

## Soil Structure, Cultivations and Establishment.

# Soil Structure, Cultivations and Crop Establishment:

CSF, Thetford January 2016.

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Wright Resolutions Limited



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## 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 certain weeds;
- Poor aggregation reduces infiltration and passage of water, air and roots through soil.
- Waterlogging can be a long term effect of poor drainage;
- Poor drainage can start from relatively shallow levels;
- Prevention is preferable to cure, both are often needed.



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## Soil Structure - Compaction

### Soil compaction effect on crop returns

Losses resulting from effects of compaction

<u>CROP</u>	<u>YIELD (t/Ha)</u>	<u>% REDUCTION</u>	<u>LOSS (t)</u>	<u>£/tonne</u>	<u>LOSS £/Ha</u>
WHEAT	7.8	10%	0.78	£115.00	£89.70
BARLEY	5.8	23%	1.32	£100.00	£132.25
OSR	4.0	25%	1.00	£265.00	£265.00
POTATOES	45.0	30%	13.50	£155.00	£2,092.50
CORN	10.0	15%	1.50	£125.00	£187.50
SOYBEAN	3.0	13%	0.39	£244.00	£95.16

NOTE: £/tonne prices based on world markets 18/01/2016 Farming Online

NOTE: Yield loss % based on 2004 worldwide literature search, Unilever "Why CTF"



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## Drainage: a key cornerstone.

### Benefits of good drainage:

- Air / Water balance
- Aerobic soil "biology"
- Extended growing season
- Improved timeliness
- Reduced structure damage
- Deeper, plant root systems
- Efficient fertiliser use
- Less weeds, pests & diseases associated with wetter soils.



### Causes of poor drainage:

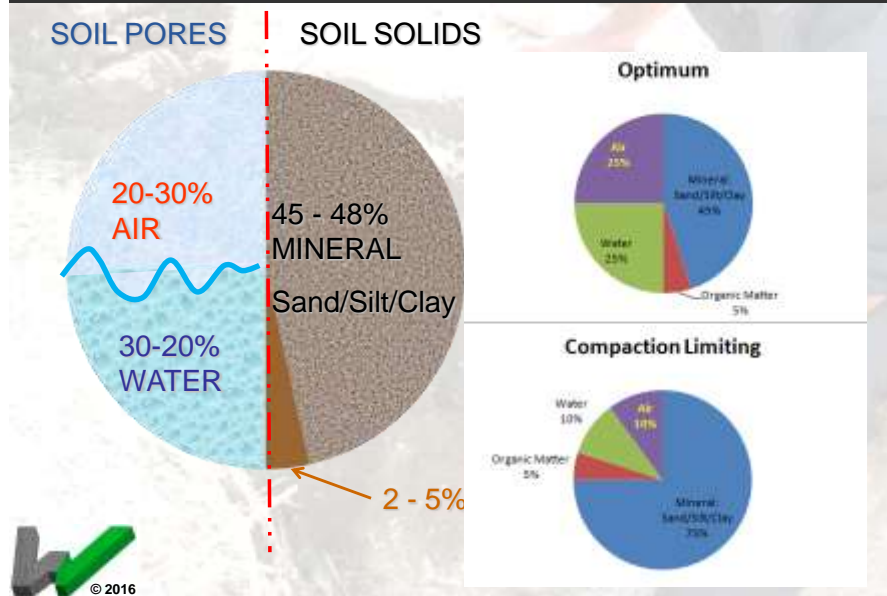
- **Compaction**
- Heavy, impervious soil (texture)
- High water table
- Blocked drains, outfalls.



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## The role of porosity



## Soil Structure – visual indicators



**Soil Structure – visual compaction indicators**



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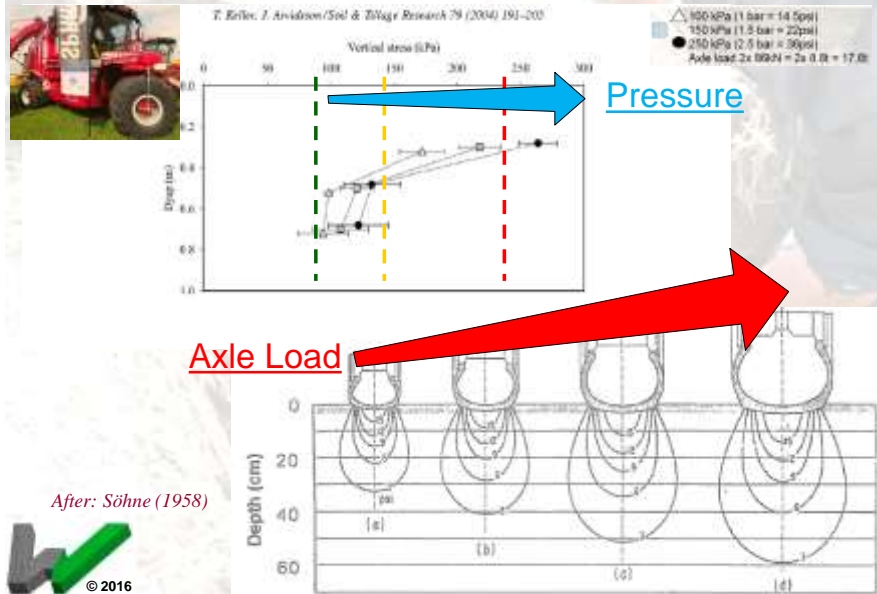
**Soil Structure – undrained / drained soils**



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## Soil Structure: trafficking effects



## Soil Structure – Aggregation

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



## Free passage of water, air & roots

- Soil structure – impaired capillary movement of water



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RIGHT

## Remediation: when to cultivate.



← Ideal working range →



*After: Bayer et al., 1972*

Soil will fail **generally in compression** when plastic if cultivated or trafficked

- Traffic damage likely in plastic >6/10psi
- Traffic damage likely @ friable >12/15psi.



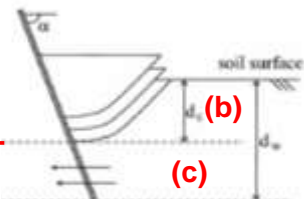
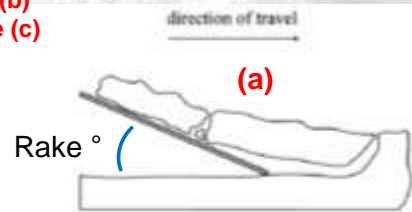
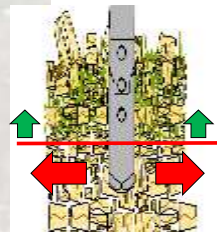
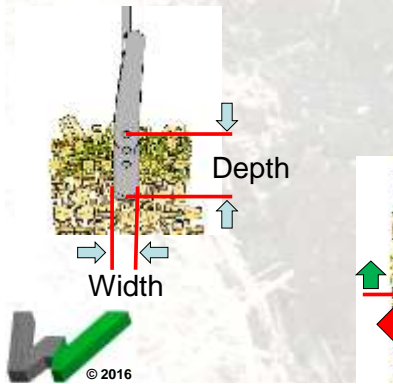
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## Tine Loosening & Cultivation

Tines – soil failure:

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

Note association with moisture

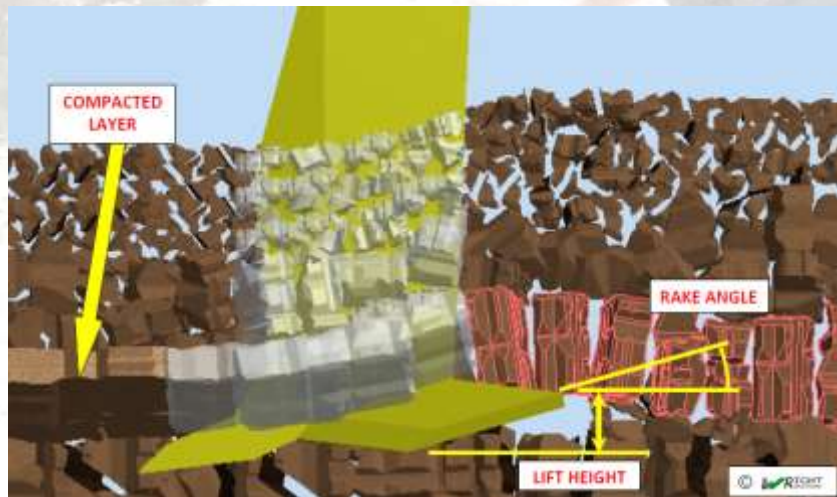


After: Spoor & Godwin; Keller, 2004

## Soil Repair: Effective Tine Loosening?



## Tine geometry – FEATURES



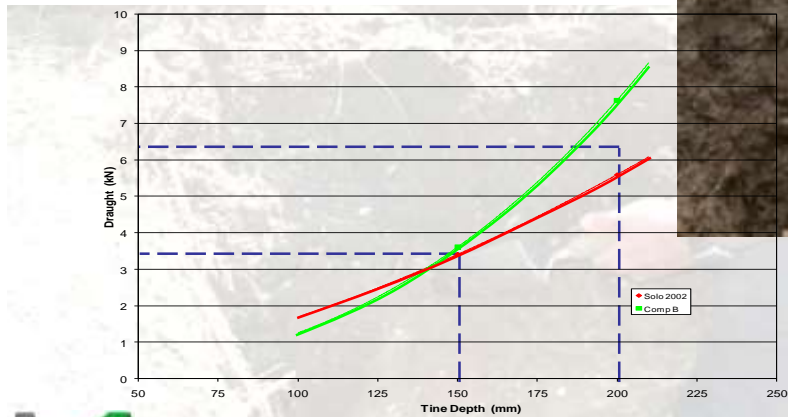
## Appropriate re-structuring at depth





## Importance of Depth: field situation.

Tine depth and draft force relationship



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## Strip Tillage and Drilling



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## Discs – features & benefits

Discs – cutting action:

- high rake angle:
  - compressive action
- risk of smearing
- effective in residues
- low disturbance
- slot closing



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## Options for compaction reduction

Controlled traffic



After: Tullberg et al. 2003

Source: CTF Europe

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



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## Benefits of reduced ground pressure

### Setting up ballast & tyre pressures

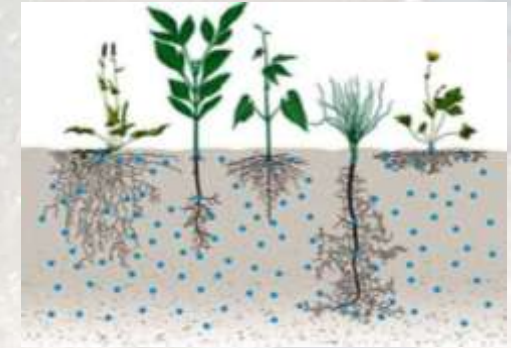


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## Cover Crops – benefits of getting roots down.

- Different modes of root growth – **target & restructure compacted zones**
- **Minimise nutrient loss** through winter
- Go before a later sown Autumn or Spring crop – **moisture benefits**
- Incorporate / Graze or Spray off; possibility to direct drill next crop
  
- Are **Spring rotations** the key for grass weed control???
- Note soil disturbance when establishing a cover and the next crop can imply different requirements.

**Moisture removal**  
and **restructuring**  
capabilities are key  
features!!



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## STRUCTURING BENEFITS FROM COVER CROPS

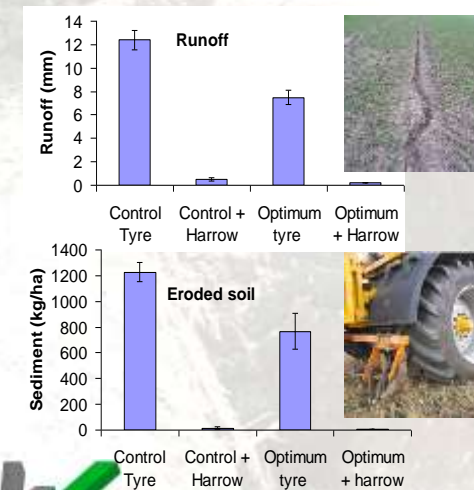
Treat as a commercial crop



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## Soil Structure – Movement of Water & Nutrient

Up to 75% of run-off is from tramlines



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- *Correctly-inflated low ground pressure tyres* reduce compaction, surface runoff and sediment loss from autumn spray operations...
- Drilling the wheeling area has no consistent effect, as autumn spray operation still causes compaction
- Novel rotary harrow usually more effective than LGP tyres
- No effect of treatments on wheelslip, fuel use or crop yield

After: Sustainable Arable LINK 2008/15



## Soil Structure – Movement of Water & Nutrient



## Ridge Management.

