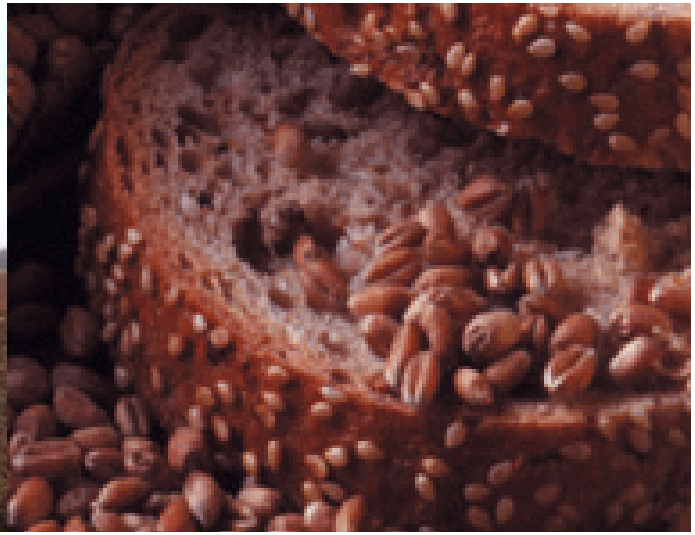
Soil and Water Management in Response to Extreme Weather

Options for Soil Management in 2012-2013: Tillage and Drainage

Paula Misiewicz

Harper Adams University





Soil&Water Management Centre

Outline

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Fundamentals

- The problem and the penalties

S&W Management Options

- Short term
- Medium term
- Long term



Conclusions

Typical problems







A less common scene

Effect of winter waterlogging on Winter wheat yield (Letcombe)

Sandy loam 1976-7 & 1977-8

Source: Belford (1981), J. Agric. Sci, 97

Waterlogging treatment	Grain Yield (g/m²)	Straw Yield (g/m²)
Free draining	937	942
From 19 Nov for 25 days Water table @ 5 cm	837*	879***
From 19 Nov for 25 days Surface water table	850*	827***
From 19 Nov f 120 days Surface water ta	876	847***
LSD (5%)	85	

Waterlogging treatment	Grain Yield (g/m²)	Straw yield (g/m²)
1. Free draining	1281	861
2. From 1 Nov for 42 days	1195	875
3. From 25 Jan for 42 days	1235	857
4. From 2 May for 21 days	1131	802
2 & 3 & 4	10 **	782
LSD (5%)		91

10.7% reduction

12.2% reduction

19 % reduction

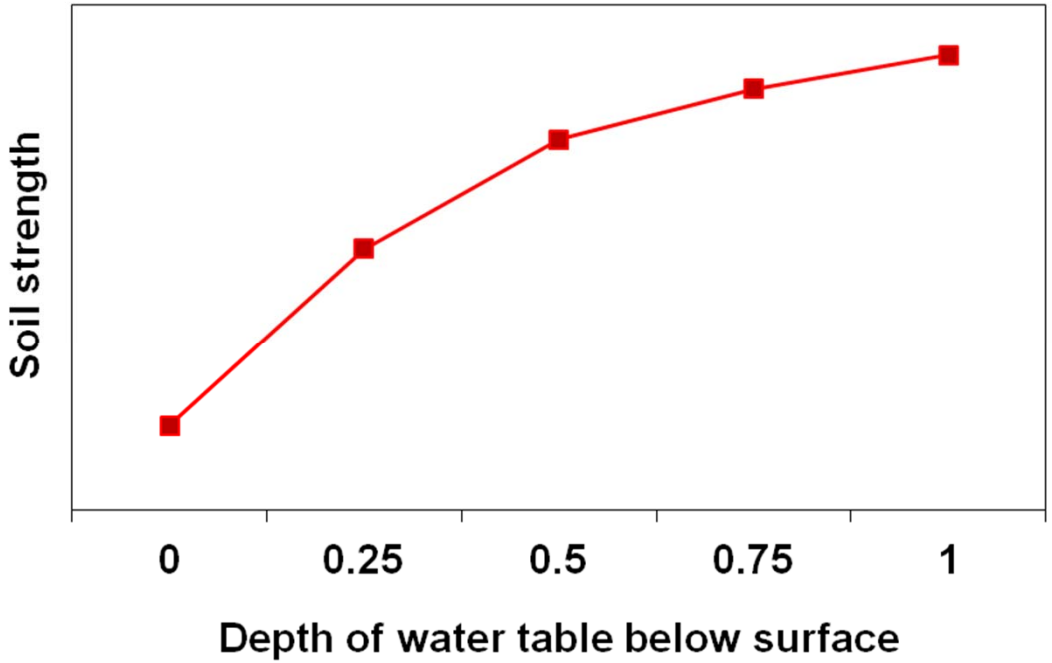
The Role of Drainage on Mechanisation

Increasing water table depth:

- Increases soil strength & trafficability
- Less soil damage or compaction.
- Easier& more effective field operations.
- Increased number of available work days, improved timeliness and establishment.



From :Profi



Land drainage and crop yield



Crop failure – during growth, in this case ~25% loss
Soya beans, Illinois - July 2008



Effect on crop growth – Denchworth Soil
FDEU studies at Drayton 1970 -74 Winter Wheat

Yield	~4.5 t/ha
Drains & Moles	+ 1.0 t/ha
Drains No moles & subsoiling	+ 0.6 t/ha

Studies at Brooksby showed + 0.5t/ha from moling

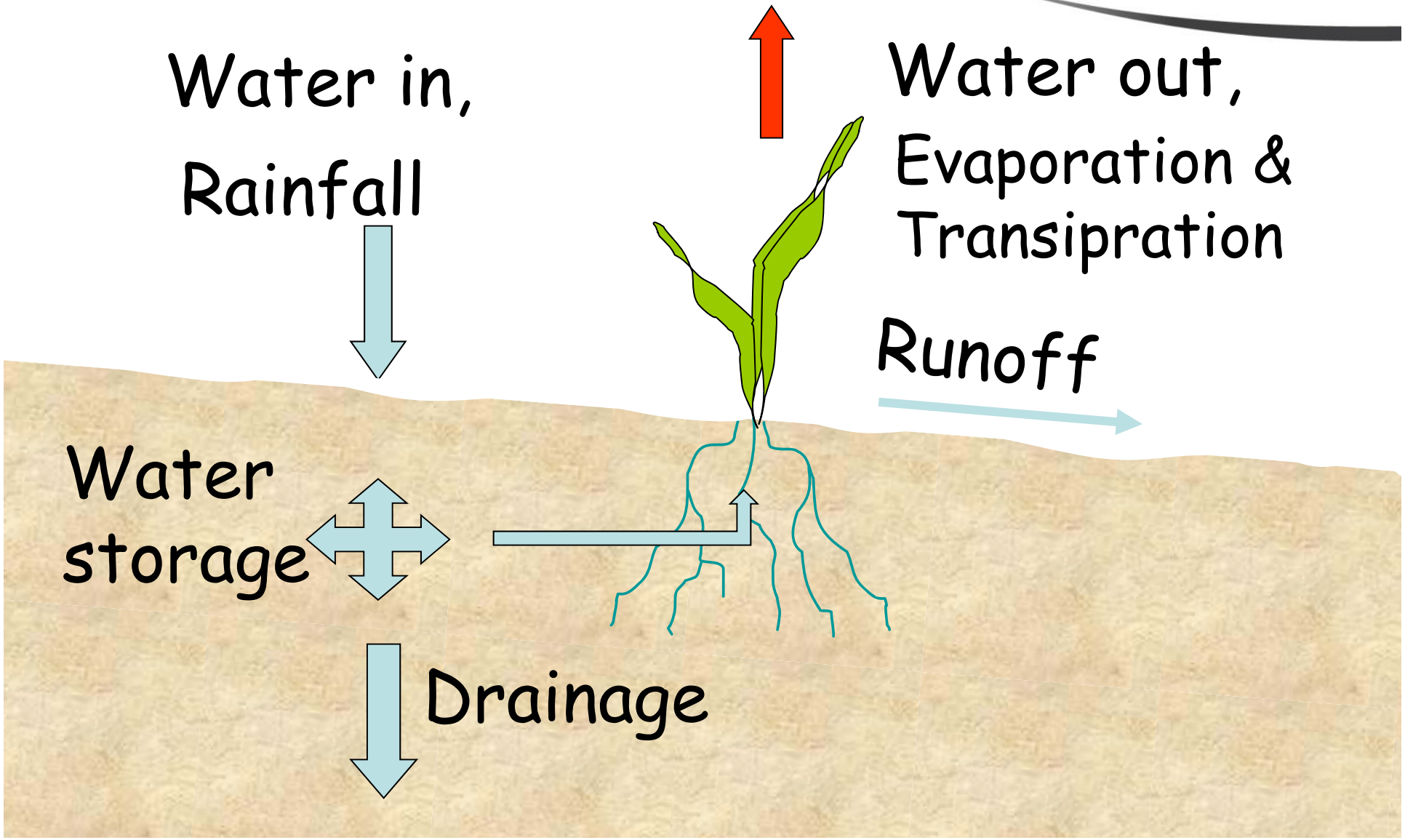


FDEU Annual Report 1975



Birds Eye lost 40% of pea yield in summer of 2007 due to poor trafficability

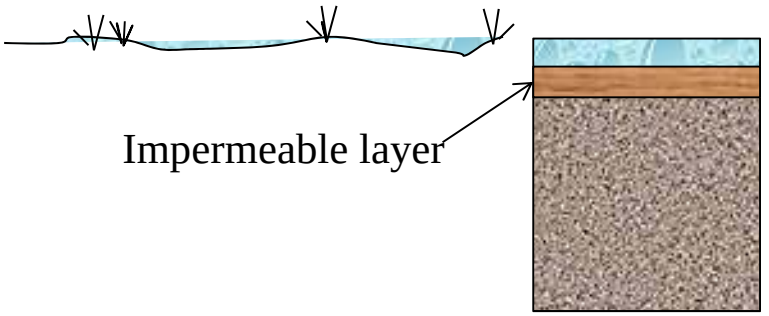
Water budget



Principal types of drainage problem

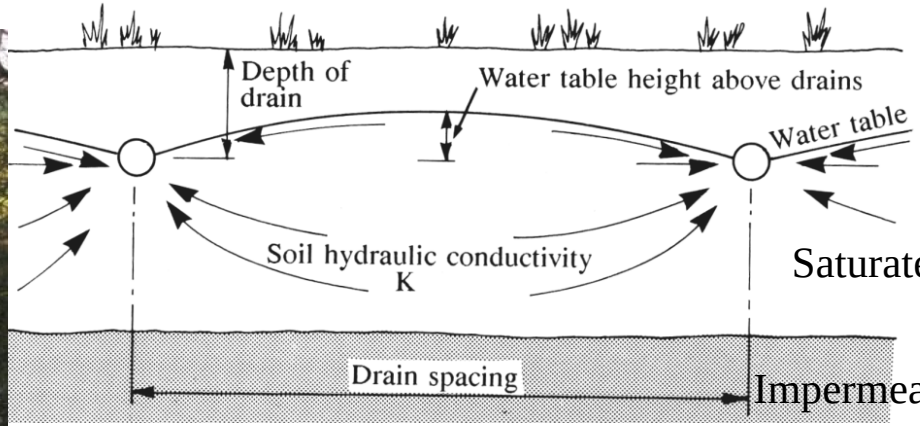
1. Surface water control (perched water table or top water)





2. Groundwater table control (bottom water)







Relationship between compaction and infiltration rate





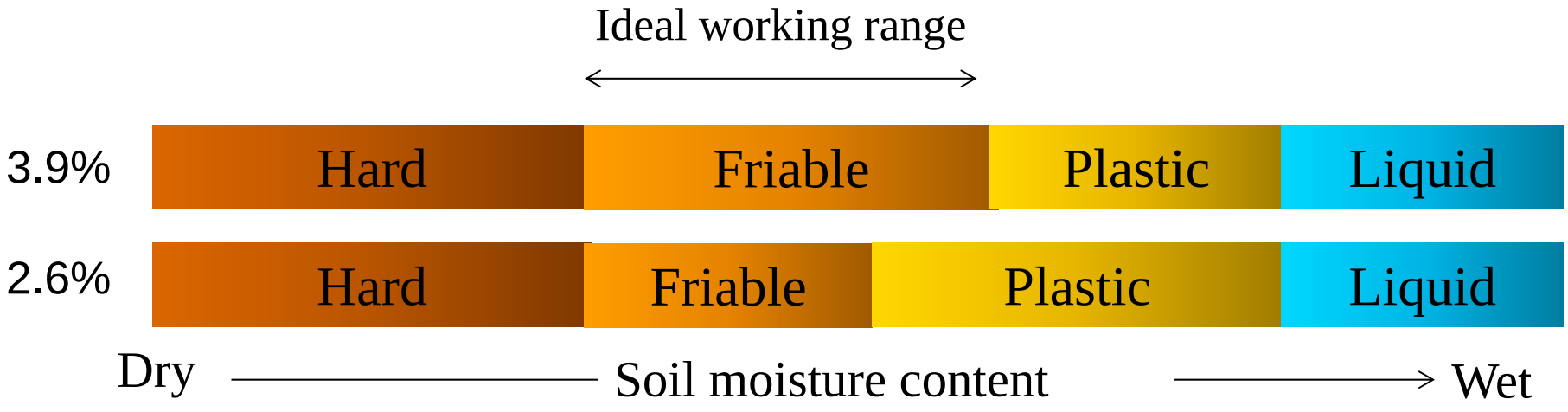
1.42 1.58 1.62 1.62

Soil Density g/cc

After: Chyba, 2012

Effect of organic matter

- Silt loam soils in Missouri:
  organic matter decline from 3.9% to 2.6% over 60 years.
- This corresponded to a change in plastic limit moisture content from 27% to 22% and a less ideal working range.



After: Baver et. al., 1972

Short term measures

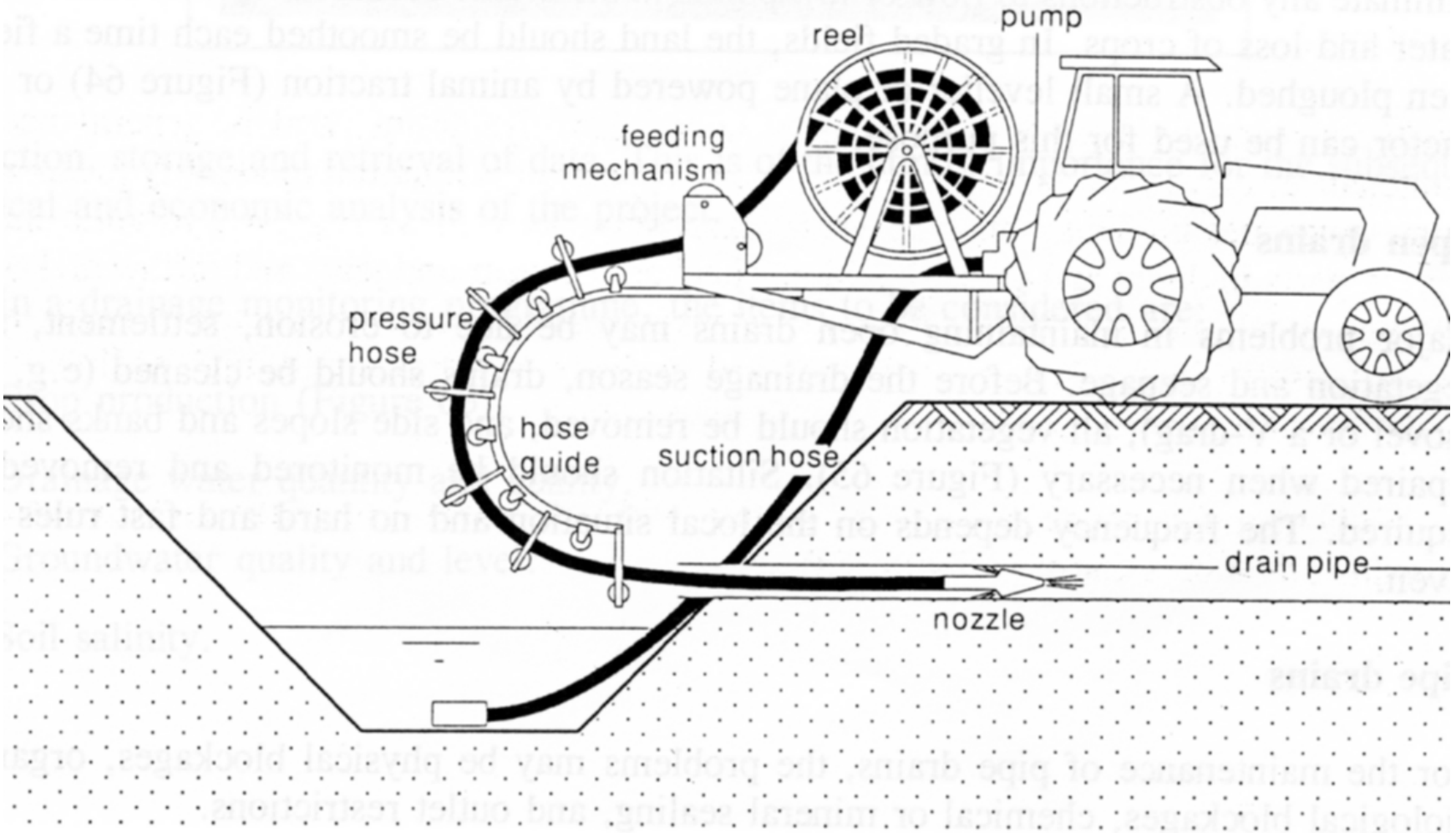
- Study “Old Drainage Plans”
- Walk ditch drains
- Check that tile drains, plastic pipes and mole drains are flowing
- Clean blocked ditch and open drains
- Flush pipe drains
- Ensure outfalls are functioning
- Install “short term” mole drains if appropriate
- Map damaged areas for repair later in the season/next opportunity

Clean ditches





Drainage Maintenance: Pipe Jetting for Blockages



Mole drain/pipe from the ditch

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+ 2nd tractor &
chains or winch



Fit duals and reduce inflation pressure



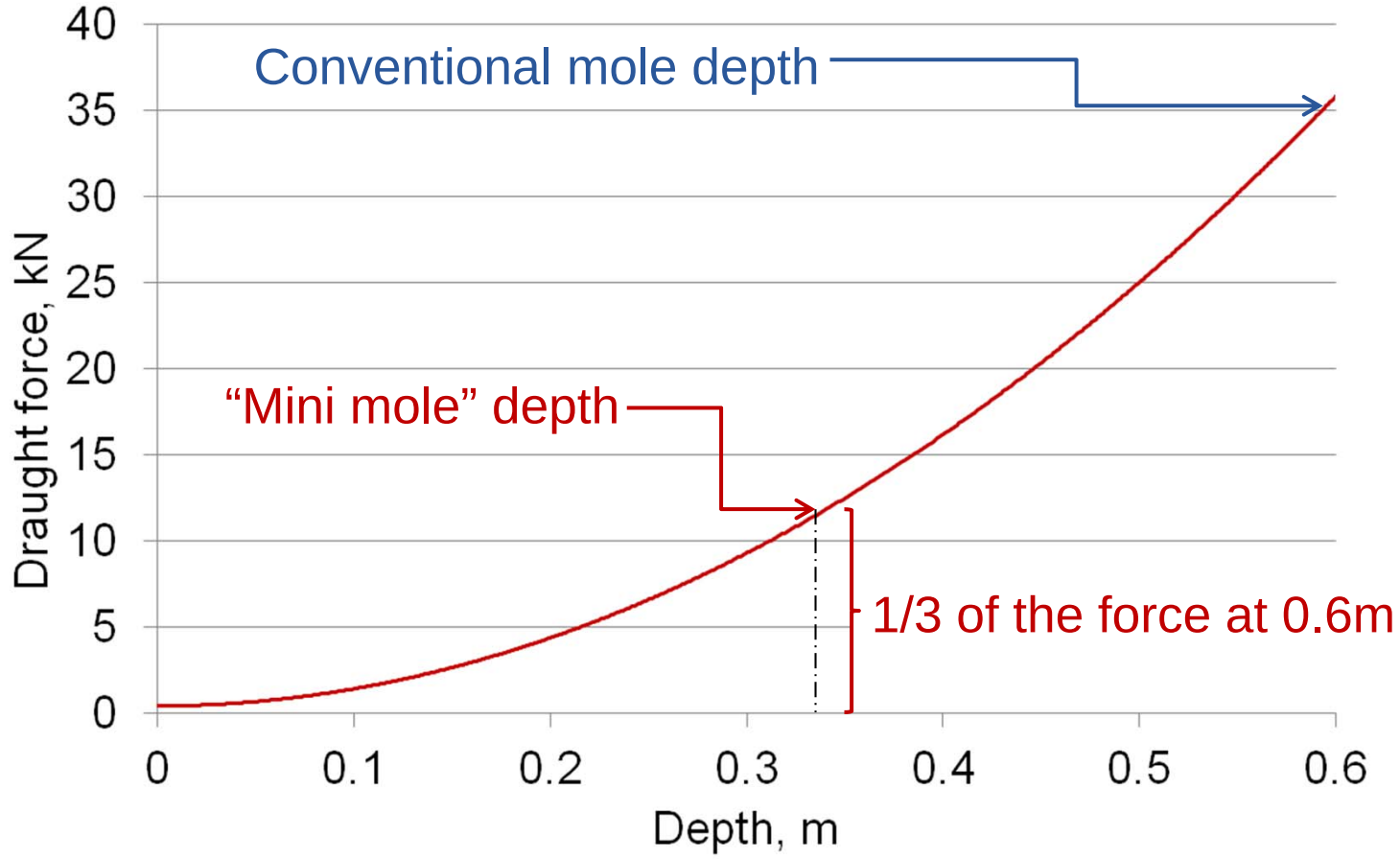
Herringbone cracks





Shallow, i.e.12-15” deep, mini-mole with 2’’ diameter foot.
No - Expander

Mole plough draught forces



After: Godwin, Spoor & Leeds Harrison, 1982

Medium term

- Mole drain clay soils with perched water tables to connect with gravel backfill of existing tile/plastic drains
- Subsoil (with wings) damaged areas after next harvest
- Improve existing drainage systems





Long term measures

- Install pipe/ditch drains (probably targeted)
- Mole drain clay soils with perched water tables to connect with gravel backfill
- Install grass waterways
- Grade low spots in flat lands
- Improve existing drainage systems
- Reduce surface compaction by reducing traffic density and intensity (CTF and LGP)
- Improve soil organic matter content (a very long term effect)

Grass waterways



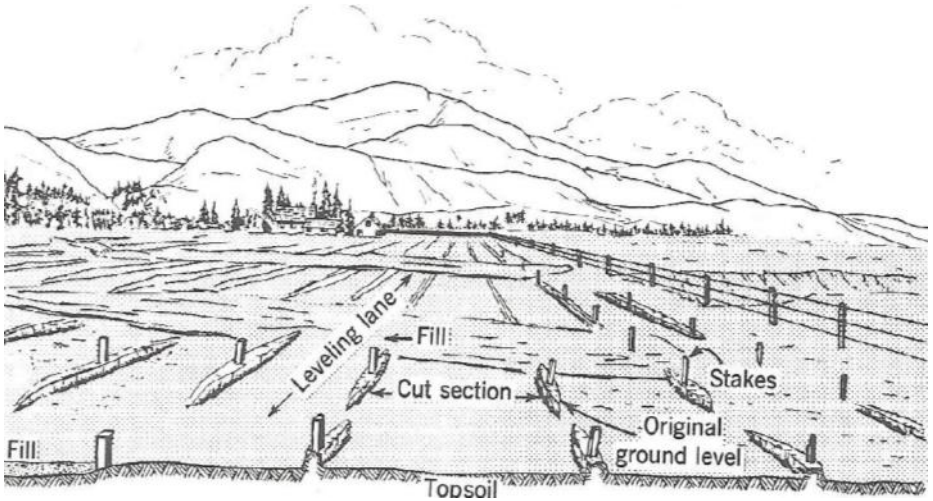




http://www.extension.uiuc.edu/

USDA NRCS Natural Resources Conservation Service

Land smoothing of low spots



After: Schwab et al 1993



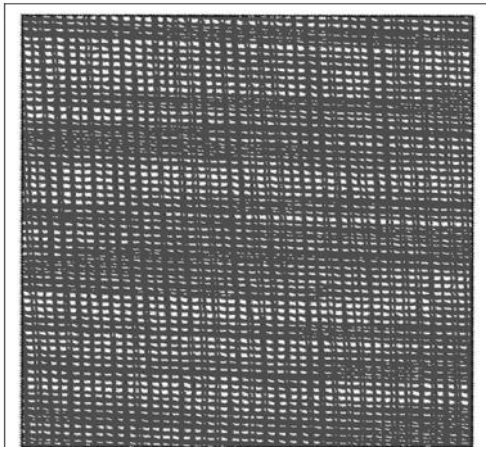




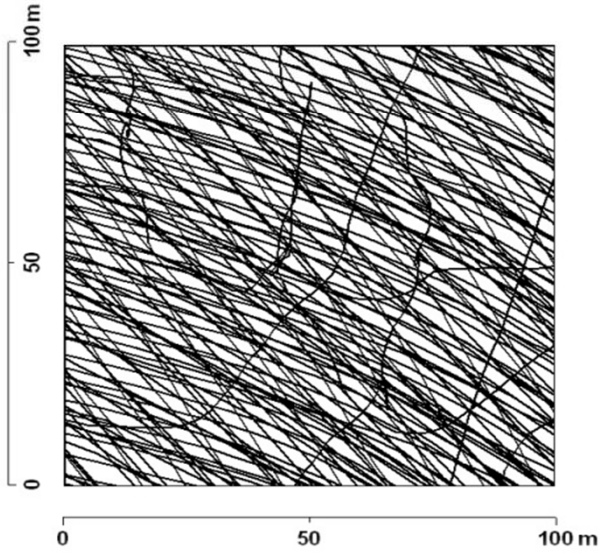
Random Traffic Problems

Extensive areas of the field are exposed to trafficking

- Random Traffic + plough = 85% covered
- Minimum Tillage = 65% covered
- Direct Drilling = 45% covered







Wheat
Czech Republic

harvest
presowing soil preparation
straw baling
ploughing
straw carting
spraying rows
liquid manure transport
liquid manure application
seeding
grain carting

Kroulik et al, 2011

Potatoes
Shropshire

Kroulik , Misiewicz, White and Godwin, 2012

Options for compaction reduction

Controlled traffic





After: Tullberg et al. 2003

Source: CTF Europe

Reduced pressure/axle weight and central tyre inflation pressure control systems









Controlled Traffic Farming (CTF)

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- Area exposed to wheels < 30-40% & could be <20%
- Improved soil structure
- Reduced input costs: time; fuel; machinery by 22%
- Operating profit up 8% (£75/ha without yield addition)
- Increased crop yields from non trafficked soils + 9 to16%
- Infiltration increased by circa 400% in UK





Source: Chamen, 2011

Lower Ground Pressure (LGP)

+ Simple

+ Cheap

- Pressure is applied

+ Less working time and improved fuel economy, trafficability and manoeuvrability





Extra costs

Tractor - 280 hp : Ultraflex tyres extra = £1/ha

Combine: Ultraflex = £0.50/ha

Price offset by fuel savings (c.20%)

Mozziconacci, Michelin

Combine: + £3 to 4/ha for 5 - 7 year life

Price offset by improved trafficability and narrower operating widths

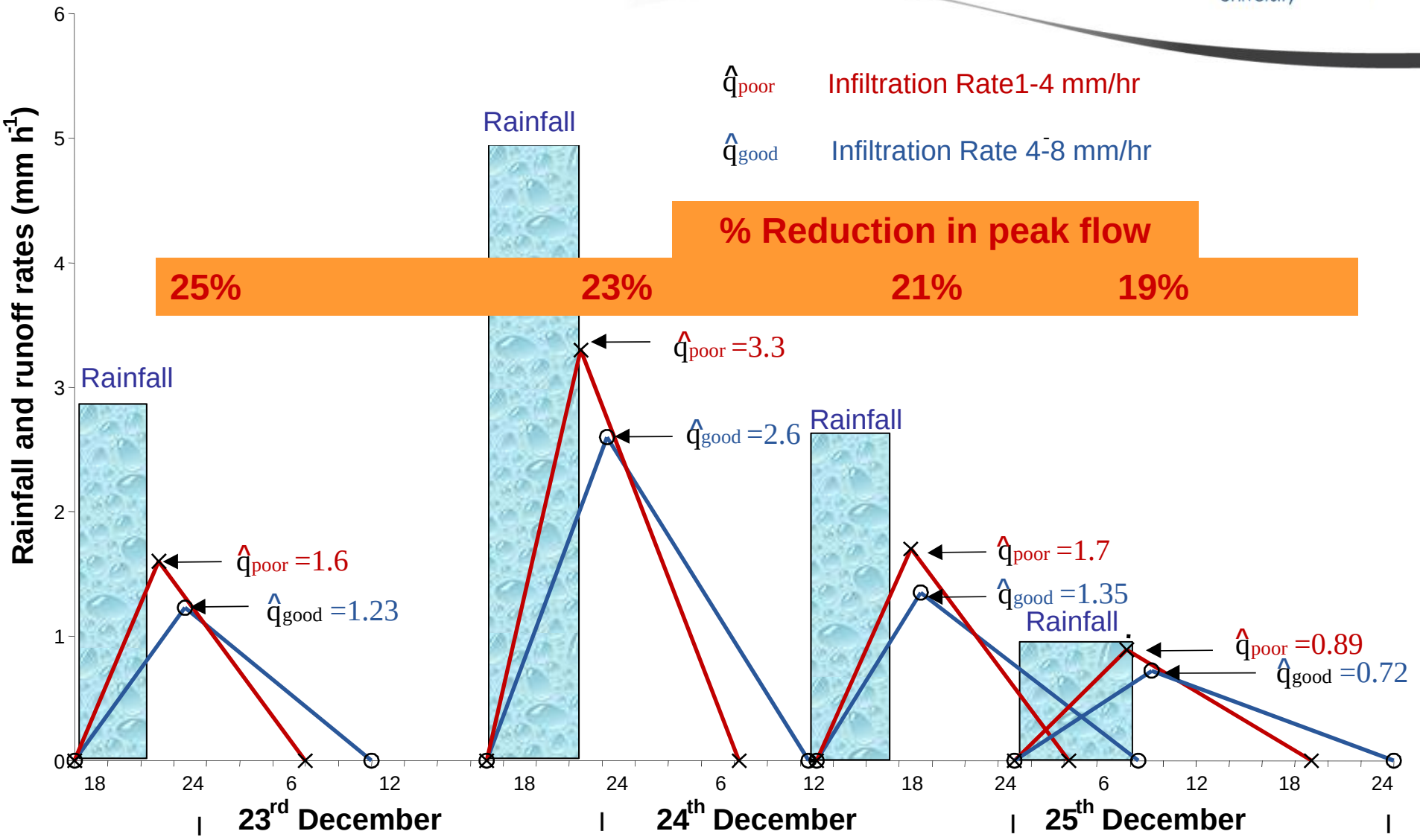
Tyrell, Claas UK

Effect of infiltration rate on runoff

Parrett and Tone Catchment, Dorset/Somerset @ Haselbury Plucknet/Chiselborough

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After: Godwin and Dresser, 2003 *From: Schwab et al., 1993*

Conclusions

- Improved soil and water management is achieved by:
  - Considering the short, medium and longer term actions
  - Checking, maintaining and improving drainage infrastructure
  - Reducing traffic intensity & contact pressure
- Prevention is better than cure

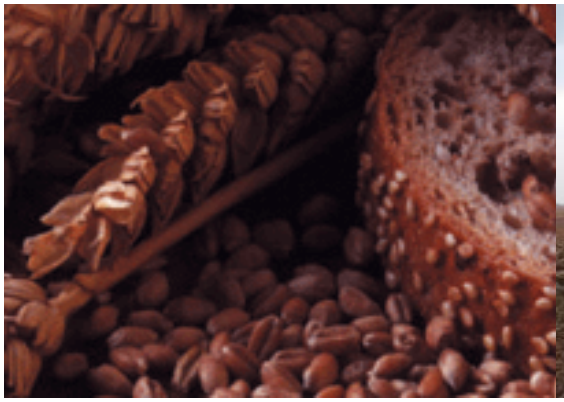
Regular inspections of drainage systems are needed.
Restoration of an old system is cheaper than a new system.



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Thank You!





pmisiewicz@harper-adams.ac.uk