Soil Health and Fertility in Grasslands

@RichTudorLlysun
Are we achieving potential grass yields?
“Soil health is like human health; it’s hard to define, but you sure know when you don’t have it.”

David R. Montgomery, Univ. of Washington
Groundswell 2017
10% yield reduction at pH 5.5 compared to pH 6.0
How much Acidity is in my soil?

- Neutral: No Acidity
- Target for Tillage Soils

Soil pH

Soil Acidity ("X times" compared to pH 7)

X10
X25
X65
X100
GRASSLAND SOIL COMPACTION

**CAUSES:**
- Intense Rainfall
- Heavy Machinery
- Cows Poaching
- Excessive Slurry Applications
- Mineral Imbalance (Calcium/Magnesium)

**CONSEQUENCES:**
- Nutrient Run Off – Polluted Watercourses
- Grassland Production Reduced
- Fertiliser Requirement Increased
- Forage Minerals Imbalanced
- Cold Soils
- Biologically Dead Soils

**Compacted Soil**
(no air)
a worm's worth: HOW EARTHWORMS HELP THE GREEN GRASS GROW

Whether you call them nightcrawlers, rainworms, legworms, earthworms, or just worms, these little wigglers contribute to healthy, beautiful lawns in a variety of ways. Learn more about these often unseen creatures, and how you can use them to benefit your lawn.

**They break up thatch**
Thatch is a rough, dense layer of material (dead grass, stems, and roots) that blocks the flow of water and nutrients.

**They eat nematodes**
Nematodes are parasites that feed on dead roots. Unchecked, they cause yellowing, wilting, and bare patches.

- **5x more nitrogen in soil with worms**

**They help water flow**
The tunnels they make break up the soil and provide a path for water to flow and reach roots easily.

- **7x more phosphate in soil with worms**

**They eat other pests**
By removing the biomass of harmful bacteria, fungi, and mites, worms increase the amount of beneficial microbes.

- **11x more potassium in soil with worms**

**They fertilize the soil**
Earthworm waste—called castings—is more nutrient-rich than the soil the worms initially consumed.

- **Test... phosphorus and potassium are the nutrients represented by the 3 numbers on fertilizer bags.**

**Help your earthworms help you!**
- Keep them fed by creating an earthworm pile (a stack of leaves, kitchen scraps, and other organics) near your lawn, and by leaving grass clippings on the lawn after mowing. 
- Baiting with fish and peanuts can kill earthworms, so be careful!
BEFORE A PLANT GROWS UP, IT GROWS DOWN
There are more living organisms in a teaspoon of soil than there are people on Earth, i.e. more than 6+ billion! *(Source: Soil-Net)*
5-20% of plant N comes from N-fixing bacteria
75% of plant P comes from Mycorrhizal fungi
Effect of post-grazing residual on pasture daily growth rate (MU-FSRC)

Time to grow 1 ton = 64 days
Time to grow 1 ton = 40 days

In a 200 day growing season
- \( \frac{200 + 64 \text{ days}}{\text{ton}} = 3.1 \text{ T/A} \)
- \( \frac{200 + 40 \text{ days}}{\text{ton}} = 5 \text{ T/A} \)

Daily growth rate (lb/acre/day)
Residual height (inches)
Different forage species and their relative root depth and structure.

Image by Integrity Soils.
### Macronutrients in perennial ryegrass, white clover and perennial chicory (% of DM)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>S</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
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</thead>
<tbody>
<tr>
<td>Perennial ryegrass</td>
<td>3.77</td>
<td>0.370</td>
<td>3.80</td>
<td>0.347</td>
<td>0.42</td>
<td>0.173</td>
<td>0.182</td>
</tr>
<tr>
<td>White clover</td>
<td>4.56</td>
<td>0.347</td>
<td>2.83</td>
<td>0.213</td>
<td>1.19</td>
<td>0.237</td>
<td>0.205</td>
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<tr>
<td>Perennial chicory</td>
<td>4.35</td>
<td>0.663</td>
<td>3.80</td>
<td>0.627</td>
<td>1.18</td>
<td>0.393</td>
<td>0.591</td>
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</tbody>
</table>

### Micronutrients in perennial ryegrass, white clover and perennial chicory (mg/kg)

<table>
<thead>
<tr>
<th></th>
<th>Fe</th>
<th>Mn</th>
<th>Cu</th>
<th>Zn</th>
<th>B</th>
<th>Co</th>
<th>Se</th>
<th>Mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perennial ryegrass</td>
<td>151</td>
<td>99</td>
<td>7.9</td>
<td>22.0</td>
<td>19.0</td>
<td>0.193</td>
<td>0.023</td>
<td>0.640</td>
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<tr>
<td>White clover</td>
<td>109</td>
<td>55</td>
<td>8.6</td>
<td>22.0</td>
<td>28.7</td>
<td>0.173</td>
<td>0.073</td>
<td>0.223</td>
</tr>
<tr>
<td>Perennial chicory</td>
<td>167</td>
<td>161</td>
<td>18.6</td>
<td>57.7</td>
<td>38.3</td>
<td>0.273</td>
<td>0.043</td>
<td>0.420</td>
</tr>
</tbody>
</table>

Source: K. Harrington, Institute of Natural Resources, Massey University, New Zealand
1. Build life in to the soil
2. Lime
3. Compaction
4. Time factor
5. Species diversity
6. Soil analyses
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