

Soil Structure, Cultivations and Establishment.

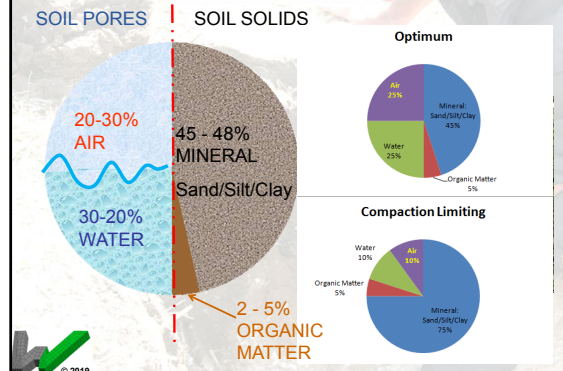
FAS Soils and Machinery Discussion: August 2019

Philip Wright
Wright Resolutions Limited

Why is soil structure important?

- Soil **compaction** costs us in yield of all crops;
- Restricted **drainage** and waterlogging also has a penalty on crop yield, and can encourage weeds through poor crop competition;
- Poor **aggregation** reduces infiltration and passage of water, air and roots through soil. This causes:
 - higher environmental costs;
 - poor aeration and porosity through the soil.
- Soil, Roots and Metal: how can we **optimise** this relationship?
- Prevention is preferable to cure.

Soil constituents



Drill and roll tractor effects – 2018



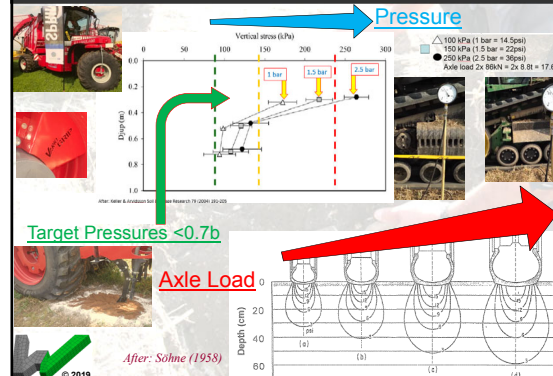
Pressures at 1.6b. Previously ploughed & pressed. Eradicators set deep.

Yield differences measured:

- Drill tractor wheeling 85% of un-trafficked;
- Drill & roll combined can reduce by 6% to 10%;
- Plough based wheeling can be down to 61%

Data from multiple areas in 8 fields surveyed in Autumn 2018, Northants

Prevention, Management and Roots



Ground Pressure: cultivating trafficking effects



Ground Pressure: trafficking effects when drilling

Fendt 516 - Xeobib 650/60R38 & 520/60R28
Set F/R 14/17psi – 11/11psi [1b/1.2b – 0.75b]
Wheeling seed depth 0-2cm compared to 3.5cm [consistent]

HF Specification Tyres – Michelin 2019 EvoBib

HF has 20% - 30% improvement over VF

- IF & standard radial max. TE @ 50kg/HP
- VF max. TE @ 40kg to 45kg/HP
- HF max. TE @ 30kg to 35kg/HP

VF – HF 710/70-R42
ISO pressure for same load gives 20% larger footprint (Michelin 2018)

HF 710/70-R42
4530kg/tyre

- 150 HP: IF = 7500kg; VF = 6000/6750kg; HF = 4500/5250kg
- 300HP: IF = 15000kg; VF = 12000/13500kg; HF = 9000/10500kg
- 400HP: IF = 20000kg; VF = 16000/18000kg; HF = 12000/14000kg

Soil Structure – Aggregation

- Good aggregation – water stability, good pore space, gaseous exchange, good water, air & root movement;
- Closely tied to Organic Matter and biological activity.

Soil Structure – Organic Matter & Soil Biology

1. Nutrient & water storage
2. Essential for coarser soils
3. Maintains healthy balance of micro-organisms & provides Nutrients through mineralisation
4. Provides resilience and stability
5. Relationship with roots (Mycorrhiza) to assimilate water & nutrients – rapid growth & establishment
6. Earthworms: improvers of porosity + stability + fertility - and excellent residue managers.

OSR Yield Response - Clay & CL

Soil Organic Matter (%)

Soil Porosity (%)

Soil Water (%)

Soil Temperature (°C)

Soil pH

Soil Bulk Density (g/cm³)

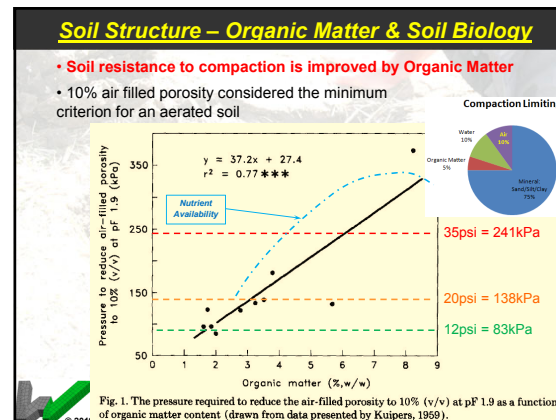
Soil Moisture (mm)

Soil Temperature (°C)

Soil pH

Soil Bulk Density (g/cm³)


Soil Moisture (mm)



Weed control: wheel-slip & pressure

Grass weed control strategy.

- Cover or Catch crops can help delayed drilling



- Soil disturbance prior to, and when drilling the next commercial crop must be managed (also the CC canopy);
- Use the opportunity to establish the cover crop with greater, but controlled disturbance – & where needed, restructuring;
 - Increased mineralisation, residue & slug management,
 - Weed seed disturbance is controlled when next drilling,
 - Moisture levels are managed when delaying drilling.

Options for compaction reduction

Controlled traffic



Reduced pressure/axle weight and correct balance by ballasting;
Note RESIDUE MANAGEMENT is key

Residue Management.




Residue Management.

Dense canopies increase slug damage risks (especially over winter for spring) and reduce weathering needed for seed/soil contact and drill slot closure.



SOIL INTERACTION WITH METAL & RUBBER



RAKE ANGLE – LOW & HIGH

HIGH RAKE: COMPACT & CONSOLIDATE

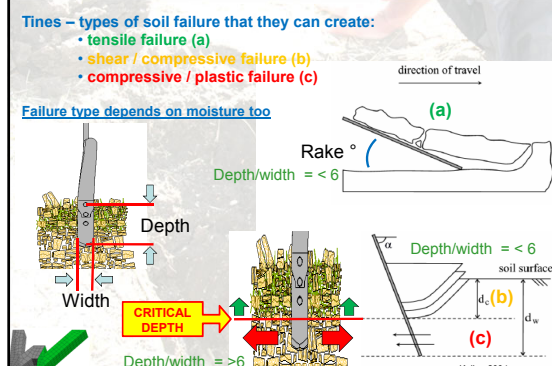
LOW RAKE: LIFT / LOOSEN

Tine Loosening & Cultivation

Tines – types of soil failure that they can create:

- tensile failure (a)
- shear / compressive failure (b)
- compressive / plastic failure (c)

Failure type depends on moisture too



Direction of travel

Rake °

Depth/width = < 6

Depth

Width

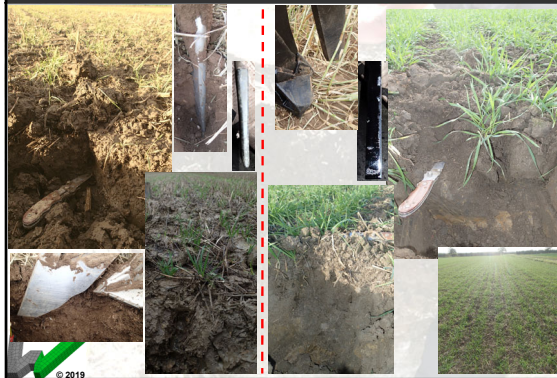
CRITICAL DEPTH

Depth/width = > 6

soil surface

Keller, 2004

Critical Depth and Drilling



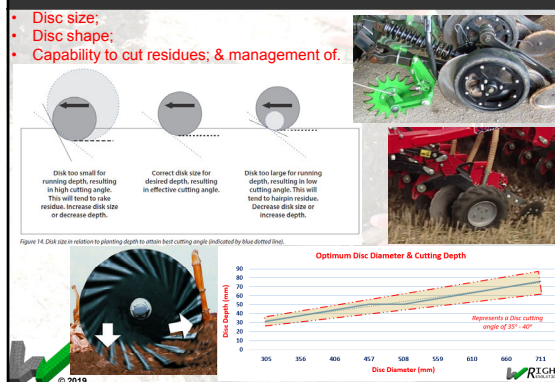
Drilling: importance of a level finish for rolling



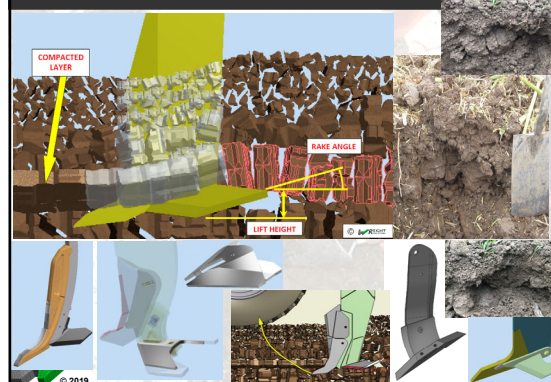
Seedbeds and seeding



Disc Effectiveness

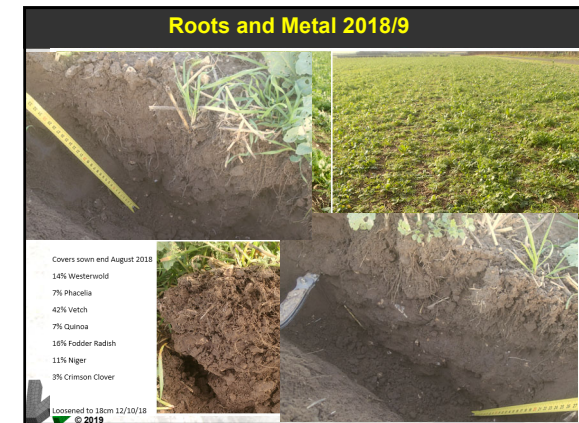
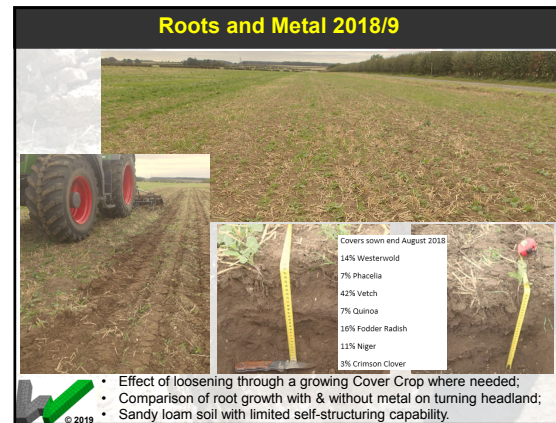
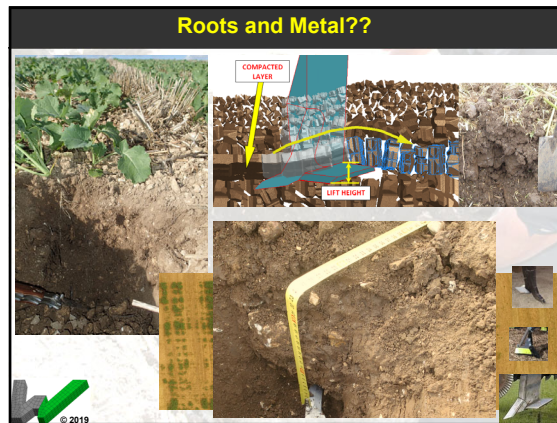


Soil Remediation



Alleviation of compaction





Final Reflections

"To be a successful farmer one must first know the nature of the soil"
Xenophon, Oeconomicus, 400 B.C.

"A cloak of loose, soft material, held to the earth's hard surface by gravity, is all that lies between life and lifelessness"
Wallace H. Fuller

"The nation that destroys its soil, destroys itself"
Franklin D. Roosevelt

"Man, despite his artistic pretensions, his sophistications and many accomplishments, owes his existence to a six inch layer of top soil and the fact that it rains"
Chinese Proverb

"Treat the earth well - it was not given to you by your parents, it was loaned to you by your children"
Indian Proverb

"Upon this handful of soil our survival depends. Husband it, and it will grow our food, our fuel, and our shelter, surrounding us with beauty. Abuse it, and the soil will collapse and die, taking humanity with it"
Vedas, Sanskrit scripture, 1500BC

"To forget our soils is to forget ourselves"
Ghandi

© 2019