



What's covered?

- Managing plant residue breakdown
- Converting plant residues into soil organic matter
- Impact of soil biology on agrichemicals
- Impact of agrichemicals on soil biology





Managing breakdown – getting the biology right

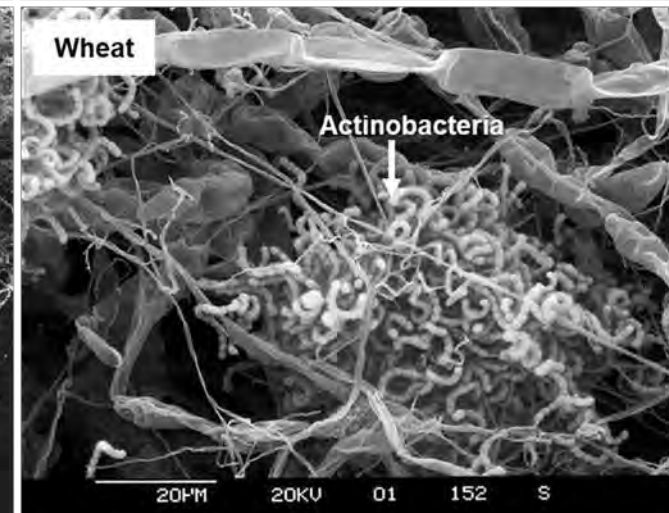
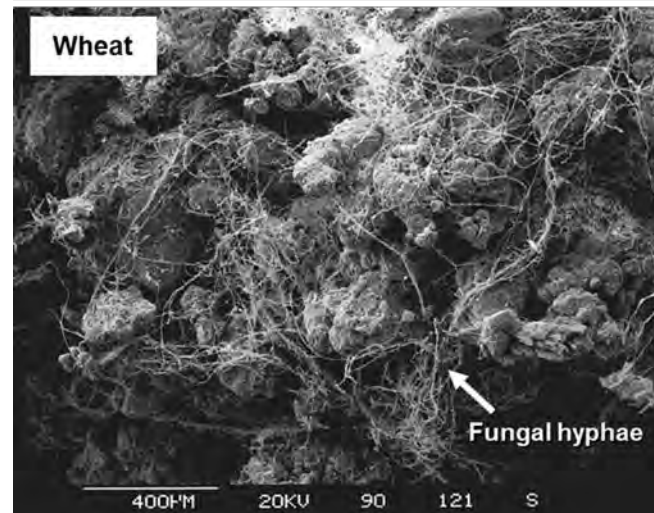
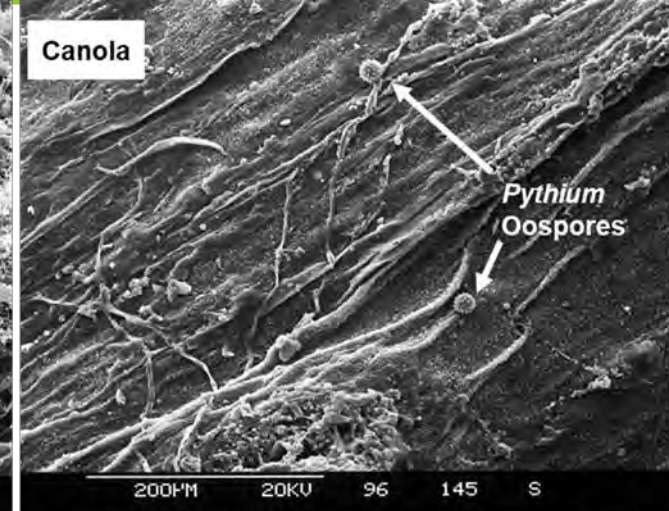
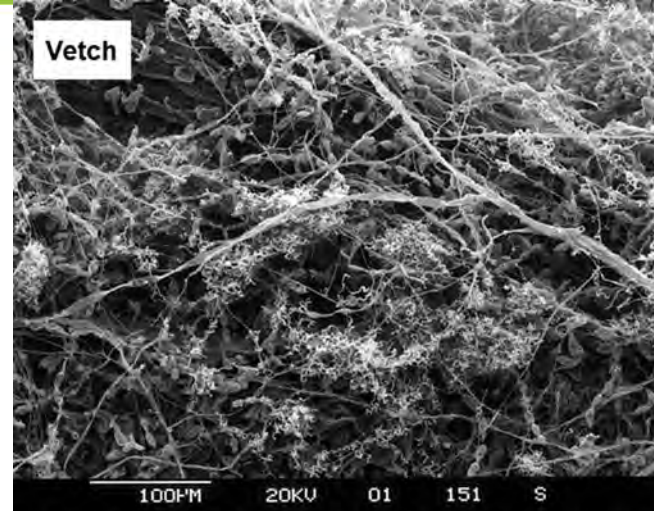
- Aim
- Who
- Food
- Conditions
- Boosters





Managing breakdown – who

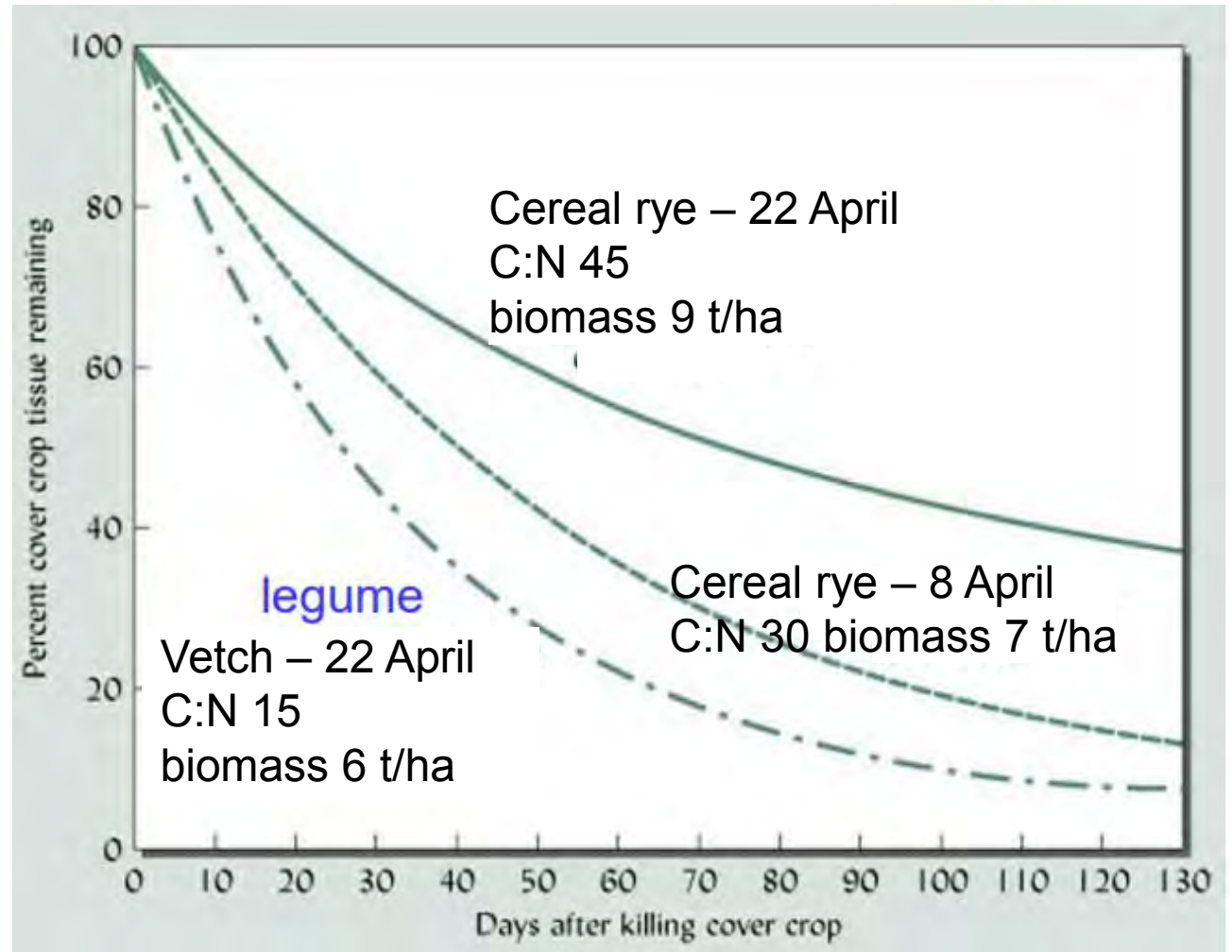
- Poll
 - Plant breakdown is dominated by
- Bacteria
- Fungi
- Earthworms

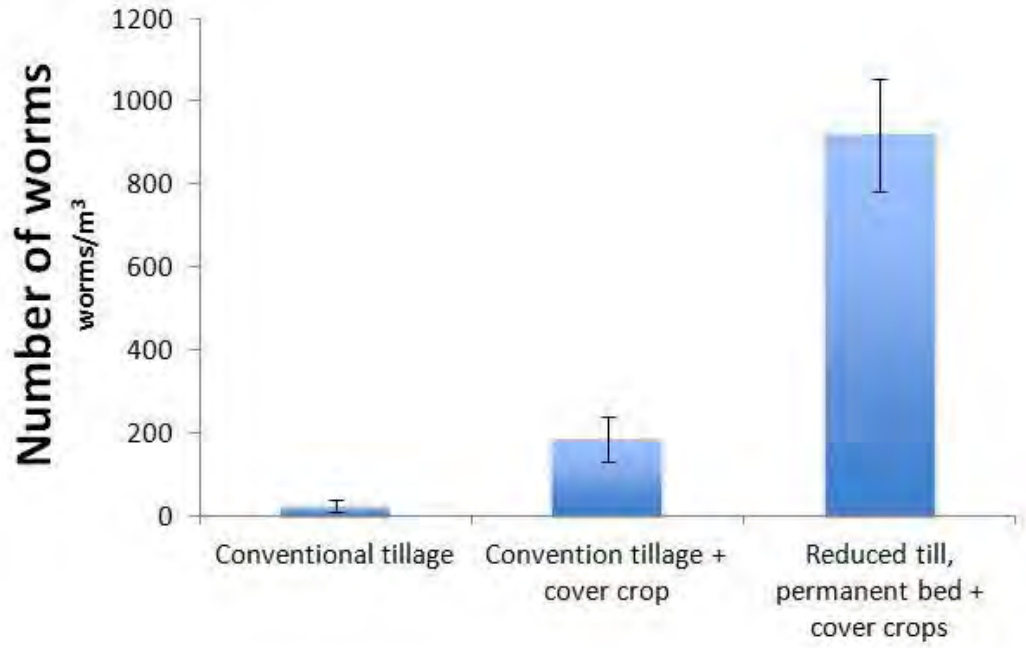




Managing breakdown – food & nutrients

- Amount
- C:N ratio
 - Cover crops choice and timing
 - Crop residues





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Managing breakdown - conditions

- Water
- Temperature
- Whole vs Mulched
- Incorporated vs surface





Managing breakdown - Boosters

- Biology
- Sugar
- Nutrients





Soil Organic Matter

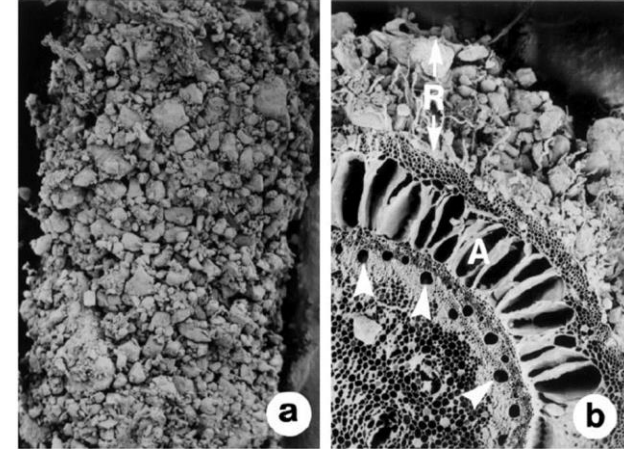
- “you can’t buy it; you have to earn it.”
- Most important soil property that you can influence.
- Key soil health indicator you already measure

- Soil microbes convert plant material into soil organic matter
- 5% of soil organic matter is microbial biomass





Soil Wealth



Soil biology builds soil organic matter

- Plant material
 - Shoots → 10% ends up as soil organic matter
 - Roots → 20% ends up as soil organic matter
- Who breaks down the plant material matters
 - Bacteria – burn more through respiration
 - Fungi - convert more to soil organic matter
 - Diverse microbial community = more soil organic matter?



Building soil organic matter – it's a big job

- Building soil organic matter
 - Soil biology, carbon and nutrients
 - Every tonne requires \approx 50kg N, 8 Kg P & S.

Example You have 3% soil organic mater and want to increase to 4%

- 4,200 t/ha soil to 0.3m in a ha ($0.3\text{m} \times 10,000\text{m}^2 \times 1,400 \text{ kg/m}^3$)
- 126 t/ha of organic matter @ 3%
- 168 t/ha of organic matter @ 4%

Soil biology needs to produce 42 t/ha of soil organic matter

- 2.1 t/ha of microbial biomass
- 280 t/ha of plant biomass
- 2,100 kgN & 336 kg P & S



Impact of soil biology on agrichemicals

- Soil biology critical to the breakdown of agrichemicals
- Agrichemical are energy or nutrients to many microbes
- Repeated use will select for microbes and reduce efficacy
 - e.g. metham sodium fumigant, pre-emergent herbicides
- Soil microbial breakdown of herbicides will affect plant back times
 - Moisture and temperature
 - Repeated use reduce efficacy





Impact of agrichemicals on soil biology

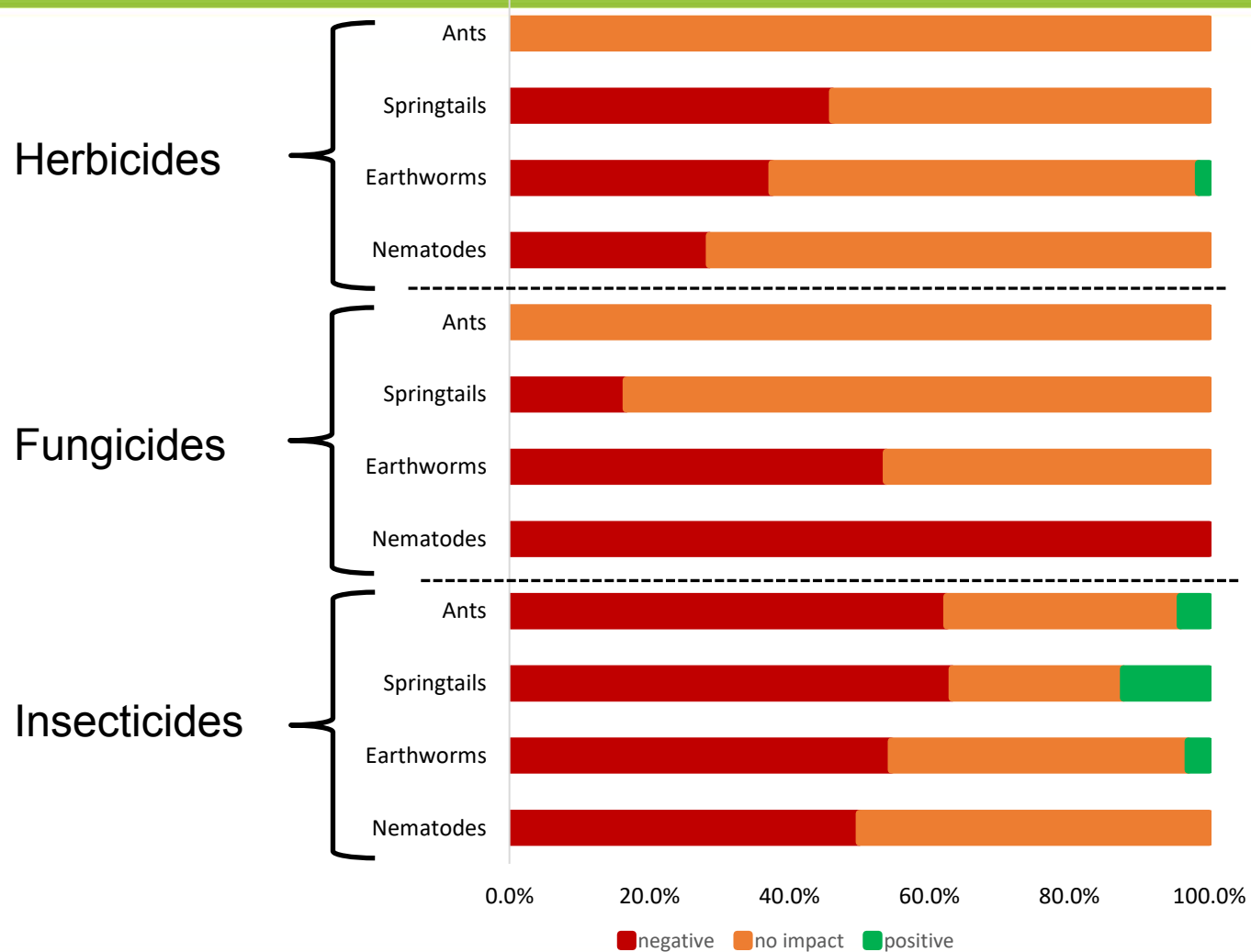
Everything you do to the soil alters soil biology

- Direct effects (toxicology vs field rates)
 - ve Toxic for soil biology reducing growth or function
 - +ve Stimulates soil biology
- Indirect effects
 - Reduced weed growth ↓ plant inputs ↓ diversity
 - Decrease cultivation
 - Plant health or pathogen resistance
- Huge range of compounds and formulations
- Huge range of soil biology
 - Bacteria, fungi, eukaryotes





Agrichemicals & soil biology - Eukaryotes





Herbicides & soil biology - Fungi

- Mechanical weed control greater impact on fungi than many herbicides

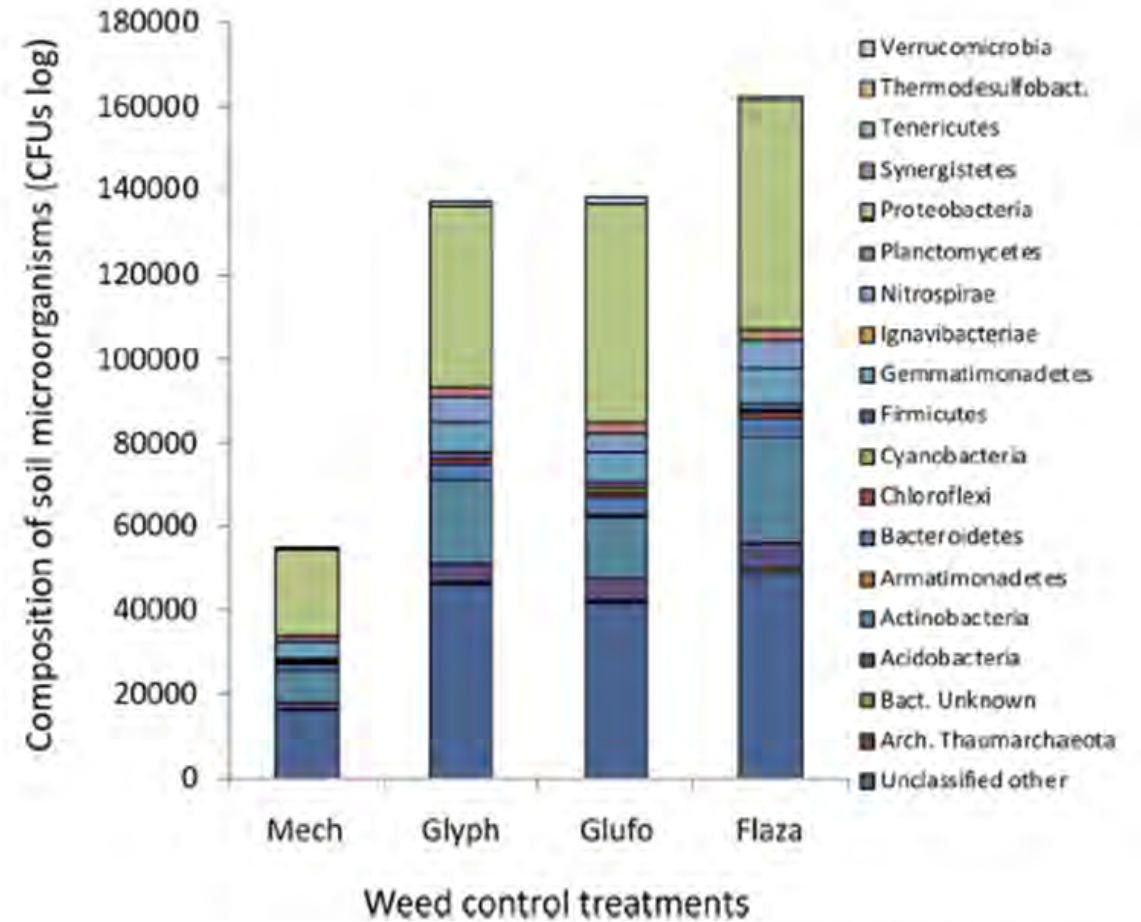
Table 3 Presence (+) or absence (-) of particular fungi taxa in soil samples under mechanical weeding (mech) and application of three herbicides (glyph...glyphosate, glufo...glufosinate, flaza...flazasulfuron)

Fungi taxa	Mech	Glyph	Glufo	Flaza
<i>Acremonium</i> sp.	-	-	+	-
<i>Arthroderma</i> sp.	-	-	-	+
<i>Aspergillus</i> sp.	+	+	+	+
<i>Cladosporium</i> sp.	-	+	+	-
<i>Clonostachys rosea</i>	+	-	-	-
<i>Colletotrichum</i> sp.	-	+	-	-
<i>Cunninghamella</i> sp.	-	+	-	-
<i>Dipodascus</i> sp.	+	-	-	-
<i>Fusarium</i> sp.	+	+	+	+
<i>Gongronella butleri</i>	-	-	+	-
<i>Mortierella</i> sp.	-	+	-	-
<i>Mucor</i> sp.	+	-	+	+
<i>Paecilomyces marquandi</i>	-	-	+	-
<i>Penicillium</i> sp.	+	+	+	+
<i>Scedosporium</i> sp.	-	+	-	-
<i>Sporothrix</i> sp.	-	-	+	-
<i>Striatibotrys</i> sp.	-	+	-	+
<i>Trichoderma</i> sp.	+	+	-	-

Taxa in alphabetical order



Herbicides and soil biology - bacteria





Herbicides and soil biology

“Taken as a whole, these results suggest that the application of glyphosate at or near recommended field rates has no demonstrable consistent, significant impact on soil microbial community structure.”

“To date, there is little evidence to suggest that long-term, repeat applications of glyphosate to soil causes negative shifts in soil microbial communities or functions.”

“Numerous studies have found that glyphosate applied at standard application rates has little impact on the microbial biomass in soil, and stimulation rather than inhibition is more commonly observed”

“suggesting potential effects are short-lived and difficult to generalize”

