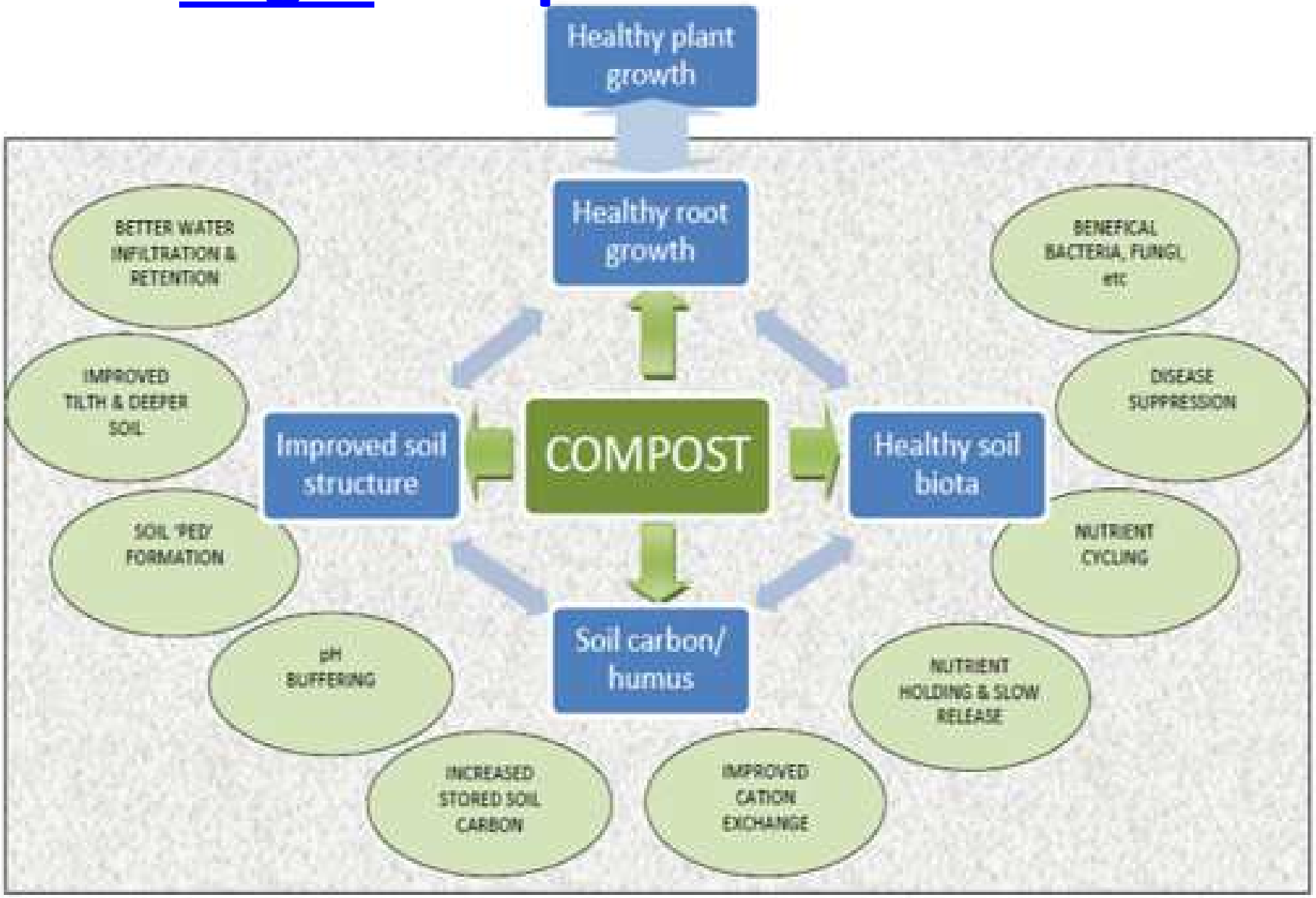
Material	DM (%)	Total (kg/t fresh wt)			Readily available (% of total)		
		N	P_2O_5	K_2O	N	P	K
FYM	25	6.0	3.5	8.0	25	60	60
Cattle slurry	6	3.0	1.2	3.5	30-50	50	90
Sewage sludge	25	7.5	8.7	0.8	15	50	100
Green waste compost	66	7.3	3.0	5.5	<10	15	50

What are compost likely to do?

Depending on application rates, product quality, where it is applied and how it is applied:

- Improve soil structure
- Improve water and nutrient holding
- Boost soil biology
  - Initially from the compost, then by creating soil conditions that promote more soil biology

What might compost do?



When and where to use composts

- **Best performance:**
  - Lower rainfall /marginal land & during dry and extreme weather events
  - Poorly structured soils
  - Low carbon soils
  - Alkaline sands
- **10-30% yield responses/improved growth have been recorded reasonably frequently under such conditions**
- **In areas with better soils, higher soil carbon and more reliable rainfall, the benefits may be less marked**

What compost won't do?

- Unless it has >3% nitrogen, composts are unlikely to meet significant and short term fertiliser needs
- Break down salt (but it may help when revegetating scalded areas)
- Break down plastic contamination in composts
- Break down heavy metals
- Break down organochlorides/non-biodegradable chemicals (but it may reduce the effectiveness of some herbicides and pesticides by binding and biodegrading active ingredients)
- At low rates it is unlikely to radically alter soil biology over an extended period

When and where to use composts

- Best applied when soil is moist or just before the autumn break

- Need to consider potential nutrient draw down and appropriate ‘withholding’ periods

- Young composts can be held and matured on-farm, and are useful for composting manures, etc. on farm.

Nutrient management

- Composts are not N fertilisers unless:
  - inputs are higher in nutrient, and the compost process is managed to retain nitrogen
  - They are blended with additives
  - Have >3% nitrogen
- Most composts have at best 1-2% nitrogen unless they have high N inputs such as manures or blended fertilisers
- Composter should be able to show test results

Compost standards and specifications

- AS 4454 – 2012
  - Sets minimum quality management and product quality thresholds
  - Composters need to have documented management systems and records showing pasteurisation, monitoring and product testing
  - sampling and laboratory test results must be undertaken and demonstrated
- 'Fit for purpose'/'application specific' specifications (e.g. 'Leaf Brand' and new Sustainability Victoria/Industry initiatives)

Compost standards and specifications

- Ask composters for specifications for the product you are getting from them
- Ask for AS 4454 test results – and not just for contamination

- Consider nutrient draw down risks and how you manage and use product

SAMPLE: Batch N°: **10722** Sample N°: **1**
Name: **A1 Compost Findlayvone**
Test Type: **AS4454 - CSC, Humic/Fulvic Testing**

Tests are performed under a quality system certified as complying with ISO 9001:2008. Results and conclusions assume that sampling is representative. This document shall not be reproduced except in full.

Characteristic	Unit	Results:	Acceptance Range Composted	Acceptance Range Pasteurised	Comments
pH	pH units	7.7	5.0 - 7.5	5.0 - 7.5	slightly high, alkaline
EC	dS/m	3.53	No Limit	No Limit	no limit, see Table 3.3
Phosphorus -Soluble	mg/L	8	≤ 5 [1]	≤ 5 [1]	not suitable, highly P sensitive
Phosphorus -Total	%		≤ 0.1 [1]	≤ 0.1 [1]	
Ammonium-N (NH_4)	mg/L	3.5	< 200	NR	low
Nitrate-N (NO_3)	mg/L	4.44	≥10	NR	low
NH_4 + NO_3	mg/L	7.9	> 200 [2]	> 200 [2]	low available N
Nitrogen -Total	%	1.41	≥ 0.6	≥ 0.6	moderately high total N
Organic Matter Content					
By Loss On Ignition	% dry wt	59.83	≥ 25	≥ 25	acceptable
Boron (B)	mg/kg		< 200	< 200	
Sodium (Na)	%		< 1 [3]	< 1 [3]	
Calcium (Ca)	%				
Magnesium (Mg)	%				
Wettability	min	10	< 7	< 7	slightly hydrophobic
Toxicity Index	mm	41	≥ 60	≥ 20	unacceptable
Particle Size Grading					
< 16mm (passing)	%	100.00			
> 16mm (retained)	%	0.00	20-70 - Fine Mulch	< 20 - Soil Cond	acceptable
Total $CaCO_3$ Equivalent If pH > 7.5	% $CaCO_3$	5.2	No Limit	No Limit	slight liming value
Moisture Content	%	33	> 25	> 25	acceptable
Visible Contaminants					
Glass, metal, rigid plastic > 2mm	%	0.0	≤ 0.5	≤ 0.5	acceptable
Light Plastic > 5mm	%	0.0	≤ 0.05	≤ 0.05	acceptable
Stones & lumps of clay ≥ 5mm	%	2.5	≤ 5	≤ 5	acceptable

Notes:

Characteristic	Requirement	(%) Result	(mol/g)	(Ca
Sodium (Na)	Na < 1.0%	0.12	0.0001	
Calcium (Ca)	or	1.52	0.0004	
Magnesium (Mg)	(Ca+Mg)/Na ≥ 7.5	0.53	0.0002	

BIOLOGICAL STABILITY AND PLANT GROWTH TO DET

Group A: Biological Stability Testing	Unit	Requirement	
Solvita Compost Maturity Index	Index	Composted Product	Mature Compost
		5 - 6	7 - 8
Nitrogen Drawdown (NDI)	Index	> 0.2	> 0.5
S.O.U.R.	mg O_2/g BVS/hr	< 3.0	≤ 1.0
Carbon Dioxide Respiration	mg CO_2/g BVS/hr	≤ 12	≤ 8
Dewar self heating test	°C above ambient	≤ 20°C	≤ 10°C
Group B: Plant Growth Testing			
Bioassay (Toxicity)	mm root length	> 60	N/A
Bioassay by TMECC-A	% root elongation	> 80	> 90
Bioassay by TMECC-B	% relative growth	> 80	> 90
NH_4 : NO_3 Ratio by TMECC	Ratio	< 3.0	< 0.5
Solvita Ammonia	Solvita scale	≥ 4	≥ 5
Volatile Fatty Acids	mol/g	< 1000	< 200

UNRESTRICTED USE UPPER LIMITS FOR CHEMICAL CONTAMINANTS				
Category	**Element**	**Unrestricted Use Upper Limits**	**Results**	**Comments**
Chemical Contaminants (mg/kg)	Arsenic (As)	20	5	Pass
	Cadmium (Cd)	1	<1	Pass
	Boron (B)	100	22.2	Pass
	Chromium (Cr)	100	24	Pass
	Copper (Cu)	100	29	Pass
	Lead (Pb)	150	72	Pass
	Mercury (Hg)	1	<0.1	Pass
	Nickel (Ni)	60	26	Pass
	Selenium (Se)	5	<5	Pass
	Zinc (Zn)	300	191	Pass
Organic Contaminants (mg/kg)	DDT/DDD/DDE	0.5	<0.01	Pass
	Aldrin	0.02	<0.01	Pass
	Dieldrin	0.02	<0.01	Pass
	Chlordane	0.02	<0.01	Pass
	Heptachlor	0.02	<0.01	Pass
	HCB	0.02	<0.01	Pass
	Lindane	0.02	<0.01	Pass
	BHC	0.02	<0.01	Pass
	PCBs	Not detected (<0.2)	-	Did not test

Characteristic	Units[1]	Median	Min	Max
Moisture content	% (w/w)	41	21	59
pH		7.3	5.6	8.3
Electrical conductivity	dS/m	1.8	0.8	5.1
Toxicity index		83	13	100
Wettability	minutes	4	0	180
Nitrogen drawdown index		0.10	0.01	1.50
Loss on ignition	% (w/w)	51	36	89
C:N ratio		35	16	134
Ammonium	mg/L	4	0	75
Nitrate	mg/L	0.3	0.0	10.0
Total nutrients				
Nitrogen (N)	% (w/w)	0.86	0.39	1.60
Phosphorus (P)	mg/kg	1650	500	4780
Potassium (K)	mg/kg	4650	1896	11000
Sulphur (S)	mg/kg	1850	840	2990
Calcium (Ca)	mg/kg	15400	9000	20900
Magnesium (Mg)	mg/kg	3610	1700	6170
Manganese (Mn)	mg/kg	210	54	300
Iron (Fe)	mg/kg	14400	2100	21800
Boron (B)	mg/kg	24	15	45
Sodium (Na)	mg/kg	1300	709	2300
Heavy metals				
Arsenic (As)	mg/kg	6	3	35
Cadmium (Cd)	mg/kg	0.5	0.4	1.7
Chromium (Cr)	mg/kg	51	8	160
Copper (Cu)	mg/kg	54	10	165
Lead (Pb)	mg/kg	81	21	272
Mercury (Hg)	mg/kg	0.2	0.1	0.4
Nickel (Ni)	mg/kg	18	5	62
Selenium (Se)	mg/kg	0.6	0.5	2.4
Zinc (Zn)	mg/kg	220	73	969

Managing risks

- Contamination
- Biosecurity – actual and perceived
- Partial Pasteurisation
- Fire
- Nutrient draw down in products

Uses in dairy farm systems & pasture management

- Management of shed/yard wastes/ manures
- Nutrient cycling
- Increasing humus content of soils

Uses in dairy farm systems & pasture management

- Target degraded and underperforming areas on farms
- Mulches and composts in gateways and feed-pad areas
- Top dressing pastures

Uses in dairy farm systems & pasture management

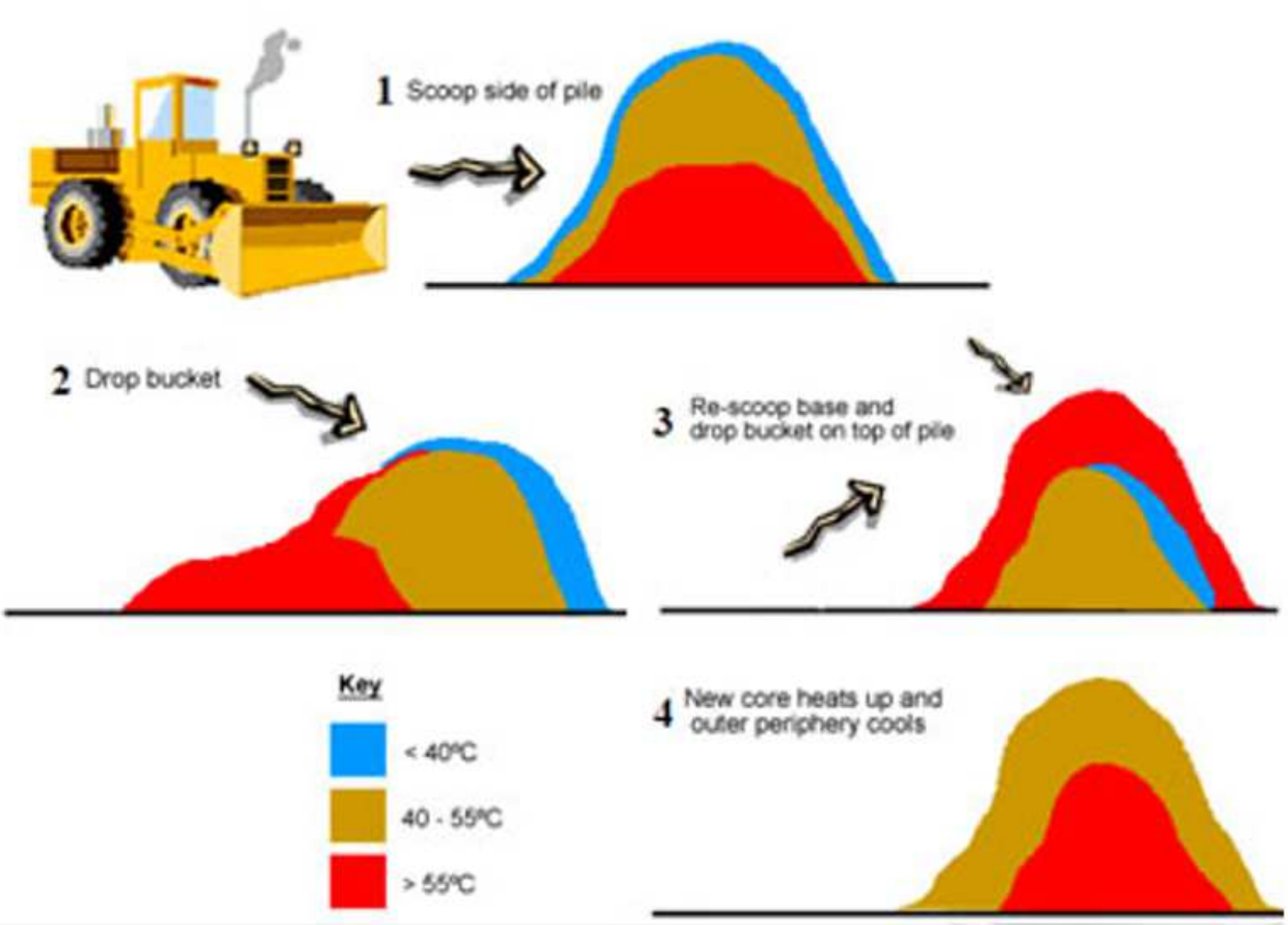
- Re-sowing/re-establishing pasture
- Re-establishing areas after laser-grading or raised/ precision bed development
- Sowing fodder or other crops
- After intensive or strip grazing

Uses in dairy farm systems & pasture management

- Re-establishing areas after laser-grading or raised/ precision bed development
- Sowing fodder or other crops
- After intensive or strip grazing
- Use compost to manage mortalities

On-farm composts

- Need a mix of inputs
  - Woody shredded ‘porous’
  - Source of nutrients (green, manures)
  - Source of moisture (manures, water)


1 Scoop side of pile
2 Drop bucket
3 Re-scoop base and drop bucket on top of pile
4 New core heats up and outer periphery cools
Key
< 40ºC
40 - 55ºC
> 55ºC


CAT
CAT

Regulation and risk management

- Need EPA approvals if >100 tonnes per month (about 300 cub m of shredded greenwaste)
- Need to be >100m from a waterway/ drain
- Should be >200-500 m from ‘sensitive receptors’

Summary

- Good quality composts can be beneficial, and a contributor to more sustainable farming when combined with other practice changes
- Composts are mainly soil conditioners that provide humus, organic matter, CEC and a ‘boost’ of beneficial microbes that can enhance soil health and fertility/productivity

Summary

- Most composts are not fertilisers, but can provide some nutritional benefits and improve soil fertility
- Immature composts can draw down nutrients
- Know your product and what it will and won't do
- Ask to see AS 4454 results and ask about how to use products

Summary

- Target underperforming areas
- Beware of and manage risks
- Consider compost-blend products (fertiliser, gypsum, lime)

- Try quality compost (test strips)

Bill Grant

Phone: 3 9018 6663 (skype)

Mobile: 0407 882 070

bill.grant@blueenvironment.com.au

blue environment pty ltd

www.blueenvironment.com.au