FARM ADVISORY SERVICE

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

FARM ADVISORY SERVICE

Balnellan Soil and Nutrient Network Meeting

23-07-18

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Main Nutrients

- Nitrogen
- Phosphate
- Potash
- Magnesium
- Sulphur

Soil Testing

FARM ADVISORY SERVICE

- Availability of nutrients is affected by the pH of the soil.

Low pH

- Phosphorus (poorer availability below 6)
- Calcium (poorer availability below 6)
- Sulphur (poorer availability below 5.5)
- Potassium (poorer availability below 5.5)

Lime recommendations for arable & rotational grass (t/ha with NV 50% CaO)

Soil pH	Sand	Sandy loam / shallow	Other mineral soils	Humose	Peaty
6.2	0	0	2	0	0
6.1	0	2	3	0	0
6.0	2	3	4	0	0
5.9	2	4	5	2	0
5.8	3	4	5	3	0
5.7	4	5	6	4	0
5.6	4	6	7	5	2

Crops differ in their sensitivity to soil acidity

increasing

sensitivity to

soil acidity

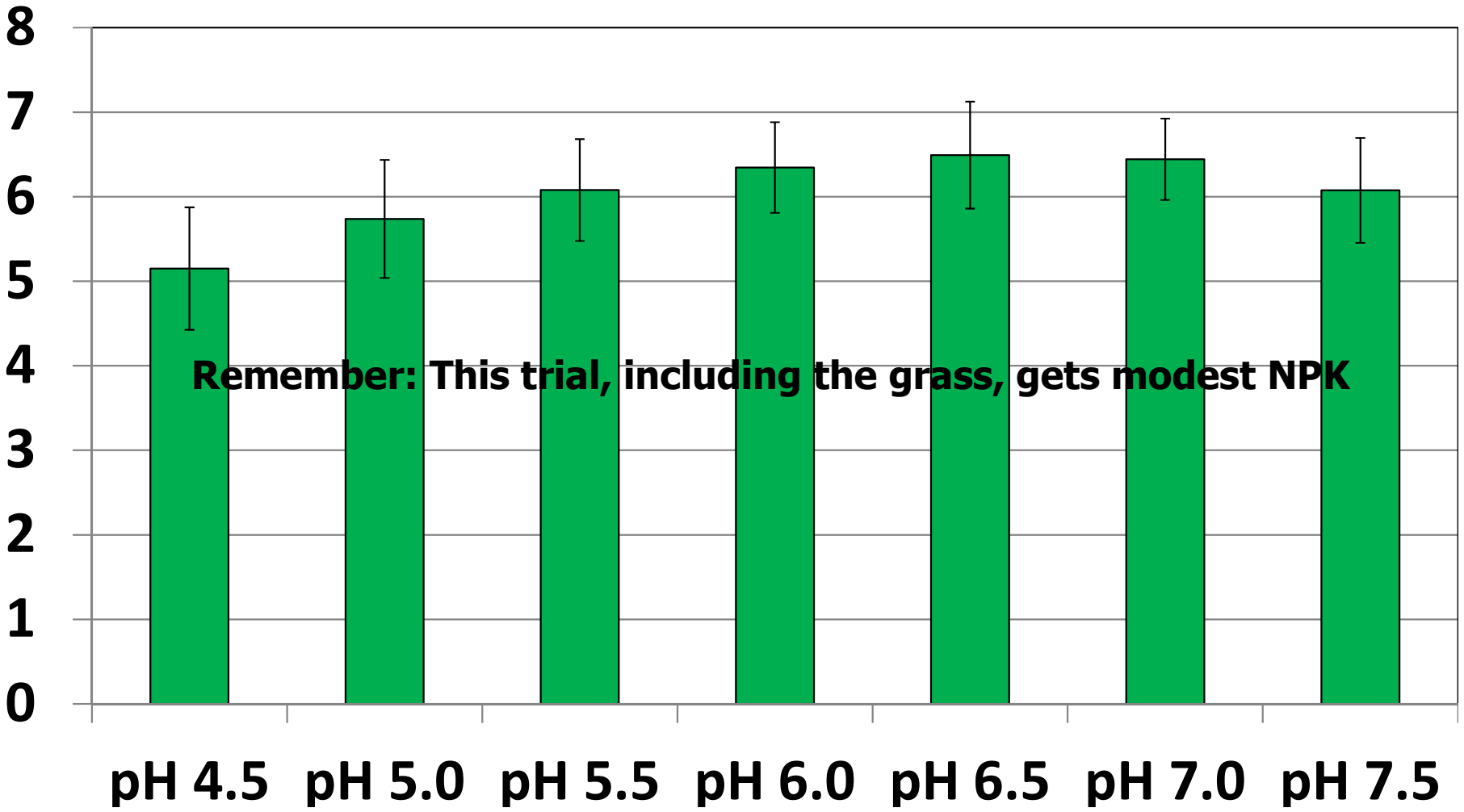
Potatoes, ryegrass

Oats, wheat, oilseed rape, clover

Barley, beans, peas, sugar beet

Hay (t/ha @ 85% DM)

FARM ADVISORY SERVICE



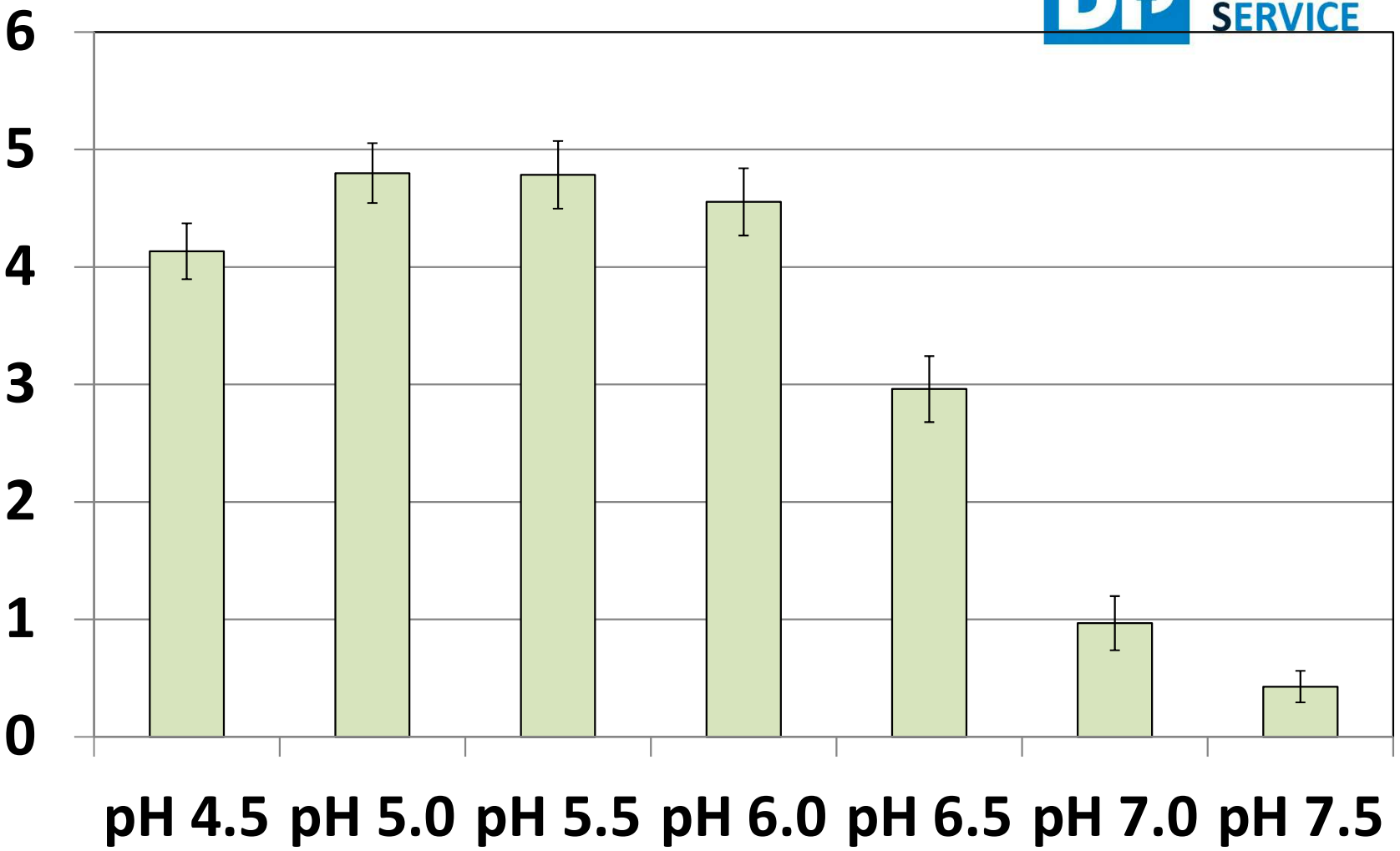
The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Oats (t/ha @ 85% DM)

FARM ADVISORY SERVICE



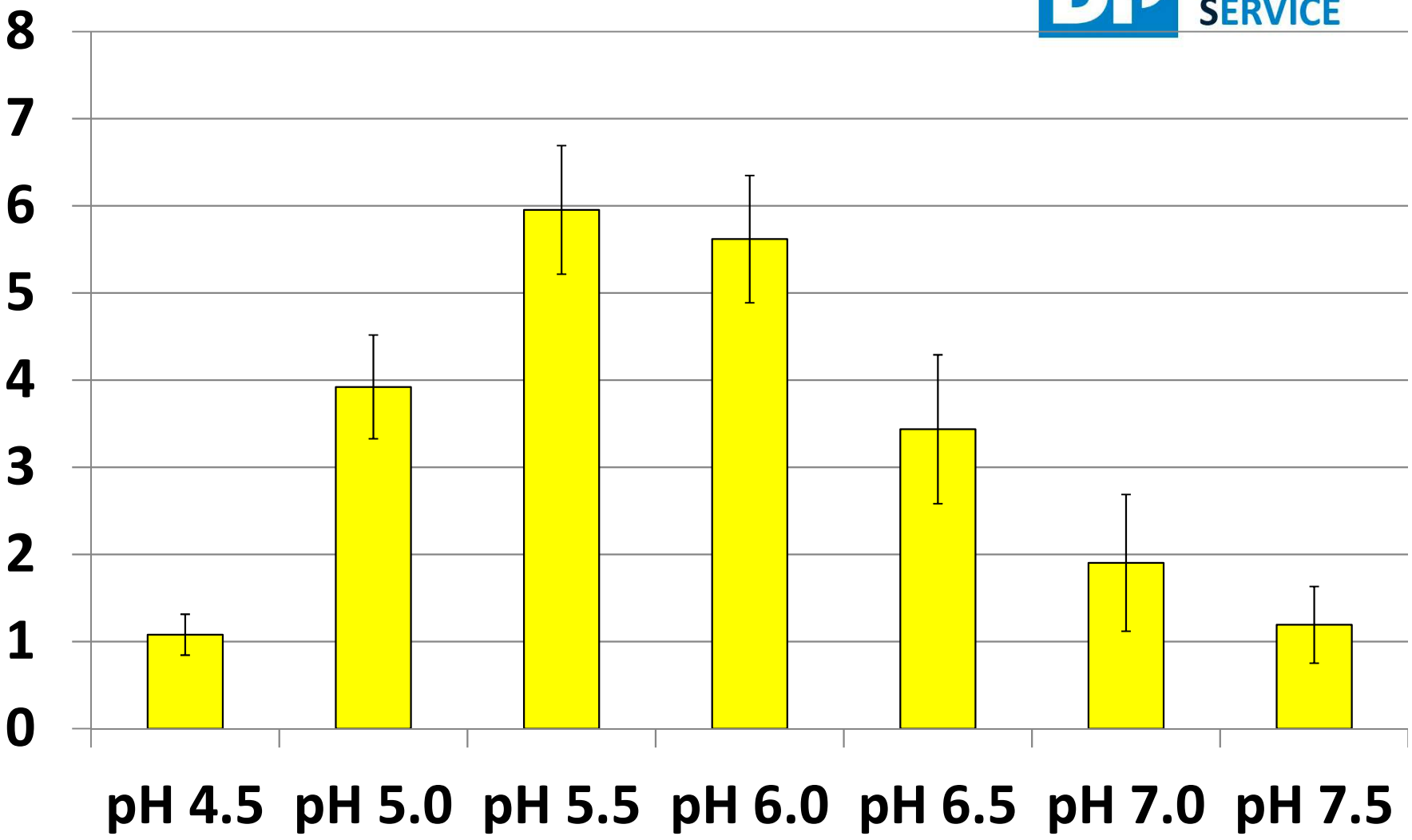
The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Winter Wheat (t/ha @ 85% DM)

FARM ADVISORY SERVICE



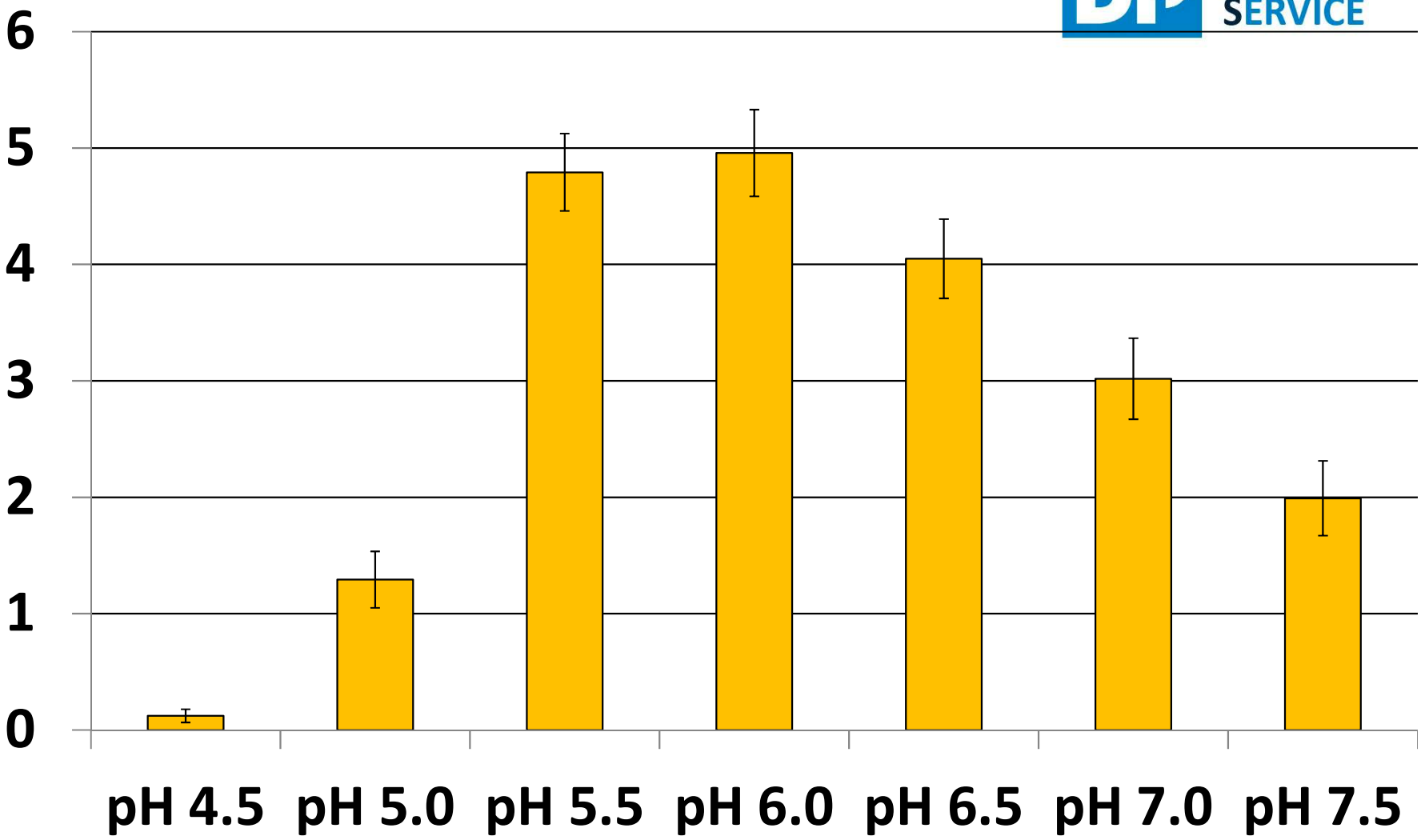
The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Spring Barley (t/ha @ 85% DM)

FARM ADVISORY SERVICE



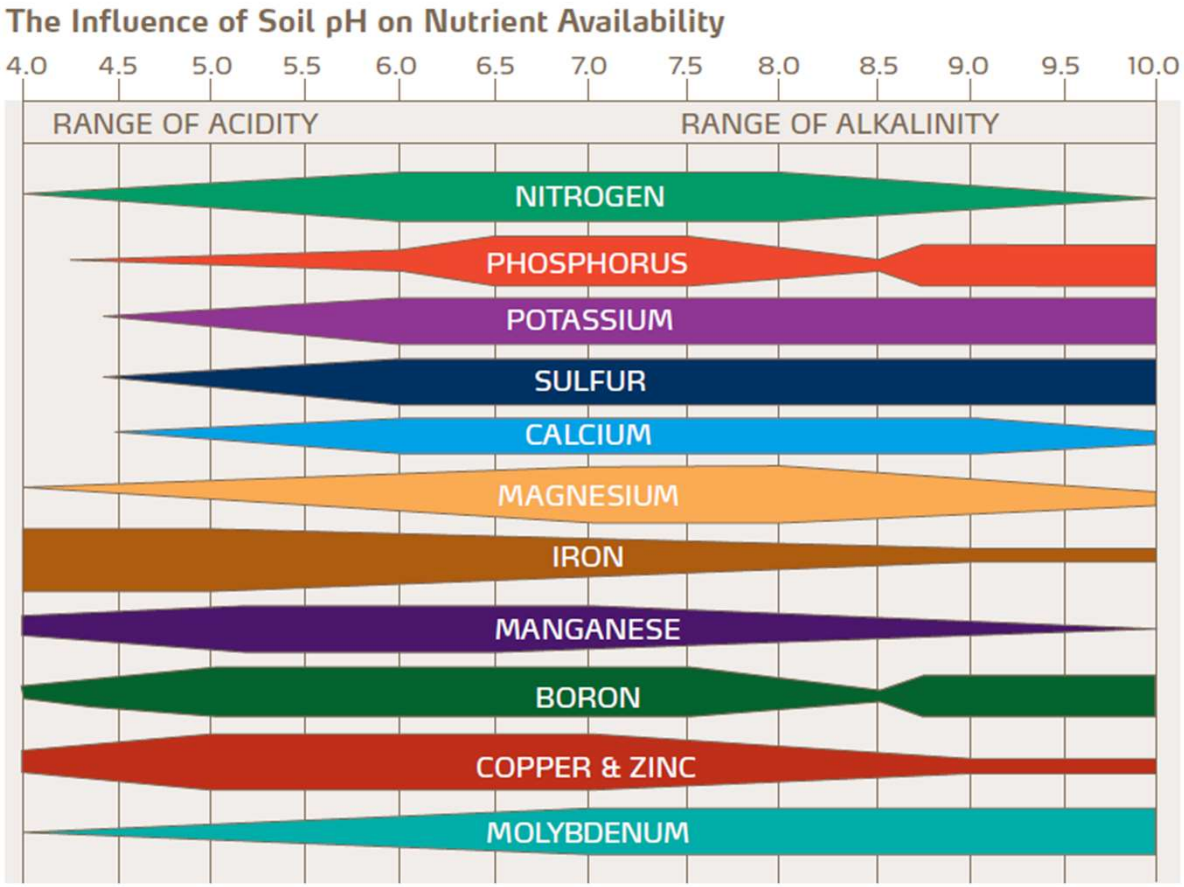
The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Nutrient Availability

FARM ADVISORY SERVICE



The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Main Nutrients

- Nitrogen
- Phosphate
- Potash
- Magnesium
- Sulphur

Nitrogen

- **Grass** – Better synthesis of amino acids, improved formulation of co-enzymes and nucleic acids, increased synthesis of chlorophyll and ATP, improved crop vigour and development.

Made worse by

- Low or high pH soils, sandy or light soils (leaching.)
- low organic matter. drought conditions,
- high rainfall (leaching),
- addition or high levels of non-decomposed organic matter/manure (e.g. straw),
- fast growing crops.

Phosphate

- **Grass** – Essential for energy transfer within the plant, therefore direct effect on yield and quality.

Made worse by

- Acidic or very alkaline soils,
- low organic matter,
- cold or wet conditions,
- crops with a poorly developed root system,
- soils with low P reserves,
- Soils with a high phosphate capacity, iron rich soils.

Potash

- **Grass** – Internal water regulation, vigorous growth and healthy foliage, required in large amounts.

Made worse by

- Acidic soils (low pH),
- sandy or light soils (leaching),
- drought conditions,
- high rainfall (leaching),
- heavy clay soils, soils with low K reserves,
- magnesium rich soils.

Magnesium

- **Grass** – Risk of Hypomagnesaemia (grass staggers), herbage uptake reduces as N and K levels increase.

Made worse by

- Sandy soils,
- acidic soils,
- potassium rich soils,
- soils receiving high potash applications,
- cold wet periods.

Sulphur

- **Grass** - Component of enzymes and other proteins, necessary for chlorophyll formation and efficient N-utilization.

Made worse by

- Acidic soils, light,
- sandy soils (leaching),
- ow organic matter,
- poorly aerated soils (waterlogged soils.),
- Areas with low industrial emissions.

Crop Nutrient Requirements (based on Technical Notes TN633 and TN651

FARM ADVISORY SERVICE

Nutrient requirement (kg/ha) following a Group 1 crop on a sandy loam soil type at (Moderate – Phosphate and Potash levels).

	Spring barley (feed)	Spring barley (malting)	Spring oats	Winter barley (feed)	Winter wheat (feed)	Winter O.S.R. (seedbed)	Winter O.S.R. (Spring)
N	130	110	100	180	200	30	200
P_2O_5	52	52	53	67	67	49	
K_2O	71	71	104	83	83	38	

Grass Nutrient Requirements (based on Technical Notes TN652

FARM ADVISORY SERVICE

Nutrient requirement (kg/ha) for Site Class 1, on a sandy loam soil type at (Moderate – Phosphate and Potash levels).

	2 or 3 Cut Silage plus grazing	1 Cut Silage plus grazing	Hay plus grazing	Grass with high clover (1 cut plus grazing)	Grass establishment (grass /low clover mix) (direct reseed)	Grass establishment (high clover mix) (direct reseed)
N	310	280	220	100	40-60	0-20
P_2O_5	39+20+15+3	39+3	41+3	39+3	50	70
K_2O	138+72+54+2	138+2	126+2	138+2	50	70

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

P & K Removal Rates

FARM ADVISORY SERVICE

	Nutrients Removed	
Crop	P Removal (kg/t)	K Removal (kg/t)
Silage	1.7	6
Hay	5.9	18
Grazing *	1.4	1.8

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

P & K requirements – Grass

FARM ADVISORY SERVICE

Soil Status	Crop	Yield - t/ha (bales per acre)	P requirement (kg/ha)	K requirement (kg/ha)
Moderate	1 cut silage	17.5 (14)	30	105
Low	1 cut silage	17.5 (14)	70	125
Very Low	1 cut silage	17.5 (14)	110	165
Moderate	2 cut silage	26 (21)	44	156
Low	2 cut silage	26 (21)	84	176
Very Low	2 cut silage	26 (21)	124	216
Moderate	Establishment		50	50
Low	Establishment		90	70
Very Low	Establishment		130	110

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

P & K requirements – Grass with High Clover

FARM ADVISORY SERVICE

Soil Status	Crop	Yield (t/ha)	P requirement (kg/ha)	K requirement (kg/ha)
Moderate	1 cut silage	17.5 (14)	30	105
Low	1 cut silage	17.5 (14)	70	125
Very Low	1 cut silage	17.5 (14)	110	165
Moderate	1 cut silage	26 (21)	44	156
Low	1 cut silage	26 (21)	84	176
Very Low	1 cut silage	26 (21)	124	216
Moderate	Establishment		70	70
Low	Establishment		110	90
Very Low	Establishment		150	130

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

FARM ADVISORY SERVICE

FARM YARD MANURES

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Nutrients in farm yard manures

	Total nutrients (kg/t fresh weight) in different Farm Yard Manures						
	Cattle FYM (fresh)	Cattle FYM (old)	Pig FYM (fresh)	Pig FYM (old)	Layer manure	Broiler / Turkey litter	Sheep FYM (fresh)
N	6	6	7	7	19	30	7
Readily available N	1.2	0.6	1.8	1	9.5	10.5	1.4
P_2O_5	3.2	3.2	6	6	14	25	3.2
K_2O	8	8	8	8	9.5	18	8
SO_3	2.4	2.4	3.4	3.4	4	8	3
MgO	1.8	1.8	1.8	1.8	2.6	4.4	1.6

Nutrient content of slurries

FARM ADVISORY SERVICE

	Dry matter (%) and total nutrients (kg/t fresh weight)		
	Cattle slurry	**Pig slurry**	**Dirty water**
Dry matter (%)	6	4	0.5
N	2.6	3.6	0.5
Readily available N	1.2	2.5	0.3
P_2O_5	1.2	1.8	0.1
K_2O	3.2	2.4	1.0
SO_3	0.7	1	0.1
MgO	0.6	0.7	0.1

Nutrient availability from organic manures in year of application

FARM ADVISORY SERVICE

	Nutrient availability in the year of application (%)			
	Slurry	**Poultry Manures**	**FYM**	**Dirty water**
N	35-75	35-70	10-20	?
P_2O_5	50	60	60	?
K_2O	90	90	90	95-100

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Nutrient supply from typical FYM application

FARM ADVISORY SERVICE

	Total nutrients (kg/t fresh weight) in different Farm Yard Manures Application Rate (25 tonnes per Ha (10 tonnes per acre)				
	Cattle FYM (fresh)	Cattle FYM (old)	Pig FYM (fresh)	Pig FYM (old)	Sheep FYM (fresh)
N	150	150	175	175	175
Readily available N	30	15	45	25	35
P_2O_5	80	80	150	150	80
K_2O	200	200	200	200	200
SO_3	60	60	85	85	75
MgO	45	45	45	45	40

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Manures – a valuable resource

- As the price of inorganic fertilisers is rising the manure benefit from organic manures can produce a considerable saving to the overall farm fertiliser bill.
- Typical prices at present:-
  - N £0.70/kg
  - P £0.61/kg
  - K £0.42/kg
- Cost of typical fertiliser grades
  - Ammonium nitrate £240/tonne
  - Triple super phosphate £280/tonne
  - Muiriate of potash £250/tonne

Value of a typical FYM application

	Financial Benefit (£ per Ha) of a typical Application Rate (25 tonnes per Ha (10 tonnes per acre) based on Available N and total P_2O_5 and K_2O.				
	Cattle FYM (fresh)	Cattle FYM (old)	Pig FYM (fresh)	Pig FYM (old)	Sheep FYM (fresh)
Available N	21.00	10.50	31.50	17.50	24.50
Total P_2O_5	48.80	48.80	91.50	91.50	48.80
Total K_2O	84.00	84.00	84.00	84.00	84.00
Total (£)	£153.80	£143.30	£207.00	£193.00	157.30

Managing Soil Drainage and Compaction in Pasture

FARM ADVISORY SERVICE

Key factors for movement of water in the soil

- Soil Texture
- Soil Structure
- Soil Compaction

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

FARM ADVISORY SERVICE

Soil Texture

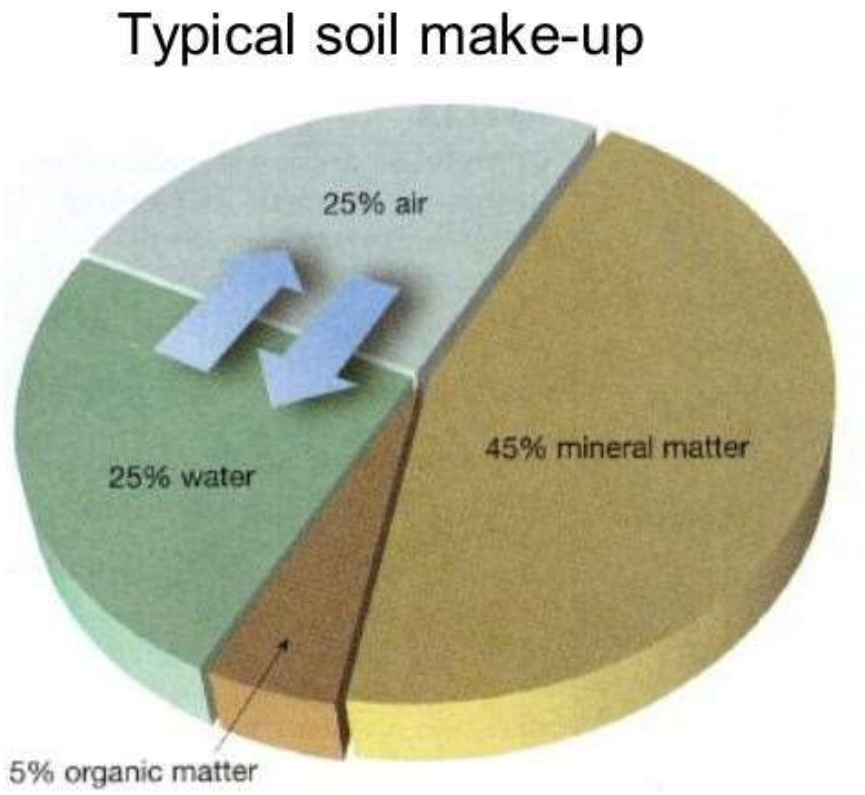
The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

What is Soil?

FARM ADVISORY SERVICE



The European Agricultural Fund for Rural Development
Europe investing in rural areas

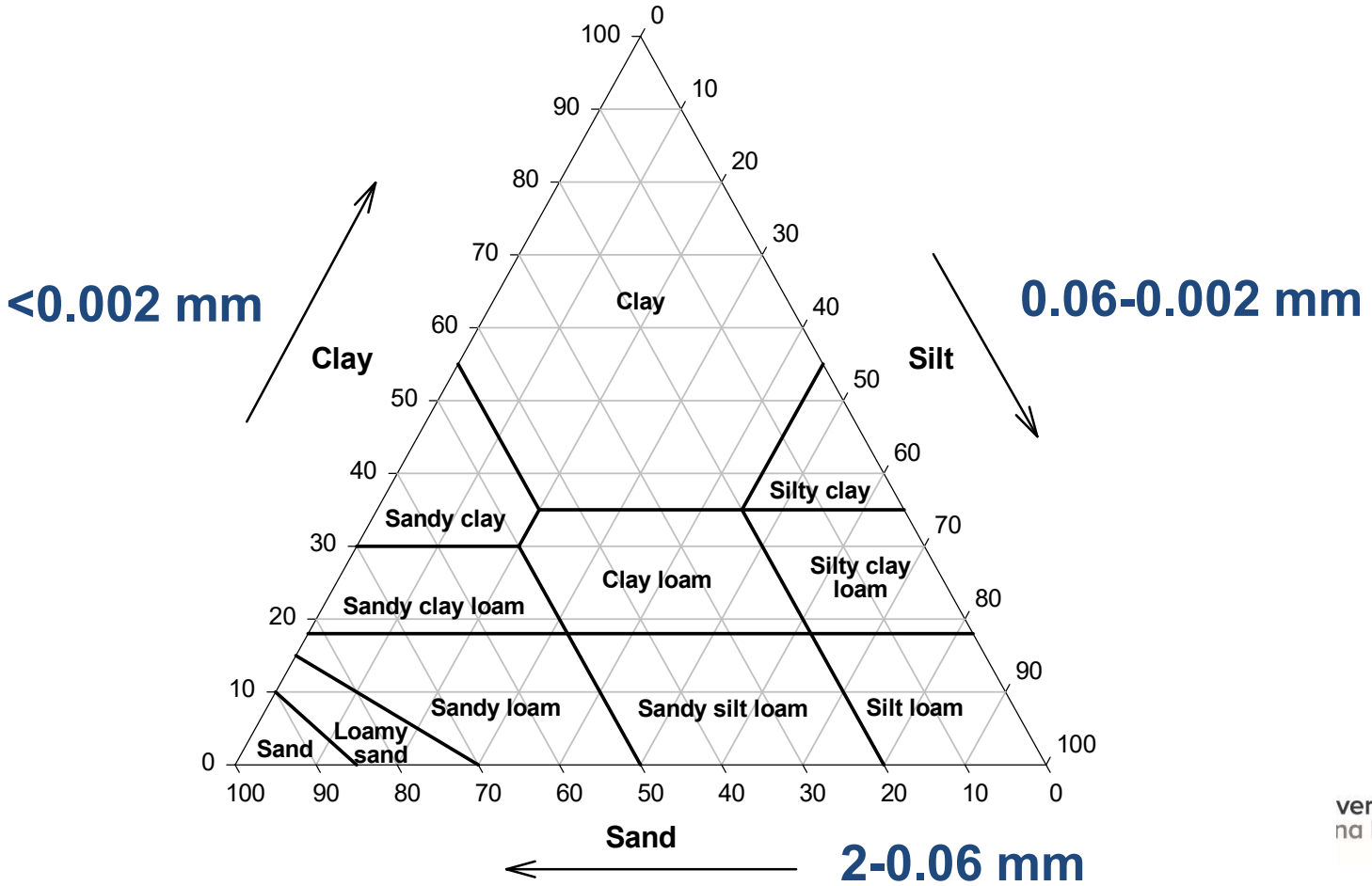
SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

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

FARM ADVISORY SERVICE

Soil Structure

The European Agricultural Fund for Rural Development
Europe investing in rural areas

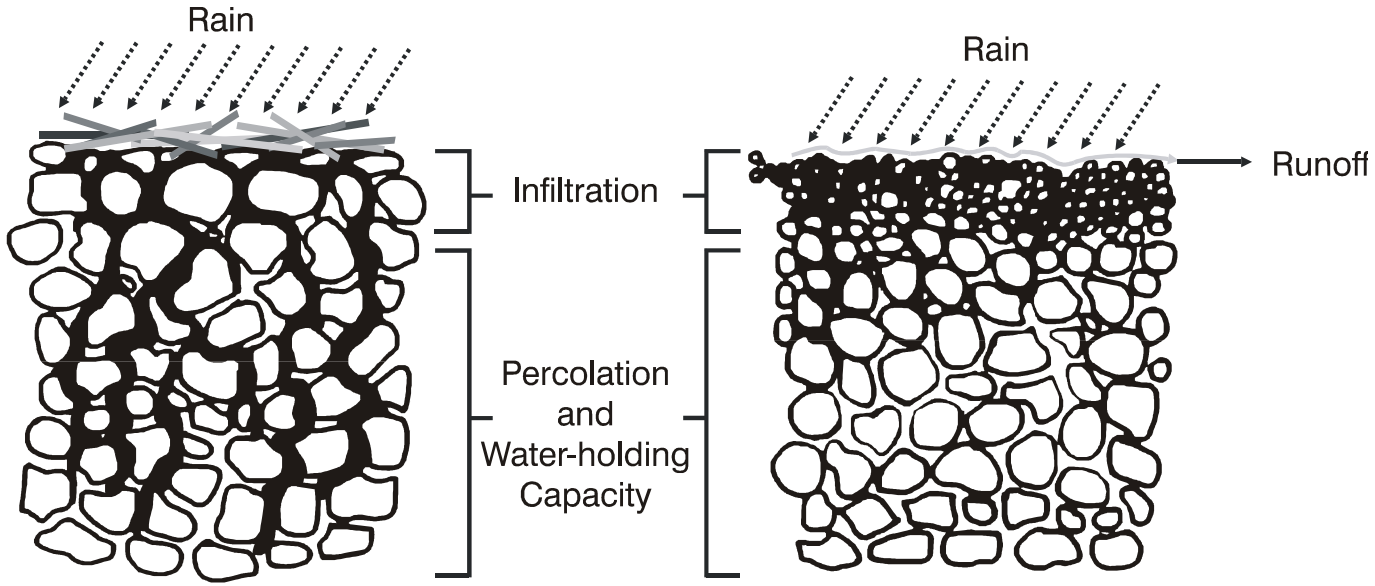
SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Soil structure: the importance of macropores

FARM ADVISORY SERVICE

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

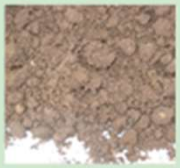
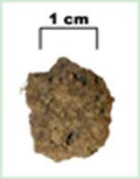
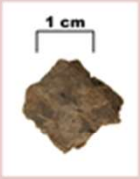


The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

SMI Soil Management Initiative

sh Government
altas na h-Alba
ot

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

FARM ADVISORY SERVICE

- 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

FARM ADVISORY SERVICE

Well structured sandy soil

Well structured clay soil

Compact sandy soil

Compact clay soil

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

FARM ADVISORY SERVICE

Soil Compaction

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

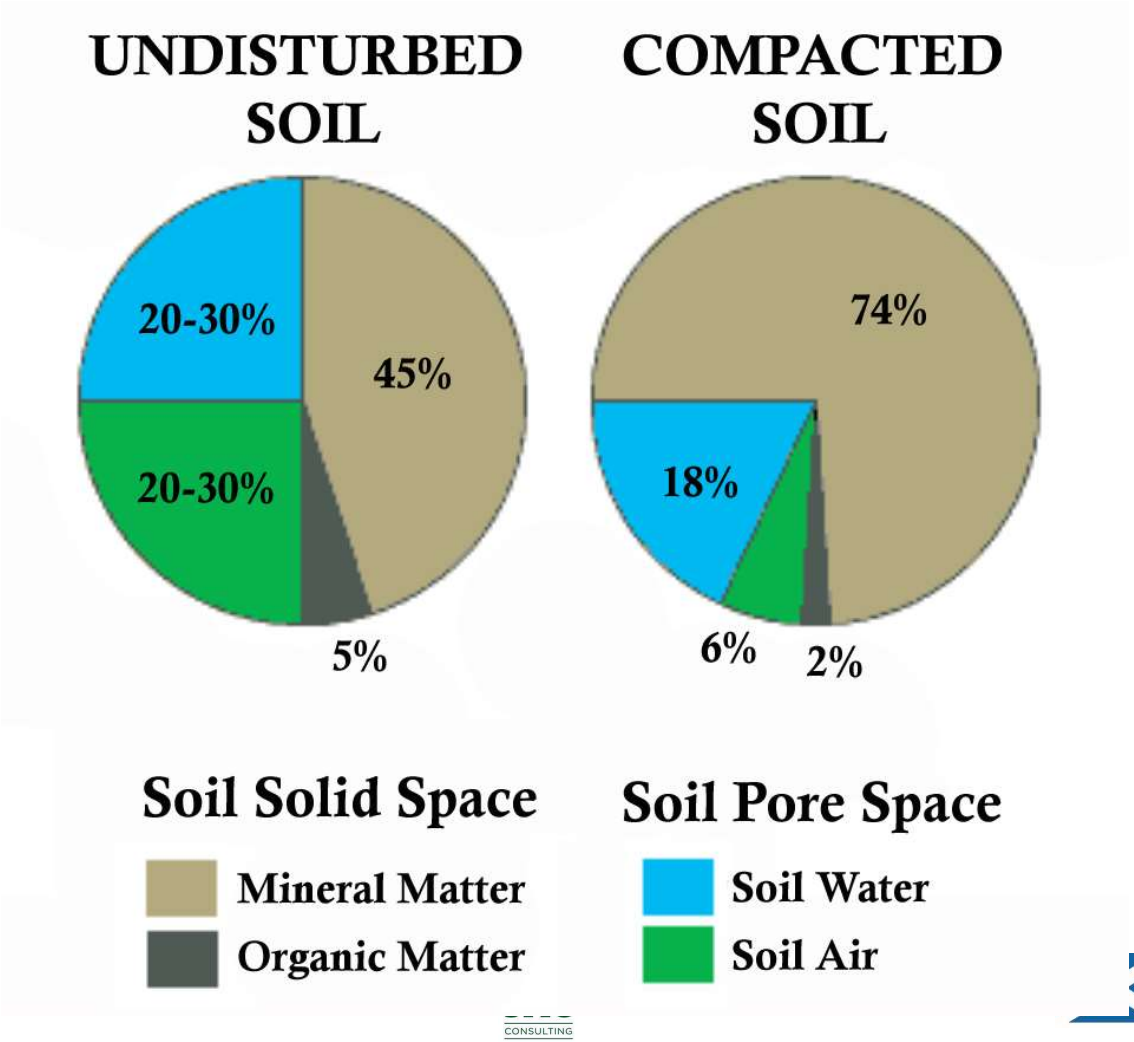
Scottish Government
Riaghaltas na h-Alba
gov.scot

Main causes of compaction

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

Effects of Compaction

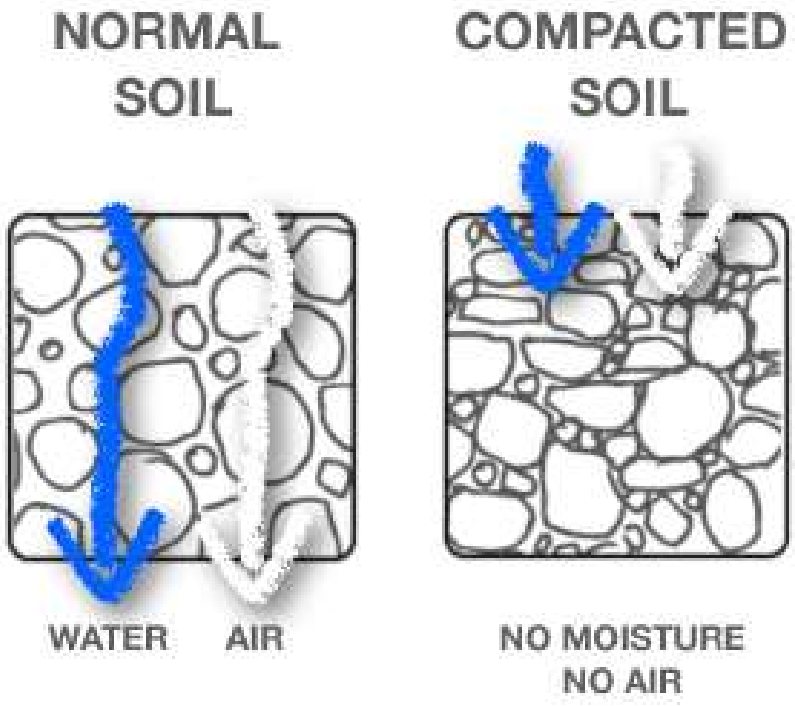
FARM ADVISORY SERVICE



The European Agricultural Fund for Rural Development
Europe investing in rural areas

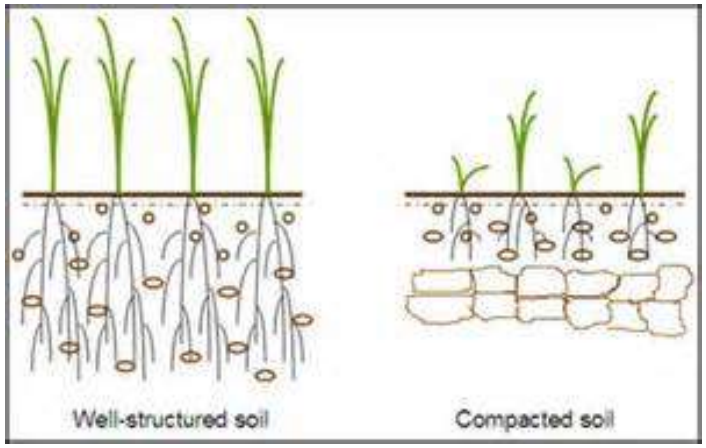
Scottish Government
Riaghaltas na h-Alba
gov.scot

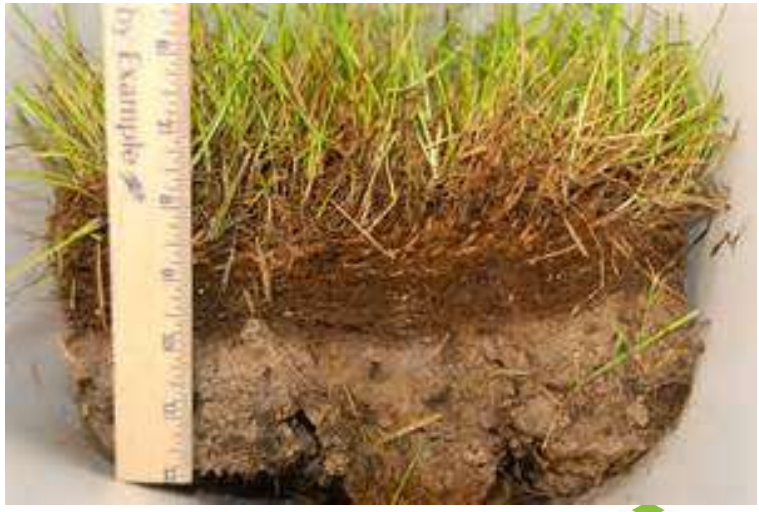
Compaction Reduces infiltration and Increases surface run-off



Rooting in compacted soils

FARM ADVISORY SERVICE





The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Soil structure is affected by management

- Compaction

- Poaching

Image: Farmers Weekly

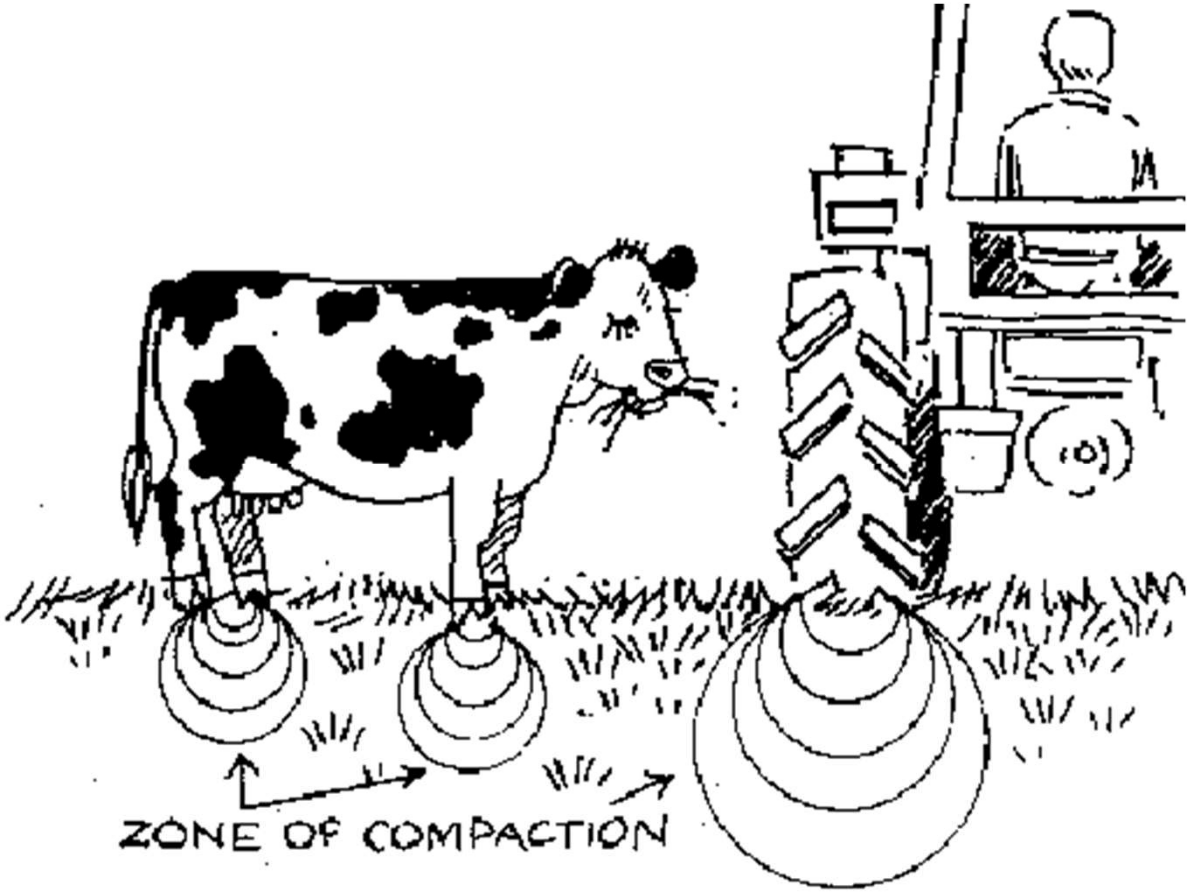
- Waterlogging

The European Agricultural Fund for Rural Development
Europe investing in rural areas

Scottish Government
Riaghaltas na h-Alba
gov.scot

Zone of Compaction

FARM ADVISORY SERVICE

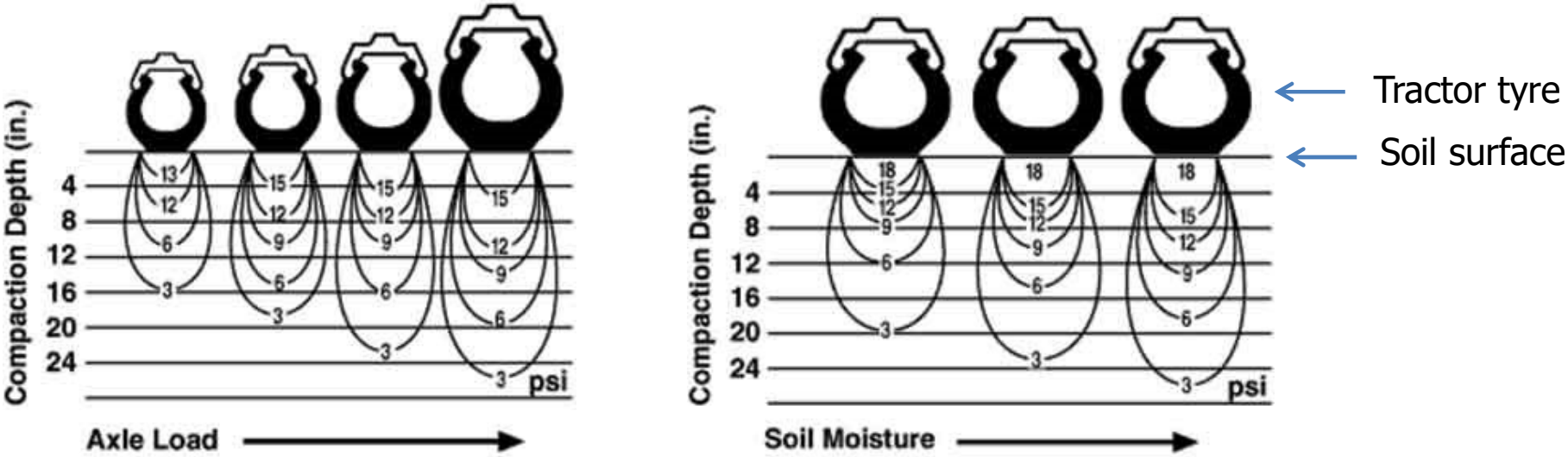


The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Compaction and soil moisture



Wheel traffic compaction. The depth of compaction increases with increasing equipment weight (axle load) or increasing moisture condition. (Adapted from Soehne, 1958. Journ. of Agr. Eng.)

Source: University of Minnesota Extension Publication WW-03115; Available on-line at:
http://www.extension.umn.edu/distribution/cropsystems/components/3115s01.html#section1

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)

FARM ADVISORY SERVICE

Farming for a Better Climate

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Tyres and Compaction (3)

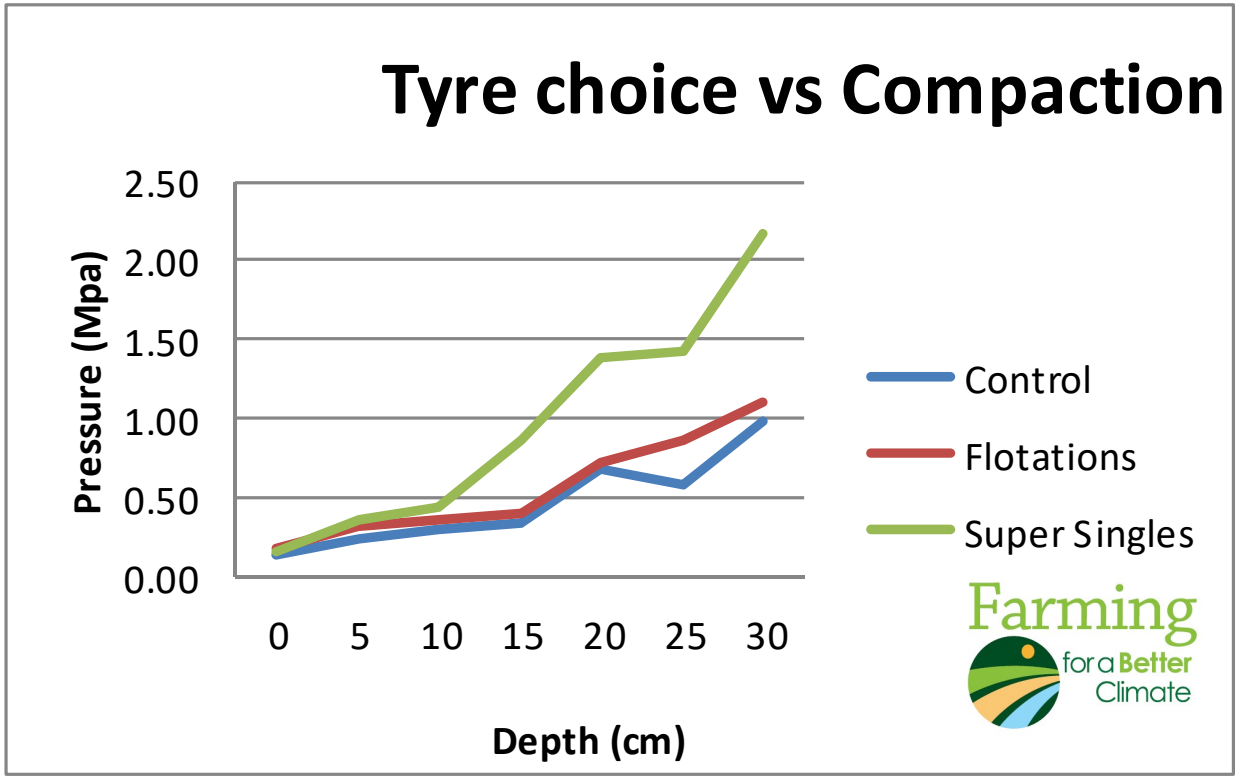
FARM ADVISORY SERVICE

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Tyres and Compaction (3)



Compaction Increases with Depth

Extreme problems

FARM ADVISORY SERVICE

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

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)

Remediation of poaching, shallow compaction

FARM ADVISORY SERVICE

www.sumo1.com

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Shallow Compaction

Pasture Harrow with Grass Seeder

Pasture Harrow

Grassland Surface Spikers

FARM ADVISORY SERVICE

Grassland spiker

Effect of surface spiking

Roller spiker with grass seeder and frame for extra weight

Spiker with water tank for extra weight

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Grassland Sward lifters

Pre-cutting Disc and Closer leg spacing

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

Spiked roller to help aereate surface

Roller to level surface following treatment

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Sub Soilers

FARM ADVISORY SERVICE

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

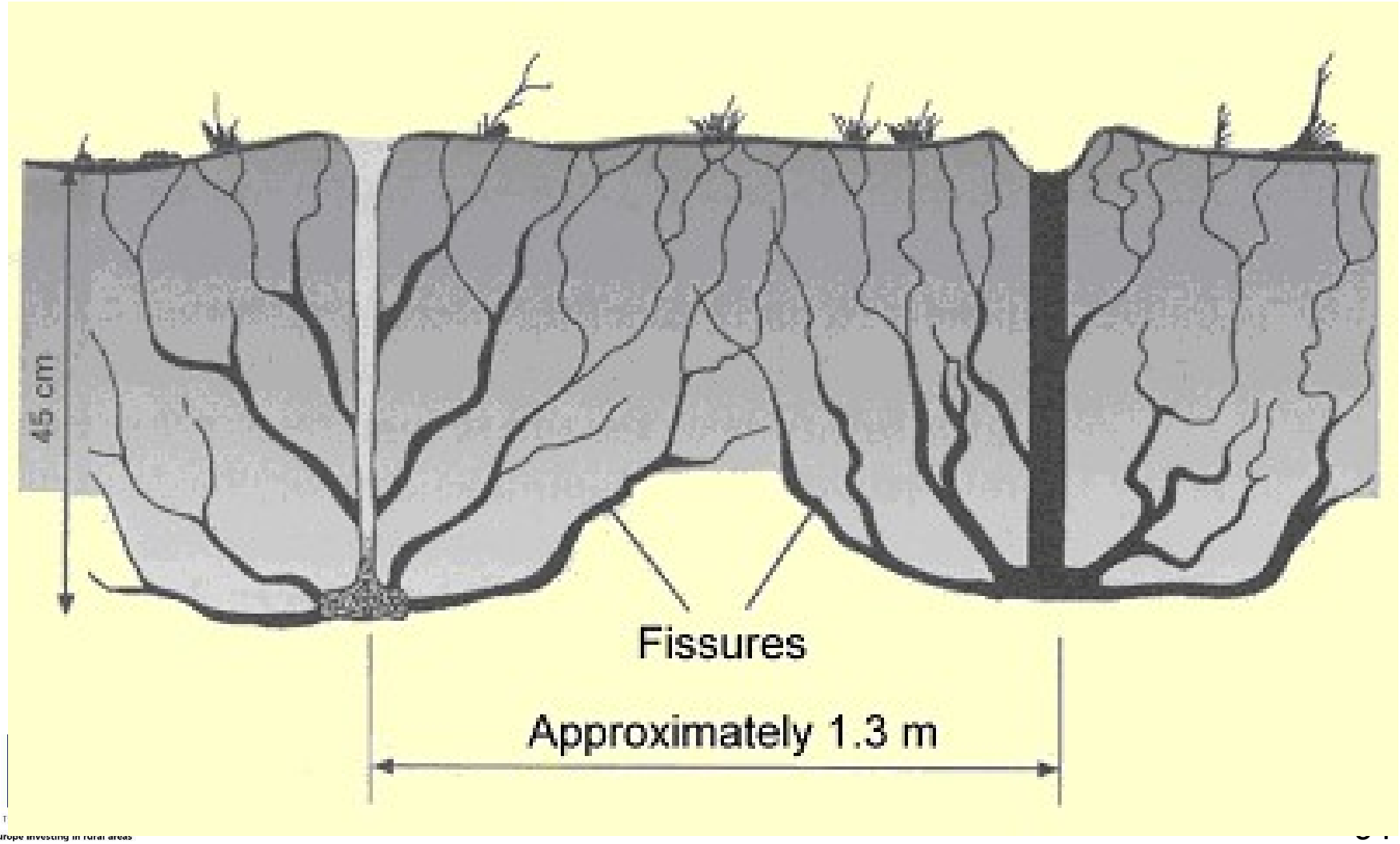
Scottish Government
Riaghaltas na h-Alba
gov.scot

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

FARM ADVISORY SERVICE



Remediation of subsoil compaction and pans

FARM ADVISORY SERVICE

- 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

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

When to subsoil

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

FARM ADVISORY SERVICE

Land Drainage

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Main Drainage Problems

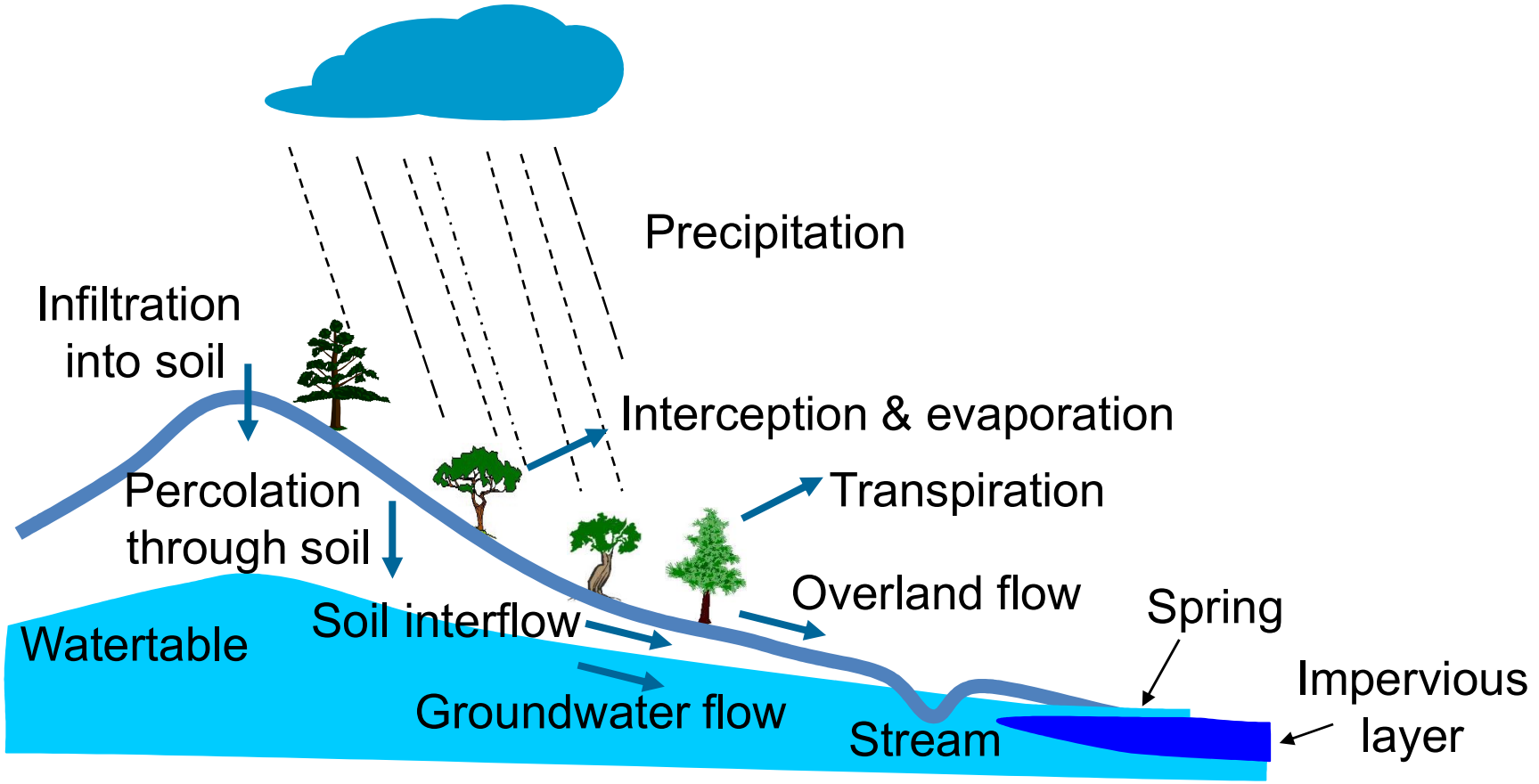
- **Surface water**
- **Ground water**
- **Springs**

Problem type and occurrence

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

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

Water Pathways



Waterlogging

- Reduces crop yield
  - low nutrients, toxins, oxygen deficiency etc
- Affects soil management, e.g.
  - cultivation machinery choice
  - cultivation timing
  - cultivation energy input (number of passes required)
- Reduces access to the field
- Reduces optimum timing for harvest without causing compaction damage

Benefits of Good Drainage

FARM ADVISORY SERVICE

- Improved root growth
- Better crop and grass yields
- Better animal health – reduces risk of some parasites and diseases
- Less surface run-off (diffuse pollution)
- Less soil damage
- Longer utilisation of fields

Effect of poor drainage on yield (t/ha)

	Freely drained	Poorly drained
Potato	40	15
Bean	10	2
Carrot	40	5

How do you know when a soil has poor drainage?

FARM ADVISORY SERVICE

- Water lies on the surface
- Water can be seen in a soil pit
- Roots are brown and shallow
- Dull grey colours (rusty or multi-coloured)
- Mottled colours in subsoil
- “Sour” smell
- Unrotted manure or crop residues

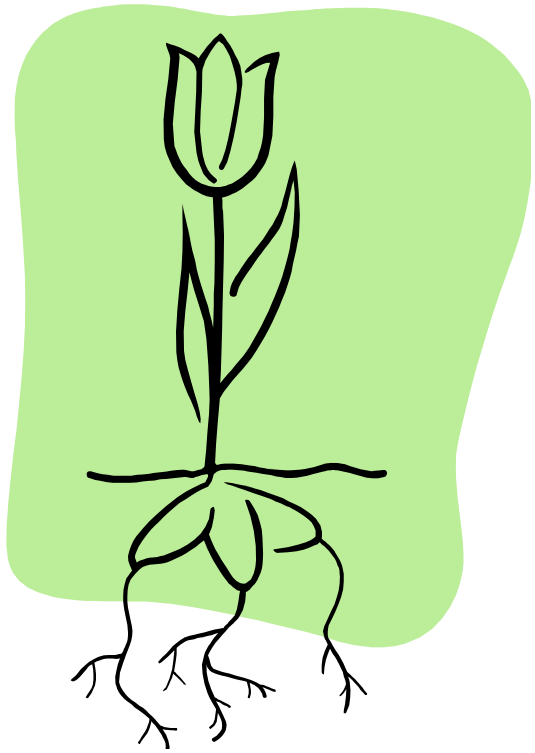
Affects of Poor Drainage

FARM ADVISORY SERVICE

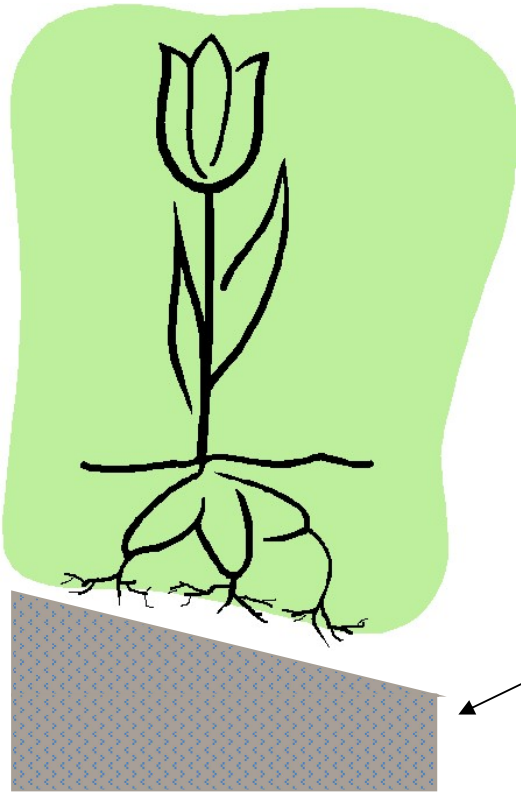
- Reduces crop yield - low nutrients, toxins, oxygen deficiency etc.
- Encourages poor vegetation – rushes, buttercup
- Affects soil management - e.g. cultivations
- Reduces access to the field
- Increases animal health risks – e.g. Liver Fluke
- Wastes fertiliser
- Increases diffuse pollution

Effect of drains on root growth

FARM ADVISORY SERVICE



With drains



Without drains

How do you Improve Drainage ?

FARM ADVISORY SERVICE

- Investigate the site
- Identify the problems
- Prepare a plan
- Budget the plan
- Prioritise the solutions
- Carry out the work
- Record the work carried out

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Where do you start?

Investigate the existing drainage scheme

- Clean ditches
- Exclude livestock where possible
- Clear pipe outfalls and culverts
- Repair burst pipes

Drainage system components

- **Outfall**
  - **where water leaves the drained area and enters a ditch, burn or river**

- **Leader pipes**
  - **larger pipe or ditch which collects water from many field drains and conducts it to the outfall**

- **Field drains**
  - **ditches**
  - **laterals - plastic or clay pipes**

New Drainage

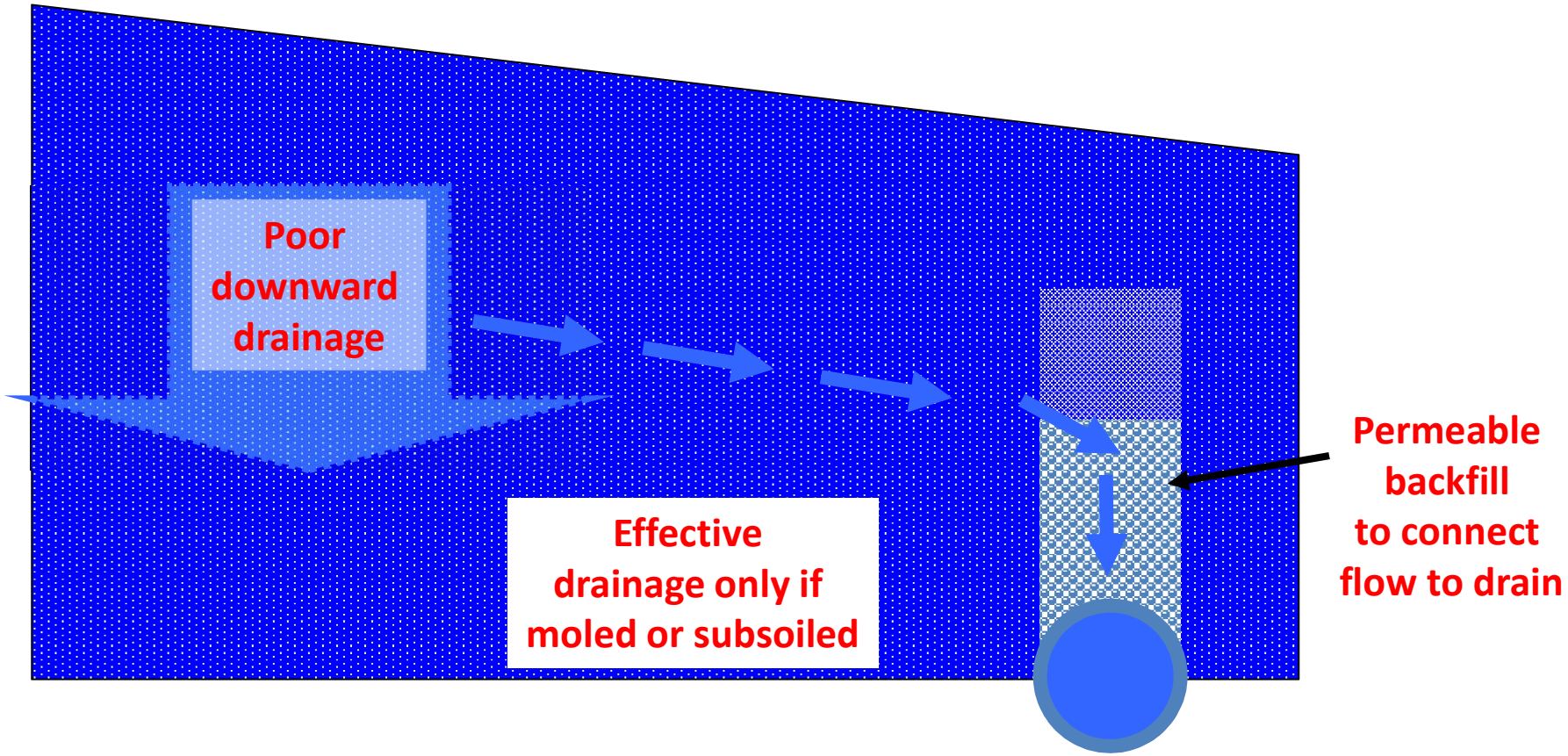
- Drainage is expensive – prioritise areas to be drained
- Collaborate with neighbours where possible to maximise benefits
- Ditches lowest cost but take up land
- Pipes with gravel most expensive but take up least land

Drainage Design

- Design for required outcome – allow for expansion at a later date
- Design from the outfall back
- Install ditches on boundaries where possible
- Minimise requirement for culverts – potential for blockage in the future.
- Install correctly sized pipes where required – use gravel if necessary
- If there are problems with ochre or running sand – install a bigger diameter pipe if practical

Drainage of impermeable soils - surface water problem

FARM ADVISORY SERVICE



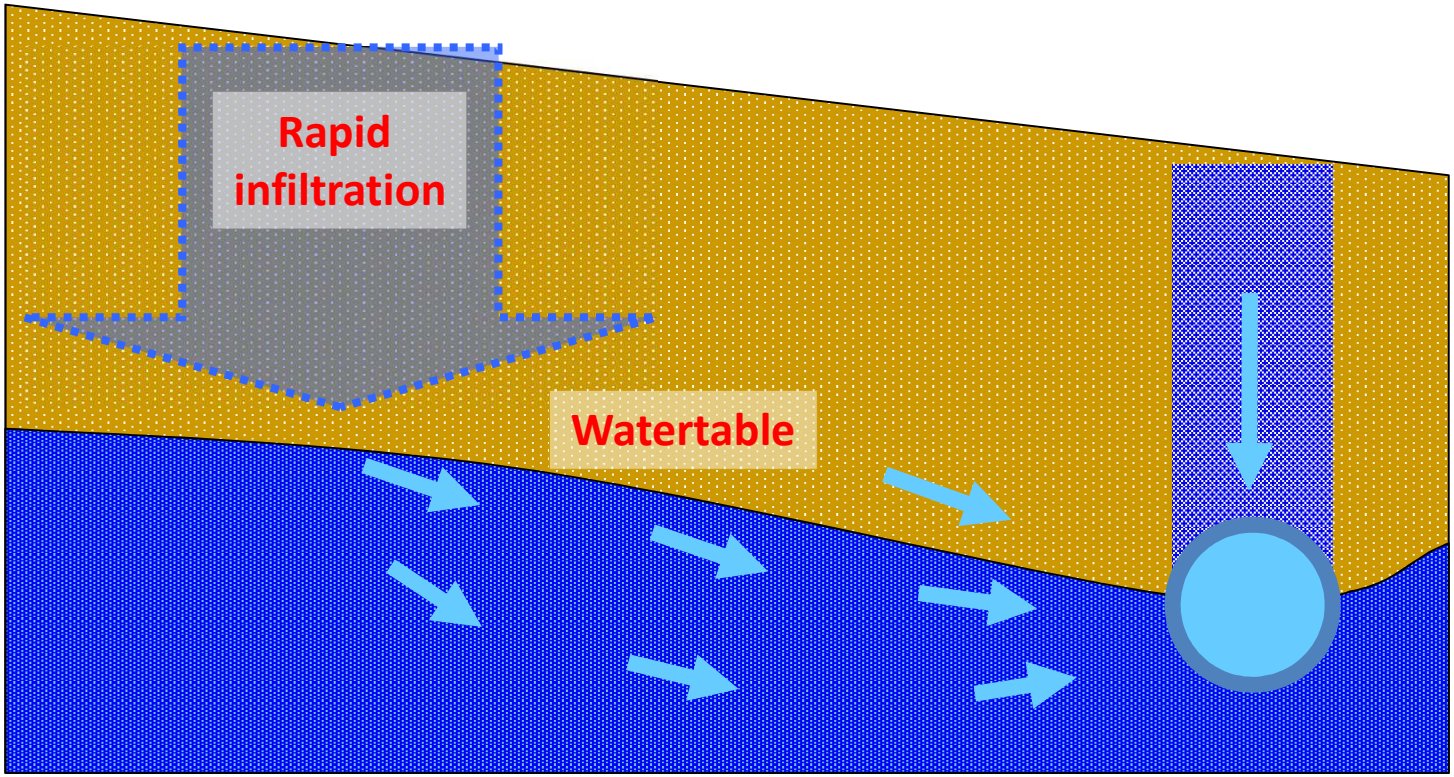
Must have gravel backfill to connect to drains

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

Drainage of permeable soils - ground water problem



No permeable backfill Necessary ?

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, Peat soils every 2 to 3 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).**

The European Agricultural Fund for Rural Development
Europe investing in rural areas
SAC CONSULTING
Scottish Government
Riaghaltas na h-Alba
gov.scot

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.

The European Agricultural Fund for Rural Development
Europe investing in rural areas
SAC CONSULTING
Scottish Government
Riaghaltas na h-Alba
gov.scot

Any Questions?

FARM ADVISORY SERVICE

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot