A Lot ~~ALL~~ ABOUT COMPOST(ING)

By Dieter Geesing,
B.C. Ministry of Agriculture, Food and Fisheries

Presented to the Maple Ridge Agricultural Advisory Committee

On October 20, 2021


Compost Hot Line
604.736.2250
growsmartsmart.ca

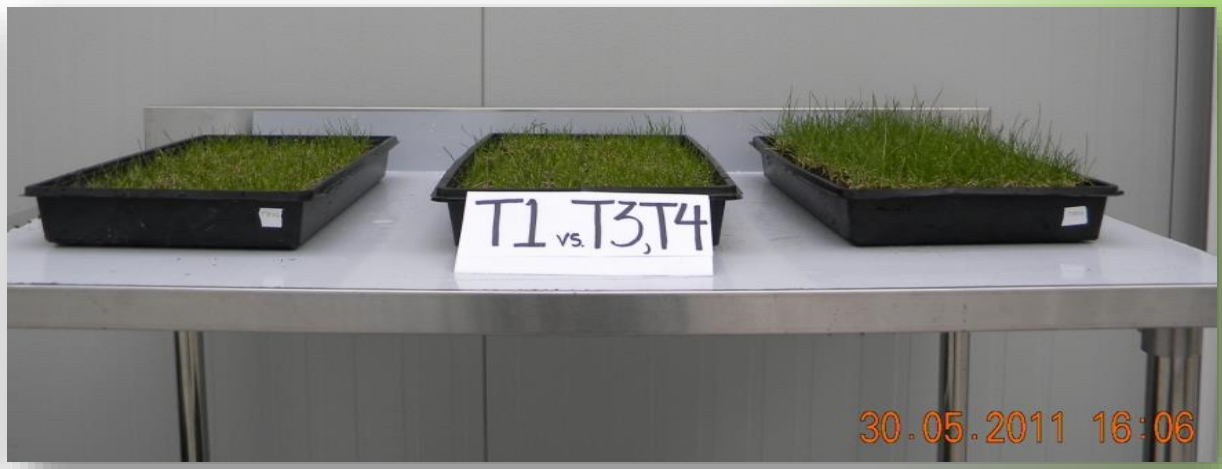

2012.11.07


2012.07.16


HITACHI
HITACHI
EX700

Why Bother Composting?

PLANTS AND SOIL ❤ COMPOST



Treatment 1: 100% Langley Soil
Treatment 2: 25% Sand 75% Compost
Treatment 3: 50% Sand 50% Compost
Treatment 4: 75% Sand 25% Compost
Treatment 5: 25% Langley Soil 75% Compost

COMPOST CAN SUPPRESS PLANT PATHOGENS

SUPPRESSION OF DOLLAR SPOT DISEASE OF CREEPING BENTGRASS WITH COMPOST

J. I. BOULTER, G. J. BOLAND, J.T. TREVORS

Department of Environmental Biology, University of Guelph, Guelph, ON, N1G 2W1

ABSTRACT

The use of composts in turfgrass disease management allows for a reduction in pesticide use in chemical control practices. In 1998, five composts were evaluated for effectiveness in suppression of dollar spot in field experiments with compost prepared in 1997-8. Multiple applications of compost (every 3 weeks) throughout the season suppressed dollar spot (*Sclerotinia homoeocarpa* F. T. Bennett) of turf to levels not significantly different than applications of fungicide every 2 weeks (P#0.05). Compost applied in a single application at the start of the season was not effective in reducing disease. Field experiments in 1999 evaluated two selected compost formulations reproduced in 1998-9 and evaluated the influence of storage on suppressiveness of the 1997-8 compost formulations. Compost formulations that were reproduced were effective in suppressing disease to levels not significantly different than the fungicide controls (P#0.05). Storage of compost for up to one year did not affect its ability to reduce dollar spot severity (P#0.05). In addition, the affect of nitrogen, a known cultural control method of dollar spot, was evaluated as a potential mechanism of disease suppression. Compost applications were significantly better at suppression of dollar spot than nitrogen treated plots (P#0.05), even though all nitrogen controls were applied at rates equivalent to, or greater than, the highest compost application rate.

INTRODUCTION

Dollar spot (*Sclerotinia homoeocarpa)* is an important turfgrass disease (5,33,37). Although fungicides are commonly used for its management, the high frequency of chemical use, associated costs, nontarget effects, development of fungicide resistant populations, and health risks to humans and the surrounding environment has stimulated the need for other methods of disease management (6,25). An exciting alternative in turfgrass disease management is the development and use of organic amendments such as composts, organic fertilizers, and sludges, or inoculation of turf with specific bacterial or fungal species known to suppress disease (2). The use of composts and other organic amendments for disease suppression has the potential to be beneficial both ecologically and economically. Although compost may not control turfgrass diseases to a level that will replace fungicides, its integration into current disease management practices may reduce the use of fungicides and associated problems. Naturally suppressive (antagonistic) composts can be incorporated into normal golf course maintenance by replacing sphagnum peat or other organic materials used in topdressing mixtures or in soil root-zone mixtures. Dollar spot is one of the more commonly studied diseases for suppression with composts, sludges and other organic materials (15,17,20,26,28). Composts are known to suppress plant diseases through a combination of biological and physiochemical characteristics (13). Biological characteristics include microbial populations in compost, competition for nutrients with pathogens, antibiotic production, lytic and other extracellular enzyme production, parasitism and predation, and induction of host-mediated resistance in plants. Compost can be a beneficial material where a high proportion of organic matter may offset sand content and increase or restore microbial populations (1). High levels of microbial activity in composts was postulated as the primary mechanism of disease control (7,8,23,24,26,27,28,30). Several bacterial and fungal species (e.g. *Fusarium heterosporum, Acremonium* spp., *Rhizoctonia* spp., *Enterobacteria cloacae, Pseudomonas fluorescens, Pseudomonas lindbergii*) are known to be highly suppressive to dollar spot (10,12,24). Researchers have generally supported the proposal that microbial populations in compost provide nutrients and other chemical compounds to competing microorganisms and plant hosts through continual breakdown of composted material (3,16,21,26,32,34).

Physiochemical characteristics include any physical or chemical aspects of composts that reduce

The use of composts in turfgrass disease management allows for a reduction in pesticide use in chemical control practices. In 1998, five composts were evaluated for effectiveness in suppression of dollar spot in field experiments with compost prepared in 1997-8. Multiple applications of compost (every 3 weeks) throughout the season suppressed dollar spot (*Sclerotinia homoeocarpa* F. T. Bennett) of turf to levels not significantly different than applications of fungicide every 2 weeks (P#0.05). Compost applied in a single application at the start of the season was not effective in reducing disease. Field experiments in 1999 evaluated two selected compost formulations reproduced in 1998-9 and evaluated the influence of storage on suppressiveness of the 1997-8 compost formulations. Compost formulations that were reproduced were effective in suppressing disease to levels not significantly different than the fungicide controls (P#0.05). Storage of compost for up to one year did not affect its ability to reduce dollar spot severity (P#0.05). In addition, the affect of nitrogen, a known cultural control method of dollar spot, was evaluated as a potential mechanism of disease suppression. Compost applications were significantly better at suppression of dollar spot than nitrogen treated plots (P#0.05), even though all nitrogen controls were applied at rates equivalent to, or greater than, the highest compost application rate.

Suppression of *Phytophthora* collar rot on apple seedlings in a compost mix

Spring et al., 1980, Phytopathol. 70:1209-1212

Compost Application Reduces Erosion

Nutrients in Compost

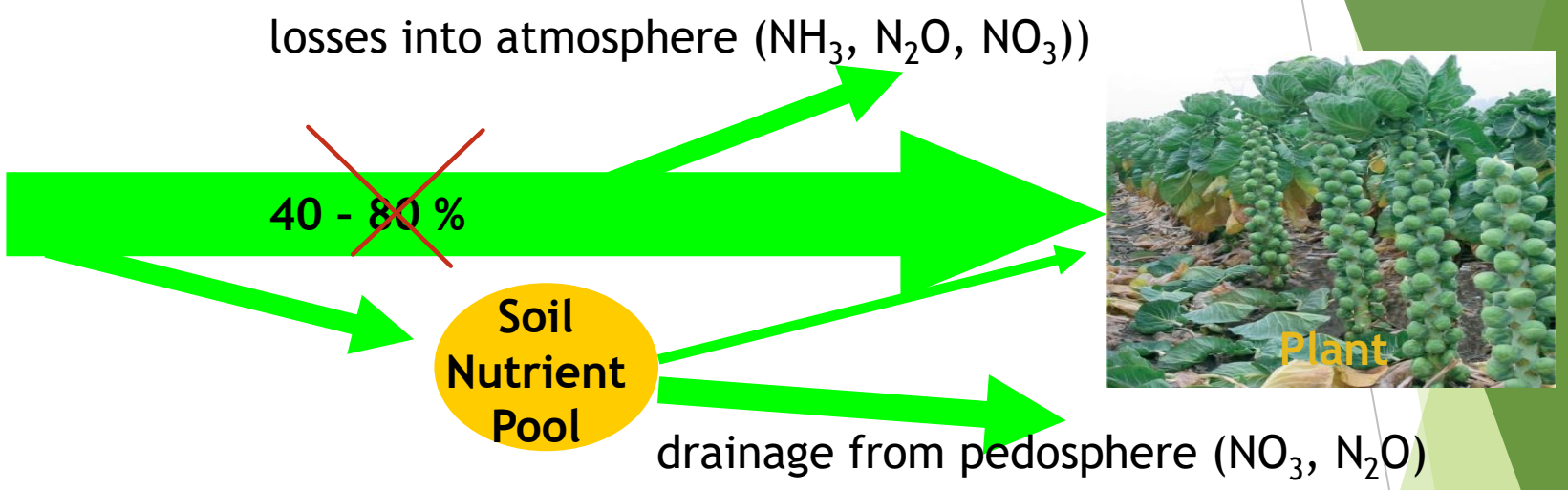
0.6% P_2O_5 = 0.26% P
1% K_2O = 0.83% K

1.2% N / 0.26% P = 4.6

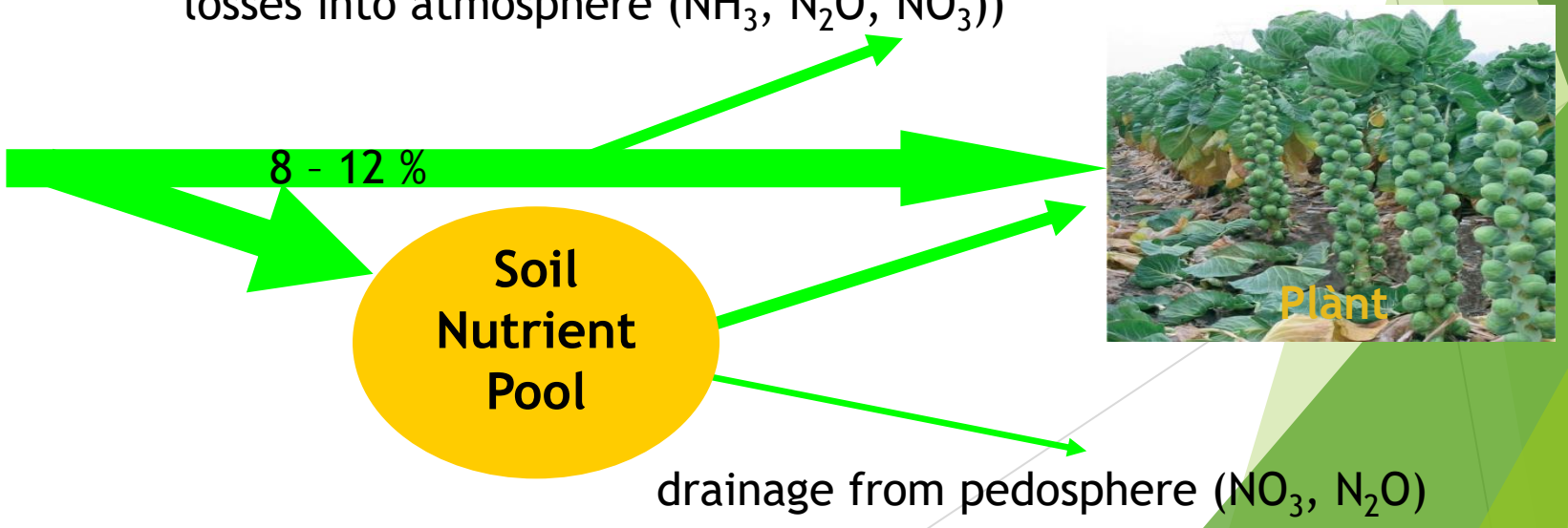
Characteristic	Median	Range
Bulk Density (kg m^{-3}) [lbs yd^{-3}]	700	557 – 872 [940 – 1,500]
Moisture (%)*	38	29 - 48
N (%)**	1.2	0.8 – 1.6
P_2O_5 (%)**	0.6	0.3 – 1.0
K_2O (%)**	1	0.5 – 1.5
Org.Matter (%)**	35	25 – 45
pH	7.4	7 – 7.8
EC (dS m^{-1})		1.1 – 5.4 …12

Compost vs. Nitrogen Mineral Fertilizer

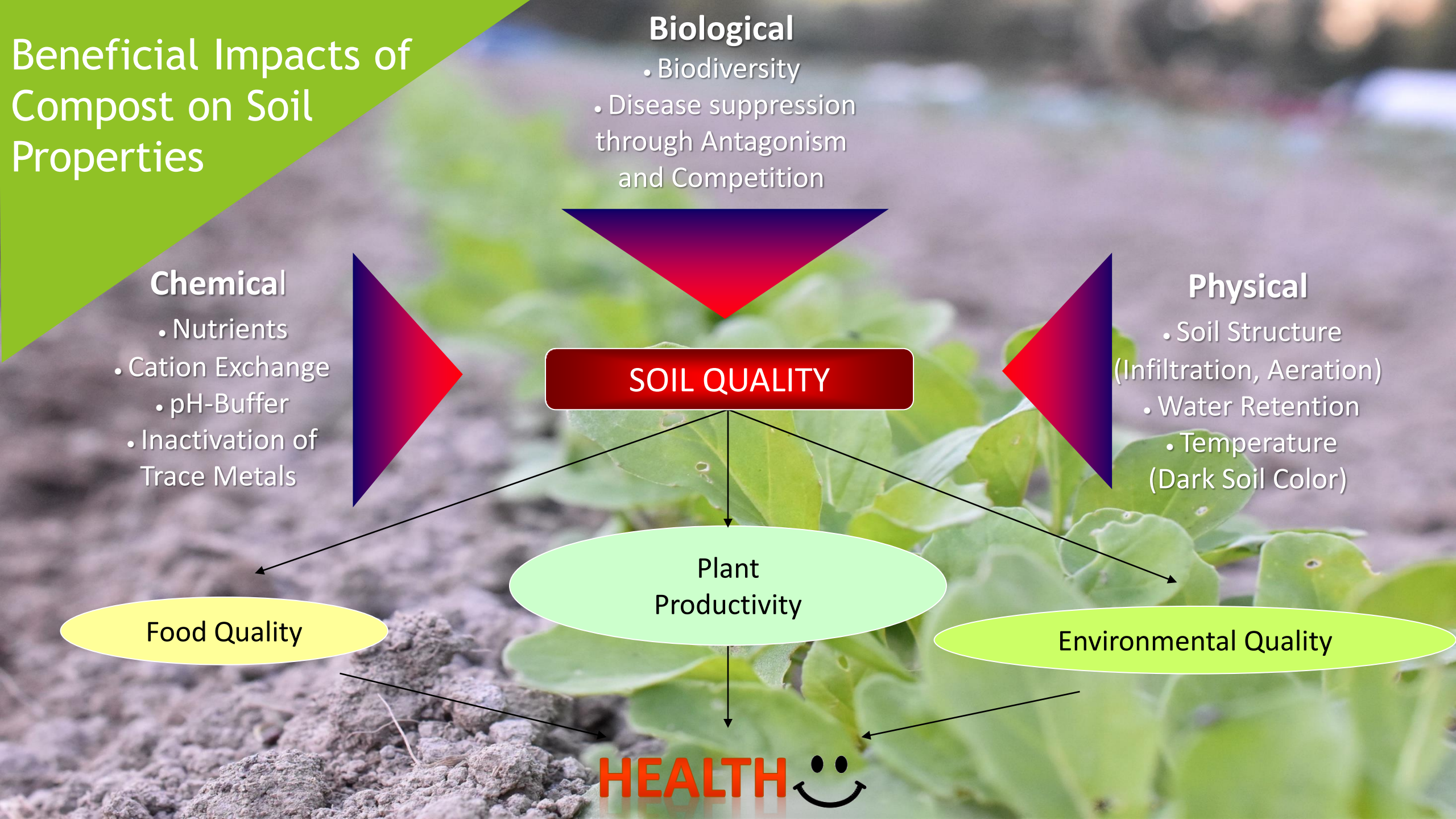
Mineral Fertilizer



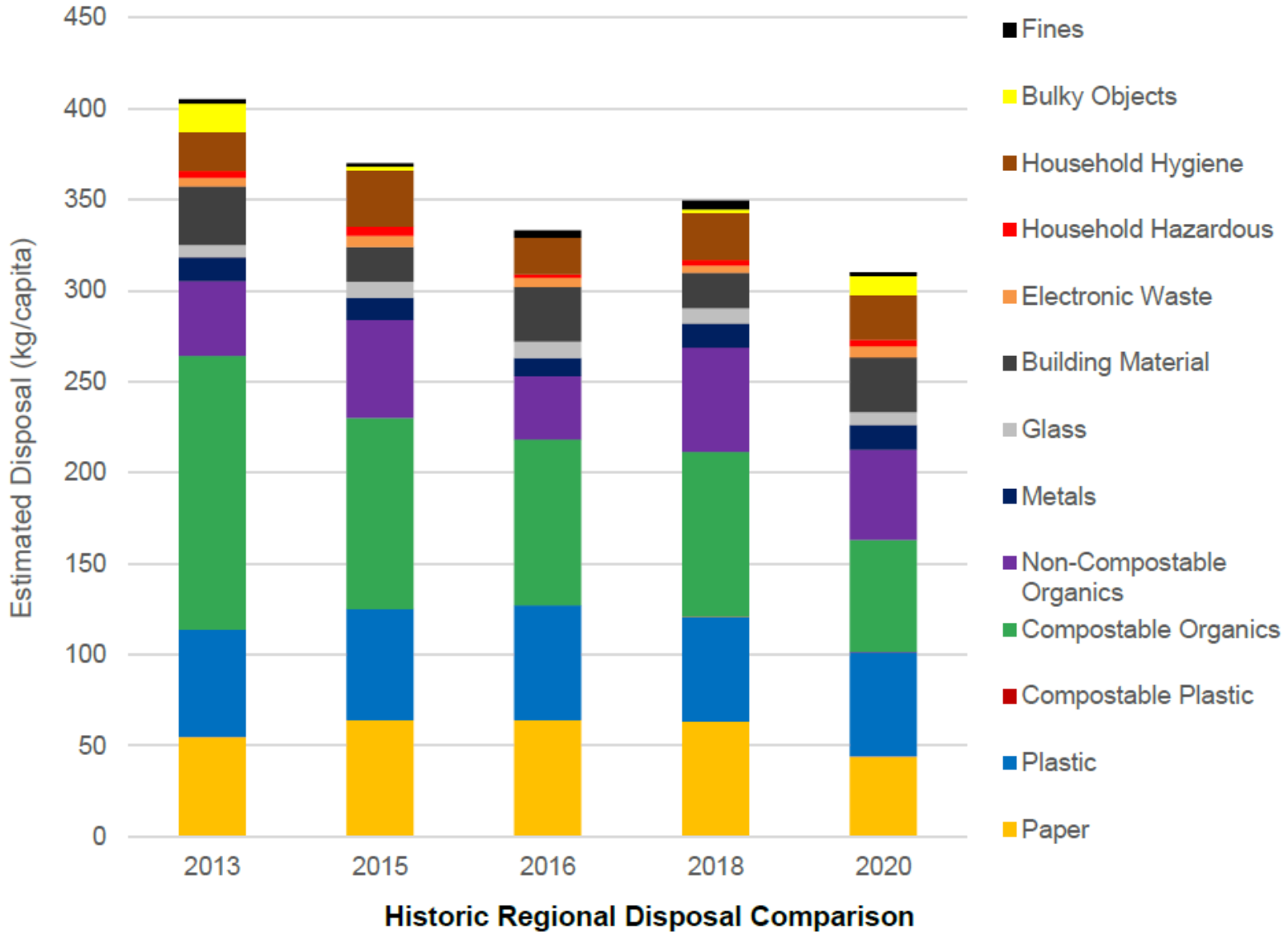
Compost

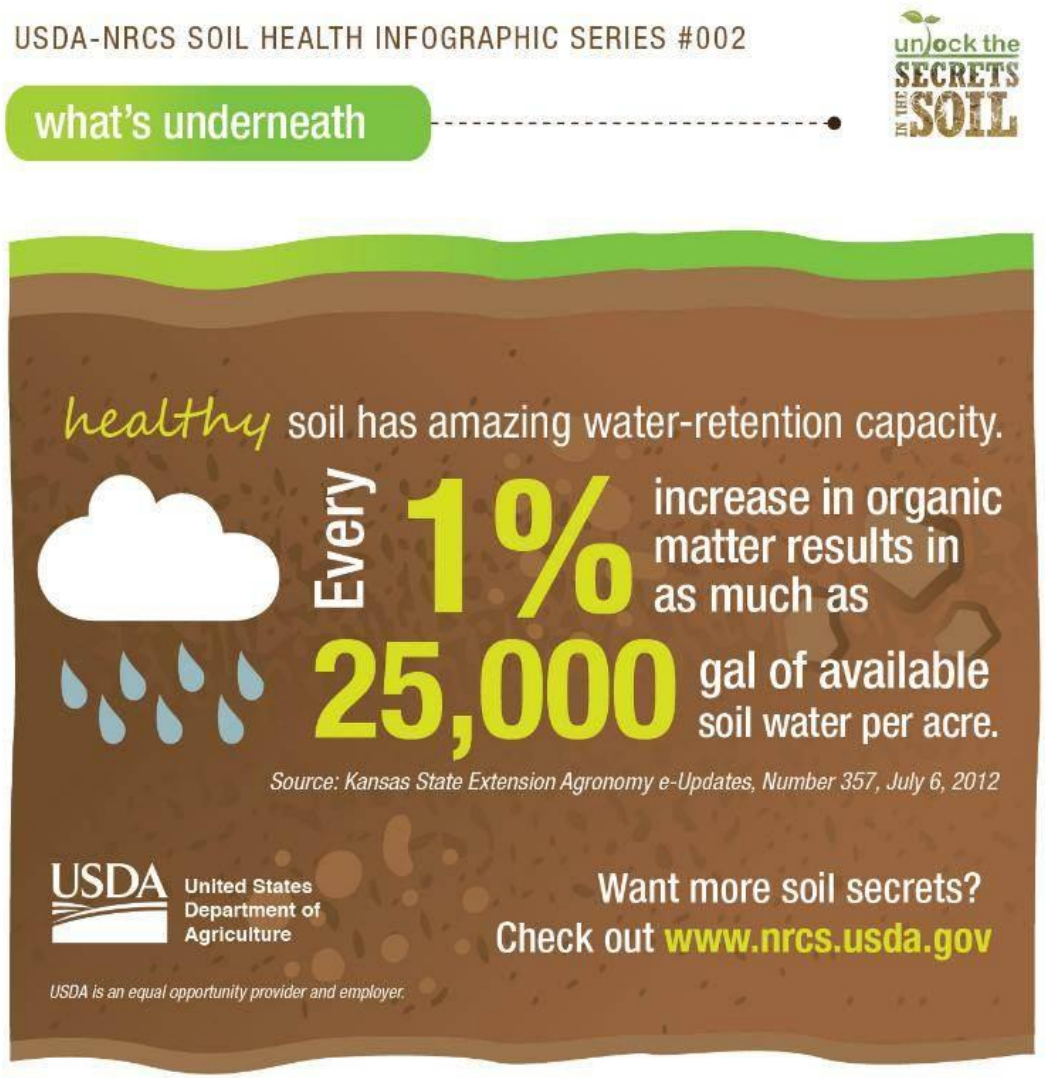


Beneficial Impacts of Compost on Soil Properties



Waste Composition Metro Vancouver



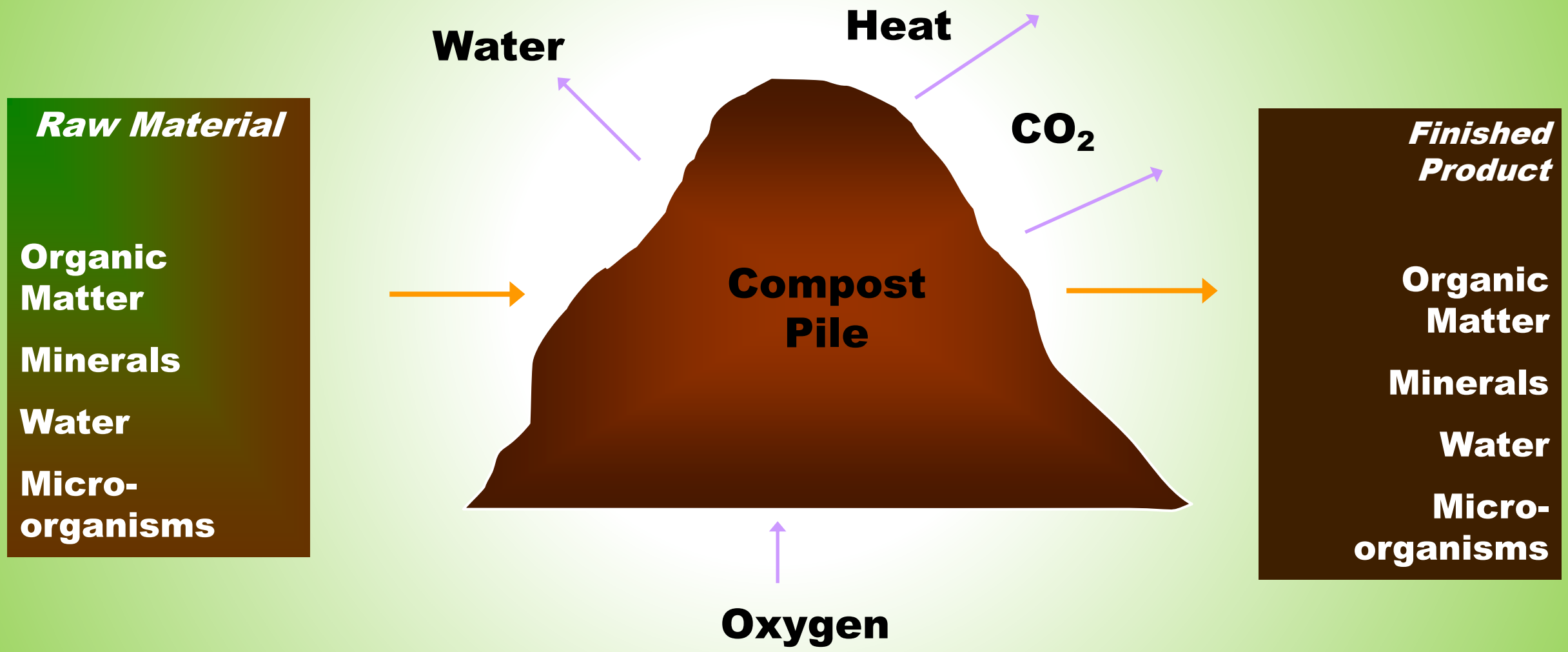


Compost Use Saves Water



Applying Compost

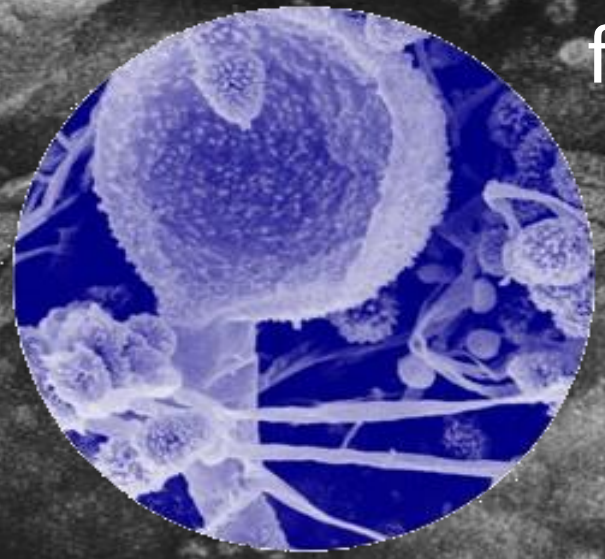
The Composting Process



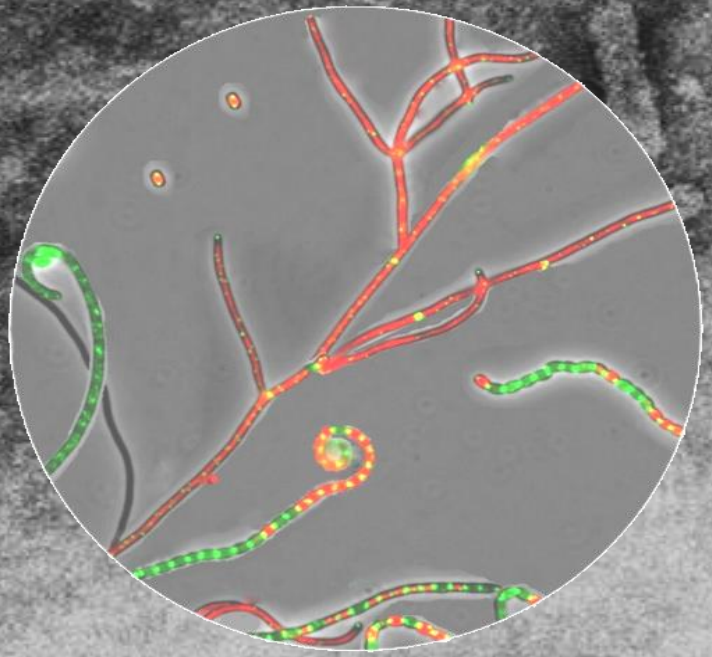
Composting: Billions of Helpers

bacteria

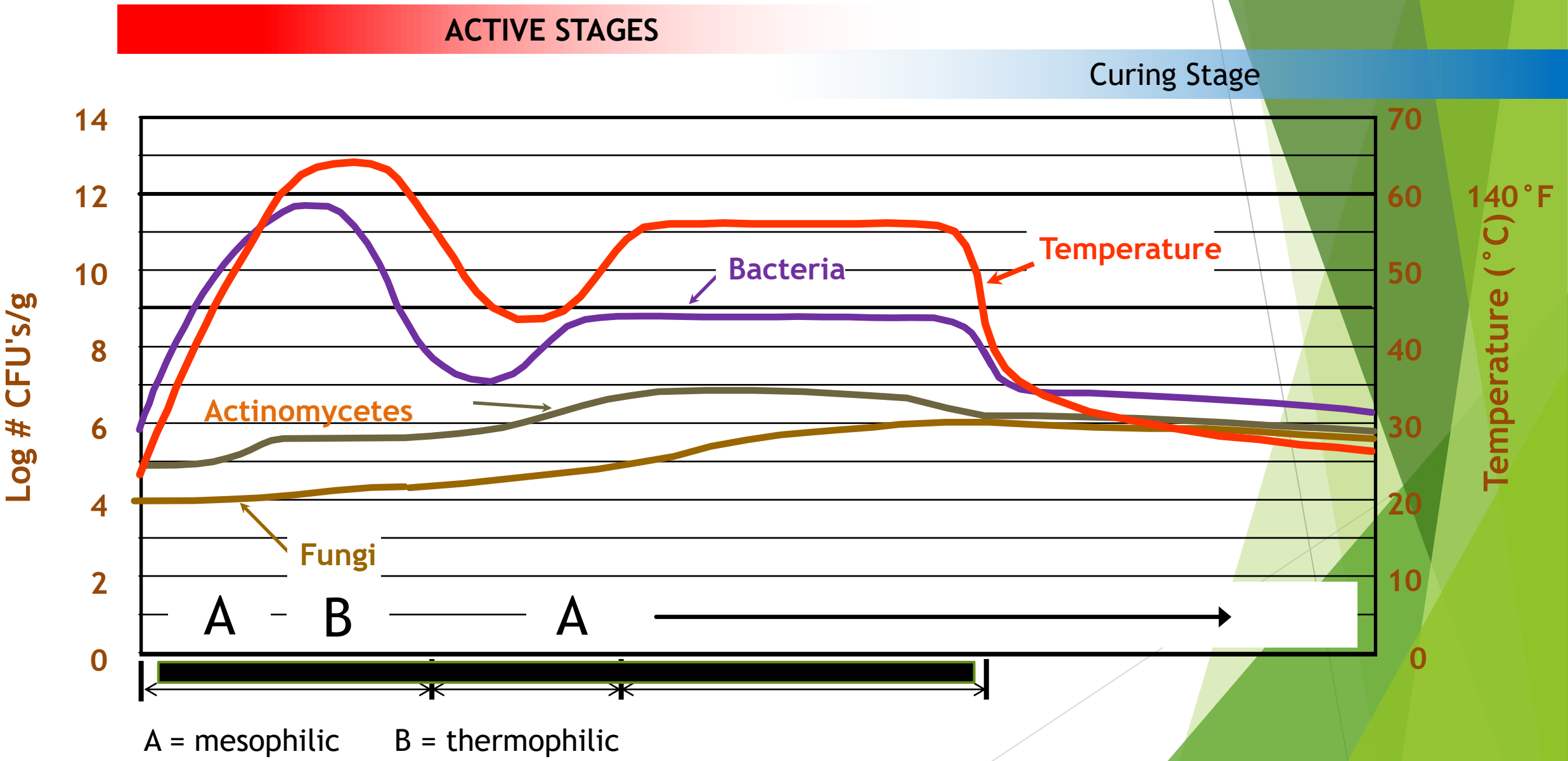
fungi



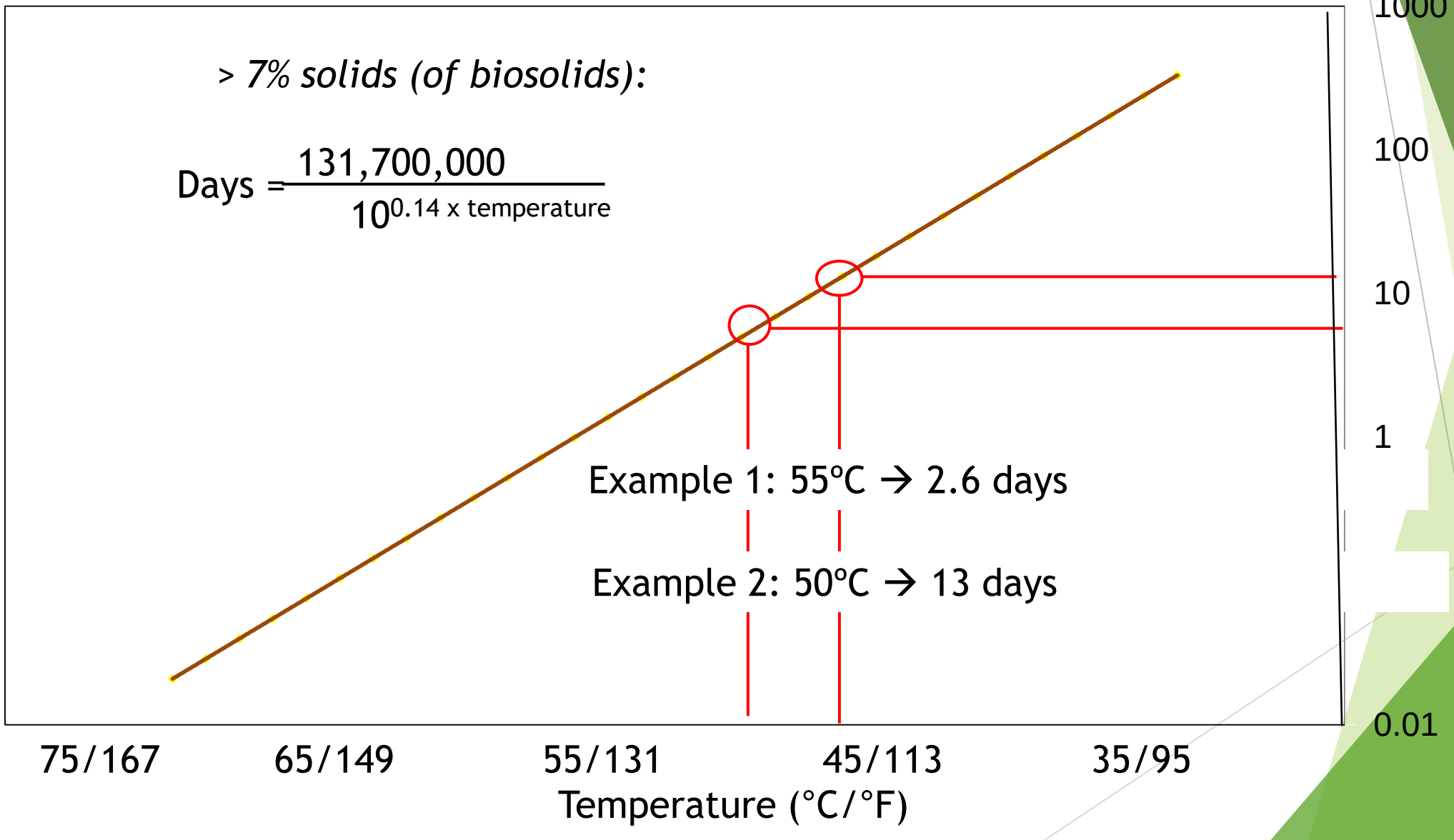
actinomycetes



COMPOST DYNAMICS



Time-Temperature Relationship for Similar Pathogen Reduction



Pathogen Destruction

Organism		Exposure time (in minutes) for destruction at various temperatures (in degree Celsius)				
		50	55	60	65	70
Entamoeba histolytica cysts	diarrhoea, invasive liver abscess	5				
Ascaris lumbricoides eggs	roundworm	60	7			
Brucella abortis	brucellosis (cow/human)		60		3	
Cornyebacterium diphteriae	diphteria		45			4
Salmonella typhi	typhoid fever			30		4
Escherichia coli	diarrhea			60		5
Staphylococcus areus	skin, pulmonary, etc. infection					20
Mycobacterium tuberculosis	tuberculosis				40	20
Shigella ssp.	shigellosis (diarrhea, fever, etc.)		60			
Necator americanus	hookworm	50				
Taenia saginata	tapeworm		30			5
Some viruses						25

FEEDSTOCK CATEGORIES

	‘Browns’	‘Greens’
Carbon	High	Low
Nitrogen	Low	High
C:N	High	Low
Decay	Slow	Fast
Moisture	Low - Moderate	High - Moderate
Porosity	High - Moderate	Low - Moderate
Bulk Density	Low - Moderate	High - Moderate
	tie up nitrogen in soil, if not fully composted	*foul odors if poorly aerated*

best composting if mixed together

FEEDSTOCK

GREENS
Vegetables, fruits
Coffee grounds, tea bags
Egg shells
Grass clippings
Flowers
Manure
Bread

BROWNS
Leaves and needles
Paper
Wood shavings
Prunings
Straw

NO, NO
Meat, fish and dairy
Fat, oil and grease
Feces
Weeds with seeds or persistent roots
Diseased plants
Treated wood
Plastic (even “compostable”)

OTHER
Egg shells

Use Only Your Own Waste If You Can

WHAT IS THE BEST MIX?

Moisture

Water as prerequisite of biological activity

Oxygen

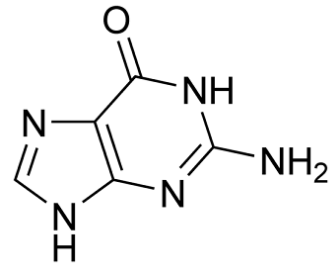
Prerequisite for aerobic organisms

Air content in competition with moisture content

Particle size, porosity and bulk density

Temperature

Typical temperature profile during composting: phases of composting



Chemical Feedstock Properties

Nitrogen and carbon, C:N ratio

Biodegradability

(pH)

MOISTURE

- Most rapid decomposition takes place in thin film of water on surfaces of organic particles.
- Too little – poor bacterial activity, slower or no decomposition
- Too much – anaerobic pockets and odor, nutrient leaching, slower decomposition
- **Ideal: 45 - 60%; "wrung-out sponge"**
- Typically controlled by adding bulking agents or liquid

Too dry

Mix falls apart after squeezing

Too wet

What flows out when squeezed

Just right

A few drops of water when squeezed

PARTICLE SIZE

Large

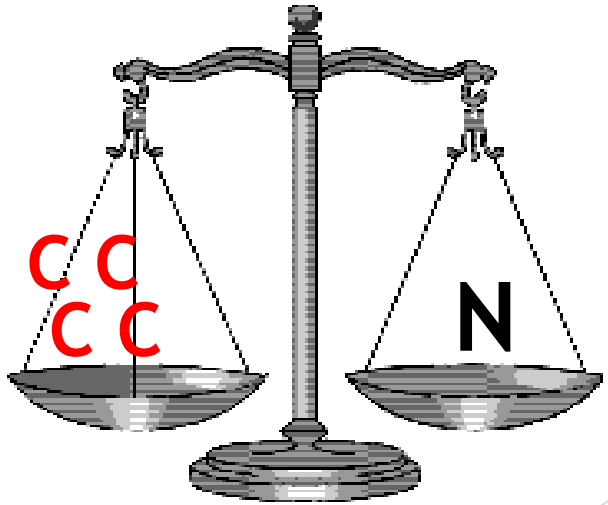
+ prevents compaction
+ allows oxygen flow and aeration
- less surface area
- increased heat removal

Small

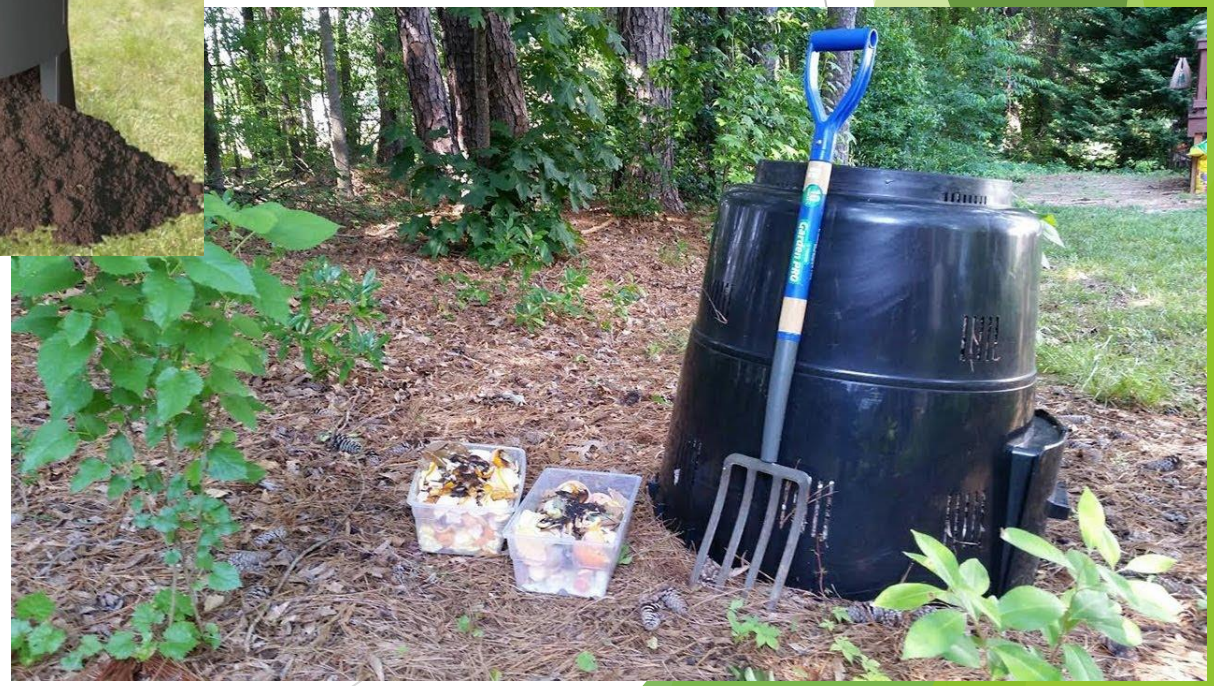
+ more surface area allow easier access to microbes = faster decomposition
- Compacts easier → impedes air flow
- small pores may restrict water flow

Carbon:Nitrogen Ratio

- Too high (> 35:1) → composting process slows, N is tied up
- Too low (< 15:1) → N loss (ammonia release)
- **Ideal starting range for composting: 35:1 to 25:1**
  = about 2/3 browns, 1/3 greens
- Depends also on degradability and accessibility of compounds

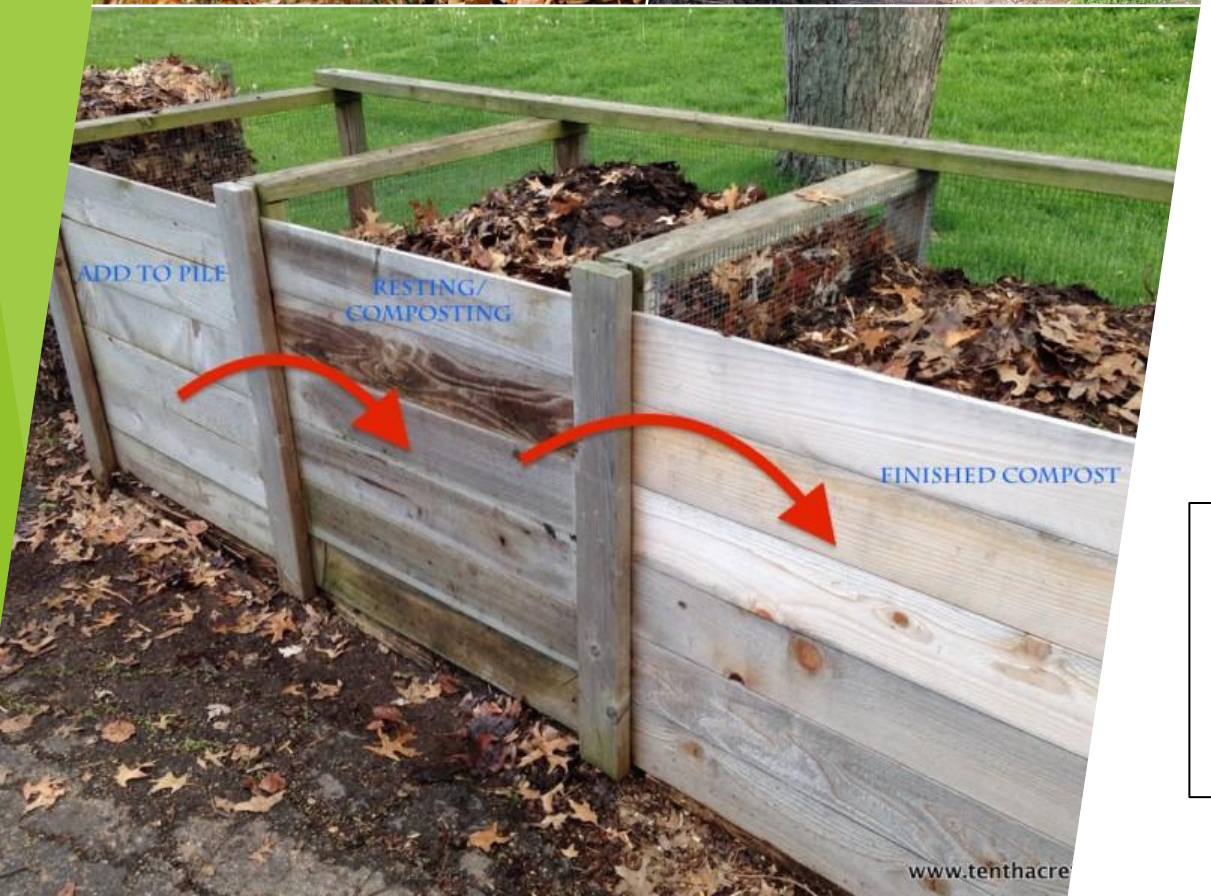


COMPOST SYSTEMS



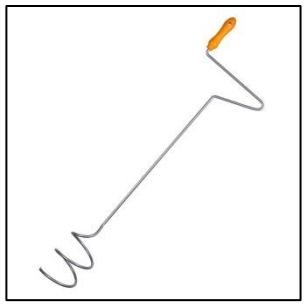
Where to Place

- Easily accessible
- Enough space to turn
- Shade or sun – does not really matter
- Keep away from neighbors



Managing Your Compost

- Composting is an Aerobic Process!
- Temperature – your best indicator



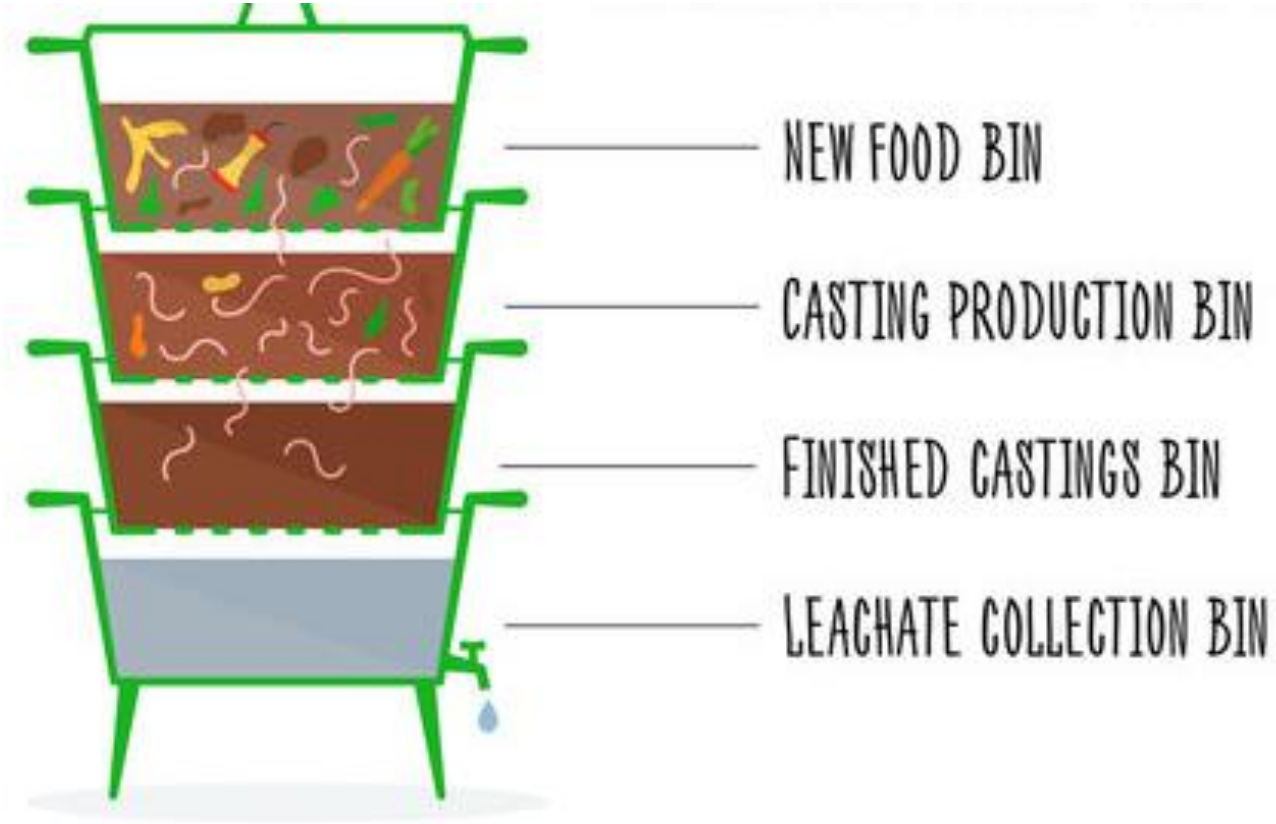
Yessss

Screening - not always necessary

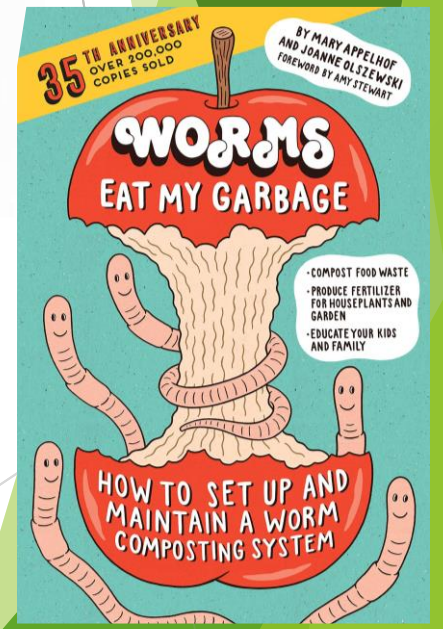
OTHER COMPOST SYSTEMS

- VERMICOMPOST
- BOKASHI
- COMPOST TEA
- SORE CONE SYSTEM
- LEAF MOLD
- COLD COMPOSTING
- INDORE SYSTEM

Vermicomposting



Vermicomposting cont’d



Vermicomposting cont'd

Bokashi

- Anaerobic decomposition
- Works well for kitchen scraps but not suited for yard waste
- Cooked food and dairy can be processed
- Facilitates break down but further steps are required (composting, burying, etc.)
- Potentially costly and smelly

COMPOST TEA

Leaf Mold

Solar Cone Food Digester

Compost Accelerator Amendments

Really necessary or

?

WHEN IS MY COMPOST READY?

- Stability vs. Maturity
- Has a dark brown color
- Is crumbly, loose, and **humus-like**
- Has an earthy smell
- Contains no readily recognizable materials

When is My Compost Ready?

- **Plant Assays**
  - Cress / Radish seed germination and growth
  - (Wheat and rye grass germination)
- **Solvita Test**
- **Chemical methods**
  - C:N (
  - Nitrogen species ($NH_3\downarrow$, $NO_2\downarrow$ $NO_3\uparrow$)
  - Humification parameters (Humification index, etc.)
  - pH, CEC, reactive C (no reliable indicators)
- **Physical methods**
  - Temperature (self-heating: Dewar flask)
- **Microbial tests and activities**
  - Respiration (CO_2 evolution / O_2 uptake)
  - Microbial changes
  - Enzyme activity

Trouble Shooting

- Leachate – too moist
  - Mix
  - Cover
  - Shape of pile
- Unpleasant odor:
  - cabbage, rotten egg smell: too moist
  - Ammonia, fish, medicinal smell: too much nitrogen
- Slow composting
  - too little or too much moisture
  - wrong C:N mix
  - too coarse
  - pile too small
- Flies –
  - too much food waste or food waste
  - not well covered,
  - temperature too low

THANK YOU FOR YOU ATTENTION

dieter.geesing@gov.bc.ca