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# Managing Soil and Drainage in the Flood Plain



## Key factors for movement of water in the flood plain

- Soil Texture
- Soil Structure
- Natural drainage paths
- Artificial Land Drainage





17/02/2017



## **Soil Texture**















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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 & 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











# 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





### 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







## **Soil Structure**





# 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 s oils	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	1 cm	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		No.	Distinct macropores	1 cm	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

#### **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**



clay soil

Well structured Well structured sandy soil Compact

sandy soil



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Compact



# **Soil Compaction**





#### Main causes of compaction

- Over-cultivation
- Continuous cultivation
- Heavy machinery
- Working in wet conditions
- Over-grazing



## Effects of Compaction



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#### **Compaction Reduces infiltration** and Increases surface run-off







NO MOISTURE NO AIR





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#### Soil structure is affected by management

Compaction







## **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)





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## 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





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## **Effective Disturbed Area**



Specific kN / m

90

74

58

54

0.242

0.236

0.283

0.360

0.416







#### **Remediation of subsoil** compaction and pans

- Make fissures through the layer with minimal soil break up and mixing.
- This creates paths for drainage and ٠ root movement while keeping the support capacity of the compacted layer







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



# Remediation of poaching, shallow compaction







www.sumo1.com



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#### Grassland Subsoilers / Sward lifters



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



Pre-cutting Disc and Closer leg spacing

Spiked roller to help aereate surface



Roller to level surface following treatment



# Grassland Surface Spikers



Grassland spiker



Pasture Harrow

The Europeen Agricultural hand for Rural Development



Effect of surface spiking



Roller spiker with grass seeder and frame for extra weights



Spiker with water tank for extra weights

## 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





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## Land Drainage



#### **Drainage Problems**



- Surface water
- Ground water
- Springs



### **Problem Occurrence**



• During the late 1970,s the various drainage problems were broken down into the following types,

Drainage Problem	Scotland as a Whole	North East Scotland
	% of problems	% of problems
Water Table	25	22
Impermeable	20	13
Subsoil		
Springs	12	39
Failure of Old	39	25
Drains		
Other	4	1



#### **Benefits of Good Drainage**

- Less surface run-off
- · Improved root growth
- Greater soil biology
- Better crop and grass yields
- Better animal health reduces risk of some parasites and diseases
- Less soil damage
- · Longer utilisation of fields

























### **Drainage Maintenance**

- Mark outfalls clearly.
- Clear outfalls on a regular basis (annual / bi annual).
- Clear ditches on a regular basis Clay soils every 3 to 5 years, sandy soils every 1 to 2 years.
- Keep trees, shrubs and bushes on the banks cut back every 3

to 5 years (Especially important on flood banks).

#### **Drainage Maintenance (2)**

- Check and clear culverts on an annually in late summer / early autumn in preparation for winter rainfall.
- Check flood banks every summer and after flood event for damage.
- Every 3 to 5 years check and repair culvert banks and crossing surface.
- Where flap valves are installed check on an annual basis that they are free to open and close before winter rains.
- Annually mark unusual wet areas on a plan and compare with drainage plans to identify areas that may need existing systems repaired or new drains installed.









