















Embracing the power

of nature's tillage tool

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Can anything be done? What could be done ?

What can I do a

Crédit photo : Jocelyn Michon









FOOTHILLS FORAGE



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Photo : André Brunelle, MAPAQ Centre-du-Québec



Photo : Victor Savoie ing. MAPAQ



Soil health, setting for the future



- 34 Compaction
- 35 Food web
- 36 Roots
- 37 Strategies
- 38 Cover and Feed





Food Web



Estimated amount



Bacterias 100 m to 1 billion Actinobacteria Up to 2 millions Up to 10 feet of mycelium Fungi Few millions Protozoaires Nématods $1\ 000 - 2\ 000$ Arthropods Up to 100 Earthworms

Estimated amount



Bacterias Actinobacteria Fungi **Protozoaires Nématods** Arthropods

Earthworms



3 - 5 animal units









The plow and the earthworm

« The plow is one of the oldest and most important invention of the man.
But long before man existed himself, the land was plowed, and continue to be, by the earthworms. »
Charles Darwin, 1881







Guiness earthworm

About 4 m 2 cm in diameter 1 kg Australia





Soil workers

- 1-2 inches
- Small residus
- High reproduction rate
- 1-2 years
- Not sensible to light



Soil health, setting for the future



Soil workers

Soil health, setting for the future

- 7 inches
- Small residus mixed and roots
- Limited reproduction rate
- 3-5 years
- Highly sensible to light



Soil workers

- 6-18 inches
- Small and big residus
- Limited reproduction rate
- 4-8 years
- Moderate sensible to light

Rejuvenate the soil Get the soil profil deeper Organic matter incorporation Enhance soil biological activities Root growth Improve soil structural stability Channel construction and maintenance



Earthworms and nitrogen

- Indirect
 - Microorganisms interactions
 - Breaking down of organic residus
 - Soil aggregation
- Direct
 - Death and excretion
- Direct flux of N due to earthworms
 - 10-80 kg N / ha / year

Earthworms and food availability

Short term:

Better availability of nutrients from residus and soil organic matter

Long term:

Increase nutrient storage in soil aggregats



Soil health, setting for the future

The next generation





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The next generation









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Protozoea





- Various organisms
- 3 µm to 250 µm
- > 80 000 sp known
- Live on the agregate surface
- Eat bacteria, fungi and other protozoea
- The most abundant after the bacteria, 10⁷ to 10¹¹/m²

Nematode



- Small worms extremely abundant
- 0,5 to 3 mm with a diameter ranging from $1/_{20}$ to $1/_{50}$ of their length
- 27 000 known sp estimated 400 000sp
- 85% within the first inch of root zone
- 100 to 1000 ind/g of soil

Enchytraeid





- Earthworm's cousin
- 2 to 35 mm (have to be enlarged 400x to be indetified)
- 600 sp known
- Litter (mainly compost), in the first 10 cm depending on humidity and temperature
- Eat crotte collembole
- 10 000 to 290 000 ind/m²



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Gastropoda







- > 100 000 sp Need high humidity and limestone
- In the first 10 cm depending on humidity and temperature. In winter can go as deep as 2m
- On cultivated land : up to 150 ind./m²

Isopoda







See 1

- 5 to 20 mm
- 2 000 sp

Litter

- Need high humidity
- Break down cellulose
- Scavengers
- Grassland : up to 30 ind/m²
- Cultivated land : from 100 to 150 ind/m²

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Myriapoda





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Break down cellulose

Scavengers Grassland : up to 30 ind/m²

Cultivated land : from 100 to 150 ind/m²

Arachnid







- 2 000 sp
- Litter
- Need high humidity
- Break down cellulose
- Scavengers
- Grassland : up to 30 ind/m²
- Cultivated land : from 100 to 150 ind/m²

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The Roots







- Compaction Food
- web
- Roots
- Strategies
- Cover and Feed

	Density g/cm³	Density reducing rooting	Density stopping rooting
Sable, sable loameux, loam sablonneux	1.6	1.7	1.8
Loam sablonneux, loam	1.4	1.6	1.8
Loam sablo-argileux,loam, loam argileux	1.4	1.6	1.75
Limons, loam limoneux	1.3	1.6	1.75
Loam-limoneux, argile limoneuse	1.4	1.55	1.65
Argile (35 à 45%)	1.1	1.5	1.6
Argile (> 45%)	1.1	1.4	1.5

Compaction and infiltration

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Water holding capacity

45% easily available

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Architecture
Depth of roots
Symbiose
Disease resistance
Complementarity

The practices

Rotation
Living roots as much as possible
Reduce compaction

Cover and Feed

The three basis for healthy soils : •Cover and feed the soil

•Cover and feed the soil

•Cover and feed the soil

