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Managing Soil and Drainage in the Flood Plain

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Key factors for movement of water in the soil

- Soil Texture
- Soil Structure
- Soil Compaction

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Soil Texture

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What is Soil?

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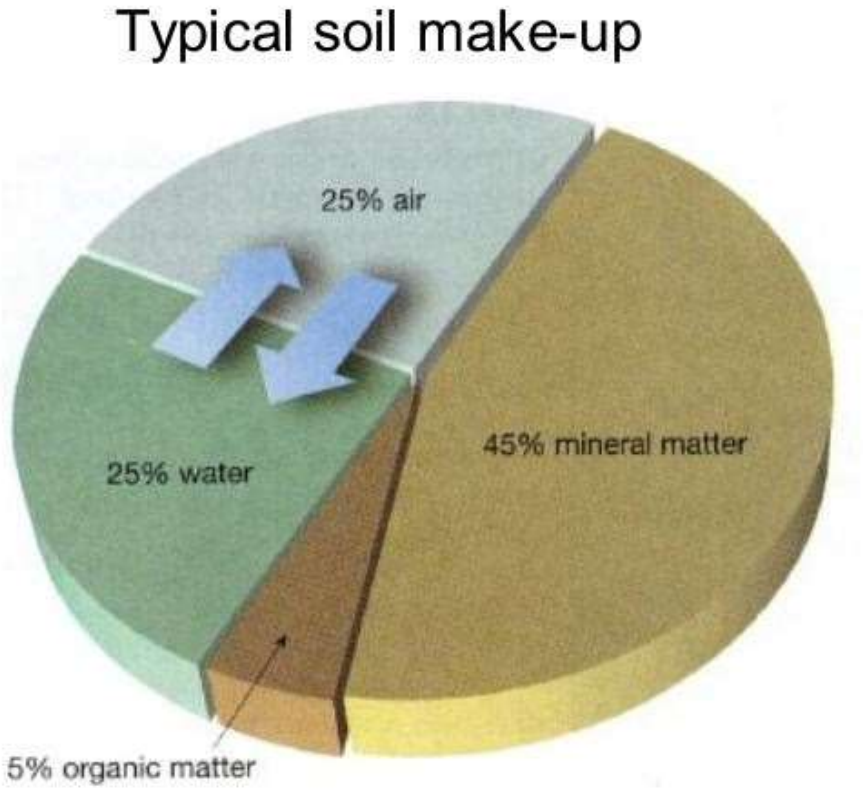

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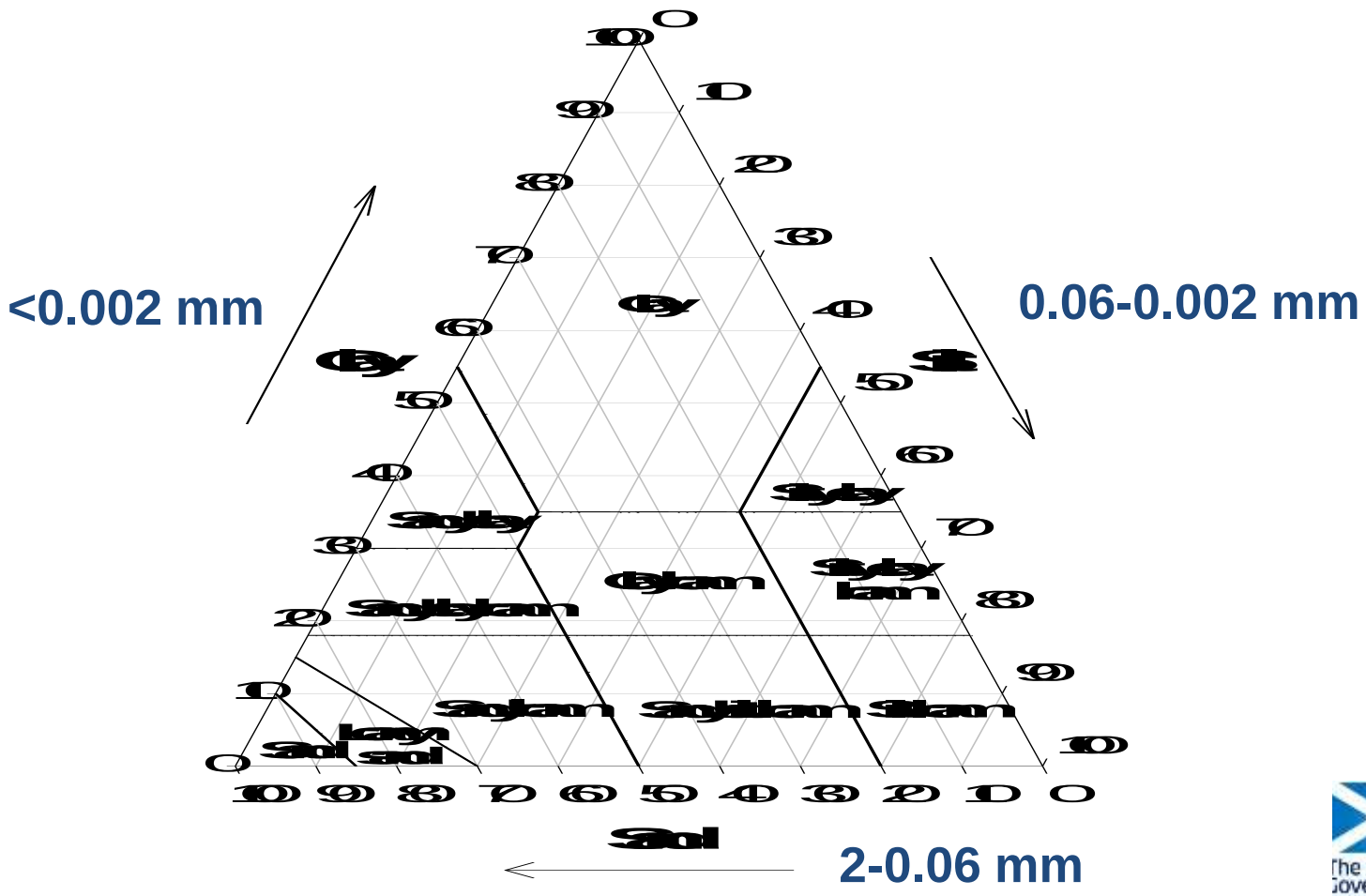
Soil Texture

- It describes the physical composition of the soil
  - % of sand, silt and clay
- Refers to the mineral fragments of the soil only
  - water and organic material are not considered
  - only considers particles <2mm
- Texture is a stable soil property - does not change measurably over a long period of years

Soil texture classes



Soil texture & water

- The sizes of pores in a soil are related to its texture
  - Sands have large pores
  - Clays have small pores
- Large pores allow free drainage
  - Sandy soils drain more easily than clays
- Small pores store water
  - Clay soils have a bigger water holding capacity than sandy soils

Water in soil

- **Gravitational water**
  - drains freely from large pores
  - only available to plants for a short time
- **Capillary water**
  - held in small pores
  - available for plants
- **Hygroscopic water**
  - held tightly around small particles
  - not available to plants

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Soil Structure

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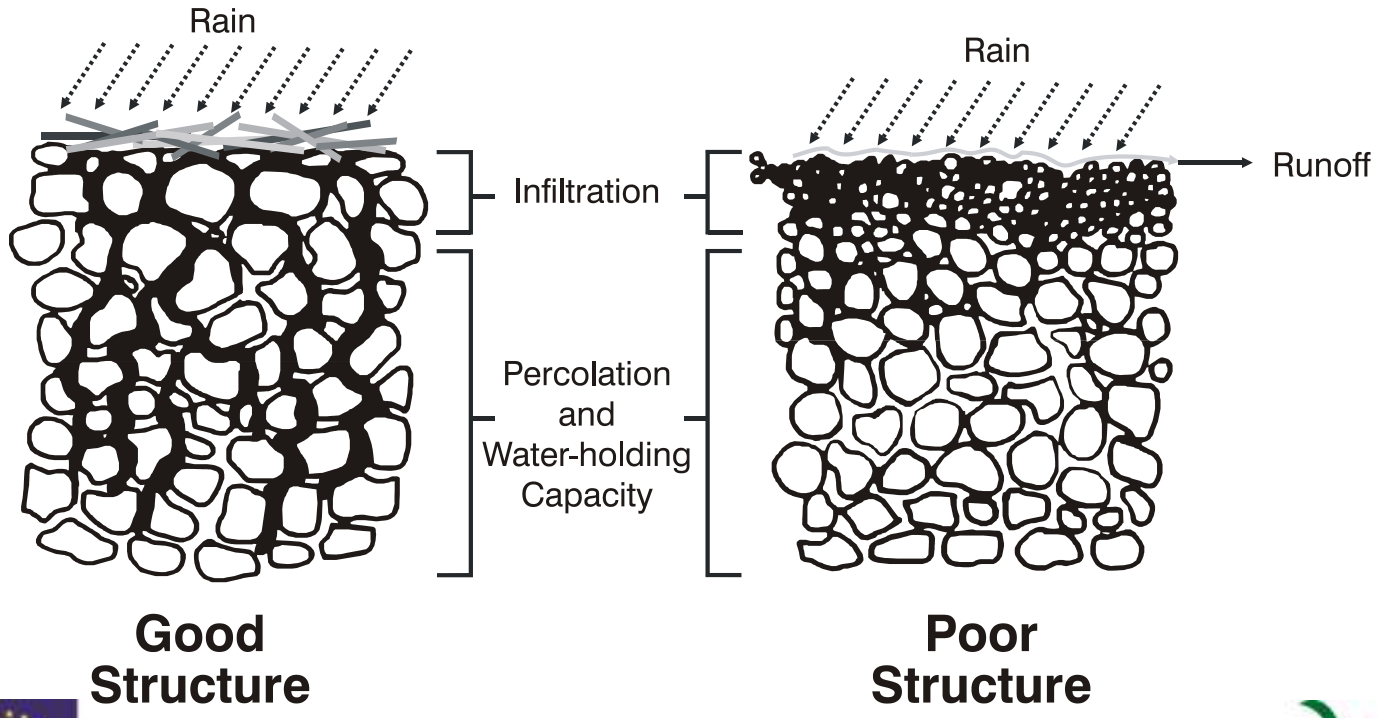
Soil structure:
the importance of macropores

- Macropores and cracks : allow water infiltration and drainage, keep the soil aerated reducing nitrous loss and increase water uptake and crop yield.



Structure quality	Size and appearance of aggregates	Visible porosity and Roots	Appearance after break-up: various soils	Appearance after break-up: same soil different tillage	Distinguishing feature	Appearance and description of natural or reduced fragment of ~ 1.5 cm diameter
Sq1 Friable Aggregates readily crumble with fingers	Mostly < 6 mm after crumbling	Highly porous Roots throughout the soil			 Fine aggregates	 The action of breaking the block is enough to reveal them. Large aggregates are composed of smaller ones, held by roots.
Sq2 Intact Aggregates easy to break with one hand	A mixture of porous, rounded aggregates from 2mm - 7 cm. No clods present	Most aggregates are porous Roots throughout the soil			 High aggregate porosity	 Aggregates when obtained are rounded, very fragile, crumble very easily and are highly porous.
Sq3 Firm Most aggregates break with one hand	A mixture of porous aggregates from 2mm -10 cm; less than 30% are <1 cm. Some angular, non-porous aggregates (clods) may be present	Macropores and cracks present. Porosity and roots both within aggregates.			 Low aggregate porosity	 Aggregate fragments are fairly easy to obtain. They have few visible pores and are rounded. Roots usually grow through the aggregates.
Sq4 Compact Requires considerable effort to break aggregates with one hand	Mostly large > 10 cm and sub-angular non-porous; horizontal/platy also possible; less than 30% are <7 cm	Few macropores and cracks All roots are clustered in macropores and around aggregates			 Distinct macropores	 Aggregate fragments are easy to obtain when soil is wet, in cube shapes which are very sharp-edged and show cracks internally.
Sq5 Very compact Difficult to break up	Mostly large > 10 cm, very few < 7 cm, angular and non-porous	Very low porosity. Macropores may be present. May contain anaerobic zones. Few roots, if any, and restricted to cracks			 Grey-blue colour	 Aggregate fragments are easy to obtain when soil is wet, although considerable force may be needed. No pores or cracks are visible usually.

Benefits of Good Soil Structure

- **Good structure improves aeration & reduces waterlogging**
  - easier for roots to access nutrients
  - leaching of nutrients less likely
- **Good structure reduces compaction**
  - more extensive root system
  - better water & nutrient uptake
- **Good structure reduces droughtiness**
  - improves nutrient uptake

Benefits of soil organic matter

- Develops and maintains soil structure
- Supplies mineral nutrients
- Increases water holding capacity
- Retains nutrients that might be leached out
- Increases availability of micronutrients to plants
- Substrate for soil organisms
- Darkens colour - increases rate of warming

Structure-forming processes

- **Activity of roots and soil organisms especially earthworms**
  - mixing, cementing, transforming
  - needs organic matter
- **Wetting & drying**
  - swelling & shrinkage
- **Freezing & thawing**

- ***Organic matter is key to structure formation and maintenance***

Topsoil structures

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Well structured sandy soil

Well structured clay soil

Compact sandy soil

Compact clay soil

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Soil Compaction

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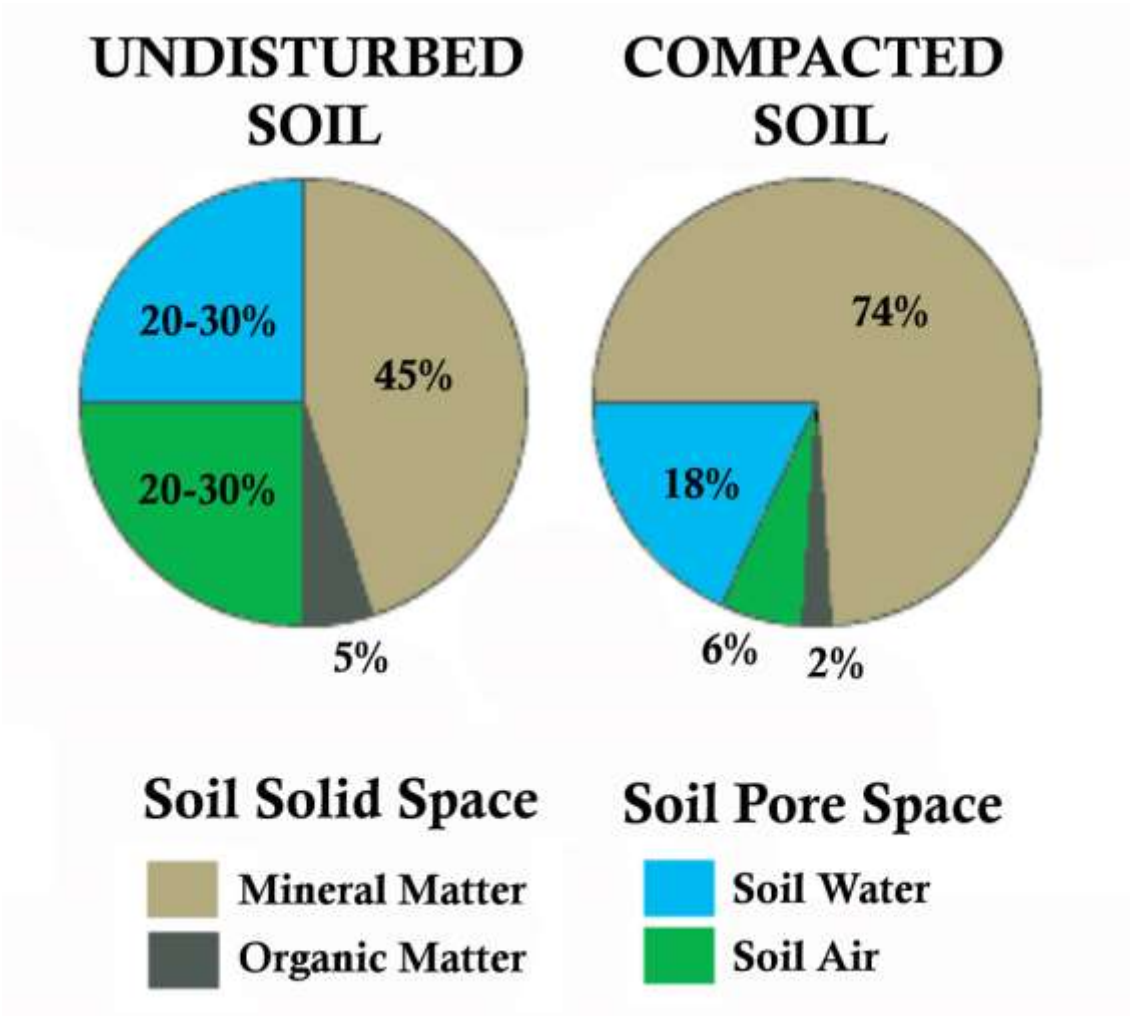
Main causes of compaction

- **Working / Cultivating / Grazing in wet conditions**
- **Over-cultivation**
- **Continuous cultivation**
- **Heavy machinery**
- **Over-grazing**

Effects of Compaction



Compaction Reduces infiltration and Increases surface run-off

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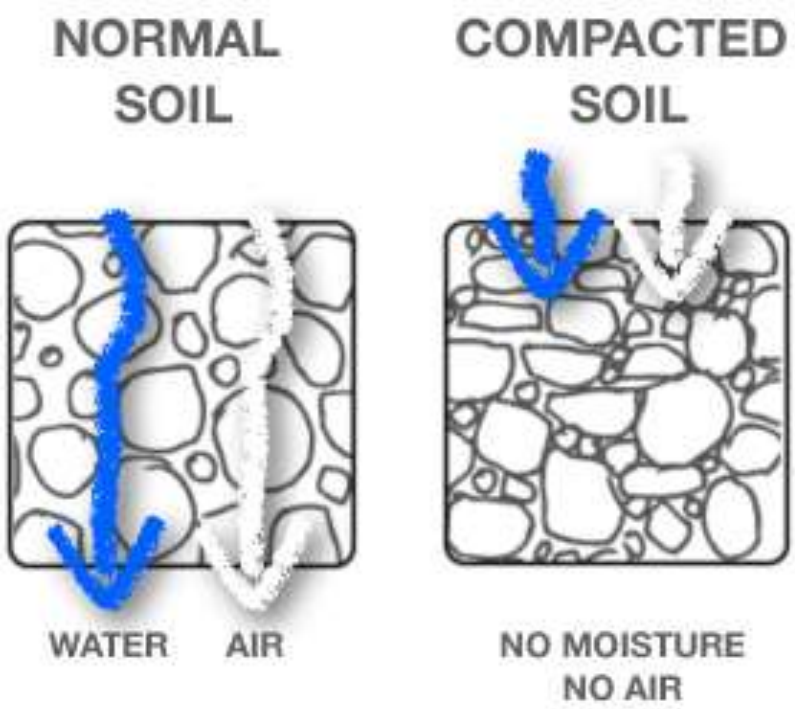


Soil structure is affected by management

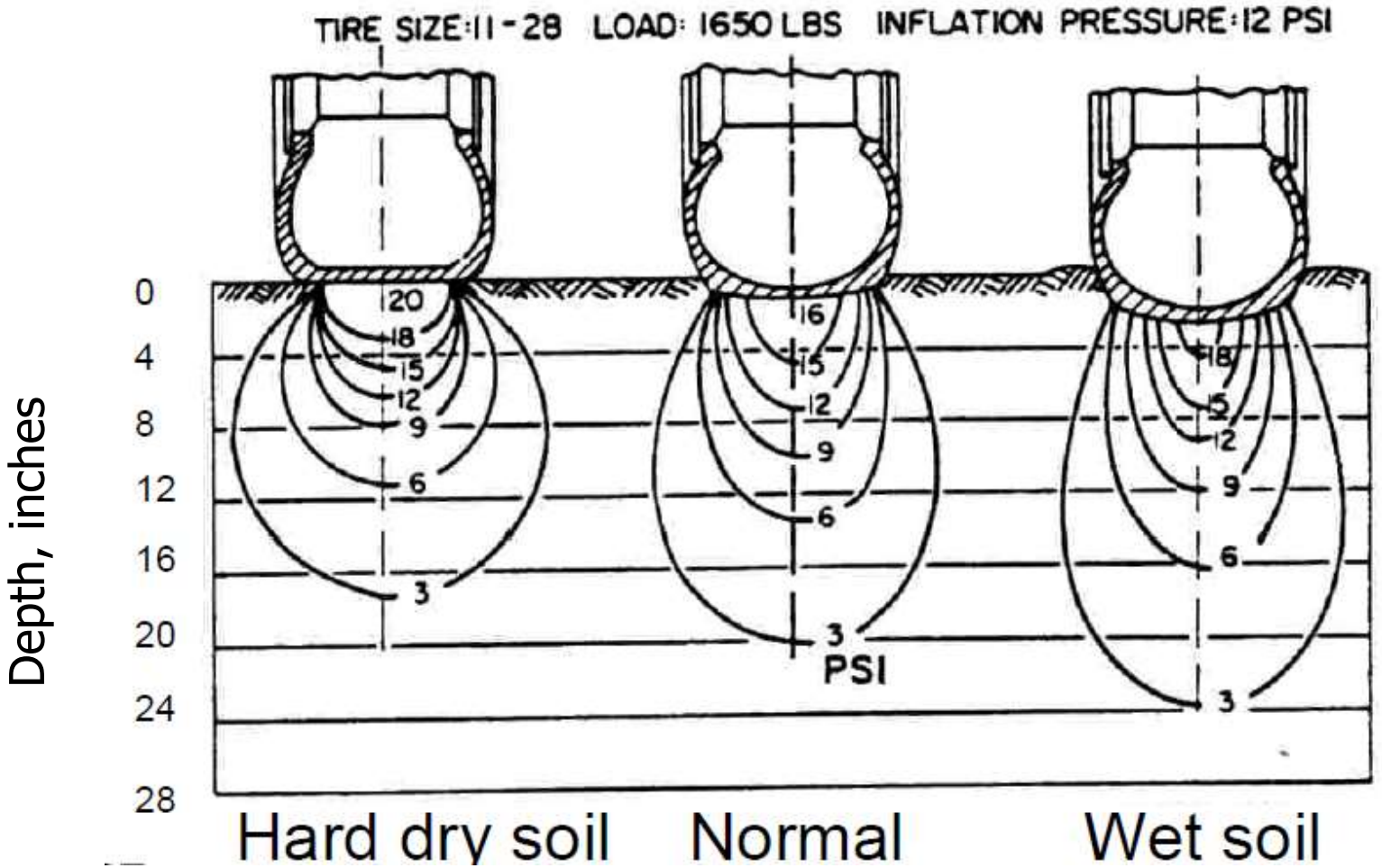
- **Compaction**

- **Poaching**

Image: Farmers Weekly

- **Waterlogging**

Compaction and soil moisture



http://www.engr.uconn.edu/~lanbo/CE240LectW041fieldcompaction.pdf

Tyres and Compaction

Spot the difference: Trailer with 11 tonne payload running on
500/60R22.5 (left)
385/65R22.5 (right)

Tyres and Compaction (2)

Tyres and Compaction (3)

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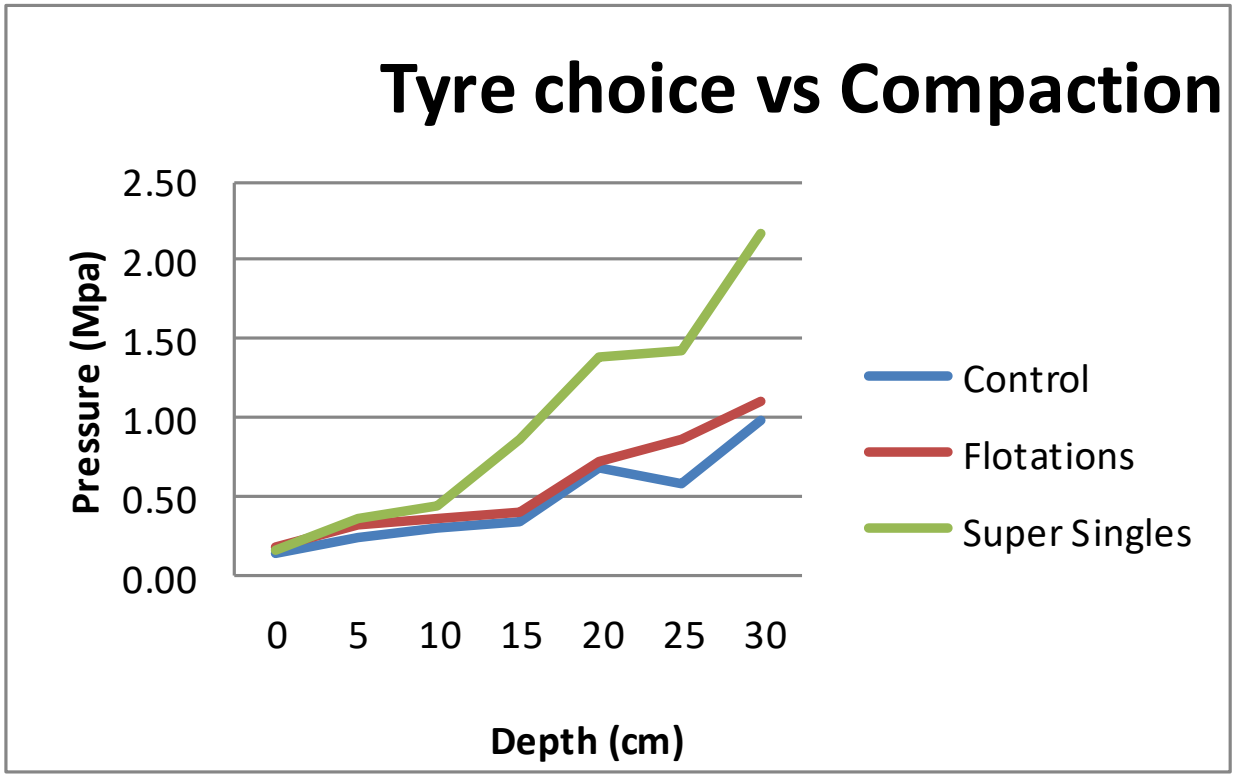
Tyres and Compaction (3)



Compaction Increases with Depth

Tyre Pressure

- **From working out the axle loads by using a weighbridge or looking up manufacturers standard data on weights, the optimum tyre pressure can be calculated.**

- **Each tyre manufacturer will have tables for a range of tyre sizes which give different ranges for tyre load and speed. This will give you a pressure to set the tyres at.**

- **New tyre technologies such as increased or very high flexion these tyres have the ability to either carry more load at the same pressure or carry similar loads at reduced pressures. This has the benefit of increasing tyre footprint spreading weight over a bigger footprint, thus reducing the pressure tyres are imprinting on the soil and minimising compaction risk.**

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Other Tyre Considerations

- **Reduce tyre pressures as per axle loads and tyre capabilities**
- **Consult manufacturer guidelines to ensure safe load capacity is not exceeded.**
- **Consider the above when replacing machinery**
- **Make sure tyres are capable of converting power into traction**

Extreme problems

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Extreme problems (2)

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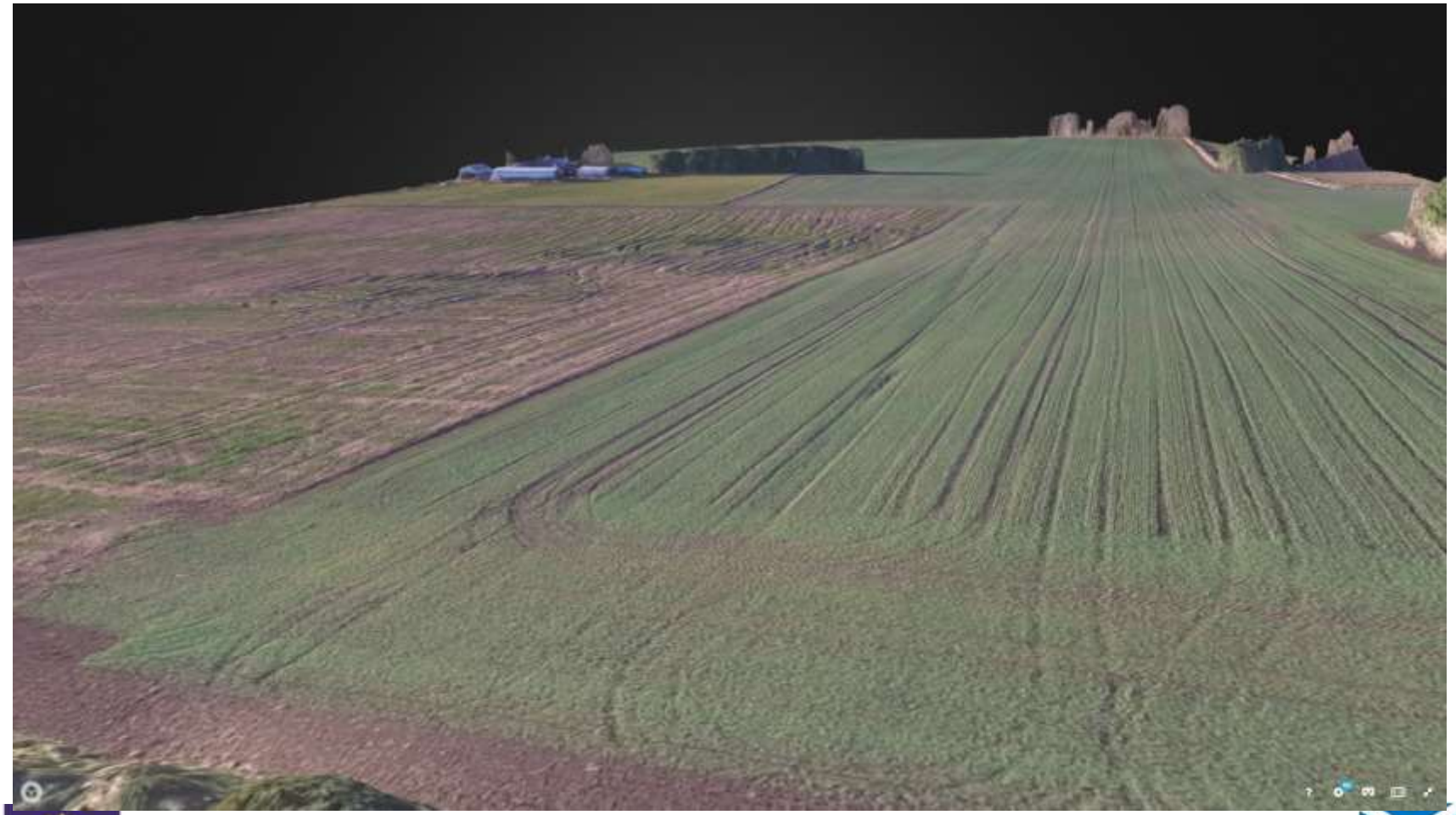

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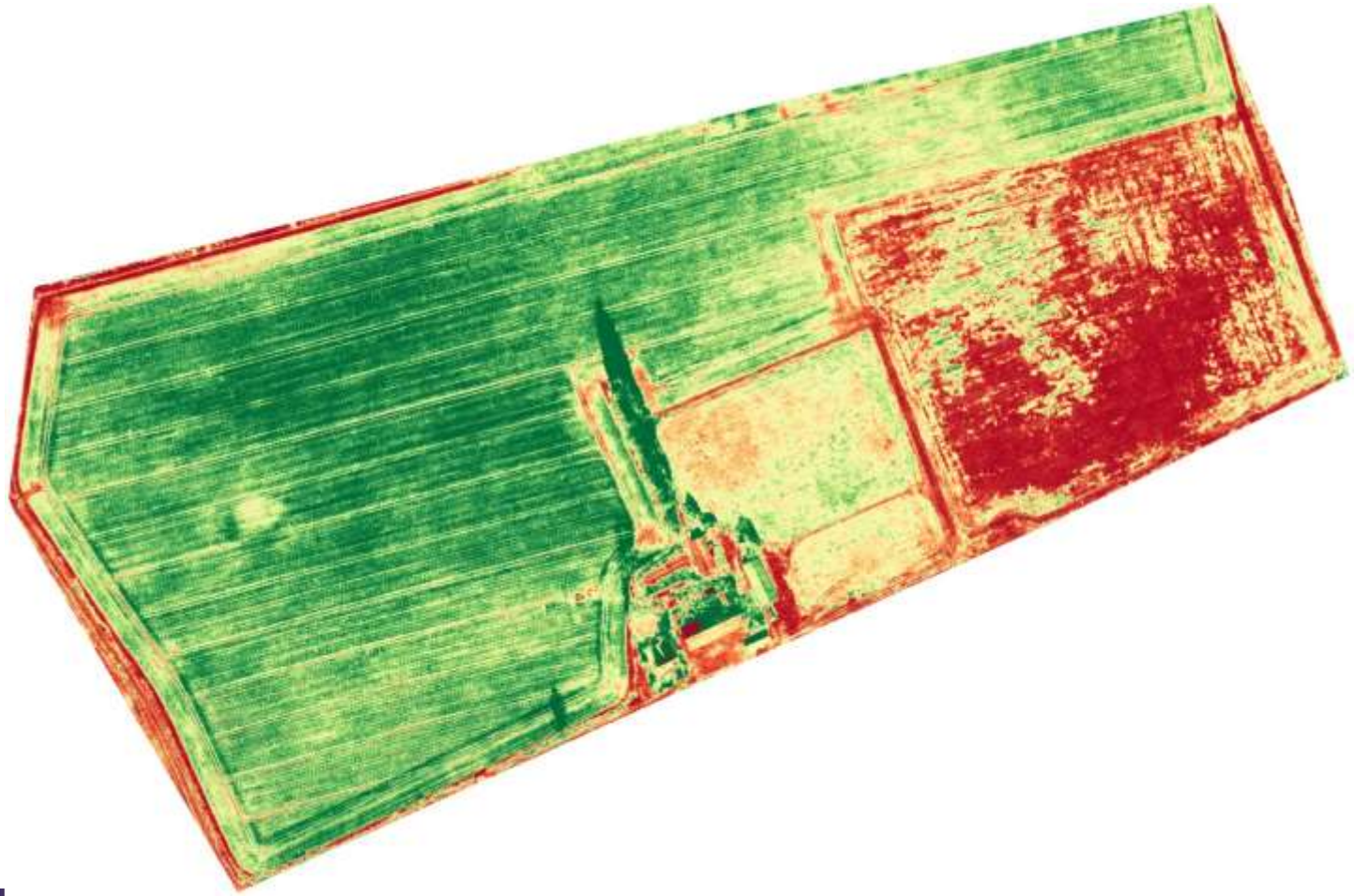

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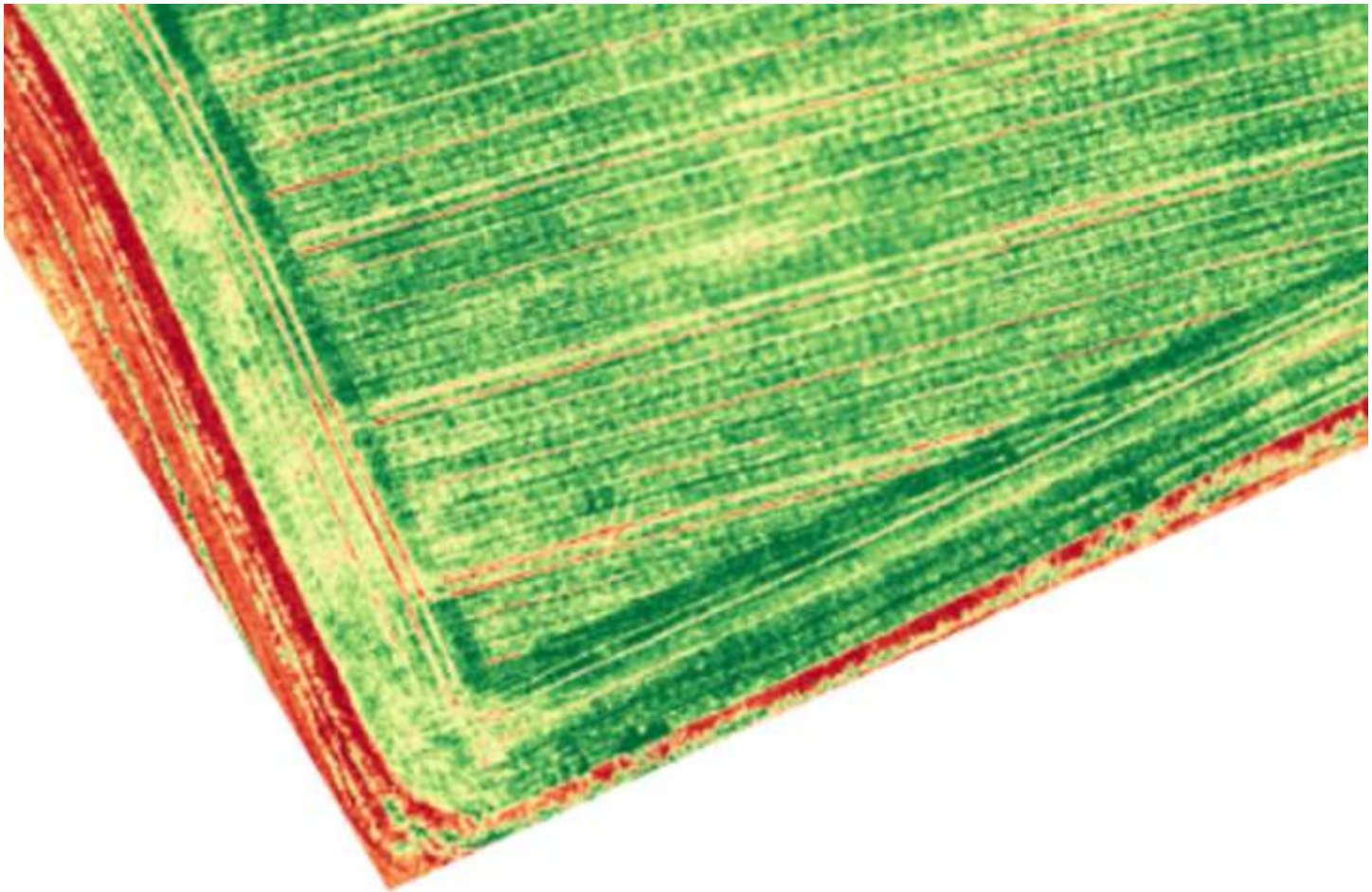

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Dealing with compaction

- Avoid compacting the soil in the first place (Prevention)
- Change management systems to protect soil
- Make the soil more resistant to compaction
- Protect the soil against raindrop impact - protects soil structure
- Eradicate the compaction (Cure)

Subsoiling

- Some soils benefit from subsoiling
- Subsoiling aims to loosen the soil and allow water to flow more freely through it
- Can be effective in soils of low clay content or stony soils where mole drains would not work

Subsoil shatter

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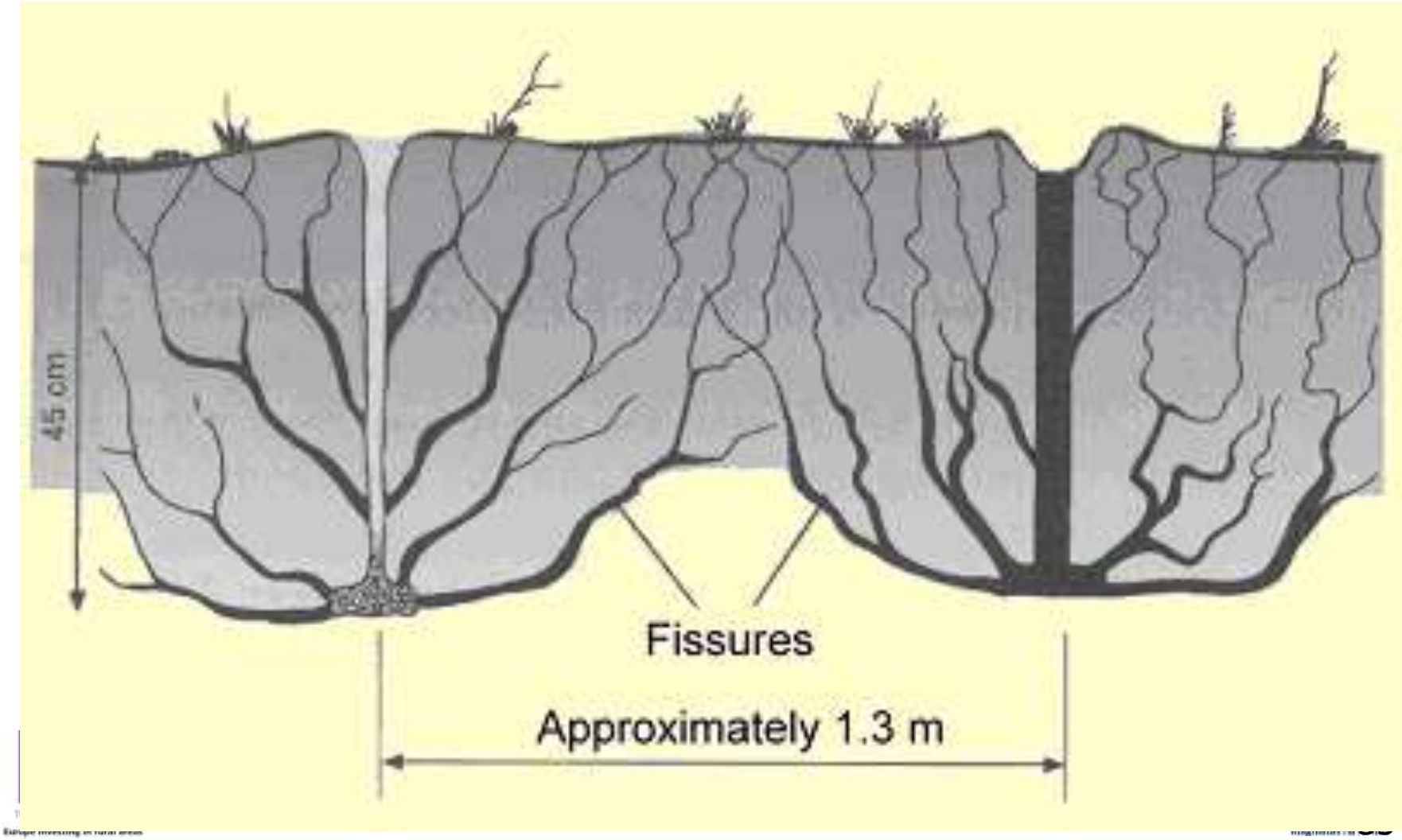

Effective Disturbed Area

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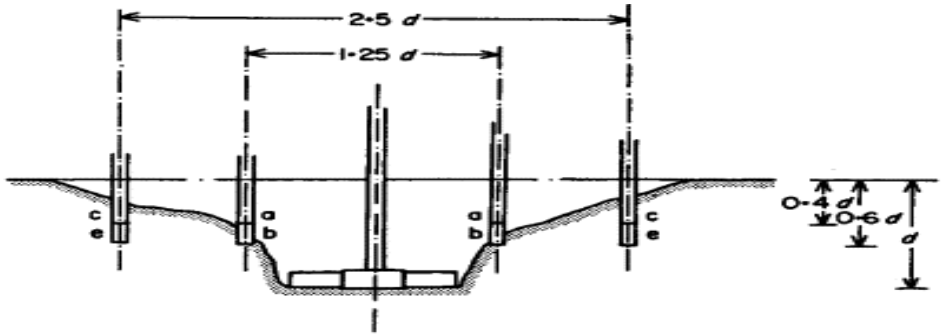

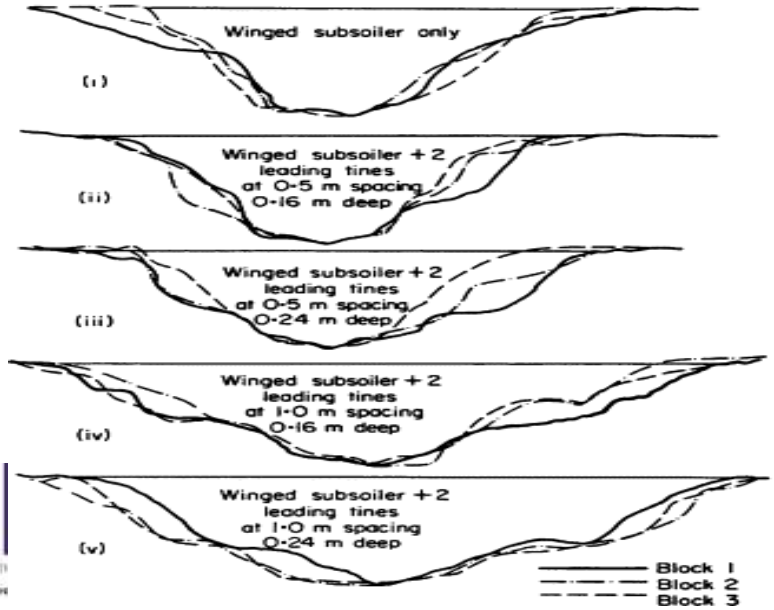

	Draught Force kN	Disturbed Area m^2	Specific Resistance kN / m^2
(i)	23.94	0.242	96
(ii)	21.41	0.236	90
(iii)	20.86	0.283	74
(iv)	20.80	0.360	58
(v)	23.48	0.416	54

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Remediation of subsoil compaction and pans

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- Make fissures through the layer with minimal soil break up and mixing.

- This creates paths for drainage and root movement while keeping the support capacity of the compacted layer

http://vro.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/gloss_ac

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Remediation of poaching, shallow compaction

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www.sumo1.com

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Grassland Subsoilers / Sward lifters

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Pre-cutting Disc and Closer leg spacing

Roller for depth control and break back legs to reduce brining stones to the surface

Spiked roller to help aereate surface

Roller to level surface following treatment

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Grassland Surface Spikers

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Grassland spiker

Effect of surface spiking

Pasture Harrow

Roller spiker with grass seeder and frame for extra weights

Spiker with water tank for extra weights

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When to subsoil

- Only when necessary - check the subsoil for compaction
- When the subsoil is brittle i.e. not too dry or too wet
- Post Harvest subsoiling is generally best in terms of land access and soil suitability
- Spring subsoiling gives the longest benefit if done in the correct conditions